

Harvard School of Dental Medicine Student-to-Student Guide to Clinic: How to Excel in Third Year

2010-2011 Edition

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1999 – Blaine Langberg & Justine Tompkins
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2007 – Deepak Gupta & Daniel Cassarella
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2010 – Adam Donnell, Tracy Pogal-Sussman, Kim Whippy, Mindy Gil, Sharon Jin, Brandon Grunes, Aram Kim, Michelle Mian

Foreword

Dear Class of 2012,

We present the 12th edition of this guide to you to assist your transition from the medical school to the HSDM clinic. You have accomplished an enormous amount thus far, but the transformation to come is beyond expectation. Third year is challenging, but fun; you'll look back a year from now with amazement at the material you've learned, the skills you've acquired, and the new language that gradually becomes second nature. To ease this process, we would like to share with you the material in this guide, starting with lessons from our own experience.

Course material is the bedrock of third year. Without knowing and fully understanding prevention, disease control, and the basics of dentistry, even the most technically skilled dental student can not provide patients with successful treatment. Be on time to lectures, don't be afraid to ask questions, and take some time to review your notes in the evening. Treat every course as an opportunity to learn regardless of the dental specialty that most interests you. Think of yourself as a general dentist in training during these foundational third year courses. There will be time to learn your specialty in the future.

Clinic is extremely rewarding. Expect to feel a strong sense of accomplishment as your cases progress. Please remember, however, that everyone has stood in your shoes, so when you're challenged by a procedure or feel overwhelmed by the management of a case, know that you're not alone.

Excellent organization is crucial to your success in clinic. Schedule your patients and procedures well in advance, and call your patients to confirm their appointments (don't rely on axiUm). Despite your best efforts, you will have last-minute cancellations and patients who fail to show for their scheduled appointment. Rather than using it as an excuse to sleep in, make the most of your time by assisting your fellow classmates or residents in clinic. You will learn from their techniques.

When you are formulating treatment plans, consult with the residents and faculty members from each specialty. The intra-oral photos and study casts that you bring to treatment planning appointments with the faculty are also excellent patient education tools. Your patients will have more confidence in you as a provider, and are more likely to accept treatment. Aside from forming good habits, this will help you maximize your productivity and education.

Finally, please remember to maintain a high level of professionalism. Respect the full-time and part-time faculty, assistants, administration, staff, your classmates, and patients. The habits you form now will stay with you for your career. We are all very fortunate to be students at Harvard School of Dental Medicine-- learning from the current and future leaders of the profession. Keep this perspective in mind when you are confronted with day-to-day challenges and frustrations.

We wish you the very best of luck during the year to come. Use this guide to its fullest, and know that the fourth years are resources for anything on or off the floor.

Sincerely,

Adam Donnell, Tracy Pogal-Sussman, Kim Whippy
Class of 2011

Acknowledgements

We would like to acknowledge and thank all those who have contributed to and supported the "Student-to-Student Guide to Clinic" this year and over the past 11 years.

This guide would not have been possible without the teaching and guidance of the Harvard School of Dental Medicine Faculty and Staff. In particular, we would like to thank the following individuals for their contributions through lectures, conversations, and feedback: Dr. Brian Chang, Dr. Isabelle Chase, Dr. John DaSilva, Dr. Bruce Donoff, Joyce Douglas, Dr. Thomas Flynn, Dr. Bernard Friedland, Katherine Hennessy, Dr. Howard Howell, Dr. Anna Jotkowitz, Dr. Nadeem Karimbux, Dr. David Kim, Dr. Sam Koo, Dr. Mark Lerman, Dr. Chin-Yu Lin, Dr. Jarshen Lin, Dr. Maritza Morell, Dr. Shigemi Nagai, Dr. Linda Nelson, Dr. Hiroe Ohyama, Dr. Sang Park, Dr. Nachum Samet, Dr. Jeffry Shaefer, Dr. Peggy Timoth  , Dr. Hans-Peter Weber, Dr. Robert White, Dr. Robert Wright, Dr. Bertina Yuen, Dr. Romesh Nalliah, Dr. Dolrudee Jumlongras, Mohamed Alaeddin, Dr. Elsbeth Kalenderian.

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Embryology and Development of Orofacial Structures

Basic Embryology

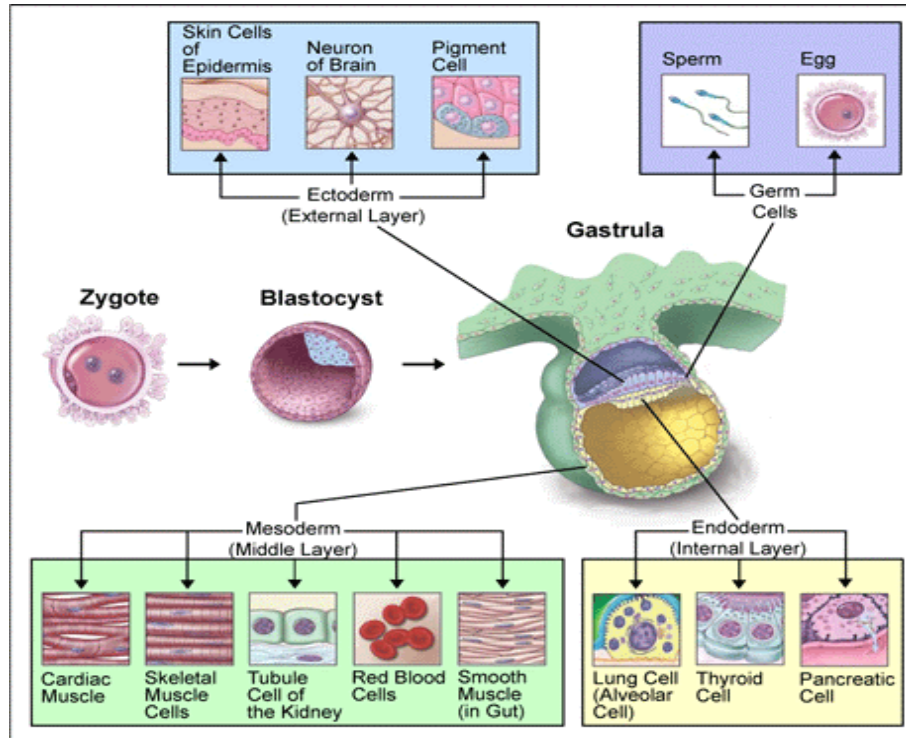
Start: Fertilization→zygote (called “embryo” after first cleavage, and “fetus” after 8 weeks)

Week 1: Cleavage, implantation of blastula

Week 2: Gastrulation→bilaminar disk with epiblast and hypoblast

Week 3: Gastrulation→trilaminar disk with ectoderm, endoderm and mesoderm

By Week 4: NCC form→Neurulation

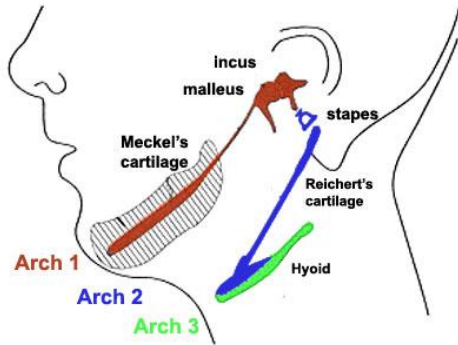


Tissue Type	Ectoderm	Endoderm	Mesoderm	NCC
General Strx	Everything that protects the inside from the outside world or transmits info from outside world to brain	Everything that protects the viscera from the outside world, on the inside of the body	Everything in between ectoderm and endoderm	From ectoderm, special tissues including some cranial bones and cartilages.
Specific Strx	Surface: anterior pituitary, lens of eye, epithelial lining of oral cavity, ameloblasts, thyroid, ear, eye, nose, epidermis, salivary, sweat and mammary glands Neuroectoderm: brain, retina, spinal cord, posterior pituitary	Gut tube epithelium and derivatives including lungs, liver, pancreas, thymus, parathyroid, thyroid follicular cells	Muscle, bone, connective tissue, serous linings of the body (mesothelia), spleen, cardiovascular structures, lymphatics, blood, urogenital structures, kidneys, adrenal cortex, microglia	ANS ganglia and neurons, melanocytes, chromaffin cells of adrenal medulla, enterochromaffin cells, parafollicular cells of thyroid, Schwann cells, pia and arachnoid, odontoblasts, aorticopulmonary septum

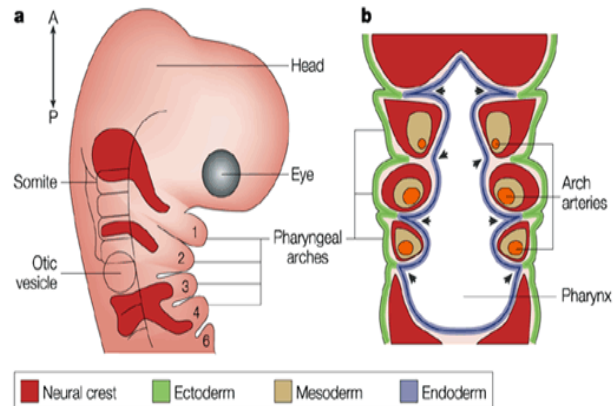
Timeline of Orofacial Development

Time	Events
3 weeks	- Pharyngeal/branchial arches become visible and grooves/clefts and pouches form - Frontal prominence, stomodeum (primitive oral cavity), and 1st arch (mandibular) become more obvious
4 weeks	- 5 facial swellings visible around stomodeum (2 mandibular, 2 maxillary, 1 frontonasal) - Maxillary process within the 1st arch enlarges and begins growing toward the midline
5 weeks	- Nasal and optic placodes visible in frontonasal prominence - Nasal placodes sink in → nasal pits - Area on either side of these pits form ridges called medial and lateral nasal processes - Mandibular processes grow together and fuse by 6 weeks
6 weeks	- The two medial nasal processes have fused at the midline to form the intermaxillary segment which forms the primary palate. - Two maxillary processes have fuse to the intermaxillary segment forming the upper lip - Maxillary processes form lateral palatal shelves in vertical fashion - Tooth buds form
7 weeks	- Center of ossification of mandible begins around future mental foramen location and grows in all directions around IAN and developing tooth buds
8 weeks	- Center of ossification of maxilla starts around primary canine bud and spreads to form maxilla and processes. - Primary palate (block of tissue formed by medial nasal processes) also helps form the nasal septum - Secondary palate develops from the maxillary processes – begins as small ledges of epithelium covered tissue growing inward to form palatal shelves. The fuse first with the primary palate and then with each other more posteriorly - Lateral palatal shelves drop to horizontal fashion and begin to fuse from anterior to posterior (finish fusing around week 12) - Tongue develops weeks 8-12

Branchial Arches



Pharyngeal Arch Structures



Nature Reviews | Genetics

Branchial Arch	Nerve	Artery	Groove derivatives	Pouch derivatives	Cartilage (NCC) derivatives	Mesoderm derivatives
I	CN V3	Maxillary artery	External auditory meatus, external lining of tympanic membrane	Eustachian tube, middle ear, internal lining tympanic membrane	Meckel's cartilage → primitive mandible, malleus, incus, sphenoid spine, lingula, sphenomandibular ligament	Muscles: anterior digastric, mylohyoid, tensor veli palatine, tensor tympani, muscles of mastication (4). Mandibular and maxillary processes
II	CN VIII	Hyoid artery and stapedial artery	Degenerates	Palatine tonsils	Reichert's cartilage → stapes, styloid process, lesser horn of hyoid and part of body, stylomandibular ligament	Muscles: posterior digastric, stylohyoid, muscles of facial expression, stapedius
III	CN IX	Common and internal carotid arteries	Degenerates	Thymus and inferior parathyroids	Greater horn on hyoid and part of body	Muscles: Stylopharyngeus
IV	CN X (Superior laryngeal)	Right subclavian artery, left aortic arch	Degenerates	Superior parathyroids	Thyroid cartilage	Muscles: Pharyngeal muscles (not stylopharyngeus), cricothyroid, muscles of soft palate (not tensor veli palatini)
VI	CN X (Recurrent laryngeal)	Right pulmonary artery, left pulmonary artery and ductus arteriosus	Degenerates	Ultimobranchial body → C-cells thyroid	Cricoid, arytenoids, corniculates, cuneiforms	Muscles: all intrinsic laryngeal muscles except cricothyroid

Face Development:

- Nasal Placodes→ olfactory epithelium
- Nasal pit→ nostril
- Optic placodes→ lenses
- Lateral nasal processes→ sides of nose, paranasal sinuses
- Medial nasal processes→ primary palate, middle of nose, philtrum, nasal septum
- Maxillary processes→ cheeks, maxilla, upper lip, secondary palate
- Mandibular processes→ mandible, lower lip

Clefts: Lack of fusion of....

- Oblique Facial Cleft: lateral nasal and maxillary
- Cleft lip: medial nasal and maxillary
- Median cleft lip: medial nasal
- Cleft palate: palatine shelves at 8-10 weeks
- Bifid uvula: palatine shelves at 11-12 weeks
- Bifid tongue: lateral swellings

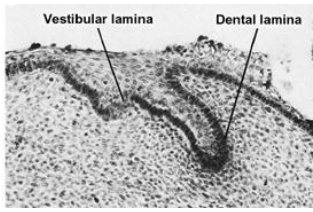
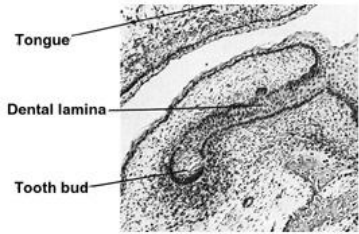
Tongue Development:

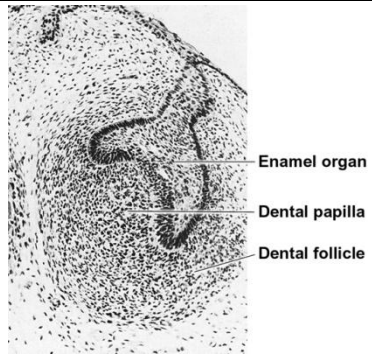
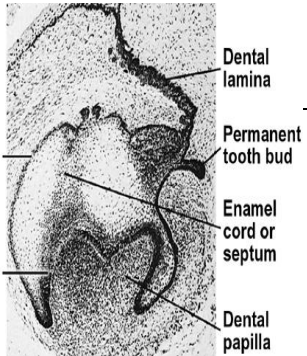
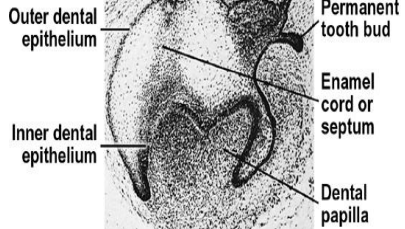
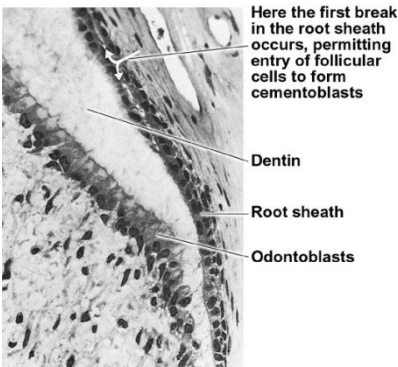
- Anterior 2/3 tongue (1st branchial arch)
 - 2 lateral lingual swellings “distal tongue buds”
 - 1 tuberculum impar
- Posterior 1/3 tongue (2nd-4th branchial arches)
 - copula (2nd arch)
 - Hypobranchial eminence (arches 3-4)
- Terminal sulcus (with foramen cecum) divide anterior 2/3 from posterior 1/3

Thyroid Development:

- Develops between tuberculum impar and copula as an endodermal proliferation at 3-4 weeks
- Thyroid gland descends via thyroglossal duct during weeks 4-7
- Thyroglossal duct degenerates during weeks 7-10
- Foramen cecum is the residual location of initial thyroid development and descent on mature tongue

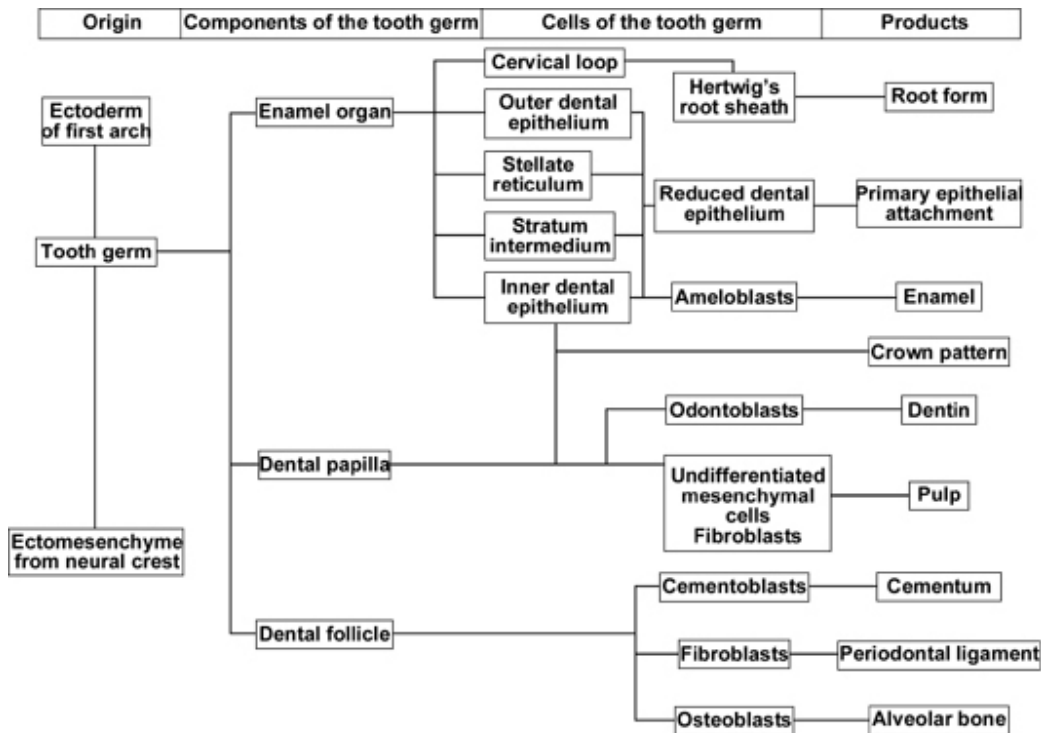
Tooth Development

Stage	Events	
Initiation (week 6-ish)	- Oral ectoderm begins to thicken and grow downward into underlying ectomesenchyme cells – this thickening is known as the dental lamina. - Odontogenesis is initiated by the transcription and growth factors present in the epithelium which influences the ectomesenchyme. Later (12 days of development), the ectomesenchyme takes over this potential.	
Bud Stage (week 8-ish)	- Continued thickening and invagination of dental lamina into 10 buds in upper arch and 10 buds in lower arch (future primary dentition).	

Cap Stage (week 9-ish)	- Deepest part of buds becomes slightly concave. - Enamel organ is formed: composed of the outer enamel epithelium (OEE), inner enamel epithelium (IEE), and stellate reticulum. - Ectomesenchyme continues to proliferate and is now called dental papilla and dental sac/follicle - Succedaneous dental lamina forms - At this stage the tooth bud consists of the enamel organ, dental papilla and dental follicle	
Bell Stage (week 11-ish)	- Begins with the appearance of the stratum intermedium between the IEE and the stellate reticulum. - IEE cells become taller – now called ameloblasts. - Peripheral cells of the dental papilla adjacent to the preameloblasts become low columnar/cuboidal cells and now are called odontoblasts. - Dental lamina disintegrates → epithelial rests of Serres	
Appositional Stage (week 14-ish)	- The odontoblasts move away from the preameloblasts (toward center of dental papilla) secreting polysaccharide matrix (pre-dentin). - Dentin matrix causes ameloblasts to change polarity, and lay down polysaccharide and organic fiber (pre-enamel) next to dentin matrix as they move toward the OEE. - IEE fuses with OEE and becomes reduced enamel epithelium, which becomes Nasmyth's membrane (primary epithelial attachment) which becomes junctional epithelium later. - Mineralization begins at 4-6mo in utero for primary teeth and at birth for permanent teeth and takes ~2y to complete	
Root Formation	- OEE and IEE join at cervical loop, which elongates to become Hertwig's epithelial root sheath surrounding dental papilla. - As the sheath moves deeper it influences cells of the papilla to become odontoblasts and lay down dentin - Once the odontoblasts start to form dentin, the root sheath begins to break apart, which causes cells of the dental sac to move through the holes in the root sheath and become cementoblasts which begin to form cementum against the dentin and fibroblasts which form the PDL. - The HERS remnants are called epithelial rests of Malassez - Cementoblasts eventually become trapped in the cementum along with periodontal fibers - The remaining dental follicle cells become osteoblasts and make alveolar bone.	

Tooth Development Summary:

- Enamel organ: IEE, OEE, stratum intermedium, stellate reticulum
- Dental lamina→ enamel
- Dental papilla→ pulp, dentin
- Dental follicle→cementum, PDL, alveolar bone
- Ectoderm→oral mucosa, gingival, enamel
- Ectomesenchyme (from NCC)→dentin, PDL, cementum, pulp, alveolar bone



Tooth Histology

- Enamel
 - o 96% inorganic (hydroxyapatite)/ 4% water and fibrous organic material
 - o Enamel Rod – column of hydroxyapatite that runs from DEJ to tooth surface
 - o Rod Sheath – fibrous organic substance that outlines enamel rod
 - o Tomes' Process – a bulge in the secreting end of the ameloblast
 - o Striae of Retzius – brown lines in the enamel (parallel to DEJ) caused by the ameloblasts changing direction of enamel production every 4th day
 - o Enamel spindle – odontoblastic process trapped in the enamel
- Dentin
 - o 70% inorganic (hydroxyapatite)/ 30% water and fibrous organic material
 - o Dentinal tubule – a column running from DEJ to pulp, contains an odontoblastic process
 - o Peritubular dentin – area of high crystalline content adjacent to tubule
 - o Intertubular dentin – the bulk of dentinal material, matrix for tubule/peritubular dentin
- Cementum
 - o 50% inorganic (hydroxyapatite)/ 50% water and fibrous organic material
 - o Acellular cementum – found in cervical 2/3rds of root
 - o Cellular cementum – found in apical 1/3rd of root, contains trapped cementoblasts
 - o Sharpey's fibers – trapped PDL fibers in the cementum
- Pulp
 - o Cell free zone – found between odontoblasts and cell rich zone

- Cell rich zone – found between neurovascular bundle and cell free zone

Dental Anatomy

Anatomic Trends

- Dental Formulas (for ½ of the mouth)
 - Perm: I 2/2 C 1/1 P 2/2 M 3/3
 - Prim: I 2/2 C 1/1 M 2/2
- Contact points:
 - All contact points are in the middle third of the faciolingual dimension, but posterior are slightly facial.
 - The approximate location of contacts in the mesiodistal dimension are below:
 - Max: IJ JM JM MM MM JM JM J
 - Mand: II II IM MM MM JM JM J
 - FL: all in middle 1/3 of teeth, in post more towards facial
- Heights of Contour
 - All teeth have facial heights of contour in cervical third, except mandibular molars, which are at the junction of cervical and middle thirds
 - Anterior teeth have lingual heights in the cervical third. Posteriors have lingual heights in middle third except for the mandibular 2nd premolar which has lingual height at occlusal third
- Embrasures
 - Facial embrasures are narrower than lingual on all teeth except maxillary 1st molar, which has bigger lingual embrasures, and mandibular centrals, which have equal size embrasures.
 - Incisal embrasures: max LI + K9 (largest) > mand LI + K9 > max CI + LI > max CIs > mand CI + LI > mand CIs (smallest)
 - Occlusal: embrasure between max K9 + PM1 is the largest in the mouth
- Incisal edge orientation
 - Maxillary incisors have edge centered over long axis of tooth
 - Mandibular incisors have edge lingual to long axis of tooth
 - Maxillary canines have edge facial to long axis of the tooth
 - Mandibular canines have edge either centered or slightly lingual to long axis of tooth
 - Mandibular 1st premolars have facial cusp centered over long axis of tooth
- Shapes of teeth
 - Facial/lingual view – all teeth have trapezoidal shape with long side occlusal
 - Proximal view – anterior teeth have triangular shape with base cervical
 - Proximal view – maxillary posteriors have a trapezoid shape with long side cervical
 - Proximal view – mandibular posteriors have rhomboidal shape leaning lingually
- Crown Trends
 - Crowns of teeth tend to get shorter from canine to 3rd molar
- Root Trends
 - Roots of all teeth are distally inclined, except for mandibular canine, which is straight or mesially inclined
- Other Anatomic Trends
 - CEJs are deeper on mesial, anteriorly on maxillary teeth
 - All distal cusp slopes > mesial cusp slope except max PM1 and max 1° canine
 - All teeth develop from 4 lobes except permanent M1s and sometimes mand PM2 (5 lobes)
 - Largest molar cusp is generally mesial supporting

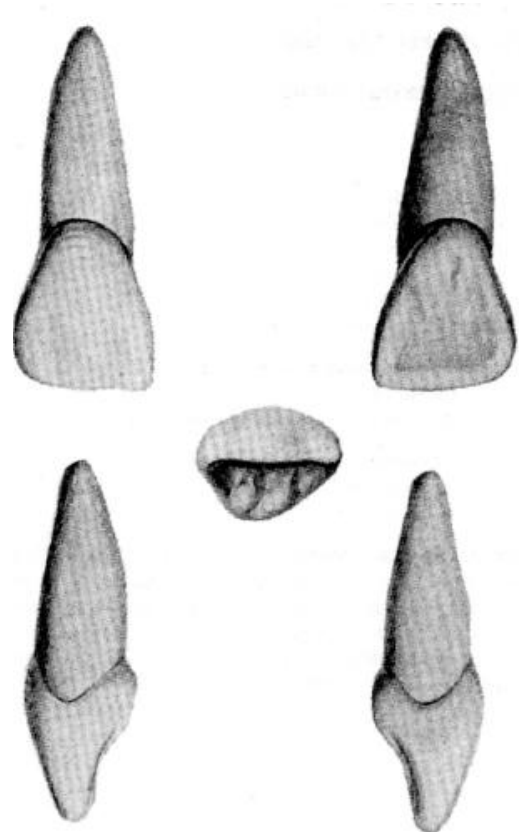
- # pulp horns generally = # cusps and height proportional to cusp height
- Special teeth characteristics
 - Widest mesiodistally – mandibular 1st molar
 - Widest anterior mesiodistally – maxillary central
 - Only tooth with pulp wider mesiodistally than faciolingually – maxillary central
 - Widest faciolingually – maxillary 1st molar
 - Widest anterior faciolingually – maxillary canine
 - Only tooth narrower facially than lingually – maxillary 1st molar
 - Tallest tooth – 1. maxillary canine 2. mandibular canine
 - Tallest crown incisocervically – 1. mandibular canine 2. maxillary central 3. maxillary canine
 - Longest root cervicoapically – maxillary canine
 - Most symmetrical – mandibular central
 - Smallest tooth – mandibular central
 - Narrowest mesiodistally – mandibular central
 - Most often missing – 1. 3rd molars 2. maxillary laterals 3. mandibular second premolars
 - Anterior most likely to have bifurcated root – mandibular canine
 - Only tooth with 2 triangular ridges on 1 cusp – maxillary 1st molar
 - Only tooth with mesiolingual groove – mandibular 1st premolar
 - Only teeth with crown concavities – maxillary 1st premolar (mesial), maxillary 1st molar (distal)
 - Only teeth with longer mesial cusp slopes – maxillary 1st premolar and max 1° canine

Permanent Tooth Anatomy

*Images of teeth are all from patient's right side

Maxillary Central Incisors

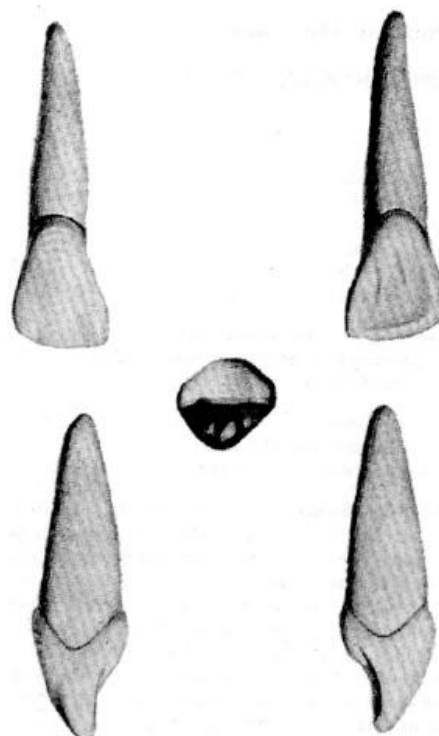
Unique characteristics	- Widest anterior tooth mesiodistally - Only tooth with a pulp wider mesiodistally than faciolingually - Has 2nd tallest crown in the mouth
Facial/Labial	- Crown shape trapezoidal (same for all teeth in the mouth) - Straight mesial outline (almost parallel to the root), Distal outline more convex - Sharp mesioincisal angle, more rounded distoincisal angle - Almost straight incisal ridge (same for all incisors) - Contacts: IJ - Occlusal contacts with mandibular central and lateral incisors
Lingual	- Mesial and distal marginal ridge, cingulum and lingual fossa present - Usually 2 developmental grooves into lingual fossa from cingulum - May have lingual pit
Proximal	- Triangular shape with incisal ridge centered over the middle of the root - Mesial cervical curvature greatest of all teeth - Heights of contour in cervical third for facial and lingual



Incisal	- Triangular shape but cingulum more toward the distal side - 4 developmental lobes: 3 facial, 1 lingual
Root and Pulp	- 1 Straight cylindrical root with blunt apex - 3 pulp horns, 1 triangular pulp chamber, 1 pulp canal

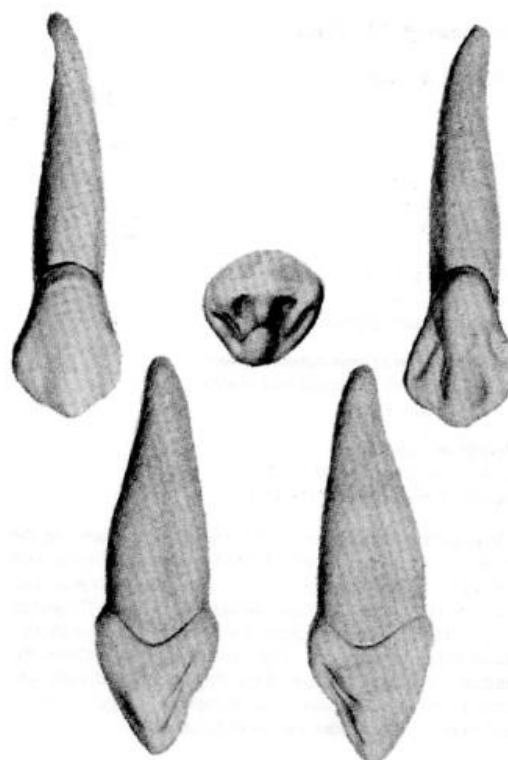
Maxillary Lateral Incisors

Unique characteristics	- 2nd most commonly congenitally missing teeth - 2nd most variable in tooth shape/ malformed (often peg shaped) or dens en dente - Most common tooth to have palatoradicular groove and lingual pit
Facial/Labial	- Crown trapezoidal - Mesioincisal angle sharper than distoincisal, but generally more rounded than centrals - Facial surface more convex than central - Contacts: JM - Occludes with mandibular lateral incisor and canine
Lingual	- Marginal ridges more pronounced than centrals - Prominent cingulum and possible lingual pit and palatoradicular groove - Lingualincisal ridge more developed than centrals and lingual fossa most concave of all incisors
Proximal	- Triangular shape with incisal ridge centered over the middle of the root - Heights of contour at cervical third for facial and lingual
Incisal	- Oval shaped and cingulum centrally placed - 4 developmental lobes: 3 facial, 1 lingual
Root and Pulp	- More narrow root mesiodistally but about as long as central incisor - Oval shaped pulp chamber in FL direction, 1 pulp canal - Sharp apex that may dilacerate distally



Maxillary Canines

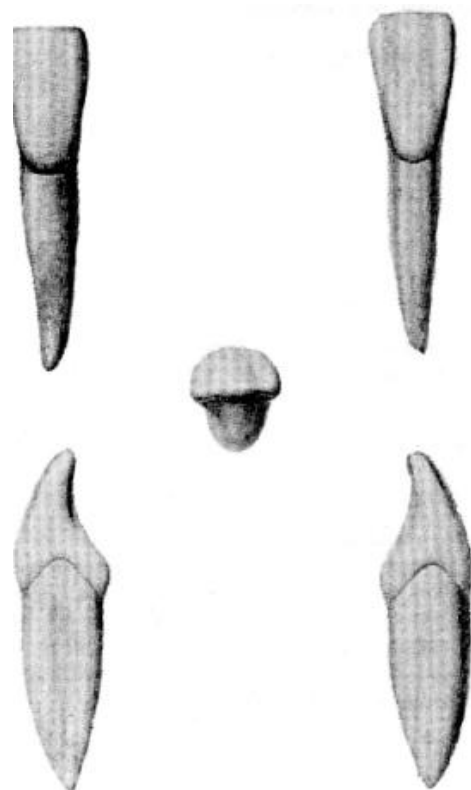
Unique characteristics	- Widest anterior teeth buccolingually - Longest tooth and longest root - 3rd longest crown - Two largest embrasures in mouth
Facial/Labial	- Mesial outline straighter than distal outline, but both mesial and distal are convex - Bulges out more than mandibular canine mesiodistally to reach contact points - Prominent facial ridge - Cusp tip positioned more mesially, mesial cusp slope shorter than distal cusp slope, which is curvier - Contacts: JM - Occludes with mandibular canine and sometimes 1st premolar
Lingual	- Mesial and distal marginal ridges, cingulum and lingual ridge present



	- Mesiolingual and distolingual fossa between ridges
Proximal	- Cusp tip is facial to the long axis of the tooth - Heights of contour in cervical thirds
Incisal	- Cingulum centered - Incisal ridge curves slightly toward the lingual, slightly more on the distal - 4 developmental lobes: 3 facial, 1 lingual
Root and Pulp	- 1 pulp horn, oval pulp chamber that is flattened mesiodistally, 1 root canal (usually straight) - Root tapers from labial to lingual, apex points distally, longitudinal grooves on both sides - Distal root concavity

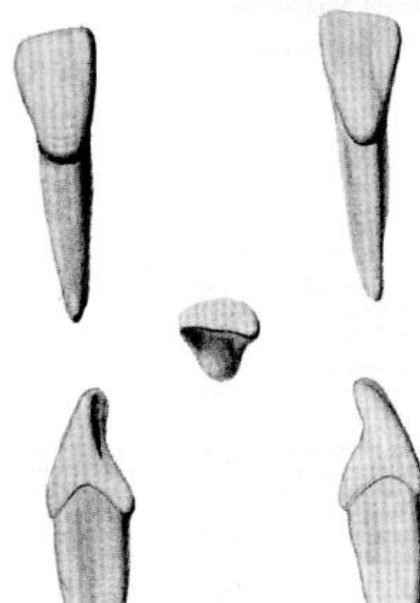
Mandibular Central Incisors

Unique characteristics	- Smallest teeth in the mouth - Narrowest mesiodistally - The most symmetrical teeth, thus hardest to tell left from right. - The only teeth to have its contact points at the same level - Two smallest embrasures in mouth
Facial/Labial	- Mesial and distal outlines almost straight, sharp angles, heights of contour both at incisal third - Contacts: II - Only occludes with 1 tooth: maxillary centrals
Lingual	- Cingulum much smaller than maxillary central, with smooth lingual anatomy - CEJ more apical on lingual than facial - Shallow lingual fossa, and no lingual pits
Proximal	- Incisal edge is lingual to the long axis of the tooth - Heights of contour at cervical thirds, but facial HOC is least protrusive in mouth
Incisal	- 4 developmental lobes: 3 facial, 1 lingual - Cingulum centered
Root and Pulp	- 2-3 pulp horns, pulp cross section oval - 40% have 2 root canals, pulp appears narrower from the facial than proximal - 1 straight root that is flat mesiodistally, with a mesial and distal concavity (deeper on the distal)



Mandibular Lateral Incisors

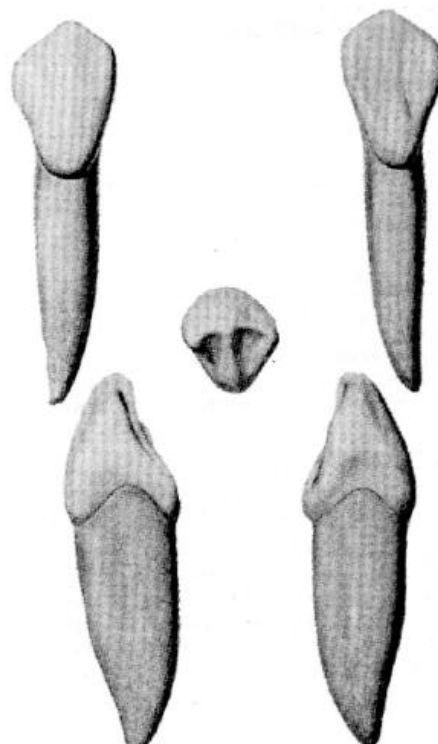
Unique characteristics	- Bigger, wider, longer, more anatomical than CIs - Incisal edge twists at distal towards lingual - Longest root of all incisors
Facial/Labial	- Incisal ridge slopes gingivally (down) going from mesial to distal - Contacts: II (but distal contact more apical than mesial contact) - Occludes with maxillary central and lateral incisors
Lingual	- Slightly more prominent features, deeper fossa



	- Mesial marginal ridge longer than distal marginal ridge, due to slope of incisal ridge - CEJ more apical on lingual than facial
Proximal	- Incisal edge is lingual to the long axis of the tooth - Incisal edge slants to lingual, due to occlusion with maxillaries - Heights of contour at cervical thirds
Incisal	- Incisal edge twisted: curves lingual going from mesial to distal - Cingulum displaced distally - 4 developmental lobes: 3 facial, 1 lingual
Root and Pulp	- 2-3 pulp horns, oval pulp chamber that is flattened mesiodistally - 40% have 2 root canals, pulp appears narrower from the facial than proximal - 1 straight narrow root that is flat mesiodistally, with a mesial and distal concavity (mesial usually deeper)

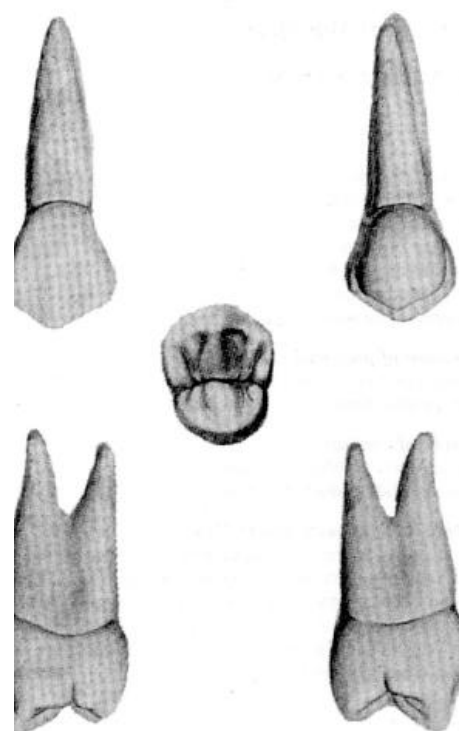
Mandibular Canines

Unique characteristics	- Longest crown - 2nd longest tooth - 2nd longest root - Ant. tooth most likely to have bifurcated root - Only root in mouth with mesial inclination
Facial/Labial	- Straighter mesial outline than maxillary canine - Mesial side of cusp slope shorter than distal - More dull cusp tip than maxillary canine - Contacts: IM - Occludes with maxillary lateral incisor and canine
Lingual	- Less prominent cingulum, labial ridge, and marginal ridges than maxillary canine
Proximal	- Cusp tip slightly lingual to the long axis or centered over long axis - Heights of contour at cervical thirds
Incisal	- Distal incisal ridge twisted lingually - Cingulum positioned slightly distally - 4 developmental lobes: 3 facial, 1 lingual
Root and Pulp	- 1 pulp horn, oval pulp chamber that is flattened mesiodistally and slightly narrow on lingual, - 1 root canal bifurcates ~15% of the time - 1 root (bifurcates ~15% of the time), root flatter on mesial and distal outlines than maxillary canine and mesial root depression present



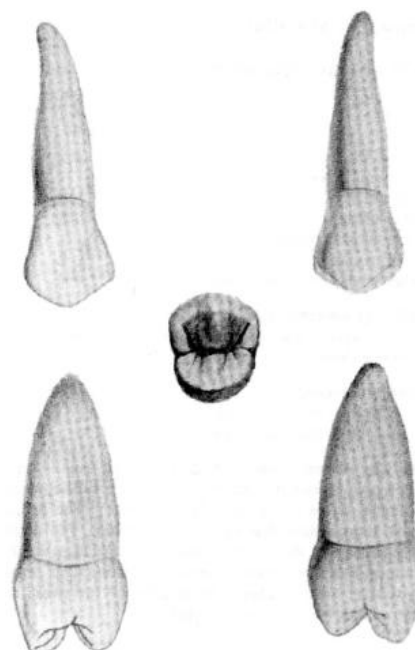
Maxillary 1st Premolars

Unique characteristics	- Concavity on mesial cervical area and mesial marginal ridge developmental groove - Largest premolar and only premolar with Mesial cusp slope > Distal cusp slope
Buccal	- Shorter crown than canine, but longer than molar - Buccal cusp tip positioned distally to midline, mesial buccal cusp ridge longer than distal - Mesial occlusal embrasure largest in mouth - Contacts: MM - Occludes with mandibular 1st and 2nd premolars
Lingual	- Lingual cusp is slightly mesial to midline, and shorter than buccal cusp by about 1mm - MMR higher than DMR
Proximal	- Trapezoidal shape - Convex buccal and lingual cusp tips centered over buccal and lingual roots respectively - Mesial cervical/root concavity present - Buccal HOC cervical, lingual HOC middle
Occlusal	- Hexagonal shape (distorted) due to prominent buccal and lingual ridges - Lingual cusp more mesial to facial cusp (appears twisted) - Central groove ends in mesial and distal pits - 4 developmental grooves: distobuccal, mesiobuccal, distolingual, and mesiolingual, which continues as mesial marginal ridge developmental groove - 4 developmental lobes: 3 buccal and 1 lingual
Root and Pulp	- 2 pulp horns, oval pulp chamber, 2 root canals - Only premolar with 2 roots that bifurcate half way down root



Maxillary 2nd Premolars

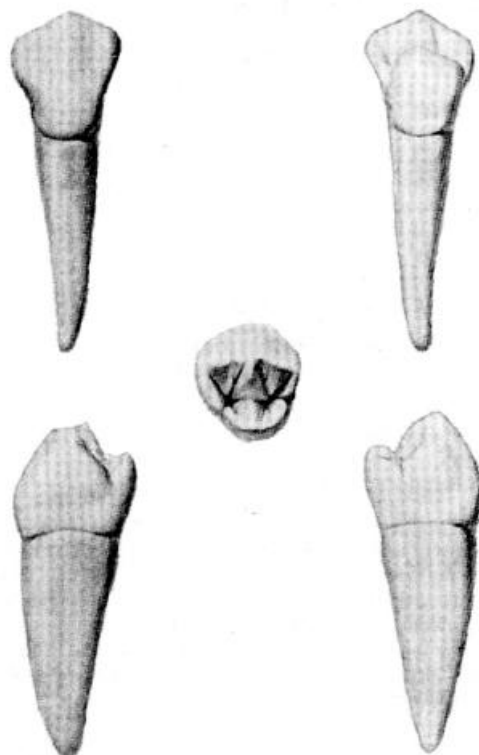
Unique characteristics	- Shorter and smaller than PM1 - Lingual cusp same height as facial - Shorter central groove and more supplementary grooves than PM1
Buccal	- No concavity on the crown - Buccal cusp not as long as PM1, but lingual cusp longer - Contacts: MM - Occludes with mand. 2nd premolar and 1st molar
Lingual	- Lingual cusp more mesial than buccal cusp, like 1st premolar but to a lesser extent
Proximal	- Trapezoidal shape - No cervical/root concavity - Buccal and lingual cusps about the same height - Buccal HOC cervical third, lingual HOC middle
Occlusal	- Hexagonal shape, but more rounded and less twisted than 1st premolar - More distance between cusp tips buccolingually



	- Mesial and distal marginal grooves are very shallow - Short central groove with lots of supplementary grooves, gives wrinkly look
Root and Pulp	- 2 pulp horns, oval pulp chamber, 1 or 2 root canals - Single root (generally) with longitudinal grooves

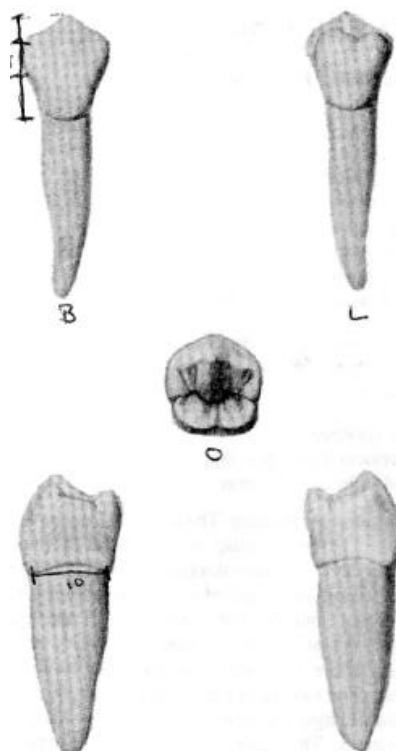
Mandibular 1st Premolars

Unique characteristics	- Smallest premolar, smaller than mand. 2nd premolar in all dimensions except crown height - Lingual cusp and MMR do not occlude - Narrowest and smallest root of all premolars - Mesio-lingual groove present
Buccal	- Resembles mandibular canine - Mesial buccal cusp ridge shorter than distal, mesial much flatter as well - Distal outline more sharply convex than mesial - Contacts: MM - Occludes with max 1st premolar
Lingual	- Lingual cusp much smaller than buccal cusp - Mesiolingual developmental groove can be seen - Tooth narrows faciolingually, which makes 4 surfaces visible from this view (l, m, d, o)
Proximal	- Rhomboidal shape - Mesial marginal ridge much lower than distal and slopes cervically from buccal to lingual - Buccal cusp tip over long axis of tooth, lingual cusp tip in line with the lingual surface of root - Buccal HOC cervical, lingual HOC middle
Occlusal	- Diamond shape - Prominent transverse ridge present, mesial and distal pits - 4 Developmental lobes: 3 facial, 1 lingual
Root and Pulp	- 1 root, 2 pulp horns, usually 1 oval canal (30% have 2 canals, 2nd would be to lingual) - May have proximal concavities



Mandibular 2nd Premolars

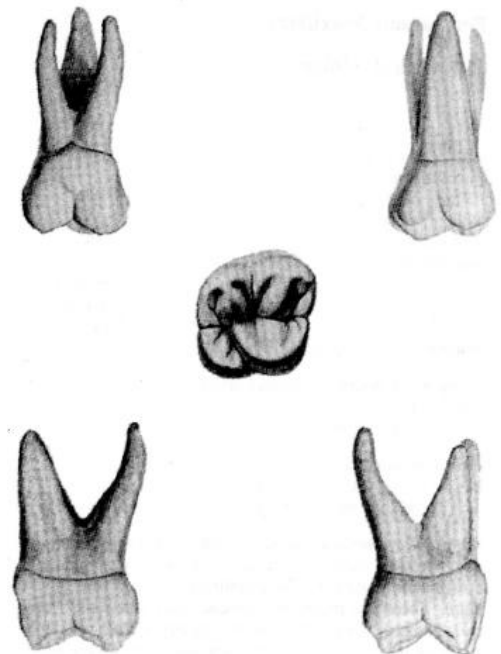
Unique characteristics	- Longer than mandibular 1st premolar - Premolar most likely to be congenitally missing - Premolar most likely to have a central pit and premolar with varying occlusal forms - Premolar most likely to have 1 root and 1 canal - Only posterior tooth with lingual HOC in occlusal third
Buccal	- Shorter buccal cusp than 1st premolar, but more rounded overall - Contacts:MM - Occludes with the maxillary 1st and 2nd premolar
Lingual	- Taller lingual cusp(s) and wider lingual surface than 1st mandibular premolar
Proximal	- Rhomboidal shape - Marginal ridge at right angle to long axis - Distal marginal ridge slightly lower than mesial - Buccal HOC cervical, lingual HOC middle



Occlusal	- 2 cusp variety shows U or H pattern - 3 cusp variety (more common) shows Y pattern, square occlusal table, bigger mesio-lingual cusp, lingual groove and central pit - 4 or 5 developmental lobes: 3 facial and 1 lingual or 3 facial and 2 lingual
Root and Pulp	- 2 cusp has 2 pulp horns/ 3 cusp has 3 pulp horns - 1 root, longer and wider buccolingually than mandibular 1st premolar, 1 round canal - Root is closest to the mental foramen

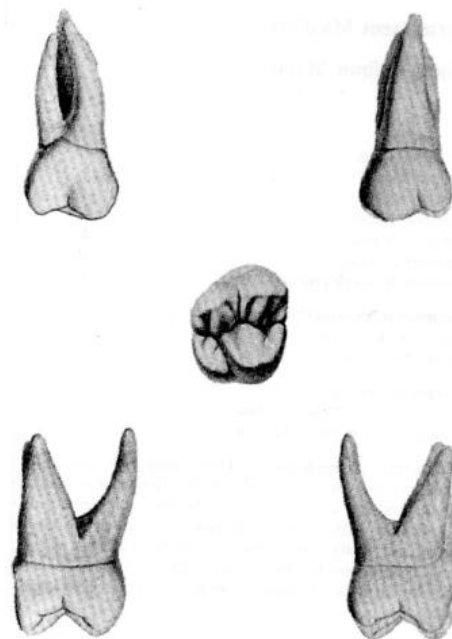
Maxillary 1st Molars

Unique characteristics	- Largest tooth in mouth - Widest tooth faciolingually - Distal root concavity - Only tooth broader on lingual than facial, therefore only tooth with bigger lingual embrasures than facial - Only tooth with 2 triangular ridges on 1 cusp
Buccal	- Trapezoidal shape - Buccal groove continues from central pit - Contacts: JM - Occludes with mandibular 1st and 2nd molars
Lingual	- Mesiolingual cusp much larger than others, mesiobuccal is 2nd largest - Lingual groove is in the middle of the tooth, 2nd and 3rd molars have it slightly distal - Cusp of carabelli separated from mesiolingual cusp by mesiolingual groove
Proximal	- Trapezoidal shape - Buccal HOC cervical, lingual HOC middle
Occlusal	- Rhomboid occlusal table (acute angles MB and DL) - Distal marginal, mesial marginal, and oblique ridge are all the same height - Cusp heights ML>MB>DB>DL>carabelli - Crown tapers distally, so buccolingual width greatest at mesial end - Distal fossa and groove, central fossa and mesial fossa - 5 developmental lobes: 2 buccal, 3 lingual
Root and Pulp	- 4 pulp horns, 1 pulp chamber and 3-4 pulp canals - If 4 canals present, 2 in ML root - 3 roots, palatal root is longest (only 1 in the mouth with buccal and lingual concavities) - Pulp access triangular - Roots closest to the maxillary sinus



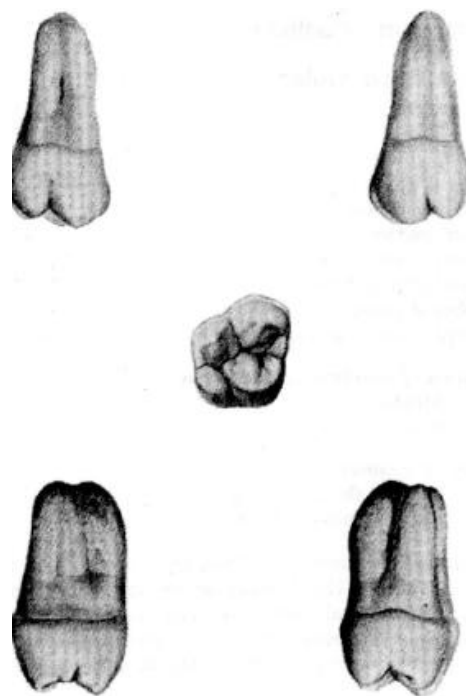
Maxillary 2nd Molars

Unique characteristics	- Similar to max. 1st molar, but smaller and there is no cusp of carabelli - 2 types exist: 4 cusp (rhomboid occlusal shape) and 3 cusp (heart occlusal shaped) - Tooth closest to Stenson's duct (parotid gland)
Buccal	- Mesio Buccal cusp slightly taller than distobuccal - Contacts: JM - Occludes with mandibular 2nd and 3rd molars
Lingual	- Lingual groove positioned more distally than on max 1st molar
Proximal	- Trapezoid shape - Buccolingual width less than max 1st molar - Buccal HOC cervical, lingual HOC middle
Occlusal	- Usually rhomboid shape, but DL cusp small - Cusp heights: ML>MB>DB>DL - 4 developmental lobes: 2 buccal, 2 lingual
Root and Pulp	- 4 pulp horns, 1 chamber, 3 root canals - Pulp access triangular - 3 roots, closer together and more distally inclined than max 1st molars



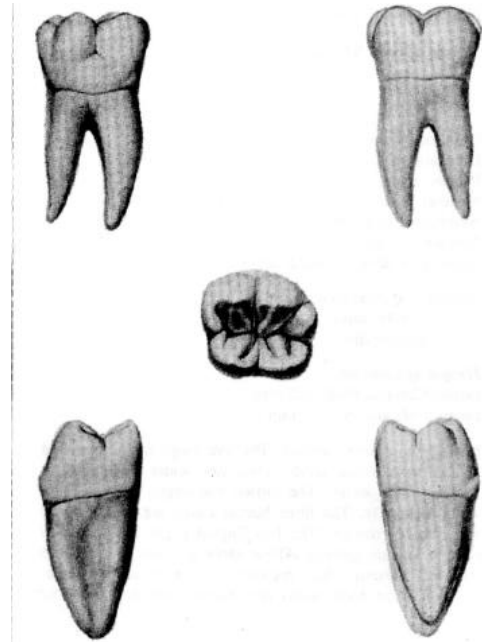
Maxillary 3rd Molars

Unique characteristics	- Tooth most frequently congenitally missing - Shortest tooth in mouth - Most likely teeth in the maxilla to be impacted - Most variable anatomy
Buccal	- Smallest mesiodistal width of the maxillary molars - Distal buccal cusp much shorter than mesio Buccal cusp - Contacts: J - Occludes with mandibular third molar
Lingual	- Distolingual cusp usually missing
Proximal	- Trapezoid shape - Buccal HOC cervical, lingual HOC middle
Occlusal	- Heart shaped - Crown tapers lingually - Cusp heights: ML>MB>DB
Root and Pulp	- 1 fused root, pronounced distal inclination - 3 pulp horns, generally 3 canals



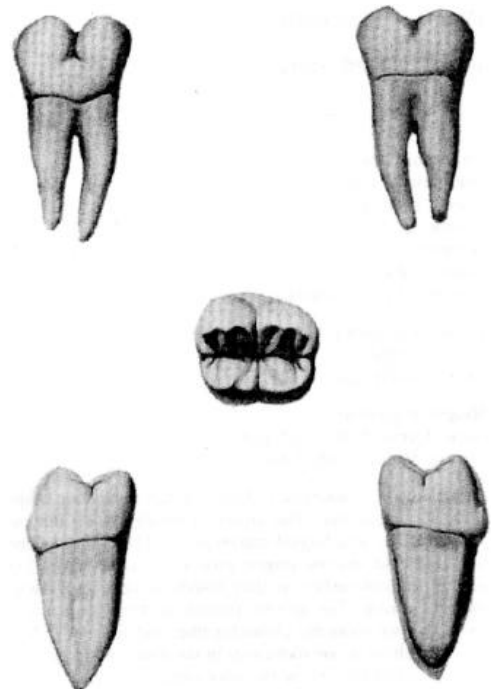
Mandibular 1st Molars

Unique characteristics	- Largest tooth in the mandible - 5 major functional cusps - Widest tooth mesiodistally
Buccal	- Can see all 5 cusps from the buccal, with lingual cusps slightly distal to buccal, 2 buccal grooves - MB developmental groove ends in pit - Contacts: JM - Occludes with maxillary 2nd premolar and 1st molar
Lingual	- Mesiolingual and distolingual cusps are same size, separated by lingual groove
Proximal	- Rhomboidal shape, leans lingually - Buccal HOC at jxn of cervical and middle, lingual HOC middle
Occlusal	- Pentagonal shape - Distolingual cusp the largest - Cusp heights: $ML=DL>MB>DB>D$ - 5 developmental lobes: 3 buccal, 2 lingual
Root and Pulp	- 5 pulp horns, 1 rectangular pulp chamber, 3 canals (2 in mesial root) or 4 canals (2 in each root) - 2 roots, widely separated, distally inclined, and mesial is longer and wider faciolingually



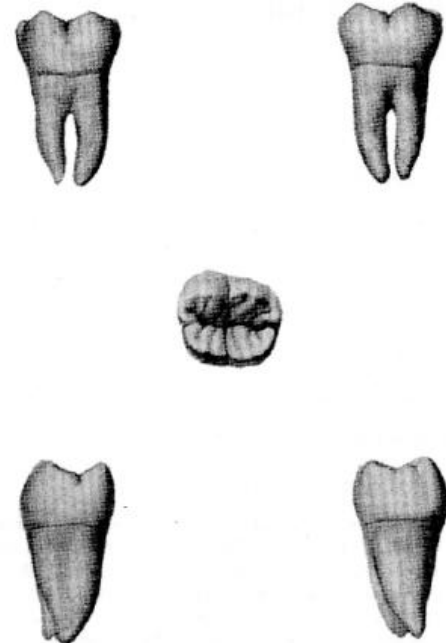
Mandibular 2nd Molars

Unique characteristics	- Resembles 1st molar but smaller crown and without distal cusp - Most symmetrical molar - Most common tooth to have cervical projections
Buccal	- Smaller mesiodistally than 1st molar - Contacts: JM - Occludes with max 1st and 2nd molars
Lingual	- Lingual groove
Proximal	- Rhomboidal shape, leans lingually - Buccal HOC at jxn of cervical and middle, lingual HOC middle
Occlusal	- Trapezoid shape, with "+" pattern - Cusp heights: $MB>ML>DB>DL$ - 4 developmental lobes: 2 buccal, 2 lingual
Root and Pulp	- 4 pulp horns, 1 trapezoidal pulp chamber, 3 canals (2 in mesial root) - 2 roots, shorter, closer together and more distally inclined than 1st molar



Mandibular 3rd Molars

Unique characteristics	- Very irregular and unpredictable morphology - Smallest mandibular molar crown - Most frequently missing or impacted tooth
Buccal	- Smaller mesiodistally than 2nd molar - Contacts: J - Occludes with max 2nd and 3rd molars
Lingual	- Lingual groove
Proximal	- Rhomboid shape, leans lingually - Buccal HOC at jxn cervical and middle, lingual HOC middle
Occlusal	- Oval/trapezoid shape - Bulbous crown that tapers distally: mesial cusps larger than distal cusps - Very wrinkled appearance - 4-5 developmental lobes
Root and Pulp	- 2 roots fused as 1, shorter and more distally inclined than 2nd molars



Primary Tooth Anatomy Characteristics

- A lot like permanent teeth, so memorize exceptions
- Thinner, whiter, less calcified enamel
- No mamelons (but still develop from lobes)
- No premolars (20 total)
- If primary tooth missing, permanent always missing
- More prominent pulp horns and larger pulp chambers
- Bigger cervical bulges and constricted CEJs (“bulbous”)
- Enamel rods go from DEJ→O instead of DEJ out
- No or small root trunk and skinny flared tapered roots
- Shorter crown:root ratio (longer roots compared to crowns)
- Anterior roots point labially
- Flatter occlusal tables with fewer grooves/depressions (smoother)
- More caries prone
- Max and Mand 1°M2 look like perm M1s
- Max 1° M1 crown looks like perm max PM1 (sort of)
- Mand 1° M1 has buccal pot belly and prominent transverse ridge and is most odd looking tooth
- This tooth is easiest to pulp out due to tall M pulp horns
- Primate space anterior to max K9 and post to mand K9
- Generalized spacing or succedaneous crowding
- Leeway space: Difference in MD width of primary molars and K9 and perm PMs and K9; allows flush terminal plane of 1° teeth→class I permanent teeth

Primary Anterior Teeth:

- Max anteriors wider and shorter in proportion to permanent anteriors (not nearly as tall)
- All wider MD than FL
- Max LI has more slanted incisal edge
- Max K9 has longer mesial cusp slope than D cusp slope
- Max and mand K9 diamond shaped (not trapezoidal) from facial
- Max K9 has long sharp cusp
- *1° anterior roots bend labially at apical 1/3
- Mand CI smallest and shortest and first tooth to erupt
- Mand anteriors taller than they are wide.

Primary Second Molars:

- These teeth are just like the permanent first molars
- Bigger than 1° 1st molars
- Max has oblique ridge, widest FL tooth, often has carabelli
- Mand has 5 cusps, distal almost as tall as MB and DB (all almost = height), most likely retained 1°

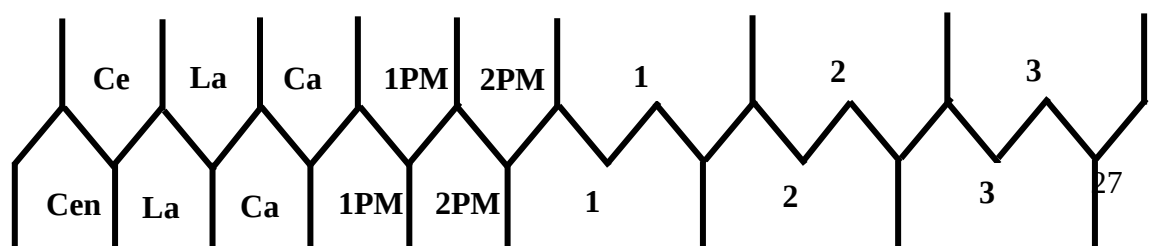
Primary First Molars:

- Most different and unusual teeth
- Maxillary:
 - o crown sometimes compared to max PM1
 - o Smallest molar
 - o Huge cartoon-ish cervical bulge on MB
 - o 4 cusps: MB longest, ML largest, DB, DL smallest
 - o 3 fossa, distal is tiny, H shaped occlusal grooves
 - o Wider FL than MD
 - o 3 roots, a lot like permanent
- Mandibular:
 - o “looks like no other tooth”
 - o Huge cervical bulge on MB, facial CEJ dips on mesial
 - o Huge MMR (looks like cusp)
 - o 4 cusps: MB largest then ML sharpest then Distals
 - o Small mesial fossa, large distal fossa, no central fossa because of massive transverse ridge
 - o 2 roots, a lot like permanent
 - o Very difficult to do class II preps on mesial, very likely to pulp out on mesial.
 - o Angled lingual and distal

Occlusion Rules:

1. Max buccal cusps oppose in facial embrasures of their mand counterparts and tooth distal EXCEPT MB cusps molars→buccal grooves and DB cusp of M1→DB groove M1
2. Max lingual cusps occlude in DMR of mand counterparts and MMR of tooth distal EXCEPT ML cusps molars→central fossa of counterpart
3. Mand lingual cusps oppose in lingual embrasures of their max counterparts and the tooth mesial EXCEPT DL cusp mand molars→L grooves and L cusp mand PM1→NOTHING.
4. Mand buccal cusps occlude on MMR of max counter and DMR of tooth mesial EXCEPT DB cusps molars→central fossa, D cusp M1→D triangular fossa max M1, B of PM1→only MMR of PM1 (no K9).

Picket
Fence:



Head and Neck Anatomy

Cranial Nerves

	Nerve	Foramen	Function
I	Olfactory	Cribiform plate	- Smell
II	Optic	Optic canals	- Vision
III	Oculomotor	Superior orbital fissure	- All extraocular muscles except LR and SO - Levator Palpebrae superioris - Constrict and accommodate pupils (ciliary ganglion)
IV	Trochlear	Superior orbital fissure	- Superior oblique muscle
V	Trigeminal V1 V2 V3	Superior orbital fissure Foramen rotundum Foramen ovale	V1 - general sense to upper face V2 - general sense to mid face and maxillary teeth V3 - general sense to lower face and mandibular teeth, general sense to anterior 2/3 rd of tongue, muscles of mastication, mylohyoid, anterior digastric, tensor veli palatine, tensor tympani
VI	Abducens	Superior orbital fissure	- Lateral rectus muscle
VII	Facial	Internal acoustic meatus/ stylomastoid foramen	- Taste to anterior 2/3 rd of tongue, muscles of facial expression, stylohyoid, stapedius, posterior digastric, lacrimal gland, nasal glands and palatine glands (pterygopalatine ganglion), submandibular and sublingual glands (submandibular ganglion)
VIII	Vestibulocochlear	Internal acoustic meatus	- Hearing, equilibrium
IX	Glossopharyngeal	Jugular foramen	- General sense and taste to posterior 1/3 of tongue and oropharynx, stylopharyngeus, parotid gland (otic ganglion), carotid body and sinus
X	Vagus	Jugular foramen	- General sense and taste to laryngeal/ epiglottal region, sensation of visceral organs thru midgut, most pharynx and soft palate muscles and laryngeal muscles, glands of the visceral organs
XI	Accessory	Jugular foramen	- Sternocleidomastoid and trapezius muscles
XII	Hypoglossal	Hypoglossal canal	- All muscles of tongue except palatoglossus

*Cervical plexus (C1-4) – infrahyoid muscles, geniohyoid and thyrohyoid (just C1), sensation to neck and shoulder

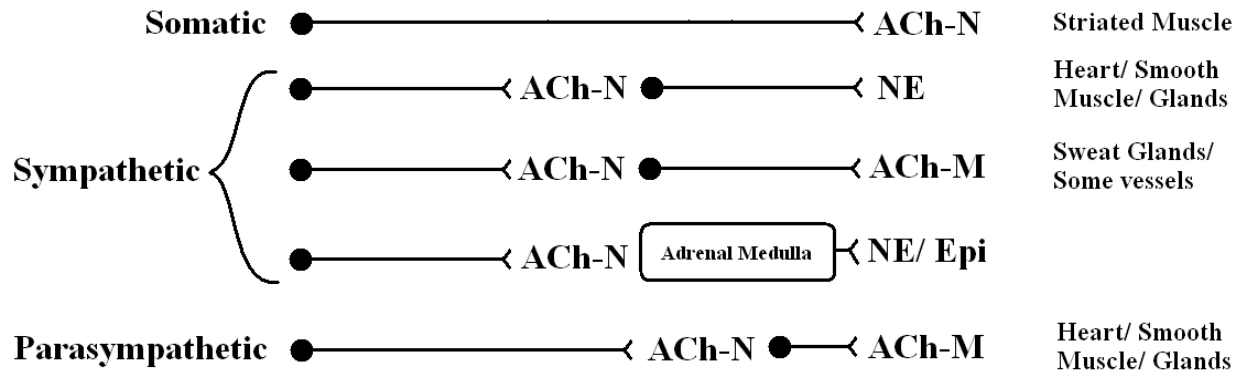
*Parasympathetics CN III, VII, IX, and X

Foramina of the Cranium

Foramen	Contents Passing Through
Cribiform plate	CN I
Optic canal	CN II, Ophthalmic artery
Superior orbital fissure	CN III, IV, V1, VI, Superior ophthalmic vein
Foramen rotundum	CN V2
Foramen ovale	CN V3, Lesser petrosal nerve
Foramen spinosum	Middle meningeal artery, Middle meningeal vein
Foramen lacerum	Emissary veins
Internal acoustic meatus	CN VII, VIII
Jugular foramen	Internal jugular vein, CN IX, X, XI

Hypoglossal canal	CN XII
Inferior orbital fissure	inferior ophthalmic vein

Nerves and Receptors



Adrenergic

Type	Location	Response to Activation
$\alpha 1$	- Arterioles in skin, viscera, and kidney - Veins	- Constriction
$\alpha 2$	- Presynaptic nerve terminals - Postsynaptic in CNS	- Inhibit NE release - Decrease sympathetic tone
$\beta 1$	- Heart	- Increase heart rate - Increase force of contraction
$\beta 2$	- Arterioles in skeletal muscle - Bronchial and uterine smooth muscle	- Dilation - Relaxation

Cholinergic

Type	Location	Response to Activation
Muscarinic	- M1: CNS - M2: CV - M3: Eye, GI/GU, Lung	- M1: stimulation - M2: decreased HR - M3: miosis/ciliary contraction, increased motility/ secretions, and bronchoconstriction/ decreased secretions
Nicotinic	- Nn: neuronal - Nm: neuromuscular junction	- CNS and ganglionic stimulation - Muscle stimulation

Nerve Fibers of Pain

- **A fibers:** Myelinated somatic nerves. Vary in size (2-20 μm).
 - **alpha:** largest, afferent to and efferent from muscles and joints. Actions: motor function, proprioception, reflex activity.
 - **beta:** large as A-alpha, afferent to and efferent from muscles and joints. Actions: motor proprioception, touch, pressure, touch and pressure.
 - **gamma:** muscle spindle tone.
 - **delta:** thinnest, pain and temperature. Signal tissue damage.

- **B fibers:** Myelinated preganglionic autonomic. Innervate vascular smooth muscle. Though myelinated, they are more readily blocked by LA than c fibers.
 - **C fibers:** unmyelinated, very small nerves. Smallest nerve fibers, slow transmission. Transmit dull pain and temperature, post-ganglionic autonomic.
- * Both A-delta and C fibers transmit pain exist within pulp and are blocked by the same concentration of LA.

Muscles of Mastication

Muscle	Attachments	Action
Masseter	Superficial – zygomatic process of maxilla to lateral surface of ramus of mandible Deep – medial surface of zygomatic arch to lateral surface of coronoid process of mandible	Elevate
Temporalis	Temporal fossa to coronoid process of mandible	Elevate and Retrude
Lateral Pterygoid	Greater wing of sphenoid and lateral surface of lateral pterygoid plate to condylar neck and disk	Depress and Protrude, stabilize disk
Medial Pterygoid	Medial surface of lateral pterygoid plate to medial surface of ramus at angle of mandible	Elevate and Protrude

Glands

Gland	Secretion	Duct	Innervation
Parotid	Serous	Stenson's	Pre: CN IX, lesser petrosal nerve Ganglion: Otic Post: V3 (Auriculotemporal)
Submandibular	Mixed	Wharton's	Pre: CN VII, chorda tympani Ganglion: Submandibular Post: V3 (Lingual)
Sublingual	Mucous	Rivian (many small) Bartholin's (1 large)	Pre: CN VII, chorda tympani Ganglion: Submandibular Post: V3 (Lingual)
Von Ebner	Serous	-	Pre: CN IX, lesser petrosal Ganglion: Otic Post: V3 (Lingual)

Clinic Operations

Attire

- Scrubs or business attire is required when you are on the clinic floor.
- Long hair must be pulled back and facial hair well-kept
- No open toe shoes, bare legs, tank-tops, jeans, or exposed mid-sections

Patient Flow

When a patient calls HSDM for dental care they are given an appointment in Oral Diagnosis (OD) for a screening exam. When the patient arrives at OD, a brief exam is conducted and radiographs are taken. Based on this information, the patient is then referred to either the pre-doctoral, post-doctoral, or faculty clinics. If the patient is assigned to the pre-doctoral clinic, the front desk gives the patient a 2nd appointment on a new patient intake (NPI) day with a randomly assigned 3rd year student.

3rd year students can obtain new patients in the following ways:

- NPI – During third year, each student has an NPI day about once a month.
- Transfers from big sibs/ 4th year students/post-docs – transfers are more common at the beginning and end of 3rd year as the class above you either goes on externship or graduates.
- Senior Tutor – If you are short on a particular type of procedure (eg crowns, scaling and root planning, etc.), your senior tutor may give you a patient with that particular need.

Treatment Planning and Treatment Plans

After seeing a new patient for an initial exam, you take the information gathered during that exam and draw up a proposed treatment plan for that patient. At the beginning of 3rd year this can be overwhelming, but do your best to write it out. You then take your tentative treatment plan along with the chart, study models, and photographs to your senior tutor. He/she will go over the proposed plan and help you fix any errors. Once the treatment plans are written properly, the senior tutor will swipe approval. If the patient is covered by MassHealth, have the approved and signed treatment plan submitted by a PSL any necessary prior approvals. Once you have the finances approved, you are ready to schedule your patient to discuss the treatment plans. Once the patient has decided on a course of action the patient must sign and accept the treatment plan. You are now ready to begin treatment.

ADA codes

The ADA has created an official list of dental codes called the CDT to describe the various procedures performed in a dental practice. They did this to make communication between dental offices and insurance companies more universal. Our clinic also uses the CDT and the Harvard Dental Fee Schedule is based on these codes, with a few modifications. When treatment planning, you can use the search function to find these procedures in axiom, and they can also be used to give your patients an idea of what certain treatments will cost. Below are the most commonly used codes during third year.

Discipline	Procedure Code	Procedure Description	Fee (\$)
Diagnostic	D0120	Periodic oral evaluation (recall)	24
Diagnostic	D0150	Comprehensive oral evaluation (initial exam)	56
Diagnostic	D0210	Intraoral-complete series (FMX)	80
Diagnostic	D0220	Intraoral-periapical 1 st film	19
Diagnostic	D0270	Bitewing-single film	19
Diagnostic	D0274	Bitewing-4 films	68

Diagnostic	D0330	Panoramic film	105
Preventive	D1110	Prophy-adult	49
Preventive	D1120	Prophy-child	40
Preventive	D1203	Fluoride-child	24
Preventive	D1204	Fluoride-adult	22
Preventive	D1351	Sealant per tooth	22
Restorative	D2140	Amalgam 1 surface	47
Restorative	D2150	Amalgam 2 surfaces	60
Restorative	D2160	Amalgam 3 surfaces	82
Restorative	D2161	Amalgam 4 or more surfaces	91
Restorative	D2330	Resin-based composite 1 surf anterior	45
Restorative	D2331	Resin-based composite 2 surf anterior	62
Restorative	D2332	Resin-based composite 3 surf anterior	75
Restorative	D2335	Resin-based composite 4+ surf anterior	92
Restorative	D2391	Resin-based composite 1 surf posterior	50
Restorative	D2392	Resin-based composite 2 surf posterior	76
Restorative	D2393	Resin-based composite 3 surf posterior	87
Restorative	D2394	Resin-based composite 4+ surf posterior	93
Restorative	D2750	Crown-PFM high noble metal	529
Restorative	D2790	Crown-Full cast high noble metal	575
Restorative	D2930	Prefab SS crown-primary tooth	76
Restorative	D2950	Core buildup	74
Restorative	D2952	Cast post and core	102
Restorative	D2954	Prefab post and core	96
Endo	D3310	Endo therapy (root canal)- anterior	221
Endo	D3320	Endo therapy (root canal)- bicuspid	240
Endo	D3330	Endo therapy (root canal)- molar	280-pre-doc price
Endo	D3330	Endo therapy (root canal)- molar	600-post-doc price
Perio	D4210	Gingivectomy/plasty- 4 or more	258
Perio	D4211	Gingivectomy/plasty- 1-3 teeth	56
Perio	D4249	Crown lengthening	176
Perio	D4260	Osseous surgery-4 or more/quadrant	211
Perio	D4261	Osseous surgery-1-3 teeth/quadrant	160
Perio	D4271	Free gingival graft	211
Perio	D4274	Distal or proximal wedge	112
Perio	D4341	Scaling/root planing 4 or more/quadrant	49
Perio	D4342	Scaling/root planing 1-3 teeth/quadrant	24
Perio	D4910	Periodontal maintenance	49
RemovProsth	D5110	Complete denture-maxillary	386
RemovProsth	D5120	Complete denture-mandibular	386
RemovProsth	D5130	Immediate denture- maxillary	552
RemovProsth	D5140	Immediate denture-mandibular	552
RemovProsth	D5213	Maxillary partial denture- cast metal frame	494
RemovProsth	D5214	Mandibular partial denture- cast metal frame	494
RemovProsth	D5410	Adjust complete denture- max	22
RemovProsth	D5411	Adjust complete denture- mand	22
RemovProsth	D5421	Adjust partial denture- max	19

RemovProsth	D5422	Adjust partial denture- mand	19
RemovProsth	D5820	Interim partial denture-max	150
RemovProsth	D5821	Interim partial denture- mand	150
FixedProsth	D6010	Implant	942
FixedProsth	D6056	Implant prefabricated abutment	240
FixedProsth	D6059	Implant abutment PFM crown	457
FixedProsth	D6750	Bridge-crown	529
FixedProsth	D6240	Bridge-pontic	529
FixedProsth	D6801	Bridge drawing bar	0
OralSurgery	D7140	Extraction of erupted teeth	44
OralSurgery	D7210	Surgical removal of erupted tooth	80
	D9940	Occlusal guard	163
	D9972	External bleaching per arch	130
	D9972A	Bleaching refill kit	62
	D9999	Unspecified adjunctive procedure	0

Charts / Charting

Document every encounter with patients. If you call a patient, write it in the chart. If you see a patient, write the progress notes in the chart. If you are scheduled to see a patient, and he/she fails to show, write it in the chart.

Sample treatment notes:

Comprehensive exam (initial)

Comprehensive oral exam, study models

CC: Need a lot of work and dentures, probably have cavities, don't want more infections.

HPI: Pt had cleaning and dental exam 2 years ago at BU teaching practice. Recently had abscess and infection relating to impacted #17 and #25 and had those teeth extracted 1/10 at BIDMC by Dr. Flynn.

PMH: Pt has hx of hyponatremia, HTN, mild Diabetes-II, GERD, scoliosis, hypercholesterolemia.

Allergies: NKDA

Meds: atenolol, omeprazole, norvasc, simvastatin, and hx 3 once yearly IV infusions of Zometa.

SH: Lives with daughter in coolidge corner, works part time at CVS, has no dental insurance

FH: Hx breast cancer and diabetes.

PDH: Pt brushes 1-2x/day with manual toothbrush and infrequently flosses. Has hx of posterior teeth extractions in Mexico and #26 came out when chewing candy last year. Recommended twice daily brushing and flossing. Pt used to wear U/L partial dentures, but has not worn since January extractions. Pt states her mouth is dry.

Exam: Extra-oral shows basal cell carcinoma removal scars and L sided TMJ click at maximal opening. Intra-oral soft tissue findings include hyperplastic retromolar pad. Hard tissue findings include multiple missing teeth, #12 carious crown loss and residual root tip. Multiple cervical carious lesions and severe xerostomia noted.

Radiographic exam reveals impacted #32 and multiple recurrent carious lesions around existing restorations.

Perio exam shows generalized mild-moderate plaque accumulation and gingivitis, generalized recession, class II mobility on #24.

Tx plan: extract #12 and #32, caries control, U/L RPDs

NV: adult prophylaxis and review and accept tx plan

Operative

Pt arrived on time.

RMH, no changes.

Tx: #15 DO composite, primary caries in the distal groove

Anesthesia achieved by PSA and palatal block with 2x1.7ml 2% lidocaine with 1:100k epi.

Isolation achieved by rubber dam and 12A clamp.

Prepped DO prep in #15 to remove caries, checked with caries indicator. Placed tofflemire matrix and wedge. Vitrebond placed, etched, OptiBond solo, filled Vit-L-Essense hybrid shade A2, adjusted occlusion, polished using PrismaGloss. Occlusion, margins, contact checked.

Procedure supervised by Drs. Kapos and Chang.

NV: 6 mo recall.

Surgical treatment note

Pt arrived on time. Consent signed.

Anesthesia achieved by 5x 1.7mL 3% polocaine by left PSA, MSA, and ASA, right MSA and ASA, and bilateral GP and NP blocks. During procedure anesthesia wore off, 2x1.7 0.5% bupivacaine w/ 1:200k epi admin by infiltrate.

Nitrous given at 35-65% throughout.

Flap raised from #11-14. All maxillary teeth extracted: #6-14. #13 required surgical extraction.

Continuous sutures placed bilaterally with 3-O plain gut. Hemostasis achieved.

Alveoloplasty performed, bilateral canine areas and left posterior.

BP: Initial- 143/86, 68 pulse, 97% O2

Highest- 249/135, 75 pulse, 99% O2

Final- 177/108, 64 pulse, 99% O2

Rx given: 5/500 Vicodin, disp 20, sig 1-2 tablets PO q4-6h PRN pain, max 8 tablets/day.

Post-op instructions provided.

Patient Management

As your patient base grows, it is important to carefully track which of your patients have particular needs and to communicate that information to the senior tutor's office.

Once you begin seeing patients, you may soon realize that the patient population at HSDM is not always the easiest with which to work. Patients have scheduling issues, financial constraints, and diverse personalities.

Here is a list of tips to help you manage your patients:

- Ask/note the best days/times for the patient to come in and if they are able to come on short notice
- Call patients 1-2 days before scheduled appointments. axiUm automatically calls each patient, but it's good to confirm yourself.
- Call patients the night after a big procedure (eg endo, perio surgery, oral surgery)
- Schedule subsequent appointments before patients leave
- When you start a removable case, schedule all appointments necessary for that case when the case starts. If you choose not to do this, make sure that the patient is aware of the approximate number of appointments required to complete the case (overestimate).

- Stay on top of your patient's financial issues. HSDM accepts Mass Health, Delta Dental Premier, and BlueCross BlueShield Dental Blue. Each plan is different and Mass Health requires approval of the treatment plan prior to treatment. Talk to your PSL if you have questions.

Sterile Technique in the Operatory:

Considering that many procedures at HSDM are done without an assistant, the suggestion is to use the tray and table for placement of dirty instruments and materials, and to use the shelves/counters for storage of clean instruments/materials. If you need something from the clean area, remove your gloves and drop the selected instrument/materials on the tray or table. Then re-glove and continue with your procedure. If you have an assistant, they can get you the needed supplies and place them on your tray, eliminating the need to change gloves. Note: the sterile technique for perio and oral surgery is much more rigorous; see these specific sections for more information. The teaching clinic does not operate under, "sterile," techniques, but the above methods are OSHA approved and consistent with standard of care.

Emergency Management:

HSDM Protocol for Patient Emergencies:

- Stay with your patient and tell someone to go to the front desk and make an announcement calling for **Dr. Harvard** to report to the appropriate bay (signals to the faculty that there is an emergency)
- Have someone grab the oxygen and crash cart - located in sterilization

Blood Borne Pathogen Exposure

- You must begin treatment within 1 hr. of exposure.
- Report incident to the Clinic Floor Manager (Pam Simmons) IMMEDIATELY.
- The Office of Clinical Affairs will arrange for you to be seen at UHS at Vanderbilt Hall.
- If there is no one in the Office of Clinical Affairs, call UHS-Vanderbilt Hall (432-1370) to be seen IMMEDIATELY.
- If there is no one at UHS- Vanderbilt Hall, go to the 24-hr. Clinic (495-5711) at UHS-Holyoke Center in Cambridge IMMEDIATELY or to BWH.
- Regardless of where you are sent to be treated, the patient should be questioned about their medical history. The Office of Clinical Affairs/ Pam Simmons usually asks the patient if they would be willing to be tested at UHS as well.
- If your eyes are exposed to spray or blood, there are eye-wash stations located between chairs 3 & 4 of each bay and there is a *shower* to wash your eyes near the sterilization counter.

Common Medical Emergencies

All of the following necessitate that a “Dr. Harvard” call be made, and the faculty member in charge will decide if the patient’s condition warrants advanced emergency care and if 911 should be called. Oxygen tank is located in sterilization.

	Symptoms	Management
Syncope (90% of all emergencies)	pallor, nausea, diaphoresis, dizziness, faint feeling, loss of consciousness	- Trendelenburg position - Ensure patent airway (head tilt-chin lift) - Give oxygen or ammonia (smelling salts) - Monitor vital signs - Postpone further dental care. Patient must leave w/ escort
Hyperventilation (9% of all emergencies)	tachypnea, prolonged may lead to syncope; ‘tight’ chest pain, stomach ache, leg cramp, arm numbness	- Calm patient and seat upright - Apply rebreathing (plastic head-rest cover or ambu bag with O₂ but no ventilation) - Monitor vital signs.
Anaphylactic Shock	hives, rash, pruritus, erythema, angioedema, tongue swells, dyspnea, wheezing	- Identify allergen and discontinue - Mild: give Benadryl - Severe: give EpiPen (1:1000, 0.3-0.5 cc IM) - Maintain airway and give oxygen. - Monitor vital signs
Asthma	gagging, dyspnea, wheezing, stridor, cyanosis, unresponsive	- Calm patient - 2-3 puffs of Albuterol and monitor vitals
Aspiration	gagging, dyspnea, wheezing, stridor, cyanosis, unresponsive	- If good air exchange, encourage patient to breathe and cough. - If poor air exchange, do Heimlich maneuver and/or CPR, and monitor vitals - Take patient to Hospital to x-ray/ surgery
MI	SOB, angina, anxiety, diaphoresis, hypotension	- Position patient upright. - Give Nitroglycerin and monitor vitals. - If pain persists: assume MI. Give oxygen and/or do CPR until EMS arrives - If Arrhythmia - use Defibrillator (3x) and continue CPR until EMS arrives
Hypoglycemia	combative, dizziness, weakness, confusion, intense hunger, sudden collapse, unresponsive, diaphoretic	- If conscious: give PO sugar - If unconscious: start IV with dextrose 50% - Maintain airway and give O₂ - Monitor vital signs.
Seizure	sudden collapse, unresponsive, diaphoretic, eyes roll back under lids, seizure, patient may vomit, twitch	- Protect patient: move instruments, try to control patient head - Maintain airway and give O₂. - Many need to start IV, give valium 1mg/min until seizure stops
Local Anesthesia Overdose	biphasic response: drowsy, visual disturbances, circum-oral numbness, increased talkativeness, apprehension, slurred speech, muscular twitching, convulsions, seizure, loss of consciousness	- Position patient supine. - Maintain airway and give O₂ - Monitor vital signs and wait for EMS - Discontinue treatment for this appointment.

New Patient Basics

General Operatory Set-up

- Wipe down chair, table, tray, tray handle, light handles, counter, suction head and hose, air/water sprays, patient glasses, hoses, and computer with disinfectant wipes
- Run the water lines for 30seconds at the beginning and end of each patient to remove bacteria and debris in the tubing
- Tray paper into tray and white napkin on moveable table
- Add suction nozzles to high and slow speed suction and nozzles to air/water sprays
- Head rest cover on head rest, and set out bib, bib clips, and safety glasses for patient
- Put mouse cover on mouse

History and Exam

History	Exam
Patient Information - Age, Sex, Insurance provider Chief Complaint HPDI - Pain: onset, duration, location, sharp/dull, intensity, aggravating/alleviating factors - Other symptoms: bleeding, swelling, ulceration, food impaction PDI - Last cleaning and frequency of dental visits - Oral Hygiene: brushing, flossing, mouth rinse, fluoride supplements - Oral Habits: nail biting, grinding/clenching - Endo: Hot/cold sensitivity, pain on biting, spontaneous pain - Perio: bleeding gums, mobility, recession - Prosth: removable or fixed - Ortho: age, reason, retainer - Oral Surgery: extractions or other - Oral Path: lumps, ulcers, biopsies - TMJ: clicking, pain, locking Med Hx - Physicians name and phone number - Current Illnesses - Past Illnesses/Hospitalization - Medications - Allergies: latex, drugs , local anesthetic preservatives, shellfish, pine nuts Social Hx - Occupation - Habits: smoking, alcohol, recreational drugs, diet, exercise	Extra-oral - Facial Symmetry and Smile analysis - Muscles of Mastication - TMJ - Lymphadenopathy - Lesions / masses / abnormal pigmentation Intra-oral - Soft Tissues: • Buccal mucosa, vestibule, floor of mouth, palate, tongue • Gingiva: biotype, color, papilla, gingival margins, stippling, bleeding, exudates - Hard Tissues: • Existing restorations/conditions: amalgam, composite, crown/bridge, absent teeth, supra-erupted teeth, diastamata, wear facets • New/Recurrent decay, fractures • TMJ: deviation on opening, pain, clicking, crepitus, locking - Orthodontic: Angle classification, overbite, overjet, crossbite, midline discrepancy, interferences - Full Periodontal (See Periodontics Section): Probing depths, furcation, recession, mobility, fremitus, MG Radiographic - Existing restorations: RCT, posts, implants - New/Recurrent decay, fractures, periapical pathology - Bone height - Pathology Photographic - Extraoral - Frontal view: smiling and at rest - Profile: left and right - Intraoral - Occlusal: max and mand - Buccal: left and right - Teeth in MIP with cheeks retracted - Each sextant if it's your case presentation Diagnoses Treatment Plan

Alginate Impressions

Indications	Set up	Procedure
Study cast for patients needing occlusal analysis, crown/bridge, RPD, complete dentures, or ortho consult	- Mixing bowl - Spatula - Water measuring cup - Impression trays - Alginate - Tray adhesive - White rope wax - Bite registration material and gun	- Clear debris from oral cavity and sit patient upright - Select tray size and mold white rope wax to tray borders (may warm wax under water) - Apply tray adhesive to impression tray (use dappen dish and benda brush if you tried the tray in the patient's mouth first) - Add 3 scoops of alginate with 3 units of water in mixing bowl, mix, and load try - Retract lip, insert tray, and seat (posterior to anterior) have patient close lips around tray - Allow 2-3 minutes after loss of tackiness so that impression develops adequate tear strength and remove rapidly to maximize tear strength - Wash off saliva and blood and spray with disinfectant, then place damp paper towel around impression and place in plastic bag (head rest cover) - Apply bite registration material to posterior teeth of patient with gun and have patient bite in MIP, wait 3-5 minutes and remove. Disinfect bite registration, trim, and place in plastic bag - Pour impression as soon as possible (within 1 hour ideally) - Separate from stone ~60mins after pouring – if not, alginate may shrink and break the stone

Using the Rubber Dam

- Method 1
 - o Punch the appropriate holes in the rubber dam (usually one tooth posterior to the tooth being treated and several teeth anterior to it)
 - o Select appropriate clamp and tie floss around the clamp
 - o Anesthetize the patient – even if you don't anesthetize the entire tooth, you should anesthetize the gingiva because the clamp will pinch.
 - o Place rubber dam on the frame and the situate the clamp in the hole punched for it
 - o Use clamp forceps to apply tension to the clamp and lock the forceps
 - o Align the frame on the patient and situate the clamp on the tooth, then release tension on the clamp forceps and remove from the mouth.
 - o Use floss to push the rubber dam into the embrasures of all the teeth
 - o Use air and plastic instrument to evert collar of rubber dam around tooth
- Method 2
 - o Punch the appropriate holes in the rubber dam (usually one tooth posterior to the tooth being treated and several teeth anterior to it)
 - o Select appropriate clamp and tie floss around the clamp
 - o Anesthetize the patient – even if you don't anesthetize the entire tooth, you should anesthetize the gingiva because the clamp will pinch.
 - o Use clamp forceps to apply tension to the clamp and lock the forceps
 - o Place clamp on proper tooth and release tension on forceps
 - o Stretch rubber dam around the clamp and use floss to push rubber dam into embrasures
 - o Use air and plastic instrument to evert collar of rubber dam around tooth

Medical Risk Assessment

Stress Reduction Protocol - Morning appointments - Short appointments - Sedation - Pain control - Minimize wait time - Premedication - Recognize signs of disease	Diabetes Protocol - Normal pre-appt meal - Normal or slightly reduced insulin dose - Glucose on hand - Watch for hypoglycemia - Reduce post-op insulin if caloric intake is hindered
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Medical Conditions and Necessary Precautions

Condition	Recommended Action
Cardiac Valve disease/Joint prostheses	- Antibiotic prophylaxis (See guidelines)
Coronary Artery disease	- Stress reduction protocol - Nitroglycerin on hand - Minimal epinephrine - Good pain control
Asthma	- Bring inhaler to appointment - Stress reduction protocol - Avoid: aspirin, NSAIDS, LA with sulfites - Triad: Asthma + aspirin + nasal polyps → anaphylactic shock
Hypertension	- ASA Guidelines - o ASA II : 140-160/ 90-95 : stress reduction protocol - o ASA III : 160-200/ 95-115 : stress reduction protocol, physician consult - o ASA IV : >200/ >115 : no treatment - Minimize Epinephrine (< 0.04mg)
Diabetes	- Stick glucose - o <85 mg/dl : postpone treatment, physician referral - o 85-200 mg/dl : stress reduction protocol, antibiotics for high risk procedures - o 200-300 mg/dl : stress reduction protocol, antibiotics for high risk procedures, physician referral - o >300 mg/dl : no treatment, send to the ER - Normal breakfast, ½ insulin dosage, have dextrose 50% available, FSBG pre, intra and post-op, ↓ post-op insulin
Anticoagulants	- Dr. Flynn's Guidelines - o Aspirin: <100 mg/day: gelfoam + sutures - o Aspirin: >100 mg/day : gelfoam + sutures - o Plavix (Clopidogrel): gelfoam + sutures - o Coumadin (INR <2.5) : no change - o Coumadin (2.5<INR<4) : physician consult, stop 2 days pre-op - o Coumadin (4<INR) : physician consult, stop 2-5 days pre-op, and check INR pre-op (<2.5)
Immunocompromised	- Antibiotic prophylaxis for high risk procedures - Pts taking steroids: 2x or 3x normal dose 1hr before procedure
Hemodialysis/ESRD	- Schedule treatment for day after dialysis - Avoid kidney metabolized drugs - No BP in same arm as shunt - Antibiotic prophylaxis
Pregnancy	- Elective treatment only in middle trimester – use left lateral decubitis position - Safe drugs: penicillin, cephalosporin, clindamycin, Tylenol - Avoid: nitrous oxide, metronidazole, tetracycline, vancomycin, sulfonamides, NSAIDs, mepivacaine, bupivacaine, opioids, flouroquinolones

American Society of Anesthesiologists (ASA) Classification

	Description	Examples	Recommendation
I	Healthy	-	-
II	Mild to moderate systemic disease Includes Kids <2 and Adults >70	Pregnant Well controlled asthma Well controlled NIDDM Hypo-/Hyperthyroidism Dental phobic BP: 140-159/ 90-94	Stress reduction protocol
III	Severe systemic disease	COPD Asthma: 1 attack/wk Well controlled IDDM Stable angina CHF >6mo Post MI >6mo Post CVA BP: 160-199/ 95-114	Stress reduction protocol Medical consult advised
IV	Disease that incapacitates patient	Unstable angina Uncontrolled IDDM, CHF, COPD <6mo Post MI <6mo Post CVA BP: >200/ >115	No elective dental treatment Send to ER
V	Life threatening, not expected to live >24 hrs	End-stage renal, pulmonary, hepatic, or cardiovascular disease	No elective dental treatment
VI	Declared brain dead	-	-

*A problem with ASA classification is that it does not include: Cancer, HIV, and several other serious medical conditions.

Antibiotic Prophylaxis

This is one of the most controversial topics within medicine and dentistry today. Although there are many references containing opinions regarding the benefits of antibiotic prophylaxis for patients, a 2007 review of the literature (JADA April 2007) shows that there is limited, if any definitive, scientific support for the practice in general. Over the past decade, there has been a trend towards more conservative use of antibiotic prophylaxis for the following reasons:

- Infective endocarditis (IE) is much more likely to result from frequent exposure to random bacteremias associated with daily activities than from bacteremia caused by a dental procedure
- Prophylaxis may prevent an exceedingly small number of cases of IE, if any.
- The risk of antibiotic-associated adverse events (hypersensitivity, pseudomembranous colitis, etc.) exceeds the benefit, if any, from prophylactic antibiotic therapy
- Maintenance of optimal oral health and hygiene may reduce the incidence of bacteremia from daily activities and is more important than prophylactic antibiotics for a dental procedure

Antibiotic prophylaxis is given in an attempt to prevent any of the following:

- Infective Endocarditis (Subacute Bacterial Endocarditis)
- Late Prosthetic Joint Infection
- Local infection of a surgical site (eg 3rd molar extraction)

When to Prescribe

It is your responsibility to read any new literature regarding this topic, to evaluate each patient individually, to communicate with your patient's PCP or cardiologist, and to use your best judgment when making the decision of whether to administer antibiotic prophylaxis or not. The following is a summary of the guidelines found in the current literature:

All procedures when the patient has any of the following:

- Prosthetic cardiac valve or prosthetic material used for cardiac valve repair
- Previous infective endocarditis
- Unrepaired cyanotic congenital heart disease (CHD), completely repaired congenital heart defect with prosthetic material during the first six months after the procedure, and repaired CHD with residual defects at the site of a prosthetic patch or prosthetic device
- Cardiac transplantation recipients who develop cardiac valvulopathy
- Immunocompromised/ immunosuppressed (some support for only high risk procedures)

High risk procedures (e.g. extraction, periodontal procedures, implants, and endodontic instrumentation) when the patient has any of the following

- Joint replacement in last 2 years
- History of prosthetic joint infection
- Joint replacement plus comorbidity: type 1 diabetes, malignancy, or malnutrition

What to prescribe:

	Drug	Dose	When
Standard	Amoxicillin	Adults 2g, Kids 50mg/kg	PO 1 hr prior
Penicillin allergy	Clindamycin	Adults 600mg, Kids 20mg/kg	PO 1 hr prior
	Azithromycin	Adults 500mg, Kids 15mg/kg	PO 1 hr prior
Unable to take oral medication	Ampicillin	Adults 2g, Kids 50mg/kg	IM / IV 30mins prior
Penicillin allergy AND unable to take oral medications	Clindamycin	Adults 600mg, Kids 20mg/kg	IM / IV 30mins prior

Pharmacology

Drug Metabolism

Factors that Affect Hepatic Drug Metabolism

- Microsomal enzyme alteration (P-450) (individual genetic variation)
 - o Many drugs can inhibit the CYP isoforms of the P-450 drug metabolism system, therefore two simultaneous drugs normally metabolized this way may cause elevated blood levels of one, and therefore toxic effects of that drug. Example: erythromycin and clarithromycin cause elevated blood levels of theophylline, resulting in CNS toxicity of theophylline → seizures, nystagmus, depressed consciousness.
 - o Other drugs or foods, such as grapefruit juice, can induce the CYP isoforms resulting in a lower than usual blood level of drugs metabolized with the P-450 system
- Plasma protein binding: drugs highly bound to plasma proteins will not enter the liver as readily, resulting in a longer drug half-life, or elevated blood levels in the elderly, whose albumin levels are lower. Example: benzodiazepines can cause increased sedation and respiratory depression in the elderly.
- Pathology: liver disease generally results in elevated levels of unmetabolized drug

How to write a Prescription:

- Date
- Patient Name, age and contact info
- Rx: name of drug and dosage
- Disp: amount to provide (example, number of pills)
- Sig: Directions (include what route of administration, dosage, frequency, max dose if relevant)
- Refills, if any
- Signature
- DEA# for schedule II drugs

Abbreviations:

- QD (quaque dies): every day
- BID (bis in die): twice per day
- TID (ter in die): thrice per day
- QID (quater in die): four times per day
- H (hora): hour
- Q (quaque): every
- HS (hora somni): at bedtime
- NPO (nil per os): nothing by mouth
- PO (per os): by mouth
- PRN (pro re nata): as needed
- Sig (signa): label, or let it be printed

Oral Pain (Analgesics)

- Mild: use OTC medications in suggested doses
 - Ibuprofen (Advil/Motrin): 400mg (2 pills) PO q4-6h PRN pain, max 3.2g/day
 - Acetaminophen (Tylenol): 325-650mg PO q4h PRN pain, max 4g/day
 - Naproxen sodium (Aleve): 220-440mg PO q8-12h PRN pain, max 1.5g/day
 - Aspirin (Ecotrin): 325-650mg PO q4h prn pain, max 4g/day

- Moderate

- Ibuprofen: 800mg ibuprofen (see below)
- Tylenol #3: 300mg acetaminophen and 30mg Codeine (equianalgesic to 600 mg of ibuprofen, so why use it instead of ibuprofen? Says Dr. Flynn)
- Vicodin: 500mg acetaminophen and 5mg hydrocodone
- Vicoprofen: 200mg ibuprofen and 7.5mg hydrocodone (for patients with liver disease)

Ibuprofen (800mg) Disp: 20 (Twenty) tablets Sig: Take 1 tab PO qid PRN pain, max 4 tabs/day	Tylenol #3 (300mg/30mg) Disp: 20 (Twenty) tablets Sig: Take 1-2 tabs PO q4-6h PRN pain	Vicodin (500mg/5mg) Disp: 20 (Twenty) tablets Sig: Take 1-2 tabs PO q4-6h PRN pain, max 8 tabs/day	Vicoprofen (200mg/7.5mg) Disp: 20 (Twenty) tablets Sig: Take 1 tab PO q4-6h PRN pain, max 5 tabs/day
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- Severe

- Percocet: 325mg acetaminophen and 5mg oxycodone, schedule II
- Combunox: 400mg ibuprofen and 5mg oxycodone, schedule II (for patients with liver disease)
- Demerol: 50mg meperidine, schedule II

Percocet (325mg/5mg) Disp: 20 (Twenty) tablets Sig: Take 1 tab PO q4-6h PRN pain	Combunox (400mg/5mg) Disp: 20 (Twenty) tablets Sig: Take 1 tabs PO qid PRN pain, max 4 tabs/day, max 7 days	Demerol 50mg Disp: 20 (Twenty) tablets Sig: Take 1 tab PO q4h PRN pain, max 6 tabs/day
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Antibiotic Prophylaxis

Amoxicillin 500mg Disp: 12 (twelve) tablets Sig: Take 4 tabs PO 1 hr prior to appointment*	Clindamycin 150mg Disp: 12 (twelve) tablets Sig: Take 4 tabs PO 1 hr prior to appointment*	Azithromycin 250mg Disp: 6 (six) tablets Sig: Take 2 tabs PO 1 hr prior to appointment*
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*The extra tablets are for future visits.

Bacterial Odontogenic Infections

- Penicillin VK or Amoxicillin
- Clindamycin (if penicillin allergy)
- Augmentin (amoxicillin with clavulanic acid)

Penicillin VK 500mg Disp: 28 (twenty eight) tablets Sig: Take 1 tab PO QID until finished	Clindamycin 150mg Disp: 56 (fifty six) tablets Sig: Take 2 tablets PO QID until finished	Amoxicillin 500mg Disp: 21 (twenty one) tablets Sig: Take 1 tab PO TID until finished	Augmentin 500mg Disp: 21 (twenty one) tablets Sig: Take 1 tab PO TID until finished (mostly for sinus infections, Dr. Flynn does not approve)	Azithromycin 250mg Disp: 6 (six) tablets Sig: Take 2 PO on day 1 then 1 PO QD until finished
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Periodontal Diseases

- Topical / Local

- Listerine (phenol) -OTC
- Peridex / Periogard (chlorhexidine gluconate): also useful when pt cannot mechanically remove plaque
- Periostat (doxycycline hyclate)

0.12% Peridex
 Disp: 16oz bottle
 Sign: Rinse with 15mL, hold in mouth for 30 seconds and expectorate BID for 14 days

Fungal infections (candidiasis and angular cheilitis)

- Topical/ Local
 - Mycostatin (nystatin suspension)
 - Mycolog (nystatin cream 1%)
 - Mycelex (clotrimazole troches) *Tastes better
- Systemic
 - Diflucan (fluconazole)

Nystatin 100,000units/ml oral suspension Disp: 300ml Sig: Rinse with 5ml for 2 mins QID and expectorate	Mycolog (Nystatin) cream 1% Disp: 45g tube Sig: Apply thin coat to affected area and inner surface of denture if applicable QID after meals and HS	Mycelex 10mg troches Disp: 70 Sig: Slowly dissolve in mouth 5x/day until finished	Diflucan 100mg Disp: 15 tabs Sig: Take 2 tabs PO for 1 day, then 1 tab PO QD until finished (Do not attempt at home)
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Ulcerative / Erosive conditions

- Recurrent aphthous stomatitis and mild lichen planus
 - Kenalog in Orabase (triamcinolone 0.1%)
 - Lidex (fluocinonide 0.05%)
- Erosive lichen planus and major aphthae
 - Decadron elixir (dexamethasone)

Kenalog in Orabase 0.1% Disp: 5g tube Sig: Apply locally as directed after each meal and HS	Lidex 0.05% gel Disp: 45g tube Sig: Apply locally as directed QID	Decadron 0.5mg/mL Disp: 300ml Sig: Rinse with 5mL for 2 min and spit out QID
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Anxiety/ Sedation

- Valium (diazepam) – half life of 20-100 hrs (long acting)
- Ativan (lorazepam) – half life of 9-16 hrs
- Halcion (triazolam) – half life of 2 hrs (short acting) *Pregnancy category X

Valium 5mg Disp: 6 (six) tablets Sig: Take 1 tablet PO hs and 1 tablet PO 1 hr before the appointment*	Ativan 1 mg Disp: 4 (four) tablets Sig: Take 1 tablet PO hs and 2 tablets PO 1 hr before the appointment* then bring the last pill to the appointment with you.	Halcion 0.25 mg Disp: 4 (four) tablets Sig: Take 1 tablet PO hs and 1 tablet PO 1 hr before the appointment*
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*When using oral sedation, the patient must have a ride to and from the appointment and sign the consent for the procedure at a date prior to the appointment. NPO status is advised, especially with Ativan, and vital signs (BP, P, O2 Saturation) must be monitored continually during the procedure.

High caries

- Prevident 5000 toothpaste

Prevident 5000 dentifrice
Disp: 1 60g tube
Sig: brush teeth with dentifrice
BID and floss into contacts

Drug Interactions

In general, we should avoid polypharmacy and never prescribe anything without being aware of the patient's full medical history and current medications. It is our responsibility to look up any possible interactions with the drugs that we prescribe. Epocrates is Dr. Flynn's preference.

Contraindicated Drugs in:

Patients with liver disease	Patients with kidney disease	Pregnant patients	Patients that are breast feeding
Aspirin Benzodiazepines Opioids Sedatives Anti-histamines NSAIDS Erythromycin Metronidazole Tetracycline	Acyclovir Penicillin Opioids Cephalosporins Benzodiazepines NSAIDS Tetracyclines Amphotericin	Aspirin Benzodiazepines Carbamazepine Opioids Cotrimoxazole NSAIDS Metronidazole Tetracyclines	Antihistamines Aspirin Benzodiazepines Carbamazepine Cotrimoxazole Metronidazole Tetracyclines

Antibiotics Overview

Antibiotic	Mechanism	Types / Targets / Examples
Penicillin	Bacteriocidal - inhibits peptidoglycan cross linking by blocking transpeptidase in last step	- Narrow spectrum: gram (+) cocci and bacilli, some gram (-) cocci: penicillin G, penicillin VK - Narrow spectrum penicillinase resistant: gram (-) beta-lactamase staphalococci: methicillin - Moderate spectrum: gram (+) cocci and bacilli, some gram (-) cocci and rods: amoxicillin, Ampicillin - Broad spectrum penicillinase resistant: augmentin - Extended spectrum: ticarcillin, carbenicillin, piperacillin, azlocillin, mezlocillin
Cephalosporins	Bacteriocidal - inhibits peptidoglycan cross linking by blocking transpeptidase in last step	- 1st generation: Moderate spectrum: gram (+) cocci and some gram (-) bacilli: Cephalexin, Cefazolin - 2nd generation: Moderate spectrum with anti-Haemophilus: fewer gram (+) cocci but more gram (-) bacilli: Cefaclor - *2nd generation – cephamycins: moderate spectrum with anti-anaerobic activity: Cefoxitin - 3rd generation: Broad spectrum: ceftriaxone - 4th generation: Broad spectrum with beta-lactamase stability: Cefepime
Metronidazole	Bacteriocidal – inhibits	Anaerobes and some protozoa

	DNA synthesis	- Brand name “Flagyl”
Fluoro-quinolones	Bacteriocidal – inhibits DNA gyrase (topoisomerase)	In general, early generations are more narrow spectrum and later generations more broad spectrum: gram (+) and gram (-) anerobes and facultatives - Ciprofloxacin (2 nd generation) - Moxifloxacin (4 th generation) – better for oral flora
Aminoglycosides	Bacteriocidal – inhibits protein synthesis via 30S Ribosome	Gram (+) and gram (-) anerobes and some mycobacteria - Streptomycin - Gentamicin *Side effects: Ototoxicity and nephrotoxicity
Vancomycin	Bacteriocidal – inhibits D-alanyl-D-alanine cross linking	Gram (+) cocci and bacilli
Macrolides	Bacteriostatic – inhibits protein synthesis via 50S	Gram (+) cocci/rods, gram (-) anaerobes, mycobacteria - Erythromycin - Clarithromycin - Azithromycin – best safety profile *May cause GI irritation, erythromycin especially
Clindamycin	Bacteriostatic – inhibits protein synthesis via 30S	Gram (+) and gram (-) anaerobes *May cause pseudomembranous colitis
Tetracyclines	Bacteriostatic – inhibits protein synthesis via 30S	Gram (+) and gram (-) aerobes and anaerobes, spirochetes, mycobacteria
Sulfonamides	Inhibits folic acid pathway by competing for PABA	Gram (+) and gram (-) *Not used to treat dental infections due to their low degree of effectiveness against oral pathogens

Dental Instruments

Rubber Dam Clamps

*Only clamps available in clinic are listed, see the chart on the wall by sterilization for selection

*Always tie floss to avoid aspiration

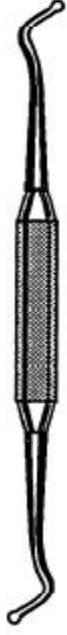
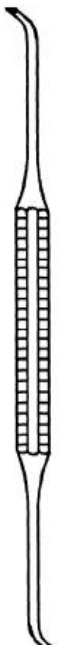
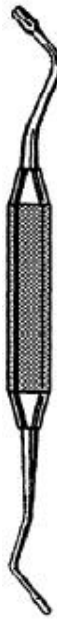
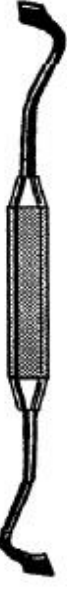
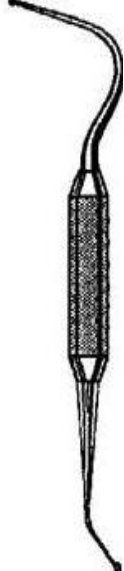
- 9 (butterfly) – **anterior**s
- 2A – **bicuspid**s or **primary molars** (if no 6yr molar present to clamp)
- 12A – UL and **LR molars**
- 13A – UR and **LL molars**
- 14 – **Maxillary molars**
- Ash – **Pediatric permanent molars** (6 yr molars), most permanent molars

Burs

- Operative Burs:
 - Types (by material)
 - **Carbide** – a rotary blade instrument composed of microscopic tungsten carbide particles held in a matrix of cobalt or nickel. Common shapes include 330 (pear), 245 (long pear), 556 (straight), and round (various sizes ¼, ½, 2, 4, etc.) Generally used for cavity preparations and to cut metal. These are generally single use and come as a set in clinic as “amalgam burs,” which includes a #2 round, a #4 round, a 330, a 245 and a 556. Use this set for direct intracoronal restoration preps. As a basic guide, the 330 and 245 are use to make prep form convergent, a 556 for flattening floors, and the round burs on a slow speed handpiece for caries removal. When you are done, these burs are disposed of in sharps.
 - **Diamond** – a rotary abrasive instrument composed of diamond particles embedded in a softer material. The size of the diamonds used impacts how aggressively the instrument removes tooth structure. They are categorized as coarse (green), medium(blue), fine(red), and very fine(yellow). Common shapes include chamfer, modified shoulder, shoulder, round, football, needle, and wheel. These also vary in thickness, with a #14 being thicker than a #12. These instruments are generally used for crown preparations, cutting porcelain, and finishing and adjusting occlusion of composites. An assortment of these burs may be found in finishing blocks, so ask sterilization for a finishing bur block if you are doing one of the above procedures. There is also a set of “crown and bridge burs,” which includes a #12 chamfer, a #12 shoulder, a round bur, and a needle bur for breaking contacts. As a basic guide, the chamfer is used for metal crown margins, the modified shoulder or shoulder for porcelain or butt joint margins, and the football or round bur for adjusting occlusion. When you are done, dispose of any heavily used burs and place the rest in the finishing block for sterilization and re-use.
 - Cutting instrument formulas
 - Example: 10-85-8-14. The first number indicates the width of the blade in tenths of millimeters. The second number is the clockwise angle of the primary cutting edge in centigrades. The third number is the blade length in millimeters. The fourth number indicates the blade angle in centigrades
- *Periodontal burs:*
 - End-cutting – A bur that only cuts at the tip, not the sides. Used to lower bone height around teeth during periodontal procedures like crown lengthening
- *Endodontic burs:*

- Safe end bur – A bur that cuts only on the sides, not the tip. Used to remove ledges around the floor of the pulp chamber during access preparation.
- Gates-Glidden – A bur with a slender shank and football shaped cutting tip. Used to flare the orifices of canals during endodontic cleaning and shaping. Make sure to irrigate well if using this bur to avoid forming a debris blockage in your canal.

Instruments to Know:

							
Spoon excavator	Chisels	Hatchet	Hoe	Gingival Margin Trimmer	Hollenback	Discoid Cleoid	Plastic Instrument
							
Acorn burnisher	Amalgam carrier	Dycal applicator	Amalgam Condenser				

Hand Instruments

- Explorer: caries detection, calculus detection, general tactile instrument
- Handcutting instruments: remove caries and refine preparation form
 - Spoon excavator: removing caries, soft dentin and debris
 - Straight chisel: cut enamel margin of the tooth to form clean cavo-surface margin
 - Hatchet: cutting enamel, smoothing walls and floor of preparation
 - Hoe: plane walls and floor of preparation
 - Gingival margin trimmer: bevel enamel for composite restoration, remove interproximal overhang
- Restorative Instruments:
 - Amalgam carrier: holds and transports amalgam
 - Condenser: compress amalgam or composite into cavity
 - Ball Burnisher: shape matrix bands, remove excess Hg from amalgam and smooth
 - Discoid/cleoid: remove excess amalgam, carve anatomy
 - Acorn Burnisher: remove excess amalgam, carve anatomy
- Composite instruments
 - Plastic instrument: like a mini-spatula to carry and condense composite
- Crown and Bridge instruments
 - Cord packer: packs cord in gingival sulcus
- Dycal Applicator: mini-ball for placing dycal on pulpal floor

Periodontal Instruments

- 13/14 Gracey: root planning distal surfaces of posterior teeth
- 11/12 Gracey: root planning mesial surfaces of posterior teeth
- 7/8 Gracey: root planning buccal/lingual surfaces of posterior teeth
- Younger Good 7/8 (Universal): Standard supragingival scaler (rounded toe)
- Sickie scaler: Interproximal surfaces of anterior teeth (sharp toe)
- Periodontal probe: measuring sulci, depth gauge
- 11/12 explorer: detecting calculus/ verifying calculus removal
- Naber's probe: measuring furcation classification
- Cavitron: Debridement of bulk calculus, staining and debris. Also used in endodontics to remove debris from pulp chamber.

Endodontic Instruments

- DG-16(Endodontic explorer): detecting orifices
- Endodontic spoon: removing pulp chamber tissue
- Apex locator: detecting working length.
- Hand files: K-file, K-flex: cleaning and shaping canals in clinic
- Rotary files: Protaper, Profile, and RaCe: adjunct to hand files for cleaning and shaping canals, not available in clinic
- Pluggers: condensing gutta percha
- Spreaders: making space for accessory cones during lateral condensation technique (recommended technique in clinic)
- Master cones: primary gutta percha cone, should be same size as master apical file
- Accessory cones: thinner cones used for lateral condensation, available in medium fine and fine sizes in clinic
- Touch and Heat: removing gutta percha for post placement, severing gutta percha cones at orifice

Dental Materials

General Concepts

One of the biggest obstacles 3rd year students encounter is trying to become familiar with the wide variety of dental materials currently on the market, as well as what properties make one material better/worse than another for a particular purpose. We also need to know the difference between the type of material, the product name, and the company that makes that product. For example, glass ionomer cement is one type of material used in cementing crowns/bridges/posts, and “Ketac Cem” is the brand name of one made by 3M/ESPE Company. Finally, we need to determine which, of the vast array of products on the market, are actually available in the student clinic and how to use those specific products.

So, where do you look for information regarding the types, properties, and pros / cons of dental materials? Unfortunately, there is no easy answer. Textbooks, primary literature, company websites / advertisements, or experts within the field can all provide information about dental materials; however, each resource comes with limitations. The problem is that dental companies create new products extremely fast, while independent research regarding those materials is relatively slow. For example, a textbook may provide a great overview of a particular group of materials, with a substantial amount of research detailing the pros / cons of each, but we must realize that the textbook is likely to be 3+ years old and that some of the products it describes may no longer be on the market. On the other hand, the most current information (<6 mo old) about dental materials will be offered by manufacturers, but this information is often incomplete and biased.

The four general categories of materials that are used in dentistry include 1)metals, 2)ceramics, 3)polymers, and 4)composites. Metals are crystalline or polycrystalline structures that share valence electrons. Metal alloys are mixtures of different metallic elements. Ceramics are a mixture of metallic and non-metallic components in a semicrystalline structure. Polymers are long chains of non-metallic elements that are covalently bonded. Individual monomers must be activated by specific accelerators so that they can polymerize into solid structures. Finally, composites are blends of ceramic fillers particles in a polymer matrix.

Material Properties

Physical Properties: how the material reacts with the environment

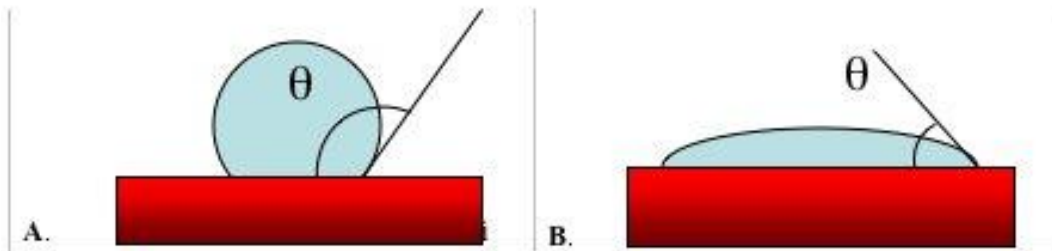
- **Shrinkage / Expansion** – happens to all materials to some extent; can be due to setting, loss of water, cooling/heating of material.
- **Linear coefficient of thermal expansion (LCTE) (α)**: Defined as the rate of change (expansion/contraction) of a material relative to changes in temperature. Expressed in cm/cm/°C or ppm/°C. It is ideal for the LCTE of a restorative material to be close to that of tooth to prevent percolation, which is the ingress and egress of fluid at the margins during the heating/cooling cycle. For example, since PMMA has such a high coefficient of thermal expansion, when the mouth is subjected to heating or cooling the temp crown expands and cools faster than the tooth, causing marginal leakage and percolation.

Tooth	PFM Ceramics	Amalgam	Composites	Gold alloys (FGC)	Unfilled acrylics and composites
9-11	14	25	28-35 (packable) 35-50 (flowable)	16-18	72-83

- **Thermal Conductivity** - Defined as the number of calories per second flowing through an area of 1 sq cm. Materials are generally classified as either insulators or conductors. Insulators include composite, dentin, and cements, whereas conductors include amalgam and gold. Important

because the pulp can only withstand small temperature changes, so materials that are thermal conductors may need adjunctive liners or bases to prevent thermal sensitivity.

- **Electrical conductivity** – Defined as the rate of electron transport through a material. Influences whether galvanic corrosion will occur.
- **Wettability** – Describes the contact angle of a liquid interacting with a solid. Another way of thinking of this is the angle a drop of liquid makes with the surface on which it rests. A low contact angle means that the liquid spreads out on the solid surface and therefore has good wettability. A high angle means that the liquid does not spread out much on the solids and therefore has only partial wetting. No contact angle means that the liquid stays completely separate from the solid, which means that the material is non-wetting. Wettability is an important property when you want your material to make intimate contact with another material, or “spread out” (eg cements, bonding agents, and varnishes). It is basically a measure of hydrophilicity.
 - Low contact angle: hydrophilic
 - High contact angle: hydrophobic



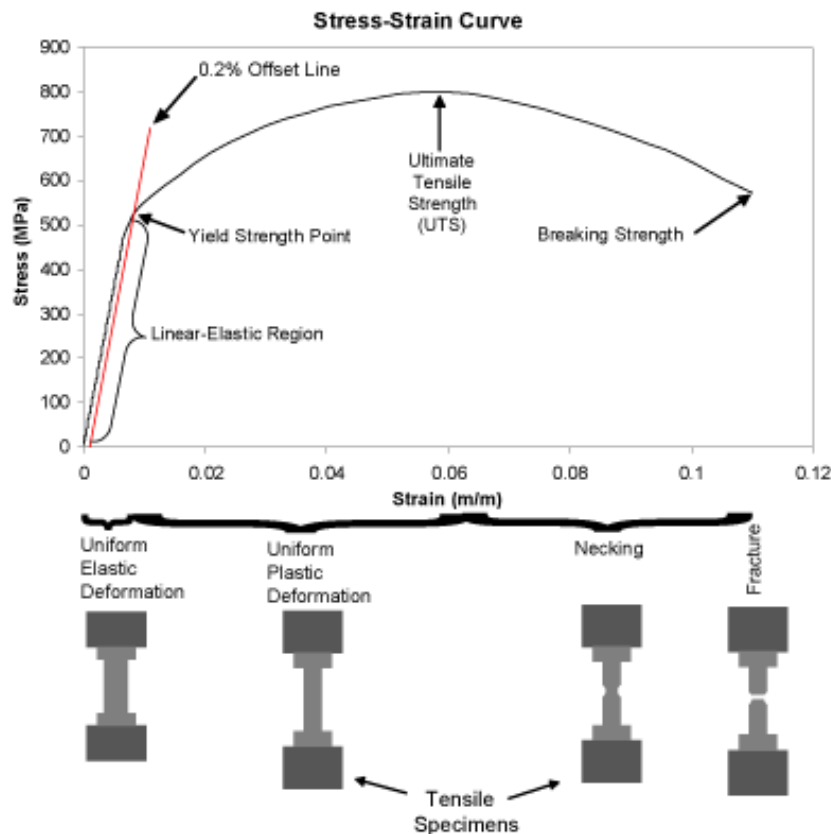
- **Density** – Defined as mass per unit volume. Important in casting and when we want to be able to differentiate restorative materials from tooth on the radiograph (denser materials appear more radiopaque).

Mechanical Properties: how the material responds to loading

- **Stress (σ)** – Load divided by area, applied as compression, tension, shearing, torsion, or flexural load forces. This is simply the force applied the material. Units are psi or MPa. A restoration with sharp contacts is subject to greater stress ($\downarrow$ area).
- **Strain (ϵ)** – Deformed Length / Original Length. This is basically the change in the length of the material when the stress is applied. Units are cm/cm, so they cancel out. Materials can deform reversibly, irreversibly, or fracture when a stress is applied to them. Rubber has high strain; Gold has low strain.
 - **Elastic strain:** this is completely reversible strain that happens first. When the stress is removed, the material will return to its original length.
 - **Elastic Limit/Proportional Limit/Yield point:** These all describe the amount of stress that begins to cause plastic strain instead of elastic strain.
 - **Plastic strain:** this is irreversible strain that causes permanent deformation of the material. When the stress is removed, the material will stay deformed.
 - **Ultimate strength:** this is the highest stress a material can withstand prior to fracturing.
 - **Fracture:** occurs with any stress higher than the ultimate strength dictates.
- **Elastic Modulus (E)** – the ratio of stress to strain, or the slope of the line on a stress-strain curve, where is plotted on the X-axis and is on the Y-axis. The elastic modulus tells the amount of deformation or strain a material experiences in response to stress. Another way to think of the elastic modulus is the stiffness of a material; the higher the elastic modulus (i.e. the higher stress it takes to cause deformation), the stiffer the material.

Material	Dentin	Enamel	Amalgam	Gold alloy	Composite	Unfilled acrylic
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Elastic Modulus	19.9	90.0	27.6	96.6	16.6	2.8
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- **Ultimate Strength** Values– defined as the point of highest stress before fracture of the material. For example, if the stress being applied is tensile, then the property is called tensile strength.

	Dentin	Enamel	Amalgam	Gold Alloys	Composite	Unfilled acrylic
Tensile (MPa)	98	10	48-69	414-828	34-62	28
Compression (MPa)	297	400	310-483	-	200-345	97

- **Resilience:** the area under the linear portion of the stress/strain curve (to the elastic limit)
- **Toughness:** total area under the stress/strain curve, to the point of fracture
- **Creep:** plastic deformation over time in response to constant stress. Indicates a materials' tendency to slowly but permanently deform over time, after many heating and cooling cycles

Chemical Properties: how the material reacts with other substances chemically or electrochemically

- **Corrosion:** the dissolution of metals in the mouth. There are two types:
 - **Electrochemical “Galvanic” corrosion:** involves electrons passing from two different metal materials in the mouth (i.e. an amalgam restoration contacting a gold crown). This can cause pain and a metallic taste in the mouth.
 - **Chemical corrosion:** involves surface chemical reactions, such as sulfide reacting with amalgam causing black Silver Sulfide “tarnish.” This is not true corrosion and can be polished.

Biologic Properties: describes biocompatibility or toxicity of the material.

Overview of Dental Materials

This is not an all-inclusive list. It is a starting-point for understanding some of the most common materials and some of their most common applications.

	Types	Uses	Notes	Examples
Restorative Materials	Amalgam	- Class I/II/V - Core build up	- Ag + Sn + Cu + Hg +/- Zn - Mechanical retention required—less conservative prep - Not as moisture sensitive - Corrosion seals margins - If prep is deep, consider base or liner since amalgam is a thermal conductor - Takes ~24 hrs to set, so no hard biting, polishing, or cutting for 1d - Wear resistant	Tytin (Kerr)
	Composite	- Class I/II/III/IV/V - Core build up (but consider Build-it)	- Resin (methacrylates) + filler particles + silane - Requires etching and bonding - Very moisture sensitive - Polymerization shrinkage an issue; cure in small increments - Thermal insulator, so usually no base/liner required - Physical properties dictated by filler size and content. Flowable composite has less filler and is therefore weaker and less stable than packable composite.	Vit-l-essence (Ultradent) Premise (Kerr) Filtek (3M) Gradia (GC) EsthetX (Dentsply)
	Resin modified glass ionomer	- Some primary teeth (PEDO) - Temporary fillings (but consider GI) - Class III or V - Restorations when caries risk high	- Glass ionomer + resin - Fluoride release (and recharge) - Flexible for class V - Tooth colored	Ketac Nano (3M) Vitremmer (3M) Fuji II LC (GC) Fuji IX (GC)
Linners/Bases	HEMA + Gluteraldehyde + water	- Micro layer under direct and indirect restorations that are thermal conductors (amalgam, gold) - Sensitive exposed roots	- Blocks dental tubules to decrease post-op sensitivity - Microthin layer so won't affect fit of restoration.	Gluma Desensitizer (Heraeus)
	Resin modified glass ionomer	- Deep preparations as a liner or base	- Glass ionomer + resin - Fluoride release - Thermal insulator	Vitrebond (3M)
	Calcium hydroxide	- Very deep preparations (<1mm of dentin between pulp and prep)	- Slow acting antiseptic - Stimulates secondary dentin formation - Acts as an anti-septic - Resin doesn't bond to Dycal, so cover with Vitrebond if restoring with composite	Dycal (Dentsply)

	Types	Uses	Notes	Examples
	Zinc oxide eugenol (ZOE)	- Used to fill primary tooth pulpotomy cavity - Interim restoration (i.e. indirect pulp cap)	- Zinc oxide + Eugenol - Soothes pulpal tissue - Resin won't bond to IRM	IRM (Dentsply)
Bonding	Bonding agents	- Used with resin cements, composites, and some sealants	- Consists of primer and adhesive. Some are also self-etching - Micromechanical bonding	Optibond SoloPlus (Kerr) Adper (3M)
FPD Cement (Luting Agents)	Glass ionomer (GI)	- Gold/PFM crowns - Prefab metal posts - Cast post and core	- Low shrinkage - Releases fluoride - High water solubility increases erosion at margin - Maybe some chemical bond to tooth	Ketac Cem (3M) Fuji I (GC)
	Resin-modified glass ionomer (RMGI)	- Gold/PFM crowns	- Resin improves strength - Fluoride release - Swells as it sets (don't use w/ feldspathic all ceramic or to cement posts)	RelyX Luting (3M) Fuji PLUS (GC)
	Composite resin	- All ceramic crowns - Gold/PFM crowns with poor retention - Ceramic veneers - Prefab fiber posts	- "Strongest" cement - Most difficult to use - Perfect isolation and moisture control required - Esthetic cements available	Maxcem (Kerr) NX3 (Kerr) RelyX Unicem (3M) PermafloDC (Ultradent)
	Zinc oxide eugenol (ZOE)	- Temporary crowns - Implant crowns	- May soothe pulpal irritation - "Poor" properties compared to newer materials - Can't use eugenol based material if planning to use composite later - Non-Eugenol available	Tempbond (Kerr) Tempbond NE (Kerr)
	Polycarboxylate	- Temporary FPD - Some implant crowns - Poorly retentive temporary crowns	- "Poor" properties compared to newer materials	Ultratemp (Ultradent) Durelon (3M)
Temporary Restorative Materials	Acrylic (eg PMMA)	- Temporary crowns	- Heats up when setting - Shrinks when setting (!) - Cheap - High strength - Good color stability - Can relined easily	TempArt (Sultan) Alike (GC)
	Bis-acrylic	- Temporary crowns	- Expensive - Can bond composite to it - Fragile – do not use to make bridges - Poor color stability	Protemp Plus (3M) Versatemp (Sultan)
	Reinforced glass ionomer	- Temporary filling (i.e. indirect pulp cap) - To fill endo access as interim restoration	- Contains silver and palladium - Releases fluoride	Ketac Silver (3M) Fuji Triage (GC)

	Types	Uses	Notes	Examples
Impression Materials (use appropriate tray adhesive)	Alginate (irreversible hydrocolloid)	- Study casts - Opposing arch - Duplicating models	- Cheap and easy to use - Need to pour ASAP (distortion) (<1hr when wrapped in wet paper towel) - Least accurate and tears - Required bulk of 5mm between teeth/tissues and tray for accuracy - Use measured amounts and cold water - 1 pour only	Jeltrate (Dentsply)
	Addition silicones (polyvinyl siloxane, PVS)	- Crowns, FPD - Bite registrations	- Very accurate (best with 2-step technique) - Allows multiple pours up to two weeks later - Slightly cheaper and easier to remove than polyether	Genie (Sultan) Precision (Discus Dent) Bite registration
	Polyether	- FPD	- Very accurate with 1-step technique - Best tear strength - Allows multiple pours up to two weeks later - Do not use if patient has bridges or large embrasures (BLOCK OUT UNDERCUTS) - Expensive	Impregum (3M)
	Polysulfide	- RPD - Complete dentures	- Long working time - Unpleasant (bad smell) - Need custom tray - Flows - Very accurate - Pour immediately and only get 1-2 pours	Permlastic (Kerr)
Ceramics	Glass ceramics	- All-ceramic crowns	- Subtypes: feldspathic, leucite, and lithium disilicate based systems - Weakest, most esthetic	Empress 2 (Ivoclar)
	Glass infiltrated ceramic	- All-ceramic crowns	- Alumina based system - “Stronger” than glass ceramics	InCeram Alumina (VITA)
	Polycrystalline ceramics	- All-ceramic crowns	- Zirconia based system - “Strongest” material but may be more opaque	LAVA (3M)
FPD Copings	High noble	- Full cast restorations - Metal-ceramic	- >60% noble metal content - >40% gold - Request high noble metal for PFM restorations at HSDM	- N/A
	Noble	- Full cast restorations - Metal-ceramic	- >25% noble metal content - No gold requirement - Avoid	- N/A
	Base metal	- RPD framework	- <25% noble metal content - No gold requirement - Nickel chromium, cobalt chromium (check allergy to nickel)	- N/A
Endodontic Materials	Calcium hydroxide	- Intracanal medicament	- Non-setting type - Slow acting antiseptic - Use for apexogenesis or canal medicament during multi-phase	UltraCal (Ultradent)

			RCT	
	Types	Uses	Notes	Examples
	Sodium hypochlorite	- Canal irrigation and lubricant	- Proteolytic and a detergent - Use 50% solution - Beware of clothing	Household Bleach
	EDTA	- Chelating agent - Lubricant	- Used to remove the smear layers	RC Prep (Premier)
	Mineral trioxide aggregate	- Perforation repair - Apexification - Pulp capping	- a.k.a. Portland Cement	ProRoot (Dentsply)

Materials We Have In Clinic

This list is as of June 2010 and may not include every material floating around clinic

Brand	Material	Instructions or Notes Regarding Use
AH PLUS Jet	Endo sealer	- dispense onto pad, coat cones with sealer and insert into canal, set time is >8 hrs
ALIKE (GC)	Temporary acrylic	- Add liquid to dampen dish then saturate with powder, allow it to set until “doughy” stage before using
Bleach	Endo irrigation	- Mix bleach in plastic cup with tap water 1:1 and use side vent syringe
Built-It (Pentron)	Core build up material (can also be used as cement for post when used as core build up)	- Etch 15 sec, rinse and lightly dry, use Optibond Solo as bonding agent, dispense material as bulk unit into preparation, light cure for 40 sec on facial / lingual / occlusal surfaces, allow to set for 4 mins *Instructions different if using Build-It to cement a post
Coe-Pak (GC)	Periodontal dressing	- Extrude equal lengths of base and catalyst, mix with spatula for 30-45 sec, lubricate fingers with Vaseline, after 2-3 min coe-pak can be handled – shape into cylinder, place around embrasures and surrounding gingiva, set time is 30 mins. Don’t use too much!
Duraflor (Medicom)	5% fluoride varnish	- Wash and dry tooth, dispense onto pad, apply to teeth with brush, air thin excess varnish - No food or only soft food for 2 hrs after
Duralay (GC)	Impression resin	- Mix powder and liquid and apply to impression post
Dycal (Dentsply)	Calcium hydroxide liner	- Extrude equal volumes of base and catalyst on pad, mix for 10 sec, apply to dry tooth with dycal applicator instrument, set time 2:30-3:30 min - No need to cure - Cover with RMGI if using composite
Fit Checker (GC)	Silicone pressure indicator	- Used to check fit of crowns, cast post / cores, dentures - Dispense equal lengths of base and catalyst and mix for 20 sec, apply to prostheses and place in mouth, have patient bite for 1:30 min, remove and assess for uniform film
Fuji Triage (GC)	Glass ionomer	- Dry canal, place cotton pellet in chamber, activate capsule by pushing in tab, mix for 11 sec on fast, place into dispenser and extrude into chamber, set time is 2:30 mins - Use as a temporary filling material
Genie (Sultan)	Addition silicone, PVS	- 4 viscosities available: bite, light, regular, heavy and 2 speeds: Rapid set (2:30 min) and standard set (4 min) - Use light body and microtip for around abutment and margins while assistant dispenses medium or heavy body into tray. Do not lift syringe once you begin dispensing or you will get voids.

		- 2-step technique: using putty in stock tray with headrest cover and either regular or light body wash.
Hemodent (Premier)	Hemostatic agent (Aluminum Chloride)	- Soak retraction cord in solution and pack into sulcus - Leave for a max of 15 mins
Impregum (3M)	Polyether	- Block out undercuts (pontics!) with tray wax, apply tray adhesive to stock tray and let dry for 60 sec, block out holes in tray with tape, dispense into tray (nozzle immersed in material as it fills) and re-useable syringe, apply around prepped tooth with syringe, seat tray into mouth and hold, set time 6 mins
Jeltrate (Dentsply)	Alginate	- See History and Exam: Alginate Impressions Section
Ketac Cem (3M)	Glass ionomer cement	- Lightly dry tooth, activate for 2 sec, mix for 11 sec on fast, place in dispenser and dispense, set time 7 min
Ketac Silver (3M)	Reinforced glass ionomer	- Lightly dry tooth, activate for 2 sec, mix for 11 sec on fast, place in dispenser and dispense, set time 7 min
Optibond Solo (Kerr)	Prime/bond agent	- Indications: composite to enamel / dentin, composite, porcelain or metal, amalgam sealing, indirect bonding of veneers / crowns / inlays / onlays / post and core - Direct bonding technique: Etch 15 sec, rinse, dry lightly, apply to enamel / dentin for 15 sec with brushing motion, air thin for 3 sec, light cure 20 sec, place composite and light cure
ParaPost XP (Coltene-Whaledent)	Stainless steel prefab posts	- Cement with Ketac Cem - Best method is to dip post into cement and then place into canal. Some instructors recommend filing canal with lentulospiral and then placing post, but you run the risk of premature setting that way.
Permaflo (Ultradent)	Flowable composite	- Use on class V restorations, as the first layer of composite in class I/II restorations, or donut technique before endo to seal rubber dam - Etch 15 sec, rinse 15 sec and lightly dry, apply bonding agent and light cure (see Optibond), apply PermaFlo in thin layer, remove bubbles with explorer light cure 20 sec
PermaSeal (Ultradent)	Composite sealer	- Use on margins of new and old composite restorations to improve longevity - After occlusion adjusted on restoration, etch 5 sec and rinse / dry, rub thin layer on for 5 sec, air thin, light cure for 20 sec
Permlastic (Kerr)	Polysulfide	- Mix equal lengths of base and catalyst for 45-60 sec, load tray / syringe and let sit in mouth for >6 mins before removing, pour immediately
Pressure Indicator Paste (Mizzy)	Pressure point indicator	- Used for dentures - Dry inside of denture, apply thin layer of paste on area to test, spray coated area with PIP spray, place denture on moist tissue, apply gentle pressure, remove, assess
Prisma Gloss (Dentsply)	Composite polishing paste	- Use with white rubber points or cups
RC Prep (Premier)	Endo lubrication and EDTA	- Use with every file you put down the canal - Dissolves inorganic matter and smear layer
Tempbond NE (Kerr)	Temporary cement	- Dispense contents of package onto pad and mix for 30 sec, apply to inner surface of temp crown and seat on dry abutment, have patient bite on cotton roll, set time 7 min, then remove excess cement around margin
Tytin (Kerr)	Amalgam	- Activate, mix 4 seconds, dispense on amalgam cloth, and make sure you have an assistant to mix extra if restoration requires more than one

UltraCal (Ultradent)	Calcium hydroxide (Endo)	- Attach tip and insert into dry canal 2-3mm short of apex, inject while withdrawing - Use irrigation to remove when ready to obturate
UltraSeal XS (Ultradent)	Pit and fissure sealant	- Etch 30 sec, rinse and dry, push out a small drop of sealant and brush/airblow around occlusal surface , light cure 20 sec
Vitrebond (3M)	Liner	- Use as lining / base under composite, amalgam, ceramic and metal restorations - Mix powder and liquid 1:1 for 10-15 sec, apply thin covering on dentin, light cure 10 sec
Vit-l-essense (Ultradent)	Composite	- Always check shade before starting to avoid matching dehydrated tooth - Always etch 15-30 seconds, rinse thoroughly, optibond solo, cure, and apply with plastic instrument in small increments and cure often.

* The policy of the school is to purchase materials based on the following criteria: evidence based, materials relevant to mainstream dental procedures, materials that will enable students to be exposed to a variety of options, innovative (but researched) materials, unit-dose packaging – for easier and better infection control, cost effectiveness, superior handling properties – as defined by the faculty. Also, these materials are revised constantly.

Oral Care Products

Toothpastes

Most toothpaste currently on the market is a combination of an abrasive, a foaming agent, and 1 or more therapeutic agents.

- **Abrasives** - Abrasives give toothpaste its cleaning power. They polish teeth by removing stains and plaque.
 - Silica or hydrated silica
 - Sodium bicarbonate
 - Others: aluminum oxide, dicalcium phosphate, calcium carbonate
- **Foaming agents (surfactants/ detergents)**
 - Sodium lauryl sulfate – can be irritating to people with aphthous ulcers. Several brands make a toothpaste without this ingredient.
 - Sodium methyl cocoyl taurate – alternative to sodium lauryl sulfate found in Sensodyne.
- **Therapeutic agents**
 - *Fluoride* - Fluoride incorporates itself into tooth enamel making teeth more resistant to acid and inhibiting the ability of bacteria to produce acid.
 - Stannous Fluoride – Tin fluoride was used in the first fluoride toothpaste because it could be used with the most common abrasive at the time (calcium phosphate). It also has antibacterial effect; however, it is believed that it also stains teeth gray.
 - Sodium Fluoride – NaF is a commonly used fluoride, but can't be used with calcium based abrasives. This is not a problem now with the wide variety of abrasives available.
 - Sodium Monofluorophosphate – Originally developed to avoid infringing on Crest patent for Stannous Fluoride. It can be used with calcium based abrasives.
 - *Desensitizing agents*
 - Potassium Nitrate – block pain transmission between nerve cells
 - Strontium Chloride – block dentin tubules
 - *Anti-Tartar agents* - remove calcium and magnesium from the saliva, so they can't deposit on teeth. Pyrophosphates do not remove tartar.
 - Tetrasodium Pyrophosphate and other Pyrophosphates
 - *Antimicrobial agents* - kill or stop the growth of bacteria in dental plaque
 - Tricolsan – bactericidal compound found in Colgate Total.
 - Zinc Citrate or Zinc Chloride – bacteriostatic compound found in some toothpaste.
 - *Whitening agents* –
 - Sodium carbonate peroxide – Breaks down into hydrogen peroxide. It is added to "peroxide" toothpastes as a whitener and antibacterial agent.
 - Hydrogen peroxide – oxidizing agent that removes stains (oxidizing reaction).
 - Citroxane – a compound of Rembrandt toothpaste that disrupts stain through the combined action of papain, citrate and aluminum oxide. Papain is a proteolytic enzyme that is thought to whiten by dissolving the proteinaceous component of the stain. Citrate is added to enhance the activity of papain. Aluminum oxide is a mild abrasive
 - Sodium hexametaphosphate – functions as a sequesterant / chelating agent to prevent tarter formation and staining. Used in Crest Pro-Health toothpaste.

Mouth Rinses

- **Alcohol**
- **Therapeutic Agents**
 - *Fluoride* – typically sodium fluoride
 - *Antimicrobial agents* -
 - Chlorhexidine gluconate – bacteriostatic antiseptic for gram positive and some gram negative microbes. Used in mouth rinses: Peridex and PerioGard.
 - Cetylpyridinium Chloride – antiseptic used in some mouth rinses to prevent plaque and reduce gingivitis. However, it has been shown to cause brown stains between teeth.
 - Thymol
 - Salivary enzymes - lysozyme, lactoferrin, glucose oxidase, and lactoperoxidase
 - *Anesthetics* - menthol

Selected Brands and Products:

This list is not all inclusive. It is intended to be a sampling of several common or unique products available. Keep in mind that this industry changes very fast and what may be here one day is off the market the next. Also, many products with a particular name come in a variety of forms (eg Prevident 5000 toothpaste, Prevident rinse, Prevident 5000 varnish, etc)

Type	Brand	Product	Notes
Toothpaste	Colgate	Total	- Contains 0.30% Triclosan - Contains 0.243% sodium fluoride (1094 ppm F ion)
	Colgate	Sensitive	- Contains 5% potassium nitrate - Contains 0.45% stannous fluoride (1125 ppm F ion)
	Colgate	Simply White	- Contains hydrogen peroxide and abrasives - Contains 0.243% sodium fluoride (1094 ppm F ion)
	Colgate	Prevident 5000	- Prescription needed - Contains sodium fluoride (5000ppm F ion)
	Crest (Proctor & Gamble)	Pro-Health	- Polyfluorite system which is the combination of stannous fluoride with sodium hexametaphosphate
	Crest (Proctor & Gamble)	Sensitivity	- Contains 5% potassium nitrate - Contains 0.15% sodium fluoride (675 ppm F ion)
	Crest (Proctor & Gamble)	Vivid White	- Contains hydrated silica abrasive and sodium hexametaphosphate - Contains 0.243% sodium fluoride (1094 ppm F ion)
	Rembrandt (Johnson & Johnson)	Naturals	- No foaming agent (sodium lauryl sulfate) - Claim to have flavor derived from natural sources
	Aquafresh (GlaxoSmithKline)	Sensitive Maximum Strength	- Contains 5% potassium nitrate - Contains 0.15% sodium fluoride (675 ppm F ion)
	Sensodyne (GlaxoSmithKline)	Original	- Contains sodium methyl cocoyl taurate (foaming agent alternative)
Mouth	Biotene Oral Balance	Toothpaste	- No foaming agent (sodium lauryl sulfate) - Contains: lactoperoxidase, glucose oxidase, and lysozyme
	Tom's of Maine	Natural with Propolis and Myrrh	- This product contains no fluoride, but be careful because other products from this brand may have fluoride
	Chattem	ACT	- Contains 0.5% sodium fluoride (220 ppm ion)

Rinse			
	Colgate	Fluorigard	- Contains 0.5% sodium fluoride (220 ppm F ion)
	Colgate	Prevident 5000	- Contains sodium fluoride (2000ppm F ion)
	Crest	Pro-Health	- Contains Cetylpyridinium Chloride - May cause staining of teeth
	Johnson & Johnson	Listerine	- Contains Ethanol (solvent), Thymol (antiseptic), and menthol (local anesthetic)
	Biotene Oral Balance	Mouth Rinse	- Contains lysozyme, lactoferrin, glucose oxidase, and lactoperoxidase
	Colgate	Periogard	- Prescription needed - Contains 0.12% chlorhexidine gluconate
	3M	Peridex	- Prescription needed - Contains 0.12% chlorhexidine gluconate
Fluoride: Gel/ Foam/ Varnish	Colgate	Prevident 5000 Gel	- Prescription needed - Contains 1.1% sodium fluoride (5000ppm F ion)
	Colgate	Phos-Flur Gel	- Prescription needed - 1.1% acidulated phosphate fluoride gel
	Colgate	Gel-Kam	- OTC topical gel - Contains 0.4% stannous fluoride (1000 ppm F ion)
	Colgate	Prevident 5000 Varnish	- In Office - 5% sodium fluoride (22,600ppm F ion)
	Colgate	Duraphat Varnish	- In Office - 5% sodium fluoride (22,600ppm F ion)
	Oral B	Minute Foam/ Gel	- In Office - Acidulated phosphate fluoride (17,690ppm F ion)
	Oral B	Neutra Foam	- In Office - 2% Sodium fluoride
	Medicom	DuraFlor	- In Office - 5% sodium fluoride (22,600ppm F ion)
Whitening	Crest	White Strips	- In Office formulations: Professional 6.5% hydrogen peroxide, Supreme 14% hydrogen peroxide - Retail formulations also available
Denture	Crest	Fixodent	- Denture adhesive
Other	OraPharma	Arrestin	- Minocycline microspheres - Used in treatment of some avulsed teeth and as a locally acting antibiotic in periodontal disease
	PharmaScience	Fluor-a-day tablets	- Prescription needed - Sodium fluoride tablets available as 0.25mg, 0.50mg, 1mg
	Orajel	Maximum Strength Gel	- Used for canker sores - Contains benzocaine
	MGI	Salagen	- Prescription needed - Contains 5 mg pilocarpine - cholinergic salivary stimulant

Calculating Fluoride Content

$(\% \text{ Stannous Fluoride}) * (0.25) = \% \text{ F ion}$ $(\% \text{ F ion}) * (10^4) = \text{F ppm}$	$(\% \text{ Sodium Fluoride}) * (0.45) = \% \text{ F ion}$ $(\% \text{ F ion}) * (10^4) = \text{F ppm}$
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Local Anesthesia

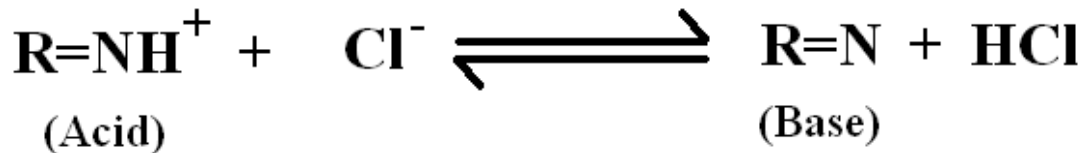
Vasoconstrictors (1:100,000 = 1mg/100mL)

	1:50,000	1:100,000	1:200,000	Max dose per Appt.
Epinephrine	0.036mg per carpule	0.018mg per carpule	0.009mg per carpule	-0.20mg (ASA I/II) -0.04mg (ASA III/IV with CAD or taking beta blockers or hyperthyroid) -0.0mg (TCA antidepressants, cocaine use) *Hypertension is NOT a contraindication to using vasoconstrictors.

Anesthetics (1% = 10mg/mL)

	Esters	Amides
Examples	Cocaine Procaine (Novocaine) Benzocaine (Topical anesthetics)	Bupivacaine Lidocaine Prilocaine Mepivacaine Articaine
Metabolism and Toxicity	Metabolized by plasma pseudocholinesterases to PABA and diethylamino alcohol – toxicity due to allergy to PABA or atypical pseudocholinesterase	Metabolized in liver with P450 (except prilocaine which is in kidney/lung) – toxicity due to overdose, liver dysfunction, or methemoglobinemia

Mechanism of Action



Acid Form	Base Form
- The form present in the carpule - Water soluble form (can NOT penetrate nerve sheath) - Active form at the receptor site (sodium channel)	- The form present in the tissue right after injection - Fat soluble form (CAN penetrate nerve sheath)

- Pharmacodynamics
 - Injection of acid form into tissues
 - pH of tissues ~ 7.4 so equilibrium pushed to base side of reaction and allows diffusion of anesthetic through nerve membrane (lower pH of tissues, due to infection, lowers the percentage of base that is present, and thus the amount of anesthetic delivered to the receptor)
 - Once inside the nerve membrane, the base converts back to the acid form
 - Acid form blocks the sodium channels and inhibits action potentials
 - Clinically the general order of loss of function goes: pain, temperature, touch, proprioception, and finally skeletal muscle tone. Local anesthetics depress small unmyelinated fibers first and large myelinated fibers last

- Pharmacokinetics

- Higher **Lipid Solubility** = increased **potency** and duration of action
- **Lower pKa** = **faster onset** of action
- Higher **protein binding** = increased **duration** of action

Specific Anesthetic Dosing (check the mL in the cartridge as some are 1.7mL and some are 1.8mL. Write total mL given not cartridges given in tx notes)

	Brand Name	Dose/ Carpule	Max Dose	Duration	Pregnancy	Notes
Lidocaine 2% Plain	Xylocaine (Blue)	36mg	4.4mg/kg 2mg/lb 300mg	Pulp: 5-10 mins Tissue: 1-2 hrs	B	Don't use this one, use mepivacaine if vasoconstrictor contraindicated
Lidocaine 2% Epi 1:50,000	Xylocaine (Green)	36mg	4.4mg/kg 2mg/lb 300mg	Pulp: 60mins Tissue: 3-5 hrs	B	Perio surgeries, biopsies, NOT for blocks
Lidocaine 2% Epi 1:100,000	Xylocaine (Red)	36mg	4.4mg/kg 2mg/lb 300mg	Pulp: 60mins Tissue: 3-5 hrs	B	Standard
Mepivacaine 3% Plain	Polocaine Carbocaine (Tan)	54mg	4.4mg/kg 2mg/lb 300mg	Pulp: 20-40 mins Tissue: 2-3 hrs	C	Fastest onset, shortest duration, best anesthetic to use if vasoconstrictor contraindicated
Prilocaine 4% Plain	Citanest (Black)	72mg	6mg/kg 2.7mg/lb 400mg	Pulp: 10-60 mins Tissue: 2-3 hrs	B	Contraindications: methemoglobinemia, hemoglobinopathy, aspirin
Bupivacaine 0.5% Epi 1:200,000	Marcaine (Blue)	9mg	1.3mg/kg 0.6mg/lb 90mg	Pulp: 1.5 – 3 hrs Tissue: 4 – 9 hrs	C	Contraindicated: Pediatrics, mentally disabled. Useful prior to oral or perio surgeries, get from E-bay
Articaine 4% Epi 1:100,000	Septocaine (Silver)	72mg	7mg/kg 3.2mg/lb 500mg	Pulp: 60-75 Tissue: 3-5 hrs	C	Contraindications: sulfa allergy, methemoglobinemia Risk of Nerve Injury with blocks, not available in our clinic

Needle Gauges:

25Gauge = RED needle. Safest, used mainly in oral surgery

27 Gauge = BROWN needle. Use for blocks and to be safe for all purposes

30 Gauge = BLUE needle. Often used for infiltrate/supraperiosteal injections and anterior injections. Higher risk of bending/breakage.

Sample Anesthetic Calculations:

- How many carpules of 2% xylocaine can safely be given to a 50 pound child?
50 pounds x 2mg/lb → 100mg max dose.
2% = 20mg/mL x 1.8ml/carpule = 36mg per carpule
100/36 = **2.77 carpules**
- How many cartridges of 0.5% bupivacaine 1:200 epi can be given to an 100lb patient after 3.6mL of 2% lidocaine 1:100 epi have been given?
100 pounds x 2.0 mg/lb → 200 mg max dose
Amount of lido given = 1.8 mL/cartridge x 20 mg/ml x 2 cartridges = 72 mg
% of max dose of lido = 72 mg/200 mg = 36%
Remaining % of max dose of bupivacaine = 100%-36% = 64%
Max dose of bupivacaine = 100 lb. x 0.6 mg/lb = 60 mg
Available dose of bupivacaine = 60 mg x 64% = 38.4 mg
Available cartridges of bupivacaine = 38.4 mg ÷ 9 mg/cartridge = **4.2 cartridges**

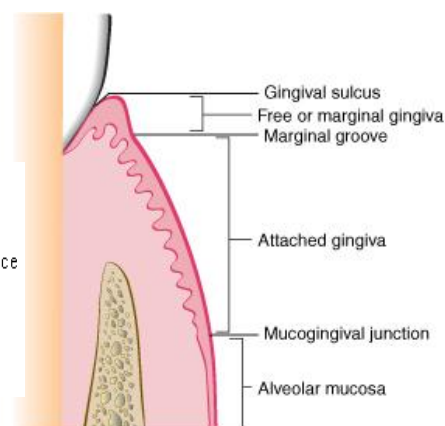
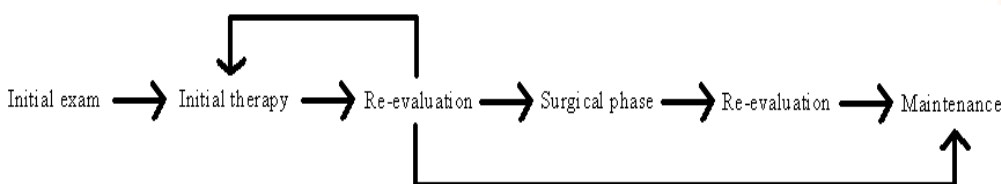
Techniques for Local Anesthesia

	Target	Technique
Supraperiosteal (Often called infiltration, but this technique is really different in that it deposits anesthetic just over periosteum instead of just under mucosa. "Local infiltration" = redundant)	Pulp and soft tissue of particular tooth	Hold needle parallel to long axis of tooth with bevel toward the bone Insert needle at height of mucobuccal fold, above apex Advance needle a few millimeters, sound bone, aspirate, and inject Deposit 1/3 carpule
PSA	Maxillary molars (except MB cusp of Max 1 st molar) and buccal gingiva	Method 1: Position needle 45 degrees to midsagittal and occlusal planes Insert needle at height of mucobuccal fold near apex of 2 nd molar posterior to the zygomatic process. Direct the needle posteriorly, medially and superiorly to a depth of 12-15mm, aspirate and inject Deposit ½-1 carpules. Don't sound bone. Method 2 (safer):
MSA	Maxillary premolars (plus MB cusp of Max 1 st molar) and buccal gingiva	Hold needle parallel to long axis of tooth with bevel facing bone Insert needle at height of mucobuccal fold near apex of 2 nd premolar Advance needle a few millimeters, sound bone, aspirate, and inject Deposit 1/2-1 carpules
ASA	Maxillary Canines, incisors, and buccal gingiva	Hold needle parallel or 10 degrees inward to long axis of tooth with bevel facing bone Insert needle at height of mucobuccal fold at apex of canine Advance needle a few millimeters, sound bone, aspirate, and inject Deposit 1/2-1 carpules
Infraorbital	Max. incisors, canines, premolars (plus MB cusp of 1 st molar), and buccal gingiva	Palpate infraorbital foramen extraorally w/ finger Hold needle parallel to long axis of max 2 nd premolar Insert needle at height of mucobuccal fold at apex of 2 nd premolar Advance needle ~15mm towards finger, aspirate, and inject Deposit 1/2 - 1 carpule
Greater Palatine	Palatal gingiva of maxillary premolars and molars	Locate palatal foramen w/ cotton swab (1cm medial to jxn of 2 nd and 3 rd molars)

		Apply pressure to injection site for at least 30 secs Place needle against blanched tissue and deposit a small amount Straighten needle and insert, depositing while advancing needle Advance needle until bone sounded (~3mm), aspirate, and inject Deposit 1/3 – 2/3 carpule
Nasopalatine	Palatal gingiva of maxillary canines and incisors	Apply pressure to incisive papilla with cotton swab Place needle against tissue lateral to incisive papilla and deposit a small amount Straighten and insert needle adjacent to incisive papilla, depositing while advancing Advance needle until bone sounded (~3mm) Deposit < 1/4 carpule, soft tissue should blanch *This is one of the most painful of all injections
Inferior Alveolar	Entire mandibular quadrant and gingiva (except buccal gingiva of molars)	Place thumb in coronoid notch and visualize line extending from thumb back to the pterygomandibular raphe (about 2/3 way up the finger nail) Replace thumb with mouth mirror or retractor to prevent accidental injection Hold needle parallel to occlusal plane with bevel away from bone and approach from contralateral premolars Insert needle ~1cm above occlusal plane 3-5mm lateral of raphe Advance needle 20-25mm (almost buried), must sound bone then retract 1-2mm, aspirate, and inject Deposit 3/4 carpules and inject 1/4 carpule while removing needle to anesthetize lingual nerve
Long Buccal	Buccal gingiva of mandibular molars	Hold needle parallel to occlusal plane Insert needle in mucosa distal and buccal to most distal molar along most buccal aspect of coronoid notch Advance needle < 4mm, sound bone Deposit 1/4 carpule
Gow-Gates	Entire mandibular quadrant and gingiva	Locate the intertragic notch and corner of mouth and hold both with 1 hand (c shape) Hold needle in line with the plane connecting the intertragic notch and corner of mouth Insert needle distal to max. 2nd molar (or if 3rd molar present, distal to 3rd molar) Advance needle 25mm to sound bone on neck of condyle, retract 1mm, aspirate, inject Deposit 1 carpule *Make sure patient is fully translated and remains that way for 1 min after injection
Akinosi (closed mouth)	Entire mandibular quadrant and gingiva (except buccal gingiva of molars)	Hold needle parallel to occlusal plane Insert needle in tissue medial to ramus at height of mucogingival jct of max. 3rd molars Advance needle ~20-25mm, aspirate, and inject Deposit 1 carpule
PDL injection	Pulp and gingiva of selected tooth	Hold needle parallel to long axis of tooth Insert needle in either medial or distal sulcus Advance needle into PDL space Deposit 0.2mL

Periodontics

Treatment Scheme:



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Periodontal Treatment Goals

- Eliminate + Suppress infectious microorganisms (i.e. pocket eradication)
- Eliminate SOURCE of infection to prevent reinfection (i.e. eliminate root irritant)
- Establish an environment to resolve inflammation and prevent perpetuation (i.e. correct existing restoration, restore carious areas)

Periodontal Definitions

Clinical Attachment Level (CAL)	Distance from the CEJ to the depth of sulcus
Probing Depth	Distance from gingival margin to the depth of sulcus
Biologic width	- CT attachment (1.07mm) + JE (0.97mm) = 2.04mm - Does NOT include sulcus depth (0.69mm) - Violation leads to inflammation, pockets, and bone loss
Repair	- Healing by replacement with epithelium or CT or both that matures into various <i>nonfunctional</i> types of scar tissue, termed new attachment. - Patterns of repair include long junctional epithelium, CT adhesion, and ankylosis.
Regeneration	Healing through the reconstitution of a new periodontium, which involves the formations of new alveolar bone, PDL, and cementum
Attached Gingiva	The portion of the gingiva bound to the bone or tooth, measured from the gingival margin to the mucogingival line minus the pocket depth
Free Gingiva	Coronal to the attached gingiva, forms the gingival margin and the sulcus
Keratinized Gingiva	Includes both the attached and free gingiva, measured from the gingival margin to the mucogingival line. It is thought that 2mm (1mm attached and 1mm free) is needed to maintain gingival health, but this is not well supported by the evidence, which suggests that there is no minimum for attached gingiva.
Positive architecture	Refers to the situation when osseous contour follows the CEJ, making interproximal bone more coronal than radicular bone
Red Complex	composed of <i>Bacteroides forsythus</i> , <i>Porphyromonas gingivalis</i> , and <i>Treponema denticola</i> -- implicated in severe forms of periodontal diseases

Risk Factors for Diseases of the Periodontium

- Gingivitis: Increased prevalence during puberty, diabetes, and with pregnancy
 - o Medications such as immunosuppressive (cyclosporine), CCB can cause modification
- Chronic periodontitis: smoking, diabetes, HIV infection or immunocompromised
- Aggressive periodontitis: genetics

Dental Plaque Formation

- 1. Pellicle formation – glycoproteins (mucins) in the saliva and GCF adhere to the tooth surface (referred to the acquired pellicle) seconds after a tooth is cleaned/ polished.
- 2. Adhesion/ Colonization – early colonizing bacteria adhere to the pellicle and use dietary sugar to produce a matrix of glucans, fructans, and levans that enables more bacteria to adhere
- 3. Plaque maturation – increasing diversity from late colonizing bacterial species
- 4. Plaque mineralization – mineralization of the plaque forms calculus

Microbiology of Periodontal Disease

- *Healthy* - Gram (+) facultative cocci and rods (Streptococcus and Actinomyces genera)
- *Gingivitis* – Gram (-) rods and filaments, followed by spirochetes and motile microorganisms
- *Chronic periodontitis* – Primarily gram (-) anaerobic species that include: P.gingivalis, T. forsythia, P. intermedia, Campylobacter rectus, Eikenella corrodens, F. nucleatum, Actinobacillus actinomycetemcomitans, and peptostreptococcus micros.
- *Aggressive periodontitis* – Primarily A.actinomycetemcomitans
- *Necrotizing diseases* – High levels of P. intermedia, spirochetes and fusobacteria
- *Periodontal abscesses* - F. nucleatum, P. intermedia, P.gingivalis, P. micros, and T. forsythia

	Bacteria	Gram stain
Early Colonizers	Blue Complex Actinomyces naeslundii	+
	Actinomyces israelii	+
	Actinomyces viscosus	+
	Purple Complex Veillonella parvula	-
	Actinomyces odontolyticus	+
	Green Complex Eikenella corrodens	-
	Capnocytophaga gingivalis	-
Late Colonizers	Capnocytophaga sputigena	-
	Capnocytophaga ochracea	-
	Capnocytophaga concisus	-
	Actinobacillus actinomycetemcomitans	-
	Yellow Complex Streptococcus mitis	+
	Streptococcus oralis	+
	Streptococcus sanguis	+
	Streptococcus gordonii	+
	Streptococcus intermedius	+
	Orange Complex Campylobacter rectus	-
	Campylobacter gracilis	-
	Campylobacter showae	-
	Eubacterium nodatum	+
	Fusobacterium nucleatum	-
	Prevotella intermedia	-
	Peptostreptococcus micros	+
	Prevotella nigrescens	-
	Streptococcus constellatus	+
	Red Complex Porphyromonas gingivalis	-
	Bacteroides forsythus	-
	Treponema denticola	N/A

Periodontal Exam

Plaque index	0 – no plaque 1 – no plaque visually detectable but plaque on probe 2 – gingival area of tooth is covered with thin to moderately thick film of plaque 3 – heavy plaque accumulation
Probing	Healthy: 1-3mm
Furcation	I – slight bone loss, not visible on x-ray, probe catches II – bone loss, widened PDL on x-ray, probe penetrates III – Intraradicular bone gone, furcal radiolucency, probe through and through IV – Intraradicular bone gone, furcal radiolucency, probe AND visually through and through
Keratinized Gingiva	>2mm from gingival margin to MG line - healthy <2mm from gingival margin to MG line – questionable health
Tooth Mobility: Miller Classification	0 – normal 1 – slightly more than normal, <1mm 2 – moderately more than normal, ~1mm 3 – severe mobility, >1mm, plus vertical depressible
Fremitus	Class I – mild vibration detected Class II – easily palpable movement but no visible movement Class III – Movement visible to the naked eye
Recession: Miller Classification	I - Not to MG junction - no interdental bone / soft tissue loss II - To or beyond MG junction - no interdental bone / soft tissue loss III – To or beyond MG junction, loss of bone / soft tissue is apical to CEJ / coronal to recession IV - Beyond MG junction – loss of interdental bone extends to point more apical than recession

Radiograph for Periodontics

- Bitewings are probably *most* important images for establishing bone height, which should be located ~2mm below the CEJ
- Horizontal defect: symmetric bone loss on mesial and distal surfaces of adjacent teeth
- Vertical defects
 - 1 walled – least amenable to regeneration
 - 2 walled – most common osseous defect, moderately amenable to regeneration
 - 3 walled – most amenable to regeneration
- Other findings of note: widened PDL, furcation involvement, unusual root morphology, calculus, periradicular radiolucency

Etiology of Recession

- Orthodontics
- Trauma: tooth brush abrasion, flossing clefs, oral habits (e.g. pen chewing),
- Periodontitis
- Morphology (e.g. thin biotype)
- Abfraction
- Restorations that violate biologic width

*Traumatic occlusion has not been shown to cause recession, but elimination of traumatic occlusion may lead to resolution of recession

Role of Occlusion in Periodontal Health

- *Primary trauma from occlusion*: injury resulting in tissue changes from excessive occlusal forces on teeth with normal periodontal support.
- *Secondary trauma from occlusion*: injury resulting in tissue changes from excessive occlusal forces on teeth with compromised periodontal support.
- *Clinical and Radiographic signs of traumatic occlusion*: mobility and widened PDL space, thermal sensitivity, attrition, hypercementosis, loss of lamina dura

Diagnosis: ADA and AAP

ADA Classification

Class	Diagnosis	Findings
0	Healthy	N/A
1	Gingivitis	Inflammation, Bleeding on probing, No attachment loss, No bone loss
2	Mild Periodontitis	Inflammation, Bleeding on probing, Pockets 4-5mm, CAL 2-4mm, <25% bone loss
3	Moderate Periodontitis	Inflammation, Bleeding on probing, Mobility, Furcation, Pockets 5-7mm, CAL 4-6mm, 25-50% bone loss
4	Severe Periodontitis	Inflammation, Bleeding on probing, Mobility (II-III), Furcation (II-III), Pockets >7mm, CAL >5mm, >50% bone loss

AAP Classification

Diagnosis	Sub-Types	Findings
Plaque Induced Gingivitis	- Plaque only - Plaque with systemic factors (endocrine, pregnancy, diabetes, leukemia) - Plaque with Medications (immunosuppressants, anticonvulsants, OCPs) - Plaque with malnutrition	- Inflammation
Non-Plaque Induced Gingivitis	- Bacterial (gonorrhea, syphilis, streptococcus) - Viral (herpes) - Fungal (Candida) - Genetic (hereditary gingival fibromatosis) - Systemic disease (lichen planus, pemphigoid, pemphigus vulgaris, erythema multiforme) - Allergic - Traumatic	- Inflammation
Chronic Periodontitis	- Localized or Generalized (>30%) - Mild (1-2mm CAL), moderate (2-4mm CAL), or severe (>4mm CAL)	- Mostly adults - Slowly progressive - Destruction consistent with local causes - P.gingivalis and A.a.
Aggressive Periodontitis	- Localized	- Circumpubertal onset - 1st molars and incisors with no more than 2 teeth other than 1st molars/incisors
Aggressive Periodontitis	- Generalized	- Patients <30 - Episodic - At least 3 teeth in addition to 1st molars/incisors
Necrotizing Periodontitis	- NUG - NUP	- Punched out papilla - Necrosis of gingiva - Foul breath - Pain and bleeding - Associated with spirochetes, and stress, smoking, poor hygiene
Periodontal Abscesses	- Gingival (along gingival margin) - Periodontal (most common abscess) - Pericoronal (around crown of unerupted tooth)	- Pain and swelling - Mobility and extrusion of tooth - Sinus tract - Lymphadenopathy - Radiolucency

Non-Surgical Periodontal Procedures

	Indication	Set-up	Procedure
Prophy	All patients w/ PPD 1-4mm	- Gauze, cotton rolls - Hand Sc/Rp Kit - Hand piece: straight attachment on slow speed - Prophy angle and prophy paste - Dental floss - Cavitron - Cavitron tip	- Review medical and dental history (any changes?), check BP if necessary - Quick exam of dentition, call instructor to begin - Provide patient with OHI based upon their habits and your findings - Dry teeth, then use hand scalers to remove supra-gingival plaque/calculus, floss teeth, and check with 11/12 probe. - Use prophy paste to polish – careful not to press too hard or hold on one tooth too long as it will get HOT. Rinse / suction. - Call instructor to check
Scaling and Root Planing	Patient with PPD of 5mm or greater	- Gauze, cotton rolls - Sc/Rp kit - Basic kit - Local anesthetic - Needles - Topical benzocaine - Cavitron - Cavitron tip - Prophy angle/paste	- Review medical and dental history (any changes?), check BP if necessary - Quick exam of dentition, call instructor to begin - Provide patient with OHI based upon their habits and your findings - Anesthetize teeth to be Sc/Rp - Remove supra- and subgingival plaque and calculus with Cavitron. Then go back with scalers. Check with 11/12 probe. - Call instructor to check - Schedule reevaluation in 4-6 weeks

Periodontal Instruments:

Hand Instruments

- Scaling – Supragingival
- Root planing – subgingival; for patients who have attachment loss due to periodontitis

Scaling, root planing and curettage instruments			
	Gracey Curettes “Site-specific”	Universal Curettes “SYG7”	Sickle Scalers
Indications	Subgingival scaling, root planing, removal of inflamed soft tissues		Supragingival Interproximal
Cutting surface	1	2	2
Toe	Cutting edge @ toe		Pointed
Best for	7/8: anterior M/D, B/L of all 11/12: Posterior M 13/14: posterior D	- B/L of posterior teeth - Lateral pull stroke - occlusal pull stroke	Interproximal Anterior
Face surface to Shank	70 degrees	90 degrees	
Lateral surface to face		70 degrees	70 degrees

Instructions:

- Have terminal shank parallel to teeth
- Use plastic instruments for implants
- LIMITATIONS --- pocket depth greater than 5mm cannot be cleaned by hand instruments predictably.
- Use #11/ 12 explorer to feel calculus build up.
- Curette efficiency (complete calculus removal) 3.7 mm
- The most efficient angle of the face of the blade to the tooth for Sc + Rp is 70 degrees (gracey)

Automated Instruments:

Category	Advantages	Disadvantage
ALL automated instruments	- Better access in pockets/furcation - Less fatigue - Minimal tissue trauma - Rapid removal - Water irrigation - No sharpening needed	- Create aerosols - Noise - Tissue damage if used incorrectly - Tip wear (every 1mm loss on tip = 25% loss of efficiency) - Root surface damage - Expenses: units(\$1500-3000) + tips (\$75-125)
Air Polishing (Prophy jet)	- Air/water/sodium bicarb slurry - Remove extrinsic stain, plaque and polish teeth at the same time - Direct 45 degrees to tooth	(never point directly to sulcus or pocket)
Sonic Scaler (Titan, Kavo) 2500-7000 Hz	- Attaches to conventional handpiece - Interchangeable tips - Autoclavable - Cheap + portable	- Tip moves in orbital motion (can cause damage to roots) - Noisy (audible range frequency)
Ultrasonic Scaler (Cavitron) - MAGNETOSTRICTIVE 20,000-50,000 Hz	- Long double elliptical motion (less damage than orbital motion) - All sides of the tip are active - Autoclavable tips - May kill bacteria (esp spirochetes)	- Requires separate drive box - Generates heat (water is critical) - May effect electromagnetic device (i.e. pacemaker)
Ultrasonic Scaler (Piezon) PIEZOELECTRIC 29,000-50,000 Hz	- Not too much heat generated - Linear oscillation (claim that this hurts tooth less)	

- Contraindications: Hep C, HIV, TB (aerosols), unshielded and unipolar(old) pacemakers

Antibiotics in Periodontics

- Local
 - **Indications:** when localized disease sites do not respond to initial therapy or when localized disease sites exist in an otherwise stable maintenance patient.
 - **Contraindications:** aggressive periodontitis/Pt sensitive or allergic to Abx
 - local systems are not intended to replace conventional scaling and root planing
 - Examples of Locally Acting Agents
 - Chlorhexidine mouth rinse
 - Chlorhexidine chip (PerioChip)
 - Doxycycline gel (Artidox)
 - Minocycline microspheres (Arrestin)
- Systemic
 - Can be used as adjunctive to initial phase therapy in patients with severe chronic periodontitis or aggressive periodontitis
 - Recommended dose: 250mg metronidazole with 500mg amoxicillin 3x/day for 8 days

Periodontitis and Systemic/Environmental Links

- Periodontal Biofilm and chronic systemic inflammation
 - Atherosclerosis, coronary heart disease, rheumatoid arthritis, type 2 diabetes, obesity, osteoporosis, and periodontal disease all share a common pathophysiologic feature: chronic, sustained, exacerbated inflammatory response to a given stimulus, marked by the

production of proinflammatory cytokines that initially help clear invading pathogens, but then result in excessive tissue damage

- The endotoxin LPS, found on gram negative bacteria can cause synthesis and secretion of: TNF- α , IL-1 β , IL-6, and IL-8. These cytokines can contribute to systemic inflammation through their direct action on blood vessel walls or through indirect action by inducing the liver to produce acute phase proteins such as C-reactive protein (CRP). CRP binds damaged cells and marks them for destruction.
- Numerous studies have indicated that periodontal disease causes an increase in CRP levels, and treatment of periodontal disease leads to decreases in CRP.
- Cardiovascular disease
 - MI: In addition to smoking and high LDL cholesterol, increased CRP level is an important risk factor for myocardial infarction. Investigators found a dose response between percent bone loss and incidence of angina and MI.
 - Atherosclerosis: Periodontal pathogens have been found in carotid atheromas. Nuclear factor- kappa B (NF-kB) is an inducible transcription factor that is responsible for macrophage activation and regulation of smooth muscle proliferation. Inflammatory stimuli (LPS, TNF- α , IL-1 β) results in upregulation of NF-kB, exacerbating the inflammatory effects on blood vessel walls.
- Cigarette Smoking
 - Smokers exhibit increased attachment, bone loss, increased number of deep pockets, and more calculus formation.
 - DNA-DNA hybridization demonstrated that the orange and red microbial complexes were more prevalent in current smokers than in former smokers and nonsmokers.
 - Smoking also reduces protective elements of the immune system.
 - Smoking alters gingival microvasculature in smokers, resulting in decreased blood flow and decreased clinical signs of inflammation.
- Hormonal Changes
 - Puberty
 - Menstruation
 - Pregnancy
- Blood dyscrasias:
 - Leukemia patients may present with gingival enlargements that appear bluish-red and cyanotic. The enlargements are often found in the interdental gingival. Gingival bleeding, caused by thrombocytopenia, are also often found.
 - Severe periodontal disease may be seen in individuals with neutropenia, agranulocytosis, leukocyte adhesion deficiency, Down Syndrome.
- Stress:
 - Similar to occlusal forces, stress may not induce periodontal disease, but stress can affect immune system. Increases in cortisol production that can subsequently suppress immune response may increase the potential for pathogens to induce disease.
- Preterm Birth and Low Birth Weight
 - It is thought that chronic infection causes early uterine contraction, cervical dilation, and premature rupture of membranes. This theory is supported by animal models that show bacteria able to induce preterm birth, by the mechanism of bacterial vaginosis leading to PTB, and numerous other lines of evidence.
- Other:
 - Periodontitis maybe/is also linked to diabetes mellitus, cerebrovascular disease (stroke) and respiratory diseases (COPD)

Set-Up for Periodontal Surgeries

- Sign up for perio surgery on the back wall ahead of time – only 2 surgeries can occur each day
- Blood pressure cuff, periodontal surgery tray, perio surgery burs, handpiece, hand scalers
- Consent form
- Gauze, cotton rolls, suction tips (high volume, low volume, and surgical)
- Anesthetics (get carpules of both 1:100,000 and 1:50,000 epi)
- Sterile gauze/Bib/Gloves and sterile table cover (B-bay)
- Sterile saline and syringes (B-bay)
- Orange biomaterials bag (B-bay)
- A variety of scalpel blades (12B: lingual, 15C: anterior, 15: posterior)
- 4-0 Silk Sutures
- Coe-Pack (periodontal dressing that stays on for 7 days), Vaseline, cotton tip applicator, paper pad, tongue blade (to mix)
- Post-op pack: ice-pack, Advil, Post-Op instructions, Rx forms (Axium)

Surgical Periodontal Procedures

Objectives of Surgical Therapy

- **Gingival Augmentation:** goal is to increase width and thickness of gingiva to establish proper vestibule depth, prevent or stop soft tissue recession, and facilitate plaque control. Specific indications include:
 - Progressive soft tissue recession
 - Mucogingival problem: triad of inflammation, recession, and no attached gingiva
 - Planned sub-gingival restoration with minimal or no attached gingiva (2mm free and 3mm attached if restoration will go sub-gingival – but again evidence is sparse)
 - Planned restorative procedures that will result in continuous mechanical insult in areas of minimal keratinized tissue (eg proximal plate and I-bar RPD)
 - Root dehiscence combined with thin biotype
 - Shallow vestibule
 - Elimination of aberrant frenum when it interferes with planned grafting procedures
 - Esthetics
- **Root Coverage:** goal is to cover a predictable amount of exposed root surface with attached gingiva and a shallow sulcus in order to improve esthetics, cover cervical root defects, prevent root caries or root sensitivity.
*Complete root coverage only possible with Miller Class I/II recession, partial root coverage is possible with Miller Class III, and no root coverage is possible with Class IV
- **Alveolar Ridge Augmentation:** goal is to improve esthetics or prepare better ridge for placement of dental implants.
- **Pre-Prosthetic Therapy/Crown Lengthening:** includes exposure of tooth structure to achieve ferrule while maintaining adequate biologic width.
- **Esthetics / Soft tissue Contour**
- **Elimination of Persistent Diseased Site:** includes removal of plaque / calculus, pocket reduction, modification / elimination of osseous defects, and reduction of tuberosity of retromolar pad.

Contraindications to Periodontal Surgical Therapy

- Uncontrolled medical condition: unstable angina, hypertension, diabetes, MI/ CVA in last 6 mos
- Active periodontal disease or unwilling patients

- Poor oral hygiene and/or high caries rate

Overview of Periodontal Plastic and Reconstructive Surgical Procedures

Procedures	Goal of therapy	Notes
Rotated flaps - Laterally positioned flap - Papilla flap - Double papilla flap	- Root coverage	- Advantages: only 1 surgical wound, better esthetics, and graft retains intact blood supply - May get recession on teeth of donor site - Combined with free soft tissue graft for better results
Advanced flaps - Coronally positioned flap - Semilunar flap	- Root coverage - Alveolar ridge augmentation	- Disadvantage: usually not enough gingival width and thickness to cover areas of significant recession - Combined w/ free soft tissue graft for better root coverage
Apically positioned flaps - Crown lengthening	- Pre-prosthetic - Esthetics	- Crown lengthening usually includes osteotomy and osteoplasty - Crown lengthening can be functional or esthetic - Contraindications: esthetics, furcation exposure, or compromised periodontal support (ie crown : root)
Replaced flaps	- Surgical access for other procedures	- Post-op position of the gingiva is the same as the Pre-op - Allows access for GTR, bone grafting, etc.
Free soft tissue grafts - Free epithelial - Connective tissue	- Gingival augmentation - Root coverage - Alveolar ridge augmentation	- 2 surgical wounds but best root coverage (using any pedicle flap plus CT graft) - Graft can be partially or totally covered with flap - Acellular dermal matrix can be used as artificial donor with complete coverage
Bone grafting	- Alveolar ridge augmentation - Socket Preservation	- Autograft: from same individual - Allograft: from same species, and can come as mineralized or demineralized - Xenograft: from different species - Alloplast: Synthetic
Guided tissue regeneration	- Periodontal regeneration - Eliminate Diseased Site	- Nonabsorbable and absorbable membranes - Most successful w/ class II furcation in mandibular molars - Bone Graft

Soft Tissue Resective Surgery

Procedure	Goal of therapy	Notes
Gingivectomy - Standard external bevel - Internal bevel - Ledge and wedge	- Esthetics - Eliminate diseased site - Pre-prosthetic	- Contraindications: pocket depth apical to MG junction, inadequate keratinized gingiva, compromise esthetics, osseous defects
Open flap curettage - Debridement and Sc/Rp - Modified Widman	- Eliminate diseased site	- Allows better access for instrumentation
Distal wedge	- Eliminate diseased site	- Reduction of tuberosity or retromolar pad - Numerous variations in technique
Frenectomy	- Gingival augmentation - Remove Frenum pull	- Removed to avoid interference with grafting

Combined Soft and Hard Tissue Resective Surgery

Procedure	Goal of therapy	Notes
Flap osseous	- Eliminate diseased site	- Includes both osteoplasty (removal of nonsupporting) and osteotomy (removal of supporting bone) - Outcome influenced by root form, tooth inclination, location, type of bony defect, and furcation involvement - Contraindications: severe perio disease, severe vertical

		defects, high caries, hypersensitivity, loss of support - Most predictable pocket reduction
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Grafting:

- Definitions:
 - **Osteoconduction:** materials (xenografts, alloplast, allograft) that facilitate new bone by acting as a scaffold
 - **Osteoinduction:** materials (DFDBA) that can induce new bone formation by recruiting undifferentiated mesenchymal cells
- Types:
 - Autograft – from the same individual, bone can be obtained from intraoral site (extraction site, tuberosity, etc.) or iliac crest, soft tissue usually from palate
 - Allograft – from same species but different individual, bone can come as freeze dried bone or demineralized freeze dried bone, soft tissue as acellular dermal matrix
 - Xenograft – different species (e.g. bovine bone)
 - Synthetic / Alloplast: include inert composite polymers and hydroxapatite
- Commonly Used Grafting Materials at HSDM
 - FDBA – cortical bone obtained from donors
 - DFDBA – demineralization version of FDBA is thought to improve osteogenic potential by exposing BMPs (an inductive factor known to increase bone formation)
 - Xenograft (Bio-Oss©) – mineralized portion of bovine bone
 - Alloderm – acellular dermal matrix derived from donated human skin (cadavers), has similar results to connective tissue grafts without palatal wound, but slower to heal and technique sensitive

Socket Preservation

Bone and associated soft tissue are important considerations when replacing teeth. If an implant is to be placed, there must be adequate bone for the fixture, and correct manipulation of gingival tissue is essential for an esthetically pleasing outcome. If bone loss is severe, an RPD may be a more appropriate choice for maximizing esthetics. With the importance of bone in mind, many clinicians have turned to socket preservation techniques. This is a controversial topic within dentistry right now. The debate is whether to bone graft at the time of extraction (socket preservation) or to allow for natural healing and if necessary, bone graft at time of implant placement.

After healing of extraction sites, there is often a decrease in alveolar ridge height and width, most pronounced within the first 6 months following tooth extraction. Buccal bone, in both arches, is particularly susceptible to postextraction resorption. Schropp (2003) found that one year after extraction the average loss alveolar width and height was 6 mm and >1 mm, respectively. Although this is a slight decrease in height, the extraction site shows a characteristic concave deformity, and bone associated with the adjacent mesial and distal dental surfaces never regains its original vertical dimension.

The purpose of socket preservation is to minimize this postextraction resorption. A split-mouth study by Lekovic (1998) found that vertical and horizontal resorption at 6 months can be decreased from 1.5 mm and 4.56 mm to 0.38 mm and 1.32 mm through utilization of a bioabsorbable membrane. Lasella (2003) found that postextraction ridge height can actually be increased by combining bone grafting (with DFDBA) and barrier membrane techniques.

Although there is literature supporting socket preservation, there is disagreement regarding its usefulness. Indeed, some researches, e.g. Becker (1998), have argued that the quality of bone in grafted sockets is not adequate for implant placement. Others view it as an often unnecessary expense for little gain. Even though general consensus regarding the appropriateness of the technique is lacking, becoming familiar

with it is a worthwhile endeavor because socket preservation is a commonly used technique that attempts to address a real problem in dentistry.

Sutures

	Type	Tensile Strength	Knot Security	Duration of Wound Security	Tissue Reactivity
Resorbable	Plain Gut	Fair	Poor	5-7 days	Most
	Chromic Gut	Fair	Fair	9-14 days	Most
	Vicryl (polyglactin)	Good	Good	30 days	Minimal
	Dexon (polyglycolic acid)	Good	Best	30 days	Minimal
Non-Resorbable	Ethilon (Nylon)	Good	Good	N/A	Minimal
	Silk	Poor	Best	N/A	Most
	Polypropylene	Best	Poor	N/A	Least

*Non-resorbable sutures should be removed in 5-7 days

Follow-Up for Periodontal Surgeries

- Inform patient:
 - discomfort is part of healing, and will be given pain medication, but do not take aspirin for 7 days after surgery
 - Swelling will last 2-3 days, ice pack of 10min on / 10min off will help
 - Bleeding may occur tonight or tomorrow morning
 - Do not rinse for 3hrs post op, after that rinse with lukewarm salt water
 - For first 24 hours only soft cool foods, no straws, chew on opposite side
 - Sutures will come out in a week
- Pain management: prescription Ibuprofen/Tylenol / VicodinES
- Chlorhexedine rinse: Rx for Peridex, swish 15-30secs 2x/day for seven days

Wound Healing

- Immediately after suturing, a clot forms and connects the flap to the tooth and alveolar bone
- 1-3 days: epithelial cells begin to migrate over the border of the flap
- 1 week: epithelial attachment is in place, consisting of hemidesmosomes and basal lamina. The clot is then replaced by granulation tissue
- 2 weeks: collagen fibers appear
- 1 month: the gingival crevice is lined with epithelium

Operative

Caries: Etiology

- 700+ species of bacteria exist in the oral cavity, but only 2 are associated with caries: *Streptococcus mutans* and *Lactobacilli* – both produce acid (acidogenic) and tolerate acidic environments (aciduric).
- **Plaque:** is a gelatinous mass of bacteria and their products adhering to the tooth surface – its accumulation is a highly organized sequence of events that includes: transmission (window of infectivity), attachment and colonization (acquired pellicle), and maturation of the plaque (from aerobes to anaerobes and facultative anaerobes). If the mature plaque contains a high proportion of cariogenic bacteria, the plaque has a high caries potential; whereas plaque dominated with more benign bacteria (*S. saguis* and *S. mitis*) have a low caries potential.
- **Diet:** bacteria use sugar (sucrose) to produce acid, which leads to demineralization of tooth structure – when oral pH drops below 5.5. Over time oral pH gradually returns to normal and remineralization can occur.
- **Host:** saliva acts to control plaque with enzymes and proteins (sIgA, lactoferrin, and mucins).
- **Oral Hygiene:** mechanical removal of plaque colony from teeth – but they recolonize.

Caries: Progression / Diagnosis

- **Incipient:** Starts as white spot of demineralization (reversible), up to half the thickness of the enamel.
- **Clinical caries:** surface cavitation with an accelerating rate of demineralization (irreversible).
 - a. *Moderate:* more than half way through enamel (up to DEJ)
 - b. *Advanced:* from DEJ to half way through dentin
 - c. *Severe:* more than half way through dentin; probable pulp involvement
- Tools for caries diagnosis: a single test is not sufficient to diagnose caries
 - Patient history: identify high risk patients - age, gender, oral hygiene, fluoride exposure, smoking, alcohol intake, medications, dry mouth, diet (types and frequency), general health
 - Clinical exam: presence of numerous restorations, plaque and calculus, discoloration of tooth, cavitation of tooth, change in surface roughness, positive dye
 - Radiographs
- Criteria for Diagnosis
 - Pit and Fissure Caries
 - i. Explorer tip “catch” is not by itself sufficient, need additional criteria: Softening at base of pit/fissure, opacity (caulky) surrounding pit/fissure indicating undermined enamel, or softened enamel that may flake away
 - ii. Radiographs – may not be evident unless lesion is extensive
 - iii. Laser (DIAGNOdent) – may aid diagnosis but should not be the primary method
 - Smooth Surface Caries - bitewings most common method of detecting proximal lesions, but these should also be examined clinically
- Determining active vs. arrested lesions
 - Active: white spot with matte or frosted surface, cavitation with soft enamel/dentin, lesion visible in dentin on radiograph, plaque
 - Arrested: brown spot with shiny surface, cavitation with hard enamel/dentin, not covered with plaque

Caries: Treatment / Prevention

- Caries risk assessment, increase frequency of recall appointments, reduce frequency of sugar, lower sucrose content in meals, chlorhexidine mouth rinse, high fluoride toothpaste, topical or systemic fluoride, improve brushing frequency / duration / technique, improve flossing frequency, stimulate salivary flow (sugarless chewing gum, saliva substitutes, etc.), pit and fissure sealants, restoration

Caries: Classification

- Class I - Pit and fissure caries on occlusal, facial, lingual surfaces
- Class II - Interproximal lesions on all posterior teeth (MO, DO, MOD)
- Class III - Interproximal lesions on all anterior teeth not involving incisal angle
- Class IV - Interproximal lesions on all anterior teeth involving the incisal angle
- Class V - Facial or Lingual lesions on smooth surfaces of teeth
- Class VI - Pit and Fissure lesions occurring on the incisal edges or cusp tips. Wear defects/fractures on cusp tips of posterior teeth or incisal edge of anterior teeth.

G.V. Black Principles

*Caveat: modern amalgam preparations still follow these guidelines, but are slightly more conservative than G.V. Black's "extension for prevention" approach. Further, current composite materials allow for a much more conservative preparation.

- **Outline form**
 - The final outline is based on extent of caries or previous restoration; and must end on sound tooth structure
 - All faults, weakened enamel, and caries susceptible areas (deep grooves) should be included in the final outline form ("extension for prevention")
- **Resistance form**
 - Rounded internal line angles
 - Adequate preparation depth (1.5mm below central fossa or 0.2-0.75mm beyond the DEJ); flat pulpal floors
 - Buccal lingual width of prep should not be wider than 1/3rd total width
 - Join 2 preps if less than 0.5mm apart
- **Retention form**
 - Includes use of convergent buccal and lingual walls (but divergent mesial and distal walls) for amalgam preps, dove tails
 - Secondary retention form: grooves, slots, pins
- **Convenience form**
 - Creating an outline that allows for adequate accessibility
- **Finish enamel margins**
 - Make all walls of prep smooth
 - Remove any unsupported enamel
 - Ideal cavosurface margin is 90 degrees to external surface
- **Cleanse cavity**
 - Remove all debris by rinsing with air/water stream, dry tooth but never desiccate

Pulpal Protection

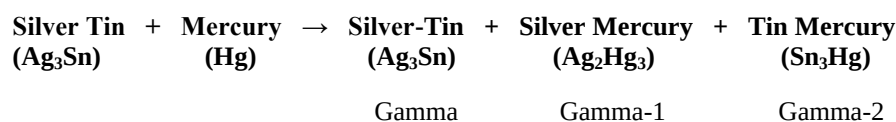
- Linings: coating of minimal thickness to provide a therapeutic effect (e.g. calcium hydroxide or glass ionomer) that promotes secondary dentin formation.
- Bases: acts to replace missing dentin and to block undercuts in indirect restorations
- Management of deep preparations: use Vitrebond as liner if all carious tooth structure is removed, but if some remains, do an indirect pulp cap procedure

- i. Indirect pulp cap - done when radiographs show deep caries that encroach on pulp, and there is no history of pulpal pain. Caries excavation is done to remove soft dentin, but leaving a thin layer of demineralized dentin just prior to reaching the pulp, then use calcium hydroxide with glass ionomer over top
- ii. Direct pulp cap - done when mechanical exposure of the pulp occurs, without bacterial contamination - use calcium hydroxide with glass ionomer over top. Increased bleeding, bacteria, or patient age may lower likelihood of success

Direct Restorative Materials

Silver Amalgam

- **Definition:** dental amalgam is a mixture of silver alloy and mercury. The silver alloy originally used by G.V. Black contained primarily silver and tin with 2-4 wt % of copper and small amounts of zinc; however, current dental amalgam contains higher proportions of copper (13-30 wt %) and are typically zinc-free.
- **Classification** (Based on 3 different factors) of dental amalgam:
 - Based on Particle Size and Geometry: particle size significantly influences the setting reaction of the amalgam and each type requires specific manipulation
 - *Lathe cut/ irregular shaped* – the original amalgam used in the 1830's used silver filings from coins and hence had irregular shapes. Requires more force than spherical particles during condensation to prevent voids.
 - *Spherical* – This shape generally requires less mercury and sets faster than amalgam containing irregular shapes, but some feel it has greater margin leakage and more frequent post-op sensitivity.
 - *Admixed* – combination of irregular and spherical shapes. Also requires more force to condense than spherical particles
 - Based on Copper Content
 - *Low copper* – considered inferior to high copper
 - *High copper* – these are the more “current” dental amalgams
 - Based on Zinc Content
 - *Zinc containing* – has >0.01% zinc content
 - *Zinc free* – has <0.01% zinc content
- **Composition**
 - *Silver* – makes up the majority of the alloy. Gives strength and corrosion resistance, but is a source of expansion in the amalgam.
 - *Tin* – reduces the setting expansion but also lowers the strength and corrosion resistance.
 - *Copper* – inhibits corrosion and helps to eliminate the detrimental gamma-2 phase of the amalgamation reaction.
 - *Zinc* – inhibits oxide formation but increases expansion if it contacts moisture
- **Amalgamation** – the alloy particles dissolve in the liquid mercury and then a reaction between the alloy and mercury begins to harden the mixture. The hardening occurs before all the alloy can be dissolved; therefore unreacted particles exist in the material.



- *Gamma phase* – this is the unreacted alloy, which constitutes ~30% of the set amalgam. This part of the amalgam gives the most strength to the material.

- *Gamma-1* – is the matrix for the unreacted alloy and is the second strongest. It comprises ~60% of the set amalgam
- *Gamma-2* – this is the weakest phase and the most susceptible to corrosion. It makes up about 10% of the amalgam.

*In this book and elsewhere, dental amalgam is often referred to as simply amalgam. Amalgam, by definition, is a material made by mixing an alloy with mercury. It is the authors' opinion that "silver filling" is therefore misleading and "mercury amalgam" redundant. (the "official" name is silver amalgam)

Composite Resin

- **Composition**

- **Resin matrix** – monomers and oligomers (such as Bis-GMA or UDMA) that can be polymerized via chemical or light-induced activation.
- **Inorganic filler** – quartz, lithium, aluminum silicate, barium, strontium, zinc, ytterbium, and colloidal silica have all been used as filler particles.
 - Generally, physical, chemical, and mechanical properties of composites all improve with higher filler content.
 - Increasing the total surface area of filler particles within a composite decreases the fluidity of that composite to the point of unusable. So larger particles have a relatively low surface area per volume, making it easier to create composites with higher filler content (thus better properties) before the material becomes too viscous. The problem is that composites with larger particles do not polish well. Smaller particle polish better than larger particles but have diminished properties.
 - New manufacturing techniques (Sol-gel processing and nanotechnology) will enable the creation of a whole new range of composite materials that do not follow the rules described above.
- **Silane coupling agent** – form bond between inorganic filler and resin matrix.
- **Initiator** of the polymerization reaction
 - **VLC** – relies on camphoroquinone photoinitiator that activates polymerization when exposed to light around 474nm (blue). Light cannot penetrate more than 1.5-2mm – need incremental placement to ensure complete cure.
 - **Self cure** – use an organic peroxide initiator and an amine accelerator.
 - **Dual cure** – a combination of both light and self curing, where light starts the reaction and the self cure component drives it to completion.

- **Classification** – has not been uniform throughout the evolution of composites.

- Particle size
 - Macrofill (10-100 μm)
 - Midifill (1-10 μm)
 - Minifill (0.1-1 μm)
 - Microfill (0.01-0.1 μm)
 - Nanofill (0.001-0.01 μm)
 - Hybrids – composites made from more than one range of particle sizes in an attempt to circumvent the viscosity problem
 - Midi-micro
 - Mini-micro
 - Mini-nano

- **Polymerization Reaction**

- **Polymerization shrinkage** – the more resin (less filler) in a composite, the more that composite will shrink (e.g. flowable shrinks more than hybrid composite).

- **C- factor** – is the ratio of bound to unbound surfaces in an uncured composite. A higher c-factor means that the composite material is touching more walls. When composite is bonded to more walls, higher internal stress (bad) is produced than if the composite was bonded to fewer. So, in order to create a great composite, place many small increments and only bond to 2-3 walls at a time.

- Overview of Bonding

• Definitions:

- *Surface energy* - Extra energy that atoms or molecules on the surface of a substance have over those in the interior. The units are erg/cm^2
- *Wetting* – The spreading of a liquid drop on the surface of a solid
- *Adsorption* – The uptake of one substance at the surface of another (absorption involves the penetration of one substance into the interior of another)
- *Adhesion* - Surface attachment of two materials in contact that resists the forces of separation (cohesion is the bonding within a single material)
- *Enamel adhesion.* Application of 35% to 50% phosphoric acid to enamel results in the selective demineralization of the ends of exposed enamel rods. This acid-etch technique produces an enamel surface with high energy and increased area. The high surface energy promotes efficient wetting by hydrophobic resins, resulting in the formation of resin tags. Mechanical bonding is thus established via the interlocking of these resin tags and the etched enamel surface.
- *Dentin adhesion.* Bonding to dentin requires the use of hydrophilic primers. The first step in dentin bonding is conditioning the surface, which consists of the application of acids to dissolve the smear layer, open dentinal tubules, and partially decalcify dentin. The optimal depth of decalcification is $\sim 5\mu\text{m}$. Following the acid step, a hydrophilic primer is applied to the dentin surface. The primer penetrates into both dentinal tubules and decalcified dentin, and acts as a coupling agent by stabilizing collagen and allowing the penetration of bonding resins (adhesives). This layer of dentin into which resin has penetrated is called the hybrid layer. Excessive etching results in a layer of decalcified dentin below the hybrid layer, which weakens resin bonding. Also, excessively drying dentin results in a desiccated surface collagen layer, this collapses and reduces diffusion of the primer.
- **Components** – All bonding systems contain the same 3 components; however, different generations/products employ these components in very different ways (e.g. multiple steps vs. 1 step systems). Example: Optibond
- **Etchant**
 - Total Etch/ Etch and Rinse Technique – etch step is done with 37% phosphoric acid in solution or gel prior to prime/bond steps. This method removes the smear layer caused by cutting tooth structure
 - Self Etch – a bonding system that utilize acidic primers/adhesives, eliminating a separate etching step with phosphoric acid. This modifies, but does not remove, the smear layer.
- **Primer** - The primer penetrates into both dentinal tubules and decalcified dentin, and acts as a coupling agent by stabilizing collagen and allowing the penetration of bonding resins. Examples: 2-hydroxyethyl methacrylate (2-HEMA) or 4-methacryloxyethyl trimellitate anhydride (4-META).

- **Adhesive** – Unfilled resin. Examples: Bisphenol A glycidyl methacrylate (bis-GMA) or urethane dimethacrylate (UDMA) monomers. Curing of the resin is done via auto-cure or visible light or both (dual cure)
 *Primer/adhesive is usually carried in a solvent such as acetone, alcohol, or water.

Temporary restorative materials

- **Indications**
 - Emergency treatment
 - Temporary coverage between appointments
 - Sensitivity follow up
 - Primary teeth
- **Materials**
 - Glass ionomer (GI)
 - “glass” refers to the glassy ceramic particles and the glassy matrix (non-crystalline) of the set material, while “ionomer” refers to ion-crosslinked polymer.
 - Examples: Fuji Triage (GC), Ketac-Fil (3M), Ketac Silver (3M), Fuji IX (GC)
 - Resin-modified glass ionomer (RMGI)
 - Glass ionomer + resin, Fluoride release, flexible for class V, tooth colored
 - Examples: Fuji II LC (GC), Vitremer (3M-ESPE)
 - Zinc oxide and eugenol (ZOE)
 - Therapeutic effect of eugenol on pulp
 - Examples: IRM (Caulk)
 - Other temporary restorative materials
 - Cavit (3M)
 - Fermit (Ivoclar) – temporary filling used for indirect restorations (inlay, onlay)

Evaluation of Existing Restorations

This is done in a clean, dry, well-lit field. Visual observation, tactile sense with the explorer or floss, or the use of radiographs will allow you to diagnose possible defects in existing restorations and decide the appropriate treatment.

- *Discolored enamel* – a blue hue seen through the enamel of teeth with amalgam restorations that results from leaching of corrosion products of amalgam. The presence of amalgam “blues” does not indicate caries and doesn’t necessitate treatment unless the color is an esthetic concern. But if the discoloration is yellow or brown, there might be secondary caries underneath.
- *Proximal overhangs* – these can create periodontal defects/disease
- *Marginal gap or ditching* – this is a gap between the restorative material and the tooth structure and can arise as the amalgam/composite ages, as a result of recurrent decay, or from erosion of the cement at the margin of an indirect restoration.
- *Fractures*
- *Recurrent caries*
- *Open contacts* – can lead to food impaction and periodontal defects/disease
- *Tight contacts* – may prevent the patient from flossing
- *High Occlusion* – may lead to sensitivity/pulpitis and/or widening of PDL

Operative Procedures

	Indication	Set-up	Procedure
Composite	Clinical Caries (past DEJ)	- Amalgam/composite cassette - Burs: 330, 556, 245, #2, #4, #6 round - Finishing burs - Handpiece cassette - Rubber dam cassette - Bite block - Rubber dam clamp - Punched rubber dam - Anesthetic (local and topical) and needles - Tofflemire bands (consider using palodent matrix system) - Mylar strips - Wedges - Dycal and Vitrebond - Articulating paper - Curing light - Shade guide - Etch - Optibond - Microbrushes - Prisma gloss - Polishing cups - Interproximal sanding strips - Discs (generally class IV only) - Floss	- Review medical and dental history - Quick exam of dentition, confirm plan for operative, select shades and retrieve composite, use articulating paper to mark contacts, call instructor - Anesthetize patient and isolate tooth with rubber dam, clamp, bite block, and floss - Matrix band and wedge if doing interproximal box - Prep tooth with high speed: G.V black vs. minimal prep depends on location and caries extent - Smooth/refine prep with slow speed and hand instruments - Call instructor to check prep - Remove wedge, place Tofflemire or mylar and replace wedge – burnish for class II to improve contact - Pulpal protection if necessary – dycal in deepest location only, then thin layer of vitrebond (light cure) - Etch for 15secs and rinse, lightly air dry - Apply Optibond with microbrush and thin out with air – light cure 20 secs - Place composite (small increments), shape, and light cure after each increment is placed - Remove isolation and use finishing burs, discs, cups, points, or strips to refine restoration - Check occlusion - Call instructor to check fill
Amalgam	Clinical Caries (past DEJ)	- Amalgam cassette - Burs: 330, 556, 245, #2, #4, #6 round - Handpiece cassette - Rubber dam cassette - Bite block - Rubber dam clamp - Punched rubber dam - Anesthetic (local and topical) and Needles - Tofflemire bands - Wedges - Dycal and Vitrebond - Articulating paper - Amalgam capsules - Floss - Curing light (for vitrebond)	- Review medical and dental history - Quick exam of dentition, confirm plan for operative, call instructor to begin - Anesthetize patient and isolate tooth with rubber dam, clamp, bite block, and floss - Wedge if doing interproximal box - Prep tooth with high speed: G.V black - Smooth/refine prep with slow speed and hand instruments - Call instructor to check prep - Remove wedge, place Tofflemire, replace wedge and burnish to improve contact - Pulpal protection if necessary – dycal in deepest location only, then thin layer of vitrebond (light cure) - Mix amalgam (4s) and load carrier - Place amalgam in prep and condense - Use hand instruments to shape anatomy as amalgam hardens - Once moderately hard, remove tofflemire and

			wedge, then smooth interproximal margins - Remove isolation - Check occlusion – NO BITING HARD for 24 hrs - Call instructor to check fill - Optional polish - after 24 hours
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Endodontics

General Concepts

- **Apical foramen** – the most apical opening of the root canal; however, it is not usually located at the anatomic apex of the root.
- **Apical constriction** – the area of the root canal with the smallest diameter, generally 0.5-1.5mm inside the apical foramen, the point most clinicians terminate shaping/obturation.
- **Straight line access** – the ability of a file to approach the apical foramen or first point of canal curvature undeflected.
- **Coronal seal** – using a restorative material (eg 1mm layer of RMGI) to seal the coronal end of the obturated canal or final cementation of post-endo restoration (post and/or core) – “good restoration w/ bad endo is better than bad restoration with good endo”.
- **Smear layer** – debris that accumulates on the walls (and is packed into dentinal tubules) of the root canal as a result of cleaning / shaping, that is 1-5 microns thick and may be contaminated with bacteria. It may interfere with adhesion of sealers and the action of disinfectants, so it is removed before obturation.
- **Working Length** – the distance from the apical constriction to a fixed reference outside the root canal (eg incisal edge or reduced occlusal table).
- **1 appointment RCT** – cleaning/shaping and obturating in same visit – indicated with vital pulp or with necrotic pulp with no periapical pathology (or asymptomatic periapical pathology).
- **2 appointment RCT** – cleaning/shaping in 1 visit, placing calcium hydroxide medicament, then completing obturation in a 2nd visit – indicated for necrotic pulp or with symptomatic periapical pathology.

Endodontic Diagnosis

History	Exam
<i>Triage</i> - Is pain odontogenic or not? • Characteristics of non-odontogenic involvement: episodic pain with pain-free remissions, trigger points, pain that crosses midline, pain that increases with stress, pain that is seasonal or cyclic, paresthesias. <i>Medical history</i> - The only systemic contraindications to endo are uncontrolled diabetes or recent MI. - Is medical consult or pre-medication necessary? <i>Dental history</i> - Location: “Point to the area that hurts / feels swollen?” • The ability to localize pain may suggest that the inflammation has spread past the apex. • Pain may radiate to preauricular area, neck, or temple. Posterior molars may refer pain to opposing quadrant. Odontogenic pain rarely refers to the contralateral side - Chronology: mode, periodicity, frequency, duration	- Extra-oral: swellings, asymmetry, fistulas - Intra-oral: general assessment of oral hygiene, amount and quality of existing restorations, caries, discolored teeth, wear facets, health of periodontium, soft tissue swellings or sinus tracts - Palpation: note swellings / tenderness / mobility that may suggest periradicular inflammation - Percussion: may suggest periradicular inflammation - Bite stick/tooth sleuth: pain on release suggests fracture - Radiographs: used to detect periapical pathology, or tracing a sinus tract with gutta percha for localization of involved tooth. Usually useless for pulpitis - Probing: localized deep pocket may suggest vertical root fracture - Mobility: correlated with extent of inflammation in PDL - Vitality testing: cold, heat or EPT. Positive response does not necessarily indicate health, only presence of vital sensory fibers within pulp.

- Quality • Dull and throbbing (vascular origin) vs. sharp and stabbing (nerve origin) - Intensity	
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Pulpal Diagnoses

	AAE Recommended Diagnostic Terminology	Clinical Findings	Radiographic Findings	Treatment
Normal	A clinical diagnostic category in which the pulp is symptom free and normally responsive to pulp testing.	- Vital pulp - Asymptomatic	- Normal lamina dura	- None indicated - May want RCT for prosthetic reasons
Reversible Pulpitis	A clinical diagnosis based on subjective and objective findings indicating that the inflammation should resolve and the pulp return to normal.	- Vital pulp w/ some degree of inflammation - Hot/cold sensitivity - Pain subsides when stimulus is removed - No carious pulp exposure	- Normal lamina dura	- Remove etiologic factor - If etiologic factor was caries or a deep restoration, place ZOE for 4-6 weeks and re-eval - May want RCT for prosthetic reasons
Symptomatic Irreversible Pulpitis	A clinical diagnosis based on subjective and objective findings indicating that the vital inflamed pulp is incapable of healing. Additional descriptors: lingering thermal pain, spontaneous pain, referred pain.	- Vital pulp with severe degree of inflammation - Hot/cold sensitivity - Pain lingers after stimulus is removed - Possible spontaneous pain, especially at night	- Most will appear normal, but few may have thickened apical lamina dura	- Emergency pulpectomy or RCT - 1 appt RCT OK
Asymptomatic Irreversible Pulpitis	A clinical diagnosis based on subjective and objective findings indicating that the vital inflamed pulp is incapable of healing. Additional descriptors: no clinical symptoms but inflammation produced by caries, caries excavation, trauma.	- Hyperplastic Pulpitis (“Pulp Polyp”) in young broken down teeth	- Heavily decayed tooth with large coronal pulp	- Curette granulation tissue and RCT or extract
		- Internal resorption - Usually asymptomatic	- Irregularly enlarged pulp canal or chamber.	- Prompt endodontic tx and fill with CaOH
Necrotic Pulp	A clinical diagnostic category indicating death of the dental pulp. The pulp is usually non-responsive to pulp testing.	- Non-vital pulp	- May or may not have periapical lesion	- RCT - 2 appt RCT recommended
Previously Treated	A clinical diagnostic category indicating that the tooth has been	- Access hole or full coverage restoration	- Root canals filled with radiopaque material	- Endo consult if concerning clinical signs, symptoms or

	endodontically treated and the canals are obturated with various filling materials other than intracanal medicaments.		- May or may not have periapical lesion	radiographic evidence.
Previously Initiated Therapy	A clinical diagnostic category indicating that the tooth has been previously treated by partial endodontic therapy (eg. Pulpotomy, pulpectomy).	- Access hole filled with cotton pellet and temporary material	- Root canals empty (can't differentiate from normal) - May or may not have periapical lesion	- Endo consult - Finish cleaning and shaping and obturate.

Periradicular Diagnoses

	AAE Recommended Diagnostic Terminology	Clinical Findings	Radiographic Findings	Treatment
Normal	Teeth with normal periradicular tissues that are not sensitive to percussion or palpation testing. The lamina dura surrounding the root is intact, and the PDL space is uniform.	- Asymptomatic	- Normal PDL space	- None
Acute Apical Periodontitis “Symptomatic Apical Periodontitis”	Inflammation, usually of the apical periodontium, producing clinical symptoms including a painful response to biting and/or percussion or palpation. It might or might not be associated with an apical radiolucent area.	- Painful apical inflammation → pain to palpation/percussion - Pulp may be vital or necrotic	- Minimal or no radiographic changes	- If pulp vital, may just need occlusal adjustment. - If pulp non-vital, 2 visit RCT indicated to prevent progression to acute apical abscess
Chronic Apical Periodontitis “Asymptomatic Apical Periodontitis”	Inflammation and destruction of apical periodontium that is of pulpal origin, appears as an apical radiolucent area, and does not produce clinical symptoms.	- Longstanding asymptomatic destruction of periradicular tissues by bacterial products released from necrotic pulp. - Acute flare up may occur (“Phoenix abscess”) - Pulp necrotic	- Periapical radiolucency (this is a periapical granuloma or cyst)	- RCT - 2 appt RCT recommended
Acute Apical Abscess	An inflammatory reaction to pulpal infection and necrosis characterized by rapid onset, spontaneous pain, tenderness of the	- Rapid onset of purulent exudates around apex → swelling, pain to palpation/percussion - Develops from acute or chronic periradicular	- May or may not have periapical radiolucency (if present called phoenix abscess because it developed	- Emergency pulpectomy or RCT - 2 appt RCT recommended

	tooth to pressure, pus formation, and swelling of associated tissues.	- periodontitis - May progress to cellulitis or osteomyelitis, and be accompanied by systemic sx like fever and malaise - Pulp necrotic	- from chronic apical periodontitis) - Normal or thickened apical lamina dura	
Suppurative Periradicular Periodontitis “Chronic Apical Abscess”	An inflammatory reaction to pulpal infection and necrosis characterized by gradual onset, little or no discomfort, and the intermittent discharge of pus through an associated sinus tract.	- Longstanding asymptomatic destruction of periradicular tissues by bacterial infection of periradicular area - Presence of sinus tract or drainage route - May progress to osteomyelitis - Pulp necrotic	- Periapical radiolucency (this is a periradicular abscess) - Sinus tract traces to involved tooth (use gutta percha to trace and take radiograph)	- RCT; sinus tract resolves spontaneously - 2 visit RCT recommended
Chronic Focal Sclerosing Osteomyelitis “Condensing Osteitis”	Diffuse radiopaque lesion representing a localized bony reaction to a low-grade inflammatory stimulus, usually seen at the apex of the tooth.	- Asymptomatic bone mineralization around apex of vital tooth that may be caused by low grade pulp irritation - Pulp vital	- Radiopacity around periapical region	- If reversible pulpitis: no RCT, remove irritant - If irreversible pulpitis: RCT - 1 visit RCT OK

*The diagnoses in quotes are the “new” AAE diagnostic terms, so try to use them. However, most texts still use the old diagnostic terms. Also, the trend is towards saying periradicular instead of periapical, but most endodontists and textbooks still say periapical.

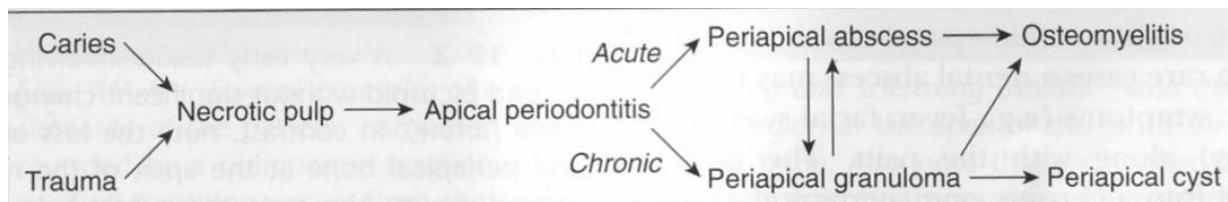


FIG. 19-1 Interrelationship of possible results of periapical inflammation.

Cracked/ Fractured Teeth

Definitions

- **Craze lines:** Cracks in the enamel, but not into the dentin. Extremely common and no treatment necessary unless a cosmetic issue
- **Infraction:** cracks in the enamel caused specifically by dental trauma (See Pediatric Dentistry).
- **Fractures:**

	Fractured Cusp	Cracked Tooth	Split Tooth	Vertical Root Fracture
Location	Crown only	Crown and root (depth of extension varies)	Crown and root (completely)	Root only
Direction	Oblique	Mesiodistally (impossible to see on radiograph)	Mesiodistally	Buccolingually (May see J-shaped or teardrop shaped radiolucency around

				root apex radiographically)
Origin	Occlusal surface	Occlusal surface	Occlusal surface	Root apex
Etiology	Increased load or weakened tooth	Increased load or weakened tooth	Increased load or weakened tooth	Excessive endo shaping, endo obturation, or posts all predispose root.
Symptoms	Sharp pain with biting and with cold	Highly variable. Occasional, momentary sharp, poorly localized pain during mastication, difficult to reproduce. May be sensitive to thermal changes. Generally sustaining pain during biting pressures, and increased pain upon release of biting pressures.	Sharp pain with biting	None to slight
Tests	Visible missing cusp	Transillumination Tooth Sleuth	Wedge segments (can separate)	-Generally isolated probing depth present. -Diagnosis confirmed with exploratory surgical flap
Treatment	Restore, generally with cuspal coverage onlay or crown.	If healthy pulp or reversible pulpitis, generally full coverage crown indicated. Leave in temp to make sure pain resolves. If irreversible pulpitis or necrosis, RCT and crown.	Extraction	Extraction, or hemisection in multi-rooted teeth
Prognosis	Very good	Questionable if associated with isolated probing depth, guarded if crack went to floor of pulp chamber.	Hopeless	Hopeless
Prevention	Be conservative with class II preps, and use partial/ full coverage restorations on undermined cusp	Eliminate damaging habits / increased load or use partial / full coverage restorations on undermined cusp	Eliminate damaging habits / increased load or use partial / full coverage restorations on undermined cusp	Minimal root dentin removal during endo or post prep, avoid wedging or threaded posts

Diagnosing Cracked Tooth

- History: painful occlusion (particularly on release of bite), history of trauma, parafunctional habits, diet (eg chewing ice, popcorn seeds), presence of a threaded post.

- Clinical exam: visible crack, movable segments of tooth, isolated increased probing depth, selective pressure on particular cusp with bite stick, multiple sinus tracts, transillumination findings.
- Radiographs: occasionally crack seen, J-shaped radiolucency.

Root Resorption

- External root resorption

- Caused by attachment damage. Periodontal defect.

1. Surface root resorption (SRR)

- Transient, self limiting, reversible.
- Mechanical damage to cementum and disruption of PDL → discontinuous lamina dura.
- Clinically asymptomatic. Pulp is generally vital, repair usually occurs within 14 days.
- No tx indicated.

2. Inflammatory resorption

• Surface inflammatory resorption (IRR)

- Necrotic pulp with bacteria in tubules is the stimulus for continued resorption of dentin after cementum resorbed due to attachment damage. Generally occurs in the apical and lateral aspects of the root.
- Radiographically looks like moth eaten resorption defects of cementum and dentin.
- Clinically asymptomatic, but PULP is NECROTIC.
- Treatment involves removing pulp and placing and replacing calcium hydroxide medicament to remove bacteria and toxins in dentinal tubules and stop process. This treatment is only sometimes effective in stopping the process.

• Cervical inflammatory resorption (CRR)-

- Results from sulcular infection caused by trauma (ortho, aggressive scaling), non-vital bleaching or unknown.
- Radiographically appears as bony defect and radiolucency around cervical area of tooth; may be confused with cervical caries or burnout. If it is located on the buccal or lingual CEJ region, appears as a hazy radiolucency overlapping the well defined pulp chamber (how you can differentiate from internal root resorption).
- Clinically the tooth may look pink and have a crestal bony defect. PULP is generally VITAL or has been RCT treated (not necrotic).
- Treatment involves flapping to expose lesion, surgical removal of granulation tissue and placing glass ionomer restoration.

3. Replacement resorption (ankylosis) (RRR)

- Caused by damage to and disruption of PDL, often after reimplantation of teeth or in some primary teeth. Cementum replaced with bone, then dentin replaced with bone.
- Radiographically loss of lamina dura and fusing of bone and tooth is evident. Often leads to infraocclusion. Located on lateral and apical aspects of root and generally continues until whole root replaced with bone and crown decoronates.

- Clinically, percussion of the tooth produces a high-pitched metallic sound, and the tooth may be in infraocclusion.
- No treatment is indicated or has been shown to stop progression or eventual loss of the tooth.
- Sometimes this is a goal of reimplanting a tooth to allow for a nice implant site later. To encourage ankylosis, before implanting the tooth scrub off all the PDL cells or place the tooth in acid to ensure their death.
- *Most people use RRR and ankylosis interchangeably, but RRR refers to the resorptive process and ankylosis refers to the end result.

- **Internal root resorption**

- Caused by pulp. Root canal defect.
- Pulpal inflammation caused by caries, attrition, cracks, trauma, deep preparations or trauma stimulates odontoclastic cells to resorb dentin inside the tooth. Relatively rare, especially in permanent teeth. Process continues as long as there are vital cells in the pulp.
- Radiographically appears as enlargement of pulp canals or chamber with altered irregular anatomy.
- Clinically, is usually asymptomatic, and picked up on routine radiographs. Tooth tests vital. If the resorption is in the coronal part of the tooth, it may look pink.
- Treatment: prompt endodontic therapy (2 visit) is highly successful in stopping the process, and the tooth has a good prognosis if the resorption is caught early and the defect is small.

Vital Pulp Therapy

- **Indirect pulp cap** – a vital pulp therapy where a thin layer of carious dentin is allowed to remain during the course of cavity preparation (in order to prevent pulp exposure) and the restorative material is placed.
 - Indications: deep carious lesions in teeth with no signs or symptoms of pulpal disease.
 - Clinical: Remove all decay from walls and leave small layer of leathery infected dentin on pulpal floor or axial wall if pulpal exposure likely imminent. Place Calcium hydroxide layer, Vitrebond layer and fill with IRM or GI temporary restoration.
 - Goal: to arrest the carious process and allow reparative dentin formation. After 8-12 weeks (reparative dentin forms at ~1.4um/day), tooth can be re-accessed and the remaining decay can be removed and the definitive restoration placed.
- **Direct pulp cap** – covering a mechanical or traumatic vital pulp exposure with dental material.
 - Indications: small (pinpoint) non-carious pulp exposed <24 hours, asymptomatic or healthy pulp.
 - Clinical: Irrigate with sterile saline and place calcium hydroxide over exposed pulp and restore as planned.
 - Goal: stimulate reparative dentin formation and survival of pulp. Follow up frequently after placing restoration to monitor pulp vitality.
- **Partial pulpotomy (Cvek Pulpotomy)** – the surgical removal of a small portion of coronal pulp to preserve the remaining pulp tissue.
 - Indications: mechanical or traumatic exposure of pulp >24 hours, healthy pulp below pulp chamber, or open apex or young tooth that has large pulp canals or open apex. Doing a full pulpectomy young teeth prevents continued dentin formation, leaving the tooth weaker and prone to fracture.
 - Clinical: Remove only coronal ~2mm of pulp with spoon or round bur.
 - Goal: Maintain vitality and allow continued dentin formation of apical pulp chamber and canals.

- **Pulpotomy** – the surgical removal of the whole coronal portion of the vital pulp to preserve the vitality of the radicular pulp.
 - Indications: vital pulp in immature teeth with carious, mechanical, or traumatic exposures after 72 hrs. No history of spontaneous pain, no abscess, no radiographic bone loss.
 - Clinical: Remove coronal pulp to level of pulp orifices. If primary tooth, use formocresol pellet, fill with IRM and place SSC, if permanent tooth fill with CaOH and restore.
 - Goal: Allow radicular pulpal vitality.
- **Apexogenesis** – the process of maintaining pulp vitality of an open-apex immature tooth during pulp treatment. RCT can be done more effectively once the apex has closed.
 - Indications: an immature tooth prior to completion of root formation with damaged coronal pulp and healthy radicular pulp.
 - Clinical: Remove coronal pulp to canal orifices, rinse with sterile saline and place CaOH or MTA and restorative material. Re-eval often until apex is closed, then most endodontists agree it is best to perform definitive RCT tx.
 - Goals: maintain vitality of radicular pulp to allow complete or continued development of the root, dentin formation and apical closure in open apex teeth

Non-Vital Pulp Therapy

- **Pulpectomy** – Non-vital therapy where all coronal and radicular pulpal tissue is removed.
 - Indications: failed pulpotomy procedures, primary anterior teeth, emergency therapy, 1st stage of 2 stage RCTs.
 - Clinical: Remove all coronal and radicular pulp tissue with hand files, rotary files, etc and clean and shape canals.
 - Goal: remove inflamed or infected pulp. Takes patient with irreversible pulpitis of acute apical periodontitis or abscess out of pain and allow them to start healing.
- **Apexification** – The process of stimulating formation of calcified tissue at the open apex of a non-vital tooth.
 - Indications: for teeth with open apices in which apexogenesis could not be performed successfully
 - Clinical: Remove all coronal and radicular pulp tissue down to open apex and fill with calcium hydroxide or MTA to stimulate mineralization of apex. May need to re-access and replace CaOH or MTA every 3-4 months until barrier formation is complete. Then proceed with standard RCT.

Emergency Therapy

- Endodontic emergencies are usually associated with pain and/or swelling and require immediate diagnosis and treatment. They are usually caused by pathoses in the pulp or periapical tissues. First diagnose the problem properly, determine restorability of the tooth and proceed with treatment after profound anesthesia has been achieved.
- **Irreversible pulpitis w/ no periapical involvement** - complete pulp removal with total cleaning and shaping – either immediately obturate or place medicament (calcium hydroxide) and obturate later, no occlusal reduction, no antibiotics.
- **Irreversible pulpitis w/ acute periapical periodontitis** - complete pulp removal with total cleaning and shaping – place medicament (calcium hydroxide) and obturate later (2 visit). Occlusal reduction indicated, no antibiotics.
- **Necrotic pulp w/ periapical abscess** - complete pulp removal with total cleaning and shaping – place medicament (calcium hydroxide) and obturate later (2 visit). If swelling present and substantial patient may also require surgical IND. Consider prescribing antibiotics.

- **Fracture** – Try to locate crack and determine if tooth is salvageable/restorable. Extract or perform complete pulp removal with total cleaning and shaping – either immediately obturate or place medicament (calcium hydroxide) and obturate later.
- **Avulsion (Permanent teeth)**

Closed Apex	Extraoral Dry Time <60 mins	Aspirate any blood clot and ensure that alveolar walls are undamaged, rinse debris from tooth and gently replant. Flexible splint for 2 weeks. Prescribe antibiotics, generally doxycycline. RCT can occur 2 weeks later.
	Extraoral Dry Time >60 mins	Aspirate any blood clot and ensure that alveolar walls are undamaged, soak tooth in 2% stannous fluoride for 5mins and replant. Splint for 4 weeks. Prescribe antibiotics. CaOH RCT can be done in your hand or 1 week later. Expect ankylosis;
Open Apex	Extraoral Dry Time <60 mins	Aspirate any blood clot and ensure that alveolar wall is undamaged, soak tooth in doxycycline for 5 mins or cover in minocycline (debateable), rinse debris, and replant. Splint for 2 weeks. Avoid endo unless no signs of revascularization. Prescribe antibiotics.
	Extraoral Dry Time >60 mins	Aspirate any blood clot and ensure that alveolar walls are undamaged, soak tooth in 2% stannous fluoride for 5mins and replant. Splint for 4 weeks. Prescribe antibiotics. CaOH RCT can occur in your hand before re-implantation or intraorally 1 weeks later. Expect ankylosis. Consider no reimplantation.

*Antibiotics of choice: Doxycycline (if >12yo) or Penicillin V for 7 days

*Always check tetanus vaccine

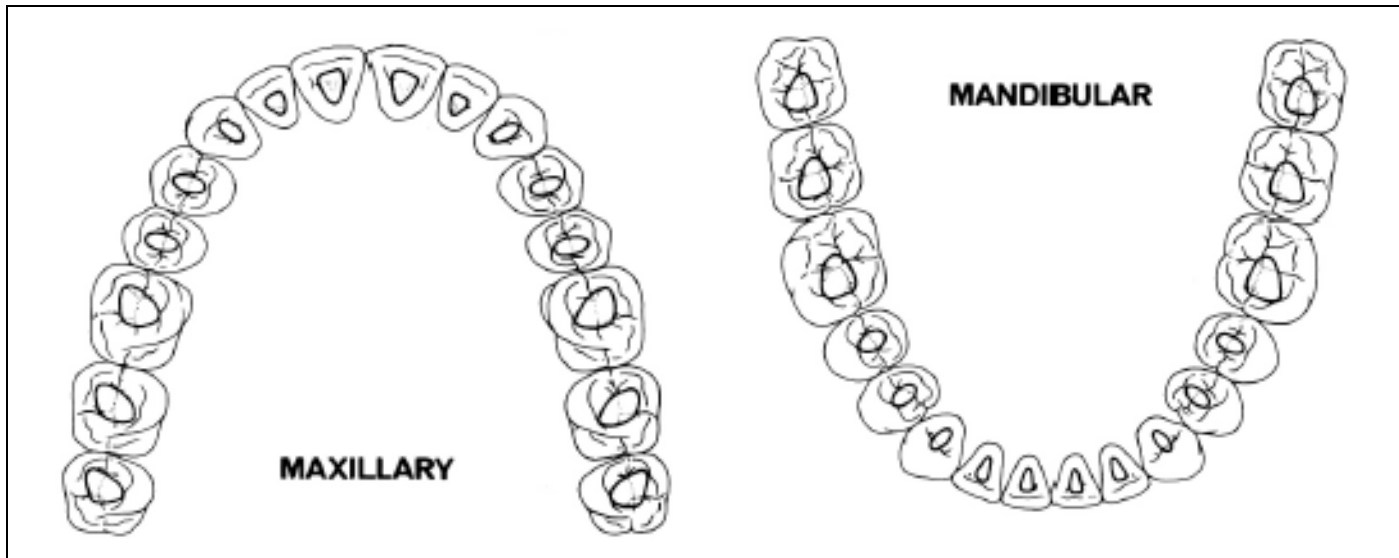
Endodontic-Periodontic Combined Lesions

1. Primary endo
 - Pulp test negative – non-vital
 - Drainage may be present
 - Tx: endo only
2. Primary perio
 - Pulp vital
 - Poor oral hygiene with plaque and calculus
 - Periodontal pockets (possible BOP)
 - Possible mobility or fremitus
 - Tx: perio tx (usually S/RP first)
3. Primary endo with secondary perio
 - Pulp test negative – non-vital
 - Long standing pulp disease with drainage to or near the sulcus
 - Attachment loss
 - Radiographs show generalized periodontitis with angular defects at affected tooth
 - Tx: endo first then perio tx
4. Primary perio with secondary endo
 - Deep pockets with long standing history poor hygiene and perio dx
 - Attachment loss (extending to lateral canals or apex)
 - Differs from the reverse only in the sequence of disease processes
 - Tx: endo first then perio tx
5. True combined
 - Pulpally induced periradicular lesion occurring at the same time as perio disease
 - Tx: endo first, then perio if tooth is restorable.

Principles of Access Opening

- Proper access preparation is the most important and technically difficult phase of RCT.
- Objectives

- Straight-line access
- Conservation of tooth structure
- Unflooding of the chamber to expose orifices and pulp horns



Principles of Cleaning and Shaping

- *Hand Files*: used in clinic
 - Made of stainless steel, generally dispose after single use.
 - Length: available in 21, 25, and 31mm lengths – but all have 16mm cutting blades.
 - Diameter: the tip of the file is called D0 and corresponds to the number on the file. For example a #10 file has a 0.1mm diameter at D0. Each diameter is color coded.
 - Taper: hand files have a standard taper of 0.02mm (or #0.02 taper) – this means that for every 1mm away from the tip (D0) the diameter of the file increases by 0.02mm. The diameter of a No 10 0.02 taper file at D16 is 0.42mm ($0.10 + 16 \times 0.02$)
 - Considerations: hand files should be pre-bent and lubricated prior to use.
- *Rotary Files*: used by post-docs; generally not available in clinic
 - Made of Nickel-Titanium, which is 3 times more flexible than stainless steel but have increased risk of fracture. Generally sterilize after use.
 - Length: some brands include 19mm files in addition to 21, 25, and 31mm lengths.
 - Taper: can have a file with constant taper (0.02, 0.04, and 0.06) or increasing taper.
 - Selected Brands:

ProFile	- First rotary files to be developed (Dentsply) - Available in 0.02, 0.04, and 0.06 tapers
ProTaper	- Designed by Cliff Ruddle - Only uses 6 files: 3 shaping files (SX, S1, S2) and 3 finishing files (F1, F2, F3) - The taper of each file varies along the long axis of the instrument - Shown to be quicker but increased frequency irregular preparations
RaCe	- Made by Brasseler USA* - Available in 0.02, 0.04, and 0.06 tapers

*Brasseler also makes other files, such as EndoSequence by Real World Endo (Ken Koch)

- *Step Back Technique*

- Flare orifice with Gates-Gliddon burs (irrigate well to avoid debris blockage), determine length with apex locator then clean and shape at the working length from #8-10 file to #30-40. The last file is your master apical file (MAF). Now you clean and shape by stepping back 5 times in 1mm increments, while increasing file size. Finally, take your MAF file and smooth the walls and take PA. For example: if your MAF is #30, then you use the #35 1mm back from working length, #40 2mm back, #45 3mm back, #50 4mm back and #55 5mm back and then use the #30 again to smooth the canal.
- *Crown Down Technique*
 - Use this technique with rotary instruments
 - Each procedure will vary with the type of rotary system used, but the general idea is to begin by flaring the orifice then cleaning and shaping with larger files then moving down in file size as you proceed toward the working length.

Principles of Obturation

- *Tug-Back* – the sensation that the master cone has resistance to displacement in the canal when seated to length and pulled coronally. We want tug-back!
- *Length* – We want the cone to sit 0.5mm short of the radiographic apex (highly debated)
- *A Few Methods:*
 - a. **Cold Lateral** – Place a standardized master cone dipped in sealer with a diameter consistent with that of the MAF (available in 0.02, 0.04, and 0.06 taper), then use spreader to create space to insert accessory cones until the spreader no longer goes beyond the coronal 1/3rd. Remove excess gutta percha with Touch-n-Heat and compacted with plugger to <1mm below the orifice. This is the most common technique used in clinic.
 - b. **Warm Lateral** – same procedure as the cold lateral; however, this system requires the Endotec II heating device. The tip is heated and inserted beside the master cone 2-4mm from apex, then rotated for 5-8 seconds and removed cold. An unheated spreader is then inserted and an accessory cone placed. Generally not used in clinic.
 - c. **Warm Vertical** - Place a standardized master cone dipped in sealer with a diameter consistent with that of the MAF (available in 0.02, 0.04, and 0.06 taper), then use the Touch-n-Heat to remove all but the apical third of gutta percha and use plugger to condense. If you need a post space, now you have one. If not, you can either back fill with thermoplastic injection (see below) or insert 3-4mm segments of gutta percha into the canal, while heating and condensing until filled to <1mm from orifice. This is a common technique used by endodontists.
 - d. **Thermoplastic Injection:**
 - Obtura II – consists of a hand-held gun that heats gutta percha pellets and injects it into the canal. Often used in a hybrid technique with one of those listed above to avoid ejecting gutta percha out the apex
 - e. **Carrier Based Gutta Percha:**
 - Thermafil – gutta percha fill with a solid plastic core that is heated and placed in canal. System often used by GPs, makes re-treatment difficult. Not available in clinic.

Endodontic Procedures

	Set up	Procedure
RCT	- Endo cassette - Handpiece - Endo Burs and endo ring (you provide these!) - Apex locator - Apex locator attachments - Touch-n-heat - Hand Files #6-60 (load into finger holder foam) - Finger spreaders - Endo Sealer - Master cones or wheel - Accessory cones - RC prep - 1-2.5% hypochlorite (mix bleach with water in Dixie cup 1:1) - Syringe w/ side vent needle for irrigation - Fuji Triage - Cotton pellets - UltraCal (CaOH) and tip - Endo rubber dam (punch a very large/multiple holes) - Rubber dam clamp kit - Anesthesia and needle	<i>Pre-Appointment</i> - Sign up on back wall in advance to let endo post doc know you are doing RCT. It is best to make sure there is endo coverage before you schedule a RCT and possible contact the resident or faculty directly <i>Appointment 1: Pulpectomy</i> - Review medical and dental history - Diagnostic radiograph: note depth of chamber roof - Quick exam of dentition: palpation, percussion, perio probe, confirm plan for endo, call instructor - Anesthetize tooth to be treated profoundly & isolate w/ rubber dam/clamp - Remove caries and defective permanent restorations - Create initial outline using round bur or 556, penetrate pulp chamber roof, check for ledges and smooth with safe end bur - Amputate coronal pulp and irrigate with NaOCl - Identify all canal orifices with endo explorer and hand files - Determine straight line access and working length with #8 or #10 file and apex locator - Take radiograph to confirm working length (WL) with #15 file - Clean and shape at WL using #10 file, #15, #20, #25, and #30 – use RC prep on every file (pre-bend) and irrigate between every file with NaOCl - Flare orifice with Gates-Glidden burs (4,3,2) after canal has been enlarged to at least #20 file, go a little deeper with each bur (1/4 of canal, 1/3 of canal, 1/2 canal) until you feel resistance. Irrigate after each instrument and re-introduce #20 file to ensure that you didn't ledge the canal. Enlarge canal away from the furcation in posterior teeth to decrease the chance of strip perforation. - Step back: if WL was #30 file at 19mm then "step-back" to #35 file and 18 mm. Then use master file size or smaller for recapitulation. Irrigate. - Continue step back until smooth taper is reached, approx 5 mm - If 2 visit RCT, insert UltraCal tip into canal 2-3mm short of apex and inject, pulling back as you fill - Place cotton pellet over orifice and place Fuji Triage over top <i>Appointment 2: Obturation</i> - Get new start check and achieve profound anesthesia - Remove Fuji triage and cotton pellet – irrigate and suction canal to remove calcium hydroxide. Dry with paper points. - Select master cone to match MAF – want tug back! Take radiograph to confirm location of the cone ~0.5mm short of the tooth apex. - Apply sealer to master cone and insert. - Insert spreader and rotate – quickly remove and place accessory cone (with sealer on every third cone) – repeat until spreader doesn't go past coronal 1/3rd of canal. - Sear off excess gutta percha with Touch-n-Heat and use pluggers to condense GP to the level of the CEJ - Take final xray - Place cotton pellet and fill with temp material OR place vitrebond layer over orifice(s) and place core or final composite restoration if anterior.

*Complete 1 appointment endo by going right from cleaning and shaping to obturation

Prosthodontics

General concepts

- **Direct restoration** – a restoration made in the tooth (eg amalgam) – *See Operative Section*
- **Indirect restoration** – a restoration made in the lab, corresponding to the form of a previously prepared tooth (eg inlays, onlays, crowns)
- **Retention** – the ability to resist dislodgement along the path of insertion (vertical)
- **Resistance** – the ability to resist dislodgement in any direction other than the path of insertion
- **Ferrule** – a metal band or ring used for strength – in dentistry, a protective “ferrule effect” occurs when the restoration embraces 2mm of sound tooth structure.
- **Biologic width** – the combined width of CT and junctional epithelial attachment formed adjacent to a tooth and superior to crestal bone – should be >2mm from bone height to margin; violation will cause inflammation and bone resorption
- **Crown-root ratio** – the relation of the amount of tooth within bone to the amount not in bone (including any restorations). Optimal crown-root ratio for single crowns and FPD abutments is 2:3, but 1:1 is ok under normal loading conditions.
- **Ante’s Law** – in fixed partial, the accepted (although not proven) recommendation that the total surface area of root surface for abutment teeth be equal or greater than the amount of total root surface to be replaced by pontics

Specific Materials in Prosthodontics

- Gypsum materials

Gypsum	ADA Type	Notes
Impression Plaster	I	- Differs from model plaster in that it sets in 3-5mins - Typically used only to mount casts
Model Plaster	II	- Used for study models that do not need abrasion resistance
Orthodontic Plaster	N/A	- This is a mix of model plaster and dental stone
Dental Stone	III	- Used for study models that require abrasion resistance - Comes as either white or yellow powder
High strength – low expansion stone (Die Stone)	IV	- Used for FPD models - Comes as a blue/violet powder
High strength – high expansion stone	V	- Used as investment materials during casting

*All gypsum products are made from $2 \text{ CaSO}_4 + 2 \text{ H}_2\text{O}$ (calcium sulfate hemihydrate). The difference between them is the physical form (size and shape) of the gypsum crystals, not the chemical composition.

- Waxes

	Type	Notes
Pattern Waxes	Inlay wax	- Used to fabricate wax patterns for crowns/bridges/inlays/onlays
	Casting wax	- Used to form metal framework of RPD
	Baseplate wax	- Pink wax used in complete denture
Processing Waxes	Boxing wax	- Red strip wax used to box complete denture impressions

	Rope wax	- White/clear wax used in numerous capacities: extension of tray during impression taking, block out undercuts intraorally, etc.
	Sticky wax	- Used to tack dental components together temporarily (e.g. hold teeth in place on a model during interim partial denture fabrication/ aka “flipper”)

- **Metals and Metal Alloys**

- Metals – Metals used in prosthodontic fixtures are subdivided into noble metals and base metals.
 - Noble metals - have a high resistance to corrosion, and are rare, which makes them expensive. There are 7 noble metals in the periodic table, but only 3 are used commonly in dentistry: gold (Au), palladium (Pd), and platinum (Pt).
 - Base metals – all the metals that are not noble metals, which in dentistry includes titanium, nickel, chromium, cobalt, copper, silver, zinc, and many others.
- Alloy – A mixture of elemental metals to create a compound with desirable properties when applied to dentistry. For example, a “gold crown” is commonly made of an alloy that is composed of 75% Gold, 10% Silver, 10% Copper, 3% Palladium, and 2% Zinc.
- Important Properties of Dental Alloys:
 - Melting Range – alloys must be able to be heated to a liquid state to allow casting
 - Density – high density alloys (high noble) are generally easier to cast
 - Strength – yield strength (resistance to deformation) is most commonly used to compare alloys, and is influenced by both the composition of the alloy and manufacturing techniques (e.g. heat treatment).
 - Hardness – a measure of how difficult it is to dent or polish an alloy, base metals are generally the hardest.
 - Corrosion Resistance - corrosion from oxidation leads to color contamination and decreased bond strength

	Noble Metal Content	Gold Content	Notes	Examples	Uses
High Noble	>60%	>40%	- Expensive - High corrosion resistance - Other elements added to increase strength	Au-Pt-Zn	- All-metal crowns - Ceramometal crowns
				Au-Pd-Ag	- All-metal crowns - Ceramometal crowns
				Au-Cu-Ag	- All-metal crowns
Noble	>25%	Not Required	- More affordable - Other properties vary significantly depending on exact composition	Au-Ag-Cu	- All-metal crowns
				Pd-Cu	- All-metal crowns - Ceramometal crowns
				Ag-Pd	- All-metal crowns - Ceramometal crowns
Base	<25% <25%	Not Required	- Highest yield strength - Hardest/ most difficult to polish - High corrosion	Ni-Cr	- All-metal crowns - Ceramometal crowns - Partial denture framework - Wrought wire
				Co-Cr	- All-metal crowns - Ceramometal crowns - Partial denture framework - Wrought wire

- **Acrylics** – a major class of polymers used in prosthodontics, used to make complete dentures, denture teeth, custom trays, composites, bonding agents and temporary crowns. Methyl methacrylate is a common example of this group found in dentures and temporary crowns, which when polymerized, forms polymethyl methacrylate (PMMA). Acrylics polymerize via free radical addition and form no byproducts during the reaction; however, there is significant shrinkage and heat production (exothermic) upon setting.
 - **Components of Acrylic Polymers** – not all are found in every application
 - *Initiator* (sources of free radicals)
 - Heat cure – benzoyl peroxide, heated to >74 C creates free radicals
 - Self cure – reaction between benzoyl peroxide and an aromatic amine (N,N-dihydroxyethyl-para-toluidine) creates free radicals at room temp
 - Light cure – camphorquinone will form free radicals when exposed to blue light (~ 462-474 nm)
 - *Cross-linking agent* – improves strength, temperature resistance, solubility, and the ability to polish the polymer. Different applications require different degrees of cross-linking.
 - *Polymer* – pre-polymerized chains of acrylic (e.g. the bulk of the powder component). The average chain length influences the physical properties of the end polymer – with longer chains generally giving more rigid end polymers.
 - *Monomer* – free monomer (e.g. the bulk of the liquid component)
 - *Fillers* – particles that sit within the polymer matrix and change the optical or physical properties of the material. (e.g. denture materials can be filled with butadiene-styrene rubber particles to improve fracture resistance while composites are generally filled with glass/silica particles).
 - *Plasticizers* – dissolves into polymer network and modifies the interactions between strands to soften the polymer. (Only used for specific applications)

PMMA (Alike)	Bis-acryl (ProTemp)
Pros -Good marginal fit -Good transverse strength -Good polishability -Durability -Color Stable -Can be modified/relined/added to	Pros -Good marginal fit -Good transverse strength -Good abrasion resistance -Low shrinkage -Low exothermic heat increase
Cons -High exothermic heat increase -Low abrasion resistance -Free monomer is toxic to the pulp -High volumetric shrinkage	Cons -Poor surface hardness -Less stain resistance -Limited shade selection -Limited polishability -Brittle

Mandibular Movement and Occlusion

- Definitions
 - Centric Relation (CR) – condyles in the most anterior superior position along the articular eminence of the glenoid fossa and the articular disc interposed.
 - Centric Occlusion (CO) - occlusion of teeth when mandible is in centric relation position. Ideally, CO is the same as maximal intercuspation (MI), however, in 90% of the population, MI and CO do not coincide.
 - Canine Guidance – upon lateral excursion, the canines are the only teeth that contact on the working side.
 - Group Function – upon lateral excursion, there are more working side contacts than just the canines.
- Mandibular Movements (TMJ is a Class III Lever)
 - Opening
 - Hinge (rotation) – movement of the TMJ within a 10-13 degree arch, which corresponds to the first 20-25mm of separation between anterior teeth
 - Translation – opening of the anterior teeth >20-25mm, a result of the condyles moving down the articular eminences.
 - Protrusive – this movement is entirely translation, no hinge movement
 - Laterotrusive
 - Working side – the side the mandible moves toward. The condyle shifts laterally (immediate side shift and progressive side shift) and sometimes slightly posteriorly.
 - Nonworking side – the side the mandible moves away from. The condyle on this side moves down the articular eminence.
- Interferences
 - Centric – a premature contact upon closure that leads to deflection of the mandible
 - Non-working – contact between maxillary and mandibular teeth on the nonworking side during lateral movement, believed to be damaging to the masticatory apparatus/TMJ
 - Protrusive – contacts between distal aspects of maxillary posterior teeth and mesial aspects of mandibular posterior teeth during protrusion.

Crowns and Fixed Partial Dentures

Types of Indirect Restorations

- Inlay – an indirect partial coverage restoration used in place of direct restoration (composite, metal, or ceramic)
- Onlay – a cast partial coverage restoration that replaces 1 or more cusps and adjoining occlusal surfaces (composite, metal, or ceramic)
- Crown – a full coverage restoration (all metal, metal ceramic, all-ceramic)
- Maryland Bridge – an artificial tooth with metal wings that are bonded to the lingual surface of adjacent teeth

Principles of Single Crown Preparation

- Is tooth restorable? Existing restorations, fractures, caries, ferrule, biologic width
- Taper and Total occlusal convergence – more parallel means more retention and resistance
 - Taper is the angulation of 1 wall, ideal is 5-10 degrees
 - Total occlusal convergence (TOC) is the combined angulation of 2 opposing walls, ideal range is 10-20 degrees
 - No undercuts!
- Margin
 - Types
 - Knife edge – used with prefab stainless steel crowns (pedo), and with long teeth that have significant gingival recession, eg. at the furcation.
 - Chamfer – used with all-metal, metal ceramic, and some ceramics (LAVA)
 - Modified shoulder – used with metal ceramic and all ceramic crowns
 - Shoulder – should only be used with feldspathic ceramic (rare use)
 - Should we bevel? NO, it doesn't help much and makes lab fabrication very hard
- Location of tooth
 - Anterior – goal is ≥ 3 mm of tooth height, second plane of reduction always on labial
 - Posterior – goal is 4mm of tooth height, second plane of reduction always on the outer aspect of the working cusps
- Material selection for crowns
 - All metal – more conservative prep, less abrasive than ceramics, fracture resistance, patient may not like esthetics. Good for bruxers.
 - Metal Ceramic – incorporates esthetics of all ceramic crowns with the mechanical properties of a metal coping
 - All ceramic – varied mechanical properties depending on composition (eg glass infiltrated, alumina, zirconia). Ceramic is much harder than natural teeth - in patient with bruxing habit can lead to fracture and increased wear of opposing teeth.
- Reduction
 - Measurement of axial reduction – there are 2 ways to this practically: 1) the horizontal width of the margin, or 2) the horizontal distance from axial wall to height of contour
 - General guidelines

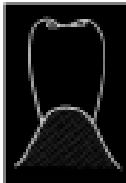
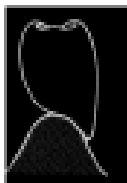
	All metal	Metal ceramic	All ceramic
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Axial / finish line reduction	0.3-0.8mm*	1-2mm*	0.5-1.5mm*
Occlusal	1-1.5mm	2mm	2mm

*These ranges include both methods of measuring axial reduction, hence if you were using method 1 to measure, your reduction should be in the lower half of the range, and in the upper half for measurement method 2.

Principles of Multiple Unit Preparation

- Abutment evaluation
 - Restorative: existing restorations, caries, remaining tooth structure, esthetics
 - Perio: furcation, mobility, crown-root ratio, Ante's Law
 - Endo: Pulpal and periapical diagnoses
 - Ortho: tooth position (inclination, supra-eruption), width number of missing teeth, occlusion
 - Path of insertion: goal is to have 1 path for the prostheses, with no relative undercuts
 - Pontic design: some designs better suited for specific clinical situations
 - Occlusion: decide if you want canine-guidance or group function in final restoration
- Pontic designs

Ridge lap/ Saddle	Modified Ridge lap	Stein	Sanitary	Ovate
- Unacceptable: Impossible to clean	- Most commonly used - Hard to clean - Reasonable esthetics	- Designed for thin ridge	- Easiest to clean - Worst esthetics	- Most functional and esthetic - Usually requires surgery
				

Principles of Veneer Preparation

- Preparation design
 - Window – margin comes close but not up to the incisal edge
 - Feather – margin is taken to the height of the incisal edge
 - Bevel – a buccopalatal bevel is taken across the incisal edge
 - Incisal overlap – preparation taken around to the palatal/lingual surface

Color Science

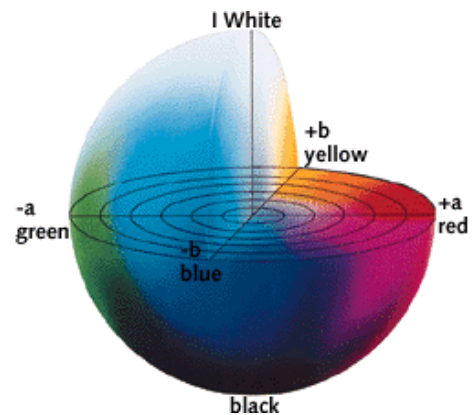
Color matching is one of the more challenging tasks in restorative dentistry. To succeed in this it is helpful to have a basic understanding of color science. Familiarizing yourself with the following definitions would be a good start.

- **Hue:** That aspect of color that causes it to appear as red, green, blue, etc. It is associated with **wavelength**.
- **Chroma:** The amount of hue **saturation**, or purity of a color. High chroma colors look rich and full, whereas low chroma colors look dull and grayish.
- **Value:** A color's **lightness or darkness**; Value is the most important property for tooth color matching. The higher the value, the lighter the color.

The Vita Classic shade guide is the tool we have in clinic for determining color. For this guide, hue is denoted by the letters A (orange), B (yellow), C (yellow – gray), and D (orange – gray, or brown).

Numbers denote value and chroma, with 1 being high value and low chroma, and 4 being low value high chroma. When using this guide, determine value first, then chroma and hue. Do not stare when color matching, since your ability to discriminate colors is diminished as your eyes fatigue. It might be helpful to arrange the shade guide according to value; half close your eyes, and scan for the best match. Through half-closed eyes you are better able to determine value, but your hue discrimination is decreased. Once you have the value you can open your eyes and settle on the best hue. Teeth usually exhibit a gradation of colors from the cervical to the incisal portions, so you may in certain instances find it necessary to report several shades for one tooth. Also report other distinguishing characteristics (fluorosis, craze lines, etc.) as necessary. You should shade match at the beginning of the visit, as color will change if dehydrated (rubber dam) or covered with debris (enamel, metal, restorative materials). To avoid *metamerism* (the phenomenon of an object appearing to be different colors depending on the light source), it is best to match under illumination that has been “color corrected” to emit light with a uniform color distribution. Some recommend natural sunlight when corrected lighting is not available. You can avoid all of these difficulties by using a top-line dental spectrophotometer (Crystaleye, Olympus).

The above definitions of hue, chroma, and value are derived from the **Munsell Color System**. Color systems are used to delineate the color parameters of objects. A different color system, the **CIE L*a*b* Color System**, is often used by dental researchers. This system utilizes the parameters L* (pronounced “L star”), a*, and b* to represent objects’ lightness, redness, and yellowness, respectively. By using a spectrophotometer to measure these parameters, a three-dimensional color space can be described (See picture right).



If the numerical value of each of these parameters is determined for an object, its color can be plotted to a point within the above color space. Within the CIE L*a*b* color system each of the three parameters (or axes of color space) has units that are equal in magnitude; this allows for the determination of the color difference (ΔE) between two objects. Given two objects, each will have a color that lies somewhere in the above color space, and the distance between these two points represents the color difference. A ΔE of less than 3.7 is often quoted as an acceptable shade match in dentistry; however, more recent findings suggest that the gold standard for dental restorations should be closer to 1.7 ΔE .

Crown and FPD Procedures

	Set Up	Procedure
Crown Prep and Temp	- Crown and bridge cassette - Handpiece - Diamond burs - Acrylic burs - Retraction cord - ALIKE (liquid and powder) - Rubber dappen dish - Mixing pad - Tempbond NE - Vaseline - Articulating paper - Putty or a pre-made vacu-form Retraction cord: size #00/0 for most patients. If patient has >4mm probing depth, pack larger size (#1, #2, #3) retraction cord.	- Review medical and dental history, quick exam of dentition, and call instructor to begin - Make 2 putty impression of tooth to be prepped or 1 putty if you have pre-made vacuform, cut one putty buccolinugally for reduction guide - Anesthesia and cotton roll isolation, also put a DRY retraction cord round prep – which allows better visualization (margin should be above cord) - Prep buccal and lingual with modified shoulder diamond, then interproximals with flame diamond. - Then refine entire prep with modified shoulder (green band) then modified shoulder (red band) - Occlusal reduction with modified shoulder or football bur - Check dimensions with putty index and get checked by instructor, if you used a cord, remove it (wet the cord before removal!) once the prep is complete. - Evaluate 1) Crown: prep dimensions, primary/secondary planes, occlusal clearance, margins, resistance and retention form i.e. taper/parallelism, base/height ratio. 2) FPD: single path of insertion. - Lightly Vaseline prep (especially if you did a core build up or have composite materials on prep) and inside of vacuform / impression mold - Mix ALIKE (10 drops liquid then saturate with powder for each crown) and allow to set until doughy (when the stringy-ness starts to disappear) - Place in vacuform/impression and seat on tooth or block temp (mold acrylic into square and push onto tooth then have patient bite down) - As the acrylic sets, carefully remove and re-seat temp in order to avoid locking it on. Learning the timing of acrylic takes a lot of practice, so do this extensively before attempting it in a real patient - Once the acrylic is set, mark the proximal contacts with pencil, and trim the acrylic to general shape of a tooth and hollow the inside to make room to reline – try not to perforate, drastically shorten the margins, or touch the interproximal contacts – try in, it should have loose fit and no high spots - Put 1-2 drops of acrylic inside the temp and nearly saturate with powder (want a little more flow for this part), seat the temp. Just like before – repeatedly remove and re-seat temp as the acrylic sets - Once set, mark proximal contacts and margin with pencil, and precisely trim temp to look like a tooth, careful not to touch the margins or contacts - Seat temp. Evaluate margins and reline as needed. Adjust occlusion. - Go into wet lab and polish temp with pumice or lustershine – careful not to cross contaminate wheels or polishing materials - Dry tooth, dispense Tempbond NE and mix, quickly put dab into the temp and coat walls/margins, seat crown and have patient bite on cotton roll, verify occlusion, and allow to set - Re-check occlusion, remove excess tempbond with explorer and have instructor check temp. - Give patient instructions regarding temp and dismiss

*Final impression may be done on the same day as Prep/Temp, but if there is bleeding or cannot achieve hemostasis, then should wait 1-2 weeks for gingiva/soft tissue healing, then try taking final impression. If do not allow soft tissues to heal, then increase risk of gingival recession. Average recession observed after prep is 0.8-0.9mm.

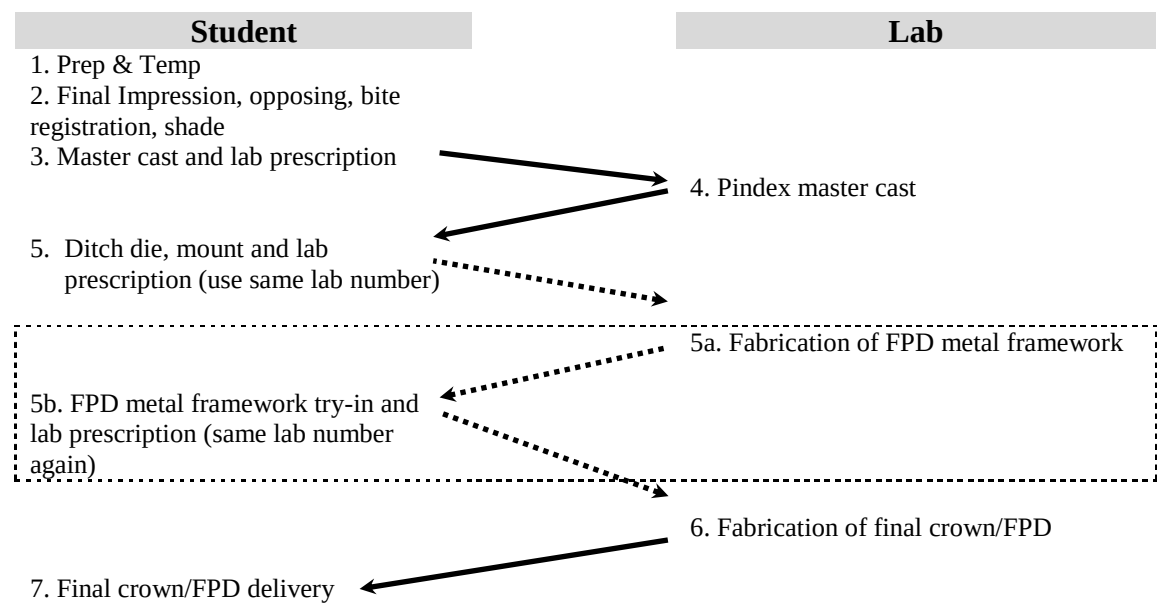
*Hemostasis - retraction cord soaked in Epinephrine (eg use Lidocaine with Epi) or Hemodent. Zinc chloride is a stronger hemostatic agent but caustic to tissues and causes delayed healing.

Crown or FPD Final Impression: *1-step method with 2 cords using PVS	- Crown and bridge cassette - Handpiece - Acrylic burs - Vaseline - Retraction cords (two different sizes, eg. #0 and #1) - Hemodent - Dappen dish - Impression tray - PVS tray adhesive - Regular (or Heavy) body and Light body PVS - Alginate - Mixing bowl, spatula, and measuring cup - Mixing pad - Tempbond - Articulating paper	- Review medical and dental history and call instructor to begin - Anesthetize teeth in question, and if it has a root canal treatment – anesthetize gingiva - Remove temp with hemostat. Remove excess Tempbond by going to the wet lab, put the temp in a baggie with “temporary cement remover” solution and place in ultrasonic cleaner for 10 minutes. - Use stock impression tray and apply PVS adhesive - Soak the cords cut to proper length in Hemodent - Remove smaller cord from the Hemodent and lay around crown of tooth – use plastic instrument or cord packing instrument to push one end of the cord into the sulcus at easiest spot (usually the interproximals), then move slightly forward along the cord - firmly pushing down and outward, then slightly back (toward the part of the cord you already packed) until you encircle the entire prep. Repeat with the larger cord. - Allow the cords to sit for 10 minutes in sulcus - Remove the second cord, then quickly extrude PVS Light body from the gun around the margin (ask instructor how to do this) of the tooth and spray air on it, then add more light body PVS to tooth until covered. Also extrude PVS Light body on the occlusal surfaces of rest of the arch for accuracy of impression. While you are placing the PVS around the tooth, have your assistant load the custom tray with PVS Regular or Heavy body – then seat the custom tray in the mouth, pushing it from back to front with slow steady pressure, and hold in place for at least 4 mins. - Remove impression with one rapid movement - Evaluate the quality of the impression – you want to see a well defined margin with no bubbles and that the impression material did not pull away from tray. Check impression quality with faculty, and if needed, repeat impression. Usually tissues are still retracted and no additional cord packing is necessary. - Remove the first cord (wet cord before removal!) - Make alginate impression of opposing arch, and take a bite registration with “Blue Mousse” material - Cement temp as described above, check occlusion - Take shade - Disinfect impression with spray
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*There are numerous ways to take a final impression. You can use either PVS or Polyether impression material. If you use PVS, you can do a 1-step or a 2-step impression technique. You have the option of doing a 1-cord or 2-cord retraction technique with either material. Floor faculty will differ in their opinions regarding which they would like you to use – each has pros/cons so it is important to learn how to do them all.

Crown/FPD processing

After the final impression, the next steps of crown and FPD fabrication are a collaboration between the student and the lab. First, the student pours up the final impression using die stone and obtains approval of lab prescription from faculty. Then the master cast is sent to the lab for pindexing. The lab returns the pindexed master cast and the student ditches the die (see description below), mounts the casts, obtains approval of lab prescription from faculty and sends die, pindexed mounted master cast and opposing arch, and bite registration back to the lab. The lab fabricates the final crown and sends back to the student for final cementation. If it is an FPD, then there is an intermediate step where the lab first fabricates only the metal framework, sends back to student, the student tries the metal framework for fit and adequate occlusal clearance in the patient's mouth, and sends back to lab for final porcelain addition and baking.



Ditching the die	Die hardener	- Trim die (tooth prep with base) with acrylic bur and blade so that a clean margin is exposed – do not touch margin* – then mark the margin with red/blue pencil - Add die hardener and allow to dry, then one layer of die spacer (staying 1mm away from margin) and let dry, then add second layer of die spacer (staying 2mm away from margin) and let dry *This is a critical step, so ask for help if you need it
	Die spacer	

Crown or FPD Final Cementation	- Crown and bridge cassette - Handpiece - Ketac Cem - Prophy cup/brush - Porcelain/gold polishing burs - Articulating paper - Floss	- BEFORE PATIENT COMES: check shape, color, fit on the die, make sure there are no positive bubbles/ undercuts in the internal surface - WITH PATIENT PRESENT: Review medical and dental history and call instructor to begin - If necessary, anesthetize teeth/gingiva - Remove provisional restoration and clean tooth with prophy cup/brush - Gently try in the crown, if it doesn't seat all the way: first check proximal contacts – and CAREFULLY adjust as needed - Use Fit Checker and remove any excess material or positive bubbles - Once crown has good clinical fit, take radiograph to confirm - Check occlusion and get faculty OK to cement crown - Dry tooth, then use Ketac Cem (activate then 11 secs fast mix) to coat inside of crown. Then gently seat crown until completely seated and have patient bite on cotton roll - After cement is set, remove ALL excess cement with explorer and floss (it may be helpful to apply Vaseline to the outside of the crown to ease cement removal prior to loading the inside with cement) - Re-check margins and occlusion for complete seating - Call instructor to check and instruct patient not to eat for the amount of time specified by manufacturer of the cement
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Post and Core

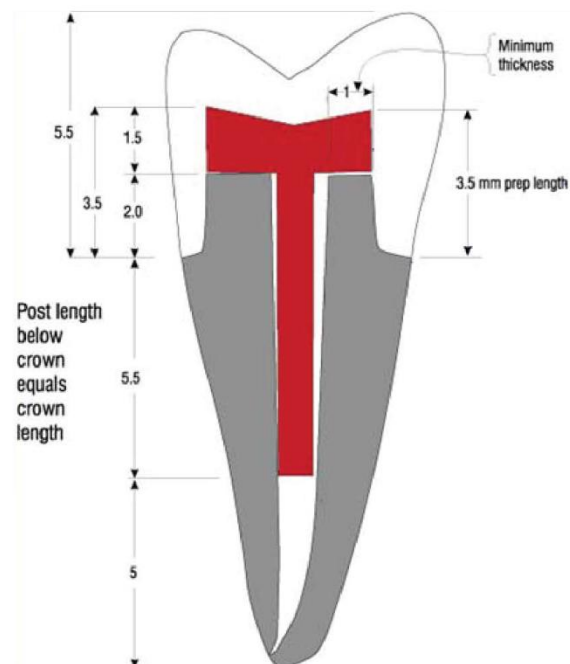
Cores:

- Used to replace coronal tooth structure to improve retention and resistance for the crown and/or provide coronal seal for endo.
- Ideal properties for cores: strength (compressive and flexural), LCTE similar to tooth (to reduce marginal leakage), ease of use, bonds to tooth, minimal absorption of water, inhibits caries
- Types of core materials:

	Pros	Cons	Examples
Gold	- Good strength - LCTE similar to dentin - No water absorption - Easy to distinguish from tooth structure	- Requires post for retention - Requires 2 visits (impression and cementation) - Questionable esthetics with all ceramic crowns	Cast post and core
Amalgam	- Good strength - Resists microleakage - Easy to distinguish from tooth structure	- LCTE is 2x dentin - Can't prep on same day as placement (2 visits) - Questionable esthetics with all ceramic crowns	Tytin (Kerr)
Composite	- Adequate strength - Bonds to dentin - Can prep same day as placement (1 visit) - Good esthetics with all ceramic crowns	- LCTE greater than dentin - Polymerization shrinkage - Absorbs water - Requires controlled filling technique to control shrinkage/prevent voids - Hard to distinguish from tooth	Vit-l-essence
Fiber reinforced Resin	- Easy to use - Good strength - Bonds to dentin - Can be done in 1 visit - Good esthetics with all ceramic crowns	- No published data on clinical performance - LCTE greater than dentin - Polymerization shrinkage - Absorbs water - Requires controlled filling technique to control shrinkage/prevent voids - Hard to distinguish from tooth	Built-It (Pentron) ParaCore (Coltene Whaledent)

Posts:

- Used to improve retention of the core – a post does NOT strengthen the tooth
- General principles of post placement
 - Post width should not exceed $\frac{1}{3}$ rd width of root
 - Need >5mm of gutta percha remaining at apex
 - Post length should not be more than $\frac{2}{3}$ rd length of root or 1.5 times the length of the clinical crown
 - Coronal seal more important than apical seal



- Types of prefabricated passive posts:

Post Material	Pros	Cons	Examples
Metallic	- Easy to use	- Root fractures tend to be more apical – less favorable - Questionable esthetics with all ceramic crowns	ParaPost
Carbon	- LCTE similar to dentin	- Questionable esthetics with all ceramic crowns	Composipost
Fiber	- Flexible - Fractures tend to be coronal – can salvage - Esthetics	- Only short-term success proven	Parapost
Zirconia	- Good esthetics	- Difficult retrieval after failure	

When to Use a Post and Core

- A core is needed when the dimensions of the preparation will not provide adequate retention and resistance
- A post is needed when there is not enough remaining tooth (# of walls) to retain the core
- Wall: defined as the remaining dentin after crown preparation, needs to be >50% vertical height of preparation and >1mm in width
- Ferrule – crown margins should be placed in 2mm of sound tooth structure around the entire crown in order to guard against root fracture caused by the post. May need crown lengthening or orthodontic extrusion to gain adequate Ferrule. Orthodontic extrusion retains better crown/root ratio.

	Post Considerations
All axial walls remaining	No post needed
3 walls remain	Usually no post needed
2 opposing walls remain	Usually no post needed
2 adjacent walls remain	Post required
1 wall remains	Post required
NO walls remain	Post required

	Recommended	Acceptable	Possible
Anterior	Cast post and core	Composite core with fiber post	--
Premolar	Cast post and core	Composite core with fiber post	Composite core with metallic post
Molar	Amalgam or composite core with metallic or fiber post	--	Cast post and core

Post and Core Failures

- Most common reason for failure: de-cementation
- Type of failure with most clinical significance: root fracture

Post and Core Procedures

	Set Up	Procedure
Prefab metal post & Amalgam or Fiber Core (tooth already has endo)	- Hand piece - Composite cassette - Diamond burs - Gates- Glidden burs - Post drill - Prefab posts - Ketac Cem - Build-It - Etch - Optibond Solo - Curing Light - Articulating paper	- Review medical and dental history - Get x-ray of tooth, and do quick exam of dentition, call instructor to begin - You can prepare the canal and remove access gutta-percha by using either a "Touch and Heat" instrument (the safer way) or Gates-Gliddon drill. - Select post size using the x-ray - Decide how far you will extend the post (must be >5mm from apex) and prepare the canal with the instrument of your choice. - Mark the instrument (use rubber stopper on drill to get proper depth). - Remove all temporary and old restorative materials, isolate the tooth and if needed, place a matrix band around it. - If you drill down the canal with the Gates-Gliddon, use VERY slow speed. - Use post drill to the same length (can use post drill as hand file = safer) - Try in post and take a x-ray to confirm proper size and seat - Trim the post - various opinions on how to do this: either from apical (best retention this way) end or coronal end – use diamonds and make the post 1mm below of the expected top of the core - Dry the canal with paper points • For amalgam cores - use Ketac Cem to cement the post – apply cement on post tip, insert slowly, use pumping action to get voids out, and hold in place until set. Wait 15min and pack the amalgam. • For fiber composite cores: use Ketac Cem as described above OR etch, prime/bond, the tooth and the canal, making sure that there is no excess bonding agent in the canal. Fill the canal with very small amount of core material and place the post in all the way. Add core material to fill the coronal aspect of the tooth. Cure and allow to set for 4 mins - Call instructor to check - Shape and smooth the margins of the core build up to eliminate ledges. • If amalgam core – wait at least 24 hours before prepping the tooth. • If composite – you can prep and temp the tooth at the same day, if you have the time to do it.

	Set Up	Procedure
Cast P/C Impression (tooth already has endo)	- Hand piece - Composite cassette - Diamond burs - Gates- Glidden burs - Post drill - Burn out post - Ketac Cem - Duralay Resin - Plastic dish - Benda brush - Vaseline - Paper clip - Articulating paper - Tempbond	- Review medical and dental history - Get x-ray of tooth, and do quick exam of dentition, call instructor to begin - You can prepare the canal and remove access gutta-percha by using either a "Touch and Heat" instrument (the safer way) or Gates-Gliddon drill. - Decide how far you will extend the post (must be >5mm from apex) and prepare the canal with the instrument of your choice. - Mark the instrument (use rubber stopper on drill to get proper depth). - Remove all temporary and old restorative materials, isolate the tooth and if needed, place a matrix band around it - If you drill down the canal with the Gates-Gliddon, use VERY slow speed. - Use post drill to the same length (can use post drill as hand file = safer) - Try in preformed plastic post (burn out posts), make sure that it sits all the way in to the prepared canal and doesn't bind - Prep the coronal aspect of the tooth and make sure that you have NO UNDERCUTS in the canal and in the coronal aspect of the tooth, and then lubricate the canal (VERY IMPORTANT!) with Vaseline and perio probe - Apply Duralay pattern resin by first dipping the post in liquid monomer and then using salt and pepper technique (dip a brush in liquid, then powder and dab it on to the post) - Place post in the canal. Ensure that the pattern goes in and out of the canal easily (like a temp crown), otherwise it will get locked in there! - Once the resin is set, remove the post and inspect for voids - if there are, add some material to that spot and reline margins - Add pattern resin to form the core, then prep the core/ tooth for a crown - have instructor check impression! - Remove cast post/core impression and save - Place piece of paper clip in the canal to serve as a temp post, then fabricate a temp crown around it – then use Temp bond to cement the temp - Adjust occlusion and have instructor check ALTERNATIVE TECHNIQUE: Once the canal and the coronal aspects are prepped: - If possible, place a matrix band around the tooth. - Prepare 10 drops of liquid with adequate amount of powder - Fill a single use syringe with the material and inject it slowly into the canal, without creating pressure. - Place the plastic post into the canal and quickly fill up the whole coronal aspect with the material, making sure there are no voids. After it gets to the "doughy stage", take the pattern out of the tooth and place it back a few times to make sure it does not "lock" in the canal.
Cast P/C Cementation		BEFORE THE PATIENT COMES - Evaluate the casting, and make sure that there are no positive bubbles or areas that correspond to undercuts - Remove such areas with a diamond bur WHEN THE PATIENT COMES - Remove any temporary material and clean the canal and the coronal areas from any leftover materials. - Try in the post by gently sliding it into position, NEVER PUT ANY PRESSURE ON IT! - If the casting does not go in all the way, use fit-checker to evaluate which areas need to be adjusted. - If you cannot get it in 3-5 minutes, as a faculty for help. - Once the casting is in place – you are ready for cementation. - Prepare the cement you decided to use (eg. Ketac Cem), dry the canal, place the cement on the post and gently tap it into place. - Allow the cement to set and you are ready to go.

Complete Dentures

General Concepts

- **Retention** – resistance to vertical dislodging forces away from the tissues
 - Maxilla – determined by palatal seal, saliva flow, compressibility of palatal seal area, well shaped tuberosities, height of alveolar ridge
 - Mandible – determined by tongue position, floor of mouth contour, neuromuscular control, peripheral seal
- **Stability** – resistance to horizontal/oblique dislodging forces
 - Maxilla – determined by alveolar ridge height
 - Mandible – determined by alveolar ridge height, floor of mouth contour, tongue position, neuromuscular coordination
- **Support** – resistance to vertical forces towards the tissues
 - Maxilla – determined by amount of keratinized mucosa, alveolar ridge contour. Primary support area is residual ridges. Secondary support area is rugae.
 - Mandible – determined by retromolar pad, alveolar ridge contour, amount of keratinized mucosa, buccal shelf access. Primary support area is buccal shelf. Secondary support area is retromolar pads.
- **Centric Relation** – position of the mandible in relation to the maxilla when the condyles are in the most superior and anterior position in the fossa
- **Centric Occlusion** – the occlusion of opposing teeth when the mandible is in centric relation, another definition floating around is that CO is the same as maximum intercuspation
- **Balanced occlusion** – the bilateral, simultaneous, anterior, and posterior occlusal contact of teeth in centric and eccentric positions
- **Hanau's Quint** – five variables related to the creation of balanced occlusion: condylar guidance, incisal guidance, occlusal plane, cuspal inclination, curve of Spee (compensating curve). Condylar guidance is fixed, occlusal plane is relatively fixed (only minor changes to it can occur), while the remaining 3 can be adjusted by the dentist
- **Consequences of tooth loss**
 - Residual ridge resorption
 - Maxillary – 0.1mm/year superiorly and posteriorly
 - Mandible – 0.4mm/year inferiorly
 - 4-5mm bone loss in first year of tooth loss
 - Decreased masticatory function – complete denture has about 20% of normal chewing efficiency
 - Loss of facial support

Evaluation of Edentulous Patient

- Med health: Type I diabetes, Lichen planus, Pemphigoid lesions, candidiasis all compromise denture tolerance
- Quality of oral mucosa: more attached keratinized mucosa = better denture support
- Residual ridge resorption: impairs retention, stability, and support
- Soft tissue morphology:
 - Buccinator determines access to buccal shelf: more access = better support
 - Frenum attachments – location may hinder denture extensions, labial frenectomy common if attachment close to ridge crest because it interferes with good seal and esthetics.
 - Tongue position – affects stability and retention, retruded tongue decreases stability

- Mylohyoid – favorable attachment allows access to retromylohyoid space, enabling greater extension of lingual flange = better stability and retention
- Palatal salivary glands – ability to compress give better palatal seal = better retention. Also, saliva production allows adhesion/cohesion = better retention
- Skeletal relationship of maxilla and mandible
- Occlusal plane
- Assess existing denture: retention, stability, esthetics, VDO, wear

Vertical Dimension of Occlusion

- *Determination*
 - Pre-extraction casts mounted on articulator
 - Mark chin/nose point on face then measure distance with existing denture in place
 - Seat wax rims and mark chin/nose points on face. Measure distance between points after determining vertical dimension at rest (VDR). Once VDR is recorded, subtract freeway space (2-4mm when observed at the position of the 1st premolars) to get VDO.
 - Swallowing – measure immediately following swallow
 - Phonetics – have patient say “m”, then measure
 - Esthetics – have patient evaluate lip support from front and profile
- *Excessive VDO* – excessive mandibular tooth display, fatigue of muscles of mastication, clicking of posterior teeth, gagging, trauma to supporting tissues
- *Insufficient VDO* – reduced force of mastication, angular cheilitis, or aged appearance (“sunken in” lower face)

Speaking Sounds

- Labiodental (f, v, ph)
 - Made by maxillary incisors contacting wet/dry line of mandibular lip
 - Position of maxillary incisors influence these sounds
- Linguoalveolar (s, z, sh, ch, j, ch)
 - Made by the tongue contacting the most anterior part of the hard palate
 - Vertical length and overlap of anterior teeth influence these sounds
- Linguodental (th)
 - Made when tip of tongue in between mandibular and maxillary incisors
 - Labiolingual position of anterior teeth influence these sounds

Denture Occlusion Schemes:

	Tooth Molds	Indications	Advantages	Disadvantages
Bilateral Balance	Anatomic (30 degree)/ Semi-anatomic (10-20 degree)	- Good residual ridges - Well coordinated patient - Opposing natural dentition	- Better chewing - Esthetics - Point intercuspation - Balanced in excursions	- More complex - Horizontal forces - Requires more frequent follow-up
	Non-anatomic w/ balancing ramp	- Poor residual ridges - Poorly coordinated patient - Arch discrepancies - Bruxers	- Allow some overbite - Less horizontal force - Balanced in excursions	- Flat premolars - Slightly harder set up than monoplane
Monoplane	Non-anatomic	- Poor residual ridges - Poorly coordinated patient - Arch discrepancies - Bruxers	- Easiest set up - Less horizontal forces	- Flat premolars - Worse chewing - No intercuspation - Not balanced in excursions
Lingualized	Anatomic teeth in maxilla and non-anatomic teeth in mandible with balancing ramps	- High esthetic demand - Malocclusion - Displaceable supporting tissues	- Upper premolars look natural - Potential for balance by adding ramp - Less horizontal forces - Better chewing	- Moderately difficult set up
	Anatomic teeth in maxilla and mandible	- High esthetic demand	- Balanced in excursions - Less horizontal force than non-lingualized	- Difficult set up

Steps in Complete Denture Fabrication

Visit #	Set up	Procedure
1	- See "Alginate Impressions" Section	- History & exam - Preliminary impression w/ alginate and rope wax - Instruct patient to leave existing denture out for 24 hrs prior to final impression appointment
Lab	- Yellow stone - Custom tray material - Vaseline - Pink wax - Bunsen burner	- Pour up preliminary casts (pour up in yellow stone) - Mark landmarks: vestibule depth(red) and tray extension line (blue) – blue should be 2mm above red - Block out undercuts with pink wax and coat in Vaseline - Fabricate custom tray with handles with VLC triad (blue) and trim – an accurate custom tray with good handles is a key step to the whole process!
2	- Compound - Bunsen burner - Water bath - Custom trays - Permlastic	- Border mold using green compound: heat compound stick until doughy, apply to edge of custom tray, dip in water bath, insert into patient's mouth, and help patient to perform muscle functions until compound is set. <i>*Much like temporary crown acrylic, it takes time to learn how to handle compound – so practice!</i> - Take final impression with polysulfide (pour within 1 hr): apply polysulfide tray adhesive generously, mix polysulfide, coat inside of custom tray with polysulfide and insert into patient's mouth. Wait 7 minutes until set
Lab	- Sticky wax - Rope wax - Red strip wax - Yellow stone - Denture base material - Wax rims - Pink wax - Bunsen burner - Pancake spatula	- Box and bead final impressions: with either plaster/pumice plus red strip wax OR white rope wax plus red strip wax. Use sticky wax to seal edges of latter method. - Pour up master cast in yellow stone - Fabricate base plates with VLC triad (pink) on master cast and add wax rims to base plates 6mm 8mm 10mm 8mm 22mm 2mm overjet 18mm 2/3 of retro molar pad <i>*This is a starting point and may be adjusted significantly for the esthetics and function necessary for your patient</i>
3	- Tongue depressor - Fox plane - Bunsen burner - Pancake spatula - Buffalo knife - Wax instruments - Facebow - Genie bite - Pink wax	- Try in Maxillary wax rim - adjust to get 1-2mm incisal display at rest, proper lip support, also use Fox plane to make occlusal plane parallel to interpupillary line and parallel to ala-tragus line (Camper's line) - Try in Mandibular wax rim – adjust to get mandibular rim parallel to maxillary rim, while creating the appropriate VDO - Determine VDO (several methods possible – discussed above) - Pick the teeth color (match to sclera or ask patient) and shape match to face shape - Mark midlines, distal of canines, and lip line at rest and smiling on wax rims. Then make notches in the posterior occlusal surfaces of both wax rims. - Mark posterior palatal seal with intraoral marking stick and insert maxillary rim (marks should have transferred to internal surface of base plate), place rim on master cast and marks should transfer to cast. Then carve 1mm deep groove along line in master cast– this can also be done after try-in of posterior tooth set up - Take bite registration with PVS - Take facebow

Lab	- Anterior teeth - Flat plane - Pink wax - Wax instruments - Buffalo knife - Bunsen burner	- Mount and articulate master casts and wax rims with facebow/bite <i>Set anterior teeth</i> - Raise pin on articulator and check to make sure maxillary and mandibular rims contact all over - Measure distal of canine to distal of canine distance on wax rims (e.g. 43mm and incisal edge to gingival margin on smiling (this is tooth length), use this info plus the tooth color and shape selected at the last visit to select the teeth with Mohammed - Set maxillary teeth first: starting at midline, use warm knife to cut out a block of wax the size of the tooth to be placed and prepare tooth bed with warm spatula. - All maxillary anteriors should be tilted mesially with the buccal surface flush with the buccal aspect of the wax rim. - Place central incisor with edge level with occlusal line of wax rim and stabilize by adding pink wax around it. - Remove wax block and prepare bed for lateral incisor. Place lateral incisor's incisal edge 0.2mm above the central incisor's edge - Remove wax block and prepare bed for canine. Incisal edge should be flush with occlusal plane of wax rim (like central) Also, prominent canine suggests is masculine characteristic, while more hidden canine is more feminine Masculine Feminine - Complete opposite side of arch and check incisal edges with metal plate: centrals and canines touching, laterals 0.2mm above plate - Stabilize palatal aspect of teeth by adding pink wax - Set mandibular teeth in the same manner as the maxillary teeth (cut out wax and prep bed): all lower incisors will be placed 1mm above occlusal plane of wax rim and should all be mesially tilted, but we do not want contact of mandibular incisors with maxillary incisors. Mandibular canines should be place 1mm above mandibular incisors and contacting maxillary canine - Once finished: we should have small diamond of space formed by the 4 central incisors – this indicates ~2mm overjet and overbite
4	- Basic cassette - Handpiece - Acrylic burs - Pink wax - Wax instruments - Buffalo knife - Bunsen burner - Bite registration	- Try in wax rims and get patient feedback – adjust anteriors as needed - Take new bite registration to confirm mounting

Lab	- Pink wax - Wax instruments - Buffalo knife - Bunsen burner	<i>Set posterior teeth</i> - Start with maxillary posteriors: set 1st premolar so that both buccal and palatal cusps touch the metal plate, 2nd premolar so that only the palatal cusp touches the metal plate, with the buccal cusp 0.2mm above plate, 1st molar so that only mesial palatal cusp touches plate, and 2nd molar so that no cusps touch the metal plate – note that all the central fossae should line up when looking at the occlusal aspect  - Set mandibular posteriors: start by setting 1st molars to intercuspace with the maxillary first molars, then go back and place the premolars (reduce premolars if not enough space, or leave gap between canine and 1st premolar or between 2nd premolar and 1st molar). Finally place 2nd molar. If the maxillary teeth were set properly, you can just push the mandibular posteriors up into occlusion. Also, make sure you secure all teeth by adding pink wax. - Festooning: wax up gingival margin on palatal side to just below the height of contour, contour buccal gingiva so that it is level on all teeth except for canine (which is slightly higher), create interproximal gingival and add stippling by dabbing tooth brush gently against interproximal gingiva - Check contacts: want at least 3 points of contact on balancing side during lateral movement.
5	- Basic cassette - Handpiece - Acrylic burs - Pink wax - Wax instruments - Buffalo knife - Bunsen burner - Bite registration	- Try in complete wax rims and get patient feedback – adjust as needed
Lab		- Write prescription and send to lab for processing
6	- PIP paste - Acrylic burs - Handpiece - Basic cassette - Articulating paper	- Deliver denture - Use pressure indicator paste to detect potential sore spots and check occlusion – we want nice even contacts on lingual cusps/central fossae of maxillary denture and on buccal cusps/central fossae of mandibular denture - Patient education: take out at night, takes 4-6 weeks for muscle/nerves to learn how to control denture, potential tissue response, oral care
7	- PIP paste - Acrylic burs - Handpiece - Basic cassette - Articulating paper	- 3 day to 1 week post insertion – check for sore spots and check occlusion

Lab Remount

- Purpose: to correct errors in occlusion that occurred during denture processing
- Steps: fit together and re-attach master casts and original plaster mount, use articulating paper to check centric for prematurities and proper VDO, do selective grinding to regain desired occlusal scheme, then check working, balancing, and protrusive, do selective grinding to regain desired occlusal scheme
- Note: Where and how you grind differs for each occlusal scheme and for each type of error (eg working prematurity vs. VDO discrepancy)

Clinic Remount

- Purpose: correct inaccuracies that occurred in the original facebow (taken with wax rims)
- Steps: Seat the dentures and have the patient bite on 2 cotton rolls for 5mins, take CR bite registration, use the remount cast for the maxilla (no need for new facebow) and the new bite registration to remount the mandible, check occlusion in centric and correct, check lateral/protrusive excursions and correct

Immediate Complete Denture

- Definitions
 - Conventional Immediate Denture – a denture placed immediately after extractions, and relined to serve as the long-term prosthesis. Usually selected when only the anterior teeth remain or if the patient is willing to have a 2-stage extraction (posterior teeth extracted and allowed to heal)
 - Interim Immediate Denture – a denture placed immediately after extractions, and a second denture is fabricated as the long term prosthesis. Usually used when both anterior and posterior are to all be extracted at once.

Steps in Conventional Immediate Denture Fabrication

Visit #	Procedure
1	- Extract posterior teeth as soon as possible and allowed to heal for 3-4 weeks. Opposing premolars should be left to maintain vertical dimension - Any other hard/ soft tissue procedures are usually done during this first surgical visit as well
2	- Preliminary alginate impressions – loose teeth should be blocked out with periphery wax around the cervical region with lots of Vaseline
Lab	- Pour diagnostic casts and make full arch custom tray (block out remaining teeth with sheet wax)
3	- Border molding and final impression with Permlastic
Lab	- Pour up master casts and fabricate occlusal wax rims on master cast
4	- Wax rim try in for comfort and remove, measure VDO, adjust wax rims to desired VDO, take facebow with wax rims in CR
Lab	- Mount casts on articulator and set posterior teeth
5	- Try in denture bases with set teeth and verify VDO, record landmarks (midline, anterior occlusal plane using interpupillary line, ala-tragus line, high lip line, tooth shade, tooth shape, overbite, overjet, pocket depths)
Lab	- Remove teeth in an every-other fashion along the length of the remaining dentition leaving a small concave site at each location, trim the buccal to account for the collapse of the gingiva to the probing depth - Set every tooth that was cut off, then remove the remaining teeth and complete the entire set up, bring posterior teeth forward and finalize set up in occlusal scheme desired, process denture - Can make surgical template from master cast (after tooth removal as guide for future ridge)
6	- Extraction of remaining anterior teeth and delivery of immediate denture and checked with PIP and adjusted
7 & 8	- 24 hour post op visit. Patient must keep dentures in mouth for first 24-48 hours or the denture will not fit due to swelling. Also 1 week post op visit (remove any sutures)
9	- Remount casts poured after 2 weeks and definitive hard reline done between 3-6 months post delivery

Repair and Maintenance

- **Rebasing** – a laboratory process of replacing the entire denture base material
- **Relining** – a process to resurface the tissue side of a denture with new base material that provides a more accurate adaptation to the changed denture-foundation area. This can be done without adversely affecting the occlusal relationships or the support of lips/face, 3 types:
 - **Hard Reline** – Using hard acrylic is used to improve fit of denture.
 - **Soft Reline** - Also called a long-term (months) soft reline. Using a silicone-based polymer to improve fit of a denture. Indications: bruxers, soreness – used as a temporary measure until a better solution is found
 - **Therapeutic Reline** - Also called a short-term (days) soft reline. When the gums are in very poor condition (i.e. after a long time with an ill fitting denture) it is often difficult to accurately reline/rebase/remake – this procedure aids healing to allow for a reline/rebase/remake.
- **Repair of a Broken Flange** – the procedure for repair involves: assembling the broken pieces and securing them with wax, pouring a stone model on the tissue side of the denture, opening the fracture line with a bur, coating the ground surface with bonding agent, and placing acrylic into the opened space (various techniques for acrylic placement depending on curing method)
- **Home Care** –
 - Dentures must be removed every night and stored in water/bleach – but don't use bleach if contains a metal alloy – will corrode metal
 - Dentures should be cleaned with a soft tooth brush and toothpaste, but avoid excessive scrubbing on the tissue supporting area
 - Dentures should not be exposed to alcohol or acetone – will dissolve acrylic
 - Dentures should not be cleaned in hot water

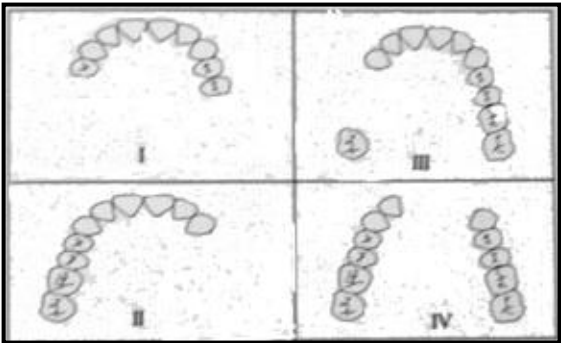
Overdentures

- **Advantages:** maintenance of more residual ridge, improved retention, resistance, and stability
- **Disadvantages:** periodontal disease and recurrent decay on tooth abutments
- **Types**
 - **Tooth abutments** – usually requires RCT, then maximum reduction of coronal portion of the crown.
 - **Unprotected** – coronal stump is sealed over with composite, glass ionomer, or resin-modified glass ionomer. Cheapest way to create overdentures.
 - **Protected** – additional expense
 - **Unattached** – a gold cover is cemented over the prepped abutment stump.
 - **Attached** – a fixture (of various designs that include “ball attachments”, “precision attachments”, etc.) is cemented onto the abutment tooth.
 - **Implant abutments** – generally 2 implants are placed between the mental foramina of the mandible and the abutment contain an attachment apparatus linking implant and denture

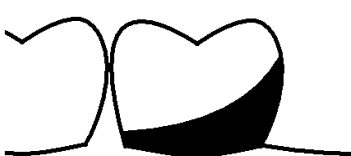
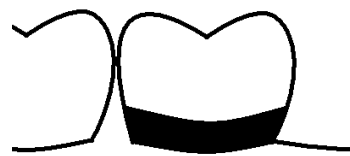
Removable Partial Dentures

General Concepts

- Requirements for RPD success
 - **Stability** – resistance to horizontal/oblique dislodging forces
 - **Support** – resistance to vertical forces towards the tissues
 - **Retention** – resistance to vertical dislodging forces away from the tissues
- Kennedy classification
 - **Class I:** bilateral edentulous areas located posterior to remaining natural teeth.
 - **Class II:** unilateral edentulous areas located posterior to remaining natural teeth.
 - **Class III:** unilateral edentulous areas w/ natural teeth both anterior and posterior to it.
 - **Class IV:** single, bilateral edentulous area located anterior to remaining natural teeth.



- Applegate Rules for Kennedy classification
 - Teeth indicated for extraction are treated as missing teeth in the classification process.
 - Teeth that are not to be replaced, such as second or third molars are disregarded for the classification process.
 - The most posterior edentulous area always determines the classification.
 - Edentulous areas other than those determining the classification are referred to as modification spaces and are noted by number (e.g. mod 2, mod 3)
 - Only the number of modification spaces, not their length, is considered in the classification process.
 - There are no modification spaces in Class IV arches.
- Survey Lines
 - 1 – low adjacent to the edentulous area and high away from it
 - 2 – high adjacent to the edentulous area and low away from it
 - 3 – low adjacent to the edentulous area and low away from it

Survey Line 1	Survey Line 2	Survey Line 3
		

RPD Components

- **Major Connectors**
 - Maxilla: need 6mm clearance to gingival margin
 - Palatal strap: between 8-12mm wide; used primarily with class III
 - Anterior-posterior bar: can be used with most designs
 - Horseshoe: 6-8mm wide all the way around, poor choice for distal extension, mainly used with several missing anteriors, i.e. Class IV or tori
 - Complete palatal plate: maximum support but may interfere with phonetics and soft tissue, may be used as transition to complete dentures
 - Mandible: need 4mm clearance to gingival margin
 - Lingual bar: most frequently used, half pear shaped bar, need 4mm width (so the patient needs 8mm from depth of vestibule to gingival margin)
 - Lingual plate: pear-shaped bar with thin piece that extends on the lingual surface of the teeth, needs a rest at each end of the plate, used with insufficient vestibule depth or mandibular tori, can be hard to clean
- **Minor Connectors:** joins major connector to other parts of the RPD (retainers, rest seats), needs to be at right angle to major connector; includes:
 - Metal framework that connects to denture base acrylic – must extend to cover the tuberosity in the maxilla, must extend 2/3 length of edentulous space in mandible.
 - Proximal plate – sits against a guide plane as part of the clasp assembly
 - Tissue stops – on all distal extension RPD
- **Rests:** component on RPD that provides vertical support. Prevents displacement of RPD toward the tissue and transfers force of mastication to supporting teeth.
- **Rest seats:** the prepared surface of a tooth or fixed restoration in which a rest sits
 - Occlusal: shape is a rounded triangle about 2.5mm wide and long, ~0.5mm deep at marginal ridge and ~1-1.5mm deep at the tip towards the center of the tooth. Floor of rest seat should be <90 degrees from marginal ridge. Rest seat should not encroach on occlusal contact area.
 - Cingulum: v-shaped half moon, just coronal to the cingulum
 - Incisal: v-shaped notch 1.5-2mm on proximal-incisal angle; rarely used
- **Guide planes:** 2 or more vertically parallel surfaces on abutment teeth that guide the RPD during placement and removal
- **Indirect retainers** - helps to prevent displacement of distal extension denture bases by functioning through lever action on the opposite side of the fulcrum line, and also contributes to stability and support. Tissue supported RPDs need indirect retainers; tooth supported do not, unless the pt is missing several anterior teeth.
- **Direct retainers:** engages abutment teeth and resists dislodgement
 - Intracoronal – female component built into crown, male component built on RPD
 - Extracoronal (clasps) -
 - Components of a clasp
 - Reciprocal arm – rigid arm placed above the height of contour on opposite side of tooth in relation to retentive arm
 - Retentive arm – refers to the shoulder part of arm (nearest to rest)
 - Retentive terminal – distal third of the retentive clasp arm. It is the only part of the clasp arm infrabulge and flexible.
 - Rest – sits in/on rest seat and provides support for clasp

- Clasp Designs:
 - **Circumferential / Aker's** – the clasp of choice for tooth supported RPD's, retentive arm originates above height of contour
 - Simple – used when the edentulous space is on one side of the tooth and the undercut is on the opposite – survey line 1
 - Reverse – used when retentive undercut is on same side of the tooth as the edentulous space and bar clasp can't be used
 - **Bar/ Vertical Projection** – approach undercut from gingival direction, usually more esthetic than circumferential, must not impinge on soft tissue or cross a soft tissue undercut. Include: I-bar, T-bar, Y-bar
 - **RPI**: Includes: mesial rest, distal plate, and I-bar
 - Pros: less food impaction, passive, possibly more esthetic – good for Kennedy class I and class II (distal extension)
 - Cons: less stability and retention, may be contraindicated with severely tipped teeth, high frenum, soft tissue undercuts
 - **Embrasure** – when there is a unilateral edentulous space, this clasp is frequently used on the opposite side of the space.
 - **Combination** – a clasp with a wrought iron retentive arm and a cast reciprocal arm, can be used with distal extension or on periodontally compromised abutment teeth – survey line 1
 - **Reverse C / Hairpin** – a circumferential clasp with retentive arm that loops back to engage an undercut on the same side as the rest, used when bar clasp can't be used – survey line 2
 - **Ring** – not a first choice clasp

Steps in RPD Fabrication

Visit #	Procedure
1	- History, Exam, alginate impressions
Lab work	- Pour up preliminary casts (yellow stone) - Survey casts (determine path of insertion and tripod the cast, determine undercuts and mark survey lines) - Design RPD on cast - Fabricate custom tray (add Vaseline before applying Triad material!)
2	- Prepare teeth (rest seats) using surveyed models as a guide - Border mold custom tray and take final impressions (different instructors recommend different materials) - Take facebow and bit registration
Lab work	- Box and bead final impressions, pour up master casts (yellow stone), and mount - Send prescription, surveyed/designed models, and master casts to lab to make metal framework
3	- Try in metal framework - Choose RPD teeth shade and shape
Lab work	- Set up teeth in wax on the metal framework on casts
4	- Try in metal framework with teeth and adjust as needed
Lab work	- Carve wax to final size and shape (festoon) - Send metal framework w/ teeth set up in wax to lab to fabricate permanent RPD
5	- Deliver permanent RPD and check fit/ occlusion

*The need for surveyed crowns will alter this sequence.

Steps in RPD Fabrication – Altered Cast Technique

*Some literature/faculty claim that this technique is not superior to the standard method for distal extension

Visit #	Procedure
1	- History, Exam, alginate impressions
Lab work	- Pour up preliminary casts (yellow stone), survey casts, design RPD on casts - Fabricate custom tray
2	- Prepare teeth (rest seats) using surveyed models as a guide - Border mold custom tray and take final impressions with permlastic
Lab work	- Box and bead final impressions, pour up master casts (yellow stone) - Send prescription, surveyed/designed models, and master casts to lab
3	- Try in metal framework - Choose RPD teeth shade and shape - During this visit – go down to lab and adapt a resin triad tray to over the metal framework sitting on the master cast and cure, trim tray - Border-mold tray/framework and take new final impression with Permlastic
Lab work	- Saw off the edentulous area of the master cast and make keyways, then place new final impression over the master cast, box and bead, and pour stone into space that was previously cut off. - Set up teeth in wax on the metal framework on casts (make wax thick so it won't break at try in)
4	- Try in metal framework with teeth
Lab work	- Carve wax to final size and shape (festoon) - Send metal framework w/ teeth set up in wax to lab to fabricate permanent RPD
5	- Deliver permanent RPD and check fit / occlusion

Immediate RPD Fabrication (“Flipper”)

*There are two ways to do this. One uses Triad denture base material and the other uses cold cure acrylic. The method for using Triad denture base material is described below – which is the method you will see presented in lab. However, some faculty prefer that we use the cold cure acrylic method – if so ask them how to do it. Like everything, the two options have pros and cons.

Visit #	Procedure
1	- History, Exam, alginate impressions
Lab work	- Pour up preliminary casts (yellow stone) - Put Vaseline on cast, form Triad denture base to cast, and trim excess - Place wrought iron clasp and/or ball clasps as needed - light cure the Triad - Place teeth in desired locations with pink wax and take putty impression - Remove wax and trim impression to gain access to the space left by the wax. Set teeth in impression and place impression back on the cast – pour cold cure acrylic into the space between the base and teeth and place the casts in warm water in the pressure cooker (~1.5atm) for 15-25 minutes - Remove from cooker and carefully remove from the master cast and trim to desired fit.
2	- Deliver Immediate RPD and trim as needed.

Implants

Background

Although the Mayans and Egyptians experimented with implants up to 1,500 years ago, dental implants did not become a reliable option until 1952, when Branemark introduced the concept of osseointegration. Osseointegration is defined as direct structural and function connection between ordered, living bone and the surface of a load carrying implant. The most widely used implant materials are titanium and its alloy.

Indications

Implant supported FPD	Implant supported Overdentures
- Unfavorable abutments: number & location - Virgin potential abutment teeth - Questionable prognosis of abutment teeth - Maintain bone after tooth extraction	- Replacement of lost hard & soft tissue - Unfavorable ridge for complete denture - Unfavorable orientation / inclination for implant supported FPD - Patient wants removable prosthesis - Economic constraints

Contraindications

There are no absolute contraindications for implants specifically; however, there are absolute contraindications to elective surgical procedures in general (See Oral Surgery section), as well as some systemic, behavioral and anatomic considerations that may create a relative contraindication for implants, including:

- Age < 18 yo. Growth is still occurring and implant may submerge.
- Immunocompromised / Immunosuppressed: diabetes, HIV, transplant, cancer, etc.
- Osteoporosis (controversial), Bisphosphonate IV or PO (controversial), Radiation (especially in Maxilla, controversial)
- Smoking (HSDM guidelines recommend a minimum of quitting one week before and two weeks after placement).
- Alcoholism
- Bruxism
- Poor oral hygiene and periodontal disease
- Local factors: location, orientation, bone quantity and quality, periodontal biotype

Bone Quantity	Bone Quality
- A: most of alveolar ridge present - B: moderate ridge resorption - C: advanced ridge resorption but basal bone remains - D: advanced ridge resorption with minimal to moderate basal bone resorption - E: advanced ridge resorption with extreme basal bone resorption	- Type I: homogenous cortical bone - Type II: thick cortical bone layer around dense trabecular bone core - Type III: thin cortical bone layer around dense trabecular bone core - Type IV: thin cortical bone layer around low density trabecular bone core *best quality in anterior mandible (Type I) and worst in posterior maxilla (Type IV)

Seibert Classification of an Edentulous Ridge

- Class I: horizontal bone loss
- Class II: vertical bone loss
- Class III: both horizontal and vertical

Implant Sequencing Protocols

- Placement
 - Immediate – same day as extraction.
 - Immediate-delayed – done 6-8 weeks after extraction
 - Delayed – done >3 months after extraction
 - Placement time will depend on each clinical situation (number of roots, need for bone graft, need for sinus lift, medical status of patient, etc.) Primary stability must be achieved in a minimum of 4mm of bone.
- Loading
 - Immediate – same day as implant placement
 - Immediate-delayed – 6-8 weeks after implant placement * Indicated most of the time
 - Delayed - >3-6 months after implant placement
 - Based on the 3 stages of healing after placement:
 - 1-8 days: Basic healing- Wound, blood clot, platelets, fibrin mesh, mesenchymal preosteoblasts, early woven bone matrix, unorganized collagen fibers with ability to become bone. Only PRIMARY STABILITY- Mechanical can be achieved.
 - 6 weeks: Osseointegration- Biologic integration and mineralization. Starts to begin at 3-4 weeks. SECONDARY STABILITY- Biologic. Implant can be loaded at this point with the same failure rate as loading at 3 months.
 - >6 weeks: Living interface. Constant remodeling and resorption at implant interface. Osseointegration can increase over time. 1.5mm of bone needed for remodeling.

Implant Options

- Pure titanium vs. titanium alloy: same outcome
- Polished surface vs. rough surface: roughened surface shows better outcome
- Implant abutment:
 - Anti-rotation mechanism necessary.
 - Internal vs. External connection (anti rotation mechanisms): internal makes walls of implant thinner but easier to seat abutment.
 - 1-step vs. 2-step: pros and cons to both – depending on the situation,
- Cement retained crown vs. screw retained crown:
 - Cement retained crowns are more esthetic and fracture less, while screw retained have better retention when interocclusal distance is diminished.
- Sizes: width and height depend on space available and location of adjacent structures. 8mm implant success to be similar to 10mm implants.

Space Requirements

- Interproximal space: 1mm of bone on both sides of implant PLUS 0.5mm to compensate for the PDL of each adjacent tooth. Example: a 3.75mm (body)/ 4.1mm (platform) implant will need at least 6.6mm of interproximal space between 2 natural teeth. This space ensures preservation of the crest of bone and papilla.
 - When implants are placed adjacent to one another, we want at least 3mm interproximally.
- Apico-coronal space: in 2-piece systems the platform should sit ~2-3mm below the CEJ of the adjacent teeth. The contact point with adjacent tooth should be at least 5mm from the alveolar bone crest

- Buccal-lingual: 1mm of bone on both sides of the implant is needed in the buccal-lingual dimension.
- Proximity of IAN, sinus and mental foramen need to be considered.

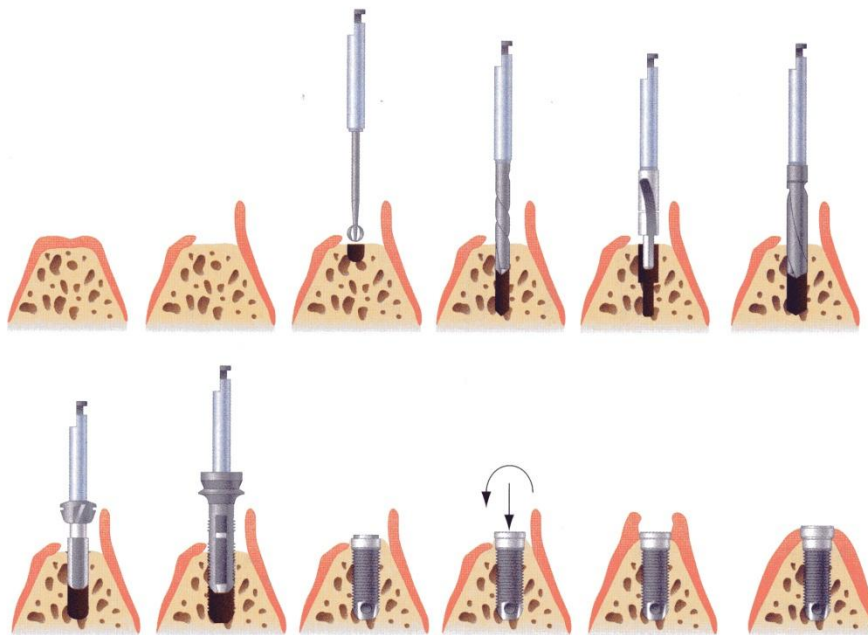
Referring a Patient for Implants

Implants are restoratively driven, and you will play the role of the restorative dentist during implant therapy. When you have a patient who needs an implant, the first step is to obtain the appropriate consults from: prosthodontics and either periodontics or OMFS, in order to discuss the indications / contraindications, timing of placement, and need for additional procedures (eg bone grafting or sinus lift) in your particular patient. You then present the treatment plan to your patient and discuss the benefits, risks, cost, and commitment that accompany implants. If the patient agrees, you need to select a surgeon to place the implants. To do this, you can email Dr. Kim or Dr. Arguello and ask them to assign a perio resident to work with you on the case. The perio resident will then schedule the patient for a consult. Between the time of consult and the actual placement of the implant, the following things may need to occur: wax-up of teeth being replaced, fabrication of radiographic stent, CT scan, fabrication of a surgical stent, and/or fabrication of an interim RPD. It is advised that you be present at the time of placement. The perio resident will then see the patient for post-op recall visits to check healing. If you are comfortable, you may also elect to place the implants yourself (provided that the case is not too challenging) by working with Dr. Flynn in OMFS, but you should speak with him about how to set this up. Once the implant is ready to be restored, it is your job to schedule the patient for the impression and deliver the crown.

Fabrication of Radiographic / Surgical Stent

	Armamentarium	Procedure
Radiographic/ Surgical Stent	- Diagnostic casts - Thick vacuform plastic - Straight handpiece - Acrylic burs - Cold cure acrylic - Metal rod (ask Mohammed) - Gutta percha point	- Duplicate original diagnostic casts - Wax up missing tooth (or use denture teeth) and duplicate the casts with wax-up in it (pick up impression) - Trim casts to U-shape for vacuform - Use thick vacuform plastic to make vacuform stent - Trim away excess plastic to be able to remove vacuform – this may result in breaking of the cast - Further trim the vacuform to just above the height of contour to allow easy insertion and removal - Place vacuform on cast and drill hole in center of tooth to be replaced - Use drill press to plan angulation of implant and drill through the pre-made hole into the cast ~6mm deep - Remove vacuform, cover hole with tape and fill tooth with cold cure white acrylic – as it sets place the vacuform on cast, remove the tape and place metal tube through hole of vacuform and into hole in cast. Hold cast upside-down and allow the acrylic to cure around tube. Once set, remove metal tube and trim excess acrylic - Fill hole with gutta percha point and sear off ends with hot instrument and seal in. This will function as a radiographic stent – removal of the gutta percha will convert to surgical stent!

Overview of Implant Placement Procedure



Implant Placement Protocol

- Incision over crest (flap vs. flapless)
 - Flap- Decreased complications because better visualization. Longer recovery time. Control of papilla.
 - Flapless- Punch out mucosa over site. Decreased recovery time. Visualization is worse.
- Pilot hole
- Expansion of pilot hole (3-7 subsequent drill steps)
 - Avoid overheating (damage to osteoblasts) with cooled saline irrigation.
 - Hole will be drilled 1mm longer than implant due to drill shape.
- Place implant and torque.
- Healing abutment or cover with tissue.

Restoring the Implant

Visit #	Procedure
Lab work	- Consult with prosthodontist or implantologist to plan restoration. Decide if using open tray (more accurate) vs. closed tray technique (easier but less accurate) – I will describe closed tray technique. - Patient must pay ½ prior to the impression day and implant crowns must be set as “in progress” to do the lab order for the impression parts you need. - Select impression cap, positioning cylinder, and implant analog for the type of implant placed. Andy or Katherine can help you do this. Order the appropriate parts in Axium and get faculty approval and front desk (billing) approval stamp. Take form to Andy to see if we have those parts in stock or take to Julian to order parts.
1	- Check out appropriate prosthetic restorative implant kit from sterilization - Remove cover screw and attach impression cap / positioning cylinder – make sure it is seated properly! It is metal, take a BWX to confirm seating. - Take open or closed tray impression with PVS – impression cap will pop off when impression is removed if you are using Straumann, or stay in the mouth if you are using Nobel. - Open tray technique is more precise and used when taking impressions of multiple implants. - Replace cover screw, take bite registration, shade, and alginate of the opposing arch

Lab work	- Attach impression analog and ask Mohommad for gingival tissue material to put around analog, then pour up in blue stone - Take the cast with the analogue to Andy or Katherine to help you decide which abutment to order. When you decide, order the abutement in axium, get approval and stamp. - Consult with Prosthodontist / Implantologist to decide if using screw retained or cement retained crown - Once you get the abutement, write a lab script for an implant crown, which includes type of crown (cement vs screw retained), shade, porcelain coverage, etc. Send cast, abutment, bite registration, opposing arch to lab
2	- Remove cover screw and attach abutment. Initially, just hand screw in abutement. - Try in crown, adjust interproximal contacts and occlusion, check with fit-checker, take BWX to confirm seating - If everything looks good, torque in abutement slowly to 35N. Place cotton ball over screw and fill screw hole with Fermit. - Cement crown with TempBond or Durelon.

Maintaining the Implant

-Implants are susceptible to peri-implantitis and need to be adequately cleaned. Instruct your patient on proper brushing and flossing habits and use adjunctive aids as needed. When performing an exam or cleaning on a patient with implants, check out special plastic probes and scalers from sterilization, as metal instrument should never be used to touch the implants to avoid potential scratching or damage.

Oral Surgery

Consult / Referral Protocol

Consults are held at OMFS clinic in faculty practice between 1pm - 2pm on Monday, Tuesdays and Thursdays. There is a sign-up sheet on the bulletin board in clinic. You will need study casts (for removable prosth cases), complete approved medical hx, approved and signed treatment plan, diagnostic radiographs or panorex, and internal referral form completed and swiped for the consult. You are expected to give a brief oral presentation that includes the patient's medical hx, allergies, medications and surgical needs as well as how to manage any of those conditions in the surgical setting. You should also know whether your patient would like nitrous oxide (\$30 fee, Dr. Flynn may waive if pt is anxious and financially challenged) and what their availability is. If you present adequately and the oral surgeon agrees with your plan, the patient will be scheduled in axium. You do not have to be present for your patients surgery as the students on oral surgery rotation should be but you may be there and perform the extraction if you like.

Indications for Extraction

- Unrestorable teeth
- Pulpal necrosis/irreversible pulpitis when RCT is not an option
- Severe periodontal disease
- Orthodontics and/or malocclusion
- Vertical root fracture
- Pre-prosthetic extractions
- Supernumerary teeth
- Pathology

Oral Surgery Rotation

One of the required rotations during third year is 4-5 clinic days of oral surgery. You should generally expect to be there for the whole clinic session. In preparation, review "How to extract a tooth," as well as management of medical conditions, allergies and medications, prescription writing, nitrous oxide usage, and aseptic technique. You should be able to access the patient's chart for oral surgery that day in axium, so review their medical history and needs before you arrive. The general procedure involves obtaining consent, taking initial blood pressure and O2 sat, nitrous if indicated, anesthetizing the patient (consider bupivacaine), extracting the tooth/teeth, achieving hemostasis (use gelfoam and sutures if needed), giving post-op instructions (print from axium), writing prescriptions, and writing post-op note.

OMFS Aseptic Technique

Mask and goggles → gown → wash hands → GLOVES!!!

* This is how it is done for all hospital-based surgical procedures. In the HSDM OMFS clinic, you may see faculty put on the gown and then wash their hands; however, this would be incorrect in the hospital setting.

Nitrous Oxide Sedation (N2O/O2)

- Indications
 - Patients with mild apprehension undergoing a significant dental procedure, some medically-compromised patients, many children
- Contraindications
 - Absolute: Pregnancy (may cause spontaneous abortion although used in Europe and not rated), otitis media, congenital pulmonary blebs, sinus blockage, bowel obstruction, nasal obstruction, cystic fibrosis, COPD
 - Relative: URI, severe fear, patients with a previous bad experience with N₂O

Give vocal anesthesia instructions before beginning nitrous.

- Confirm patient not pregnant
- Tell about floating, comfort, loss of time sense, but avoid telling about tingling (paresthesia)
- Too low: no change
- Too strong: oppression, unpleasant, nausea, sleepiness, sweating
- Onset in 2-3 min
- Total flow = 6L/min = respiratory minute ventilation = tidal volume x respiratory rate = 500mL x 12
 - Low = 33% N₂O (children) – 2L/min N₂O to 4L/min O₂
 - Medium = 50% N₂O (most adults, max children) – 3L/min N₂O to 3L/min O₂
 - High = 62.5% N₂O (some adults) – 5L/min N₂O to 3L/min O₂
 - Maximum = 70% – 7L/min N₂O to 3L/min O₂ (for party animals :)
- Failsafe mechanism: (our OR system)
 - If oxygen tank runs out or tubing is not connected, nitrous will shut off
 - If nitrous runs out or tubing is not connected, oxygen will keep going
 - Oxygen must always keep flowing at least 3L/min
- Procedure
 - 1. Place monitors: pulse oximeter and BP cuff
 - 2. Turn on 6L/min oxygen (100%) BEFORE placing the mask on the patient
 - 3. Place mask on patient – ensure snug fit (no breeze in eyes)
 - 4. Adjust scavenging system valve to green zone
 - 5. Adjust nitrous oxide to desired level
 - 6. When finishing procedure, turn off nitrous and leave pt on 100% oxygen for 5 mins to prevent headache or diffusion hypoxia. There is no need to taper nitrous levels down before shutting it off, as long as 100% oxygen is used afterwards.
- Physiology of Nitrous Oxide
 - Nitrous oxide acts on the CNS to produce a generalized depression and inability to concentrate, decreasing all forms of sensation.
 - Solubility: relatively insoluble in blood, so requires high alveolar concentration to have effects
 - Concentration effect: higher concentration inhaled, the more rapid the increase in arterial concentration
 - Second gas effect: If a second gas (e.g. Halothane) is inhaled at the same time as N₂O administration, it too is rapidly taken up due to concentration effect –“ riding the N₂O vacuum”
 - Diffusion hypoxia: when N₂O flow is ended, rapid N₂O diffusion from blood into lungs dilutes O₂ concentration in alveoli faster than it can be replaced, causing decreased oxygen blood saturation. This can be prevented with step 6 above, because the 100% oxygen is almost 5x greater concentration than atmospheric oxygen (21%), so adequate oxygen concentration in alveoli can be maintained.

Indications for 3rd Molar Extractions (Dr. Dodson)

- Clear Indications
 - Pericoronitis
 - Bony destruction (periodontal disease or mandibular fracture)
 - Caries
 - Injury to adjacent teeth (root resorption, etc)
 - Cysts/Tumors
- Ambiguous Indications
 - Prevention of crowding – not supported by the literature
 - Pain of unknown origin
 - Prevention of cyst/ tumors from forming
 - The presence of impacted or ectopically positioned 3rd molars
- Recommendation, extract if....
 - Patient has symptoms
 - <25yo with 1 episode of pericoronitis or perio defect on M2s
 - 26-40yo with repeated pericoronitis episodes or pockets >4mm
 - >40yo with pus or pathology
 - Routine intervention supported by AAOMS: “Incidence of problems associated with impacted third molars is sufficient to warrant their removal when they are currently asymptomatic.”
- Risks of nonintervention
 - Crowding (not really proven)
 - Injury to adjacent M2 (root resorption, perio defects)
 - Pericoronitis
 - Development of pathology
- Risks of intervention
 - Nerve injury: <5% have some transient loss of function, risk of permanent damage is 1:1000 to 1:2000
 - Infection of surgical site: ~3-5% of cases, serious risk is if spread from maxillary molars to masticator space which presents as swelling/ trismus, or mandibular molars spreading to deep neck spaces and compromise airway
 - Alveolar Osteitis: ~5-7%, presents as pain 3-5 days post op, with foul smell/ bad taste, lost clot/ exposed bone – treat with eugenol dressing
 - Sinus Complications: frequency unknown, treat with antibiotics, decongestants, sinus precautions
 - Hemorrhage
 - Alveolar or mandibular fracture
 - TMJ injury
- Radiographic assessment:
 - Risk of paresthesia goes up to 7% if....
 - Darkening of roots where crossed by inferior alveolar canal
 - Loss of superior margin of the canal
 - Constriction or diversion of the canal
 - Partial odontectomy (coronectomy) is good alternative to high risk surgical extractions
 - Increased difficulty extracting....
 - Mandibular: distoangular>vertical>horizontal>mesioangular
 - Maxillary: mesioangular>distoangular>vertical

How to Extract a Tooth: Simple

1. Test the effectiveness of local anesthesia with the pointed end of a periosteal elevator.
2. Sever the gingivodental fibers with the same end of the periosteal elevator.
3. Elevate the tooth (never use an elevator on the lingual side of a tooth)
 - a. Small straight elevator: Insert the elevator into the mesial or distal PDL space with firm apical pressure, with the concave side toward the tooth to be extracted. Rotate the elevator in such a way as to move the tooth toward the facial.
 - b. Large straight elevator: Use the same technique to obtain a greater amount of movement. This instrument may be too large for small teeth, such as lower incisors.
 - c. Offset elevator: Maxillary third molars
 - d. Cryers: Left or Right, to get to a section of a tooth
 - e. Davis: double ended to get tiny roots out.
4. Luxate and extract
 - a. Forceps selection
 - i. Upper universal (#150) – any upper tooth, #150s for pediatric patients
 - ii. Lower universal (#151) – any lower tooth, #151s for pediatric patients
 - iii. Cowhorn (#23) – lower molars with fairly straight non-fused roots – you can use Figure 8, pump handle, or can-opener motion
 - iv. Ash (various sized) – lower anteriors and bicuspid
 - v. Anatomic upper molar forceps (#88R and #88L) – for upper molars with non-fused roots.
 - b. Forceps placement: Keep the beaks in the long axis of the tooth and between the free gingiva and the tooth. Seat the forceps as apical as possible (keeps center of rotation apical, minimizes root fracture). Squeeze hard enough that the beaks do not slip when you luxate the tooth.
 - c. CONSTANT FIRM APICAL PRESSURE during luxation – converts the center of rotation of the tooth from the apical third to the apex. Prevents broken root tips.
 - d. Directions of luxation: Take your time; let the bone of the socket expand.
 - i. Upper anteriors – rotate in the long axis of the tooth
 - ii. Upper bicuspid – luxate to the buccal until you feel a loss of resistance, then PULL. Protect the lower teeth from injury if the tooth comes out suddenly. Only tooth you pull!
 - iii. Upper 1st and 2nd molars – buccal luxation
 - iv. Upper 3rd molars – buccal and distal luxation
 - v. Lower anteriors and bicuspid – rotate in the long axis of the tooth. A little bit of buccal luxation is okay for canines and bicuspid.
 - vi. Lower molars – Can opener or pump handle; figure 8, buccal luxation motions in that order for extraction of lower molars using cowhorn (#23) forceps
5. Examine the root for complete extraction.
6. Carefully palpate the apical region with a curette.
 - a. To check for oro-antral communication (upper posteriors)
 - b. To check for and then remove periapical granulation tissue or cyst.
7. Remove periodontal granulation tissue with a Lucas curette and/or rongeur.
8. Palpate the alveolar process for sharp edges and undercuts (use Flynn's guide - ie your own finger.) Perform alveoloplasty as necessary.
9. Suture the gingival tissues if necessary.
10. Place gauze dressing. Check for hemostasis before dismissing the patient.
11. Give postop instructions, analgesic prescription, and follow-up appointment if necessary.

How to Extract a Tooth: Surgical

Perform a surgical extraction when there is:

- Severe loss of crown
- A tooth that cannot be luxated w/ forceps
- Widely divergent roots
- Dense, unyielding surrounding bone ex. Buccal exostoses
- Nearby structures that must be visualized and protected –severely crowded teeth
- Unplanned crown fracture during extraction

1. Flap: Incise the mucoperiosteum using a sulcular incision, extending at least one tooth anterior and posterior to the tooth to be extracted. Principles of flap design:
 - a. The base / apical end of the flap should be wider than Coronal end of the flap
 - b. Keratinized mucosa heals more rapidly/comfortably than non-keratinized mucosa.
 - c. Vertical releasing incisions should be placed at least 1 tooth anterior or posterior to the site of interest
 - d. Make vertical releasing incisions parallel to the local vasculature. Include a papilla at the apex of the flap, perpendicular to the gingival margin at line angles of teeth
2. Remove bone conservatively around the tooth if necessary. The purpose of this step is to allow elevator access to the periodontal ligament space
 - a. Make a trough with a bur around the crestal margin of the tooth, avoiding the periodontal ligament or tooth structure of the adjacent teeth. As a last resort, or if part of a necessary alveoloplasty, remove part of the facial plate of bone.
3. Section the tooth with a handpiece:
 - a. Stop short of completely sectioning through the tooth. You will crack the last 1-2 mm with an elevator.
 - b. Sectioning patterns
 - i. Upper first and second molars- a Y-with the stem passing between the two buccal roots and the branches passing to the mesiopalatal and distopalatal, around the palatal root.
 - ii. Lower molars- buccolingual, between the mesial and distal roots
 - iii. Upper bicuspid- mesiodistal and deep, to enter the furcation near the apex if possible. Be careful of the adjacent teeth
 - iv. Other conical-rooted teeth- mesiodistally or buccolingually and deep
 - c. Complete the sectioning of the tooth with a straight elevator inserted into the slot you have made in the tooth structure.
4. Elevate the tooth fragments with a succession of elevators starting with a small straight elevator and then a large straight elevator.
5. Examine the root pieces for complete extraction
6. Inspect the socket for remaining pieces of tooth or exposure of the sinus, inferior alveolar nerve, or perforations of the cortical plates.
7. Irrigate the socket and under the mucoperiosteal flap copiously with sterile saline
8. Achieve hemostasis with gelfoam, bone burnishing, firm pressure, sutures, vasoconstriction, hot cloth treatment. Use gelfoam for all patients on anti-coagulants, including 81mg aspirin.
9. Suturing
 - a. Use smallest diameter and least reactive material
 - b. Take adequate bite of tissue
 - c. Place sutures in keratinized tissue
 - d. Pass the suture from movable tissue to nonmovable tissue

- e. Remove 7-10 days after surgery

Healing Process Following Extraction

- Phases of bone healing:
 - 1. Hemorrhage and clot formation
 - 2. Organization of the clot by formation of granulation tissue
 - 3. Replacement of granulation tissue by connective tissue and epithelialization of the site
 - 4. Replacement of the connective tissue by fibrillar (“woven”) bone
 - 5. Remodeling of the alveolar bone and bone maturation
- Impaired healing
 - 4M’s: malignancy, metabolic, manipulation, mobility
 - Glucocorticoids retard healing by interfering with migration of PMNs and macrophages. They also inhibit the formation of granulation tissue by decreasing capillary, fibroblast, and collagen production potential
 - Poor vascularity in area around the wound, anemia, dehydration, increase age, infection, diabetes mellitus can all slow the process.

Surgery Complications

- Pain and Hemorrhage
- Infection/cellulitis
- Nerve damage: inferior alveolar nerve or lingual nerve - most of the cases, spontaneous recovery.
- Alveolar osteitis (a.k.a. Dry Socket): This is caused by dislodgement or lysis of blood clot and exposure of bone. It is NOT an infection and should NOT be treated with antibiotics. However, irrigation of extraction socket with antibiotics postoperatively has been shown to decrease risk, because it kills that bacteria that have fibrinolytic agents (like streptolysin) that contribute to clot breakdown. The risk of AO is higher in smokers and women on OCPs.
- Injury to adjacent tooth
- Jaw fracture

Post-Op Instructions

- Bite on gauze for 20 minutes. If bleeding persists, place another piece of gauze over the area for another 20 minutes.
- Be careful not to bite cheek, lip, or tongue while still anesthetized.
- Do not rinse mouth today.
- Red-colored saliva may be apparent for 12-24 hrs.
- If necessary, take NSAIDS prn pain.
- Drinking (but not rinsing) is encouraged; try to stay away from hot liquids first day.
- Try to eat a soft diet (i.e. soups, jello).
- Slight swelling may be expected to accompany the removal of teeth.
- Sinus precautions (only if OA communication occurs): don’t blow your nose, sneeze through mouth, no smoking or sucking through straws.
- Call if questions or concerns.

Post-Op Indications for Antibiotics

- Increased risk for local infection (Immunocompromised/Immunosuppressed): use PROPHYLACTIC not post-op antibiotics
- Evidence of pre-op local infection (eg pericoronitis): swelling, redness, fever, lymphadenopathy, pus
- Prolonged surgery or aseptic technique

Prescriptions for OMFS

- See Pharmacology section

Orofacial Infections

- *Cavernous sinus thrombosis* – spread of odontogenic infection from maxilla to cavernous sinus via hematogenous route. The veins of the head and orbit lack valves so this process can occur via one of two possible routes
 - Inferiorly through alveolar veins to pterygoid plexus to emissary veins.
 - Superiorly through angular vein and then the superior or inferior ophthalmic veins
- *Ludwig's Angina* – when single submental and bilateral submandibular and sublingual spaces become involved with an infection, leading to difficulty swallowing or breathing.
- *Fascial Planes/ Spaces*

Space	Odontogenic Sources of Infection	Contents
Buccal	Mandibular premolars Maxillary molars and premolars	- Parotid duct - Ant. facial artery/vein - Transverse facial artery/vein - Buccal fat pad
Infraorbital	Maxillary canine	- Angular artery/vein - Infraorbital nerve
Submandibular	Mandibular molars	- Submandibular gland - Facial artery/vein - Lymph nodes
Submental	Mandibular anteriors	- Ant. jugular vein - Lymph nodes
Sublingual	Mandibular molars and premolars	- Sublingual glands - Wharton's duct - Lingual nerve and artery - Sublingual artery/vein
Infratemporal	Maxillary molars	- Pterygoid plexus - CN V3

Cellulitis vs abscess

- Cellulitis is a warm, diffuse, erythematous, indurated, and painful swelling of the tissues in an infected area. Tx: antibiotics, surgical IND if no improvement over 2-3 days, evidence of purulence or risk of airway compromise
- Abscess is a localized and well circumscribed fluctuant pocket containing necrotic tissue, anaerobic bacteria, and dead white cells. Treatment: IND.

Facial Fractures

- Definitions
 - Simple – complete transection of the bone with minimal fragmentation at the site
 - Compound – results when fractured bone communicates with the external environment
 - Comminuted – a fracture that leaves the bone in multiple segments
 - Greenstick – incomplete fracture with flexible bone
 - Favorable – when the fracture line is angled in such a way that muscle pull resists displacement of the fractured segments
 - Unfavorable – when the fracture line is angled such that muscle pull results in displacement of the fractured segments
- Treatment options
 - Intermaxillary fixation (IMF) = Closed reduction
 - Rigid fixation (plates and screws) = Open reduction

- Combo of above

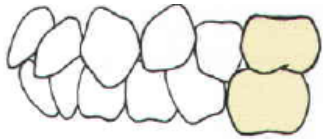
Osteonecrosis/ Osteoradionecrosis

- **Osteoradionecrosis (ORN)** – radiation of the head/neck results in permanent damage to bone osteocytes and microvasculature. The altered bone becomes **hypoxic, hypovascular, and hypocellular**. This altered bone is broken down and a nonhealing wound develops in which the tissues' metabolic demand exceeds supply. Most cases arise secondary to local trauma after radiation, but it can also occur spontaneously following radiation. Most frequently in the mandible.
 - **Clinical Presentation:** Diagnosis of ORN requires at least 3-5mm of intraoral exposed bone in an irradiated field present for at least 6 months. Other clinical features may include intractable pain, cortical perforation, fistula formation, surface ulceration, or pathologic fracture.
 - **Radiographic Presentation:** Ill-defined zone of radiolucency that may develop zones of relative radiopacity.
 - **Prevention:** Extractions should occur prior to radiation with at least 3 weeks healing time or within 4 months post radiation. Procedures after the 4 month “golden period” should be preceded and followed by hyperbaric oxygen therapy
- **Bisphosphonate-related Osteonecrosis (BRON)** – reports of osteonecrosis of the jaws in patients taking the IV bisphosphonates Zometa (zoledronic acid) and Aredia (pamidronate) in high doses for metastatic cancers or multiple myeloma began to arise in 2003. The majority of cases have been associated with dental procedures such as tooth extraction; however, BRON has also arisen in spontaneously. Cases of BRON have also been associated with the use of oral bisphosphonates Fosamax (alendronate), Actonel (risedronate), and Boniva (ibandronate); however the risk of BRON with oral bisphosphonate use seems very minimal.
 - **Clinical Presentation:** Generally presents with painful bone exposure, but patients may also be asymptomatic with the only finding being exposed bone. Possible associated findings include soft tissue swelling, infection, loosening of teeth, drainage – often at the site of tooth extraction.
 - **Prevention:**
 - Oral bisphosphonates: the ADA council on scientific affairs recommends emphasis on conservative surgical techniques, proper sterile technique, and antibiotic therapy. If patient has been taking oral bisphosphonates for greater than 5 years, they may no longer benefit the patient and PCP consult may be advised.
 - IV bisphosphonates: dental procedures should be avoided if at all possible while patient is undergoing IV therapy, especially after 3 months of therapy.

Orthodontics

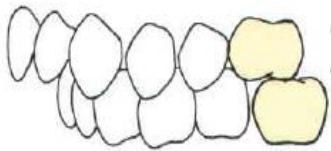
Occlusal Relationships

- **Angle's 3 classes of MALOCCLUSION** (based on **Molar** relationship; does NOT apply to canines). Based on the MB cusp of maxillary 1st molar in relation to buccal groove of mandibular 1st molar



Class I malocclusion

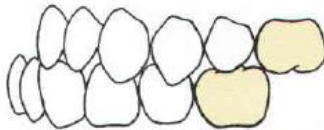
Class I malocclusion (50-55% of population): MB cusp of Max 1st molar is directly in line with buccal groove of Mand 1st molar; normal relation of molars, but line of occlusion is incorrect due to malposed teeth, rotations, etc.



Class II malocclusion

Class II malocclusion (15% of population): Buccal groove of Mand 1st molar is posterior to MB cusp of Max 1st molar

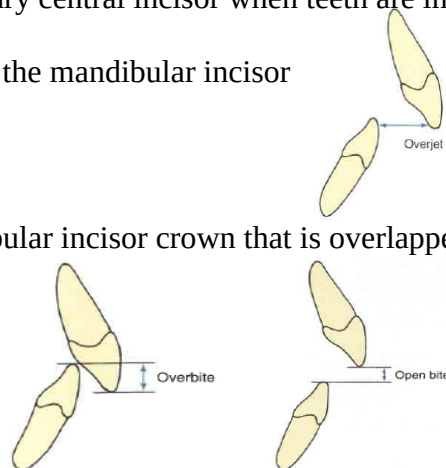
- Division 1: anteriors have labial inclination
- Division 2: anteriors have palatal inclination



Class III malocclusion

Class III malocclusion (< 1% of population): Buccal groove of Mand 1st molar is more anterior than normal to MB cusp of Max 1st molar

- Subdivision: when disocclusion occurs on 1 side of the dental arch only
- **NORMAL** occlusion (not defined by Angle) – 30% of population: Class I molar relationship AND proper line of occlusion
- **Canine relationship**
 - Class I: upper canine fits in the embrasure btw the lower canine and premolar
 - Class II: upper canine is mesial to Class 1
 - Class III: upper canine is distal to Class 1
- **Skeletal relationships** – based on cephalometric measurement of SNA, SNB, and ANB as compared to norms for a particular population
- **Overjet**: the horizontal distance between the labial surface of the most labial mandibular central incisor and the incisal edge of the most labial maxillary central incisor when teeth are in maximum intercuspation.
 - Negative when maxillary incisor is lingual to the mandibular incisor
 - Normally 2mm
- **Overbite**: The percentage or amount of the mandibular incisor crown that is overlapped vertically by the maxillary incisors when in MIP.
 - Expressed in % but measured in mm
 - Normally 30%, 2-3mm
 - Negative when open bite
- **Midline discrepancy**



- Distance between the upper and lower dental midlines measured in mm
- Normally coincident
- Midline diastema (space between the max CI) should also be measured

- **Cross-bite**

- Lingual crossbite: when the upper teeth are too far lingual in relation to the opposing lower teeth
- Buccal Crossbite: when the upper teeth are positioned too far buccally (lingual cusp of maxillary teeth are buccal to buccal cusp of mandibular teeth)

Normal occlusion

- Andrew's 6 keys to normal occlusion

- **Molar relationship:** in addition to features of mesiobuccal cusps described by Angle, Andrew requires that the distal surface of the distobuccal cusp of the upper first permanent molar occlude with the mesial surface of the mesiobuccal cusp of the lower second molar - because it is possible for molars to occlude in Angle's Class I molar relationship while leaving a situation unreceptive to normal occlusion
- **Crown angulation:** teeth have mesial tilt
- **Crown inclination**
 - Anterior: upper and lower inclination are intricately complementary and affect overbite and posterior occlusion
 - Posterior: more lingual as you go further posterior for both maxilla and mandible
- **Rotations:** free of undesirable rotations
- **Spaces:** contact points should be tight and serious tooth-size discrepancies corrected
- **Occlusal plane:** intercuspatation of teeth is best when a plane of occlusion is relatively flat (flat curve of Spee).

- ABO Standards for normal occlusion

- Andrew's 6 keys plus:
 - Flat curve of Wilson
 - Less than 0.5mm of marginal ridge discrepancy in posterior teeth
 - Relatively parallel roots

Functional Occlusion – no universal standard

- Bilateral occlusal contacts in the retruded contact position
- Coincidence in the position of retruded contact and MIP or only a short slide between the two positions (<1mm)
- Contact between opposing teeth on the working side during lateral excursion (either canine guidance or group function)
- No Contact between teeth on non-working sides during excursions

Orthodontic Exam

- **Smile Analysis**

- **Smile**

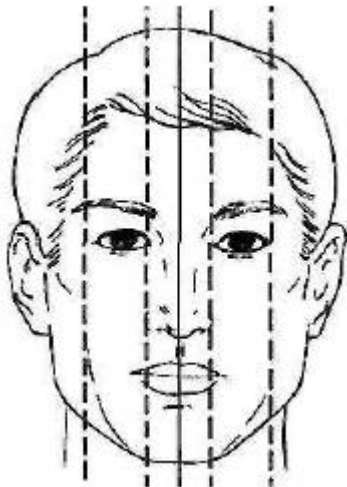
Incisal display

Elevation of the upper lip on smiling should stop at or near the gingival margin, so that all of the upper incisor is seen

- mm of incisor show:
- % of lower incisors not displayed:
- Gingival display

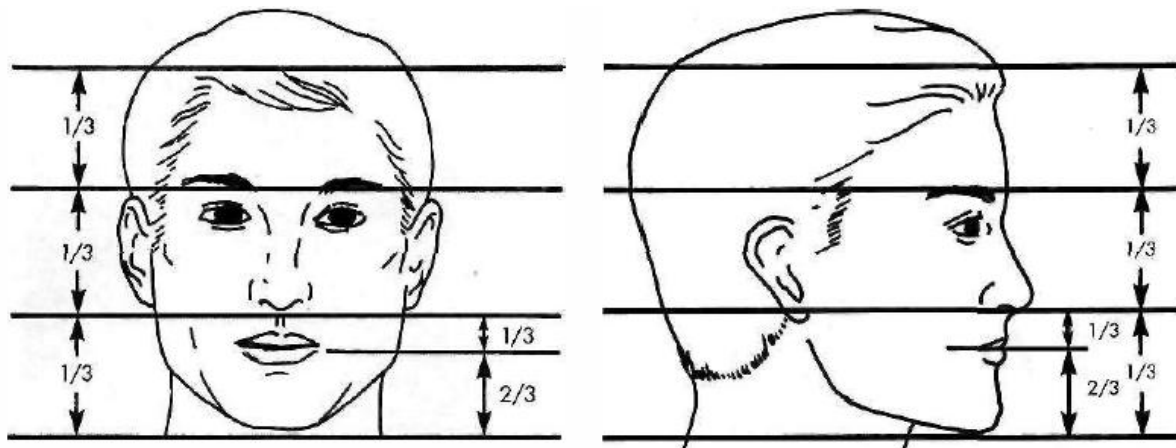
Excessive gingival display may be due to a long face or short upper lip

- Findings regarding Symmetry/proportions:
- Relationship Max Dental Midline to Facial Midline:
- **Frontal**
 - Facial type:
 - Ovoid/Round/Square/Triangular/Long & narrow
 - Findings regarding symmetry of face:



An ideally proportional face can be divided into central, medial and lateral equal fifths. The separation of the eyes and the width of the eyes should be equal. The nose and chin should be centered on the central fifth. The width of the nose should be the same as, or slightly wider than the central fifth. The inter-pupillary distance should equal the width of the mouth.

- Vertical proportions discrepancy:
-

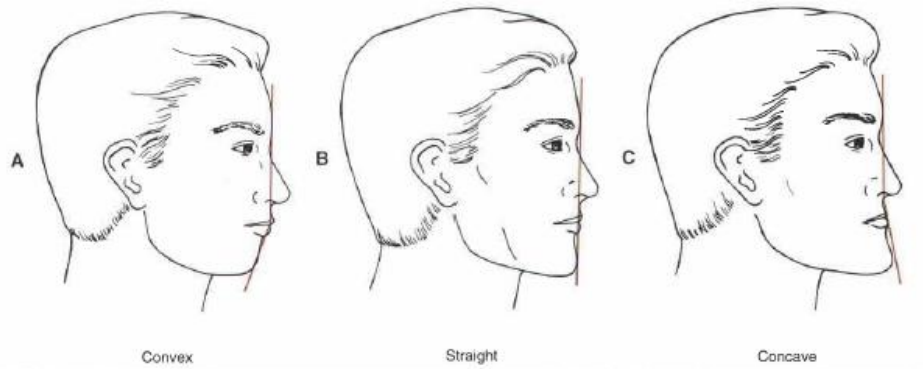


- Nose
 - Lips incompetency at rest?
Lips that are separated by > 3-4mm at rest are incompetent
- Incisor show
 - mm at rest:
 - mm smiling:
 - deviation in maxillary skeletal midline:
 - deviation in mandibular skeletal midline:
 - deviation in chin midline:

- is there a cant of the lip:
- Profile

- Shape:

Draw line from forehead (Glabella) to base of nose (Subnasale), and a second line extending from that point to the chin (Pogonion)



- Forehead: Straight/Bossed
- Malar eminence: Flat/Prominent
An indication that a patient has a flat malar eminence is the presence of excess scleral show
- Upper lip: Everted/Averted/Flat
- Lower lip: Everted/Averted/Flat
- Naso-labial angle: acute/90°/obtuse



Normal is 90-120 degrees (more obtuse angle more favorable in females, more acute in males).

- Mental sulcus: shallow/deep
The fold of soft tissue between the lower lip & chin. Patients with excessive lower incisor proclination or shortened lower facial height tend to have a deeper mental sulcus.
- Mentalis strain: Thick/thin
*If the mentalis strain is **thick**, the patient's chin will appear wrinkled upon closure of the lips.*
- Chin: prominent/extruded/retruded
Chin projection is determined by the amount of anteroposterior bony projection of the anterior, inferior border of the mandible, and the amount of soft tissue that overlays that bony projection. Prominent is considered normal.

- Cervico-mental length:



Longer is better, up to a point

- Cervico-mental angle:



*Normal range between 105-120°;
An obtuse angle often indicates
chin deficiency, excessive
submental fat, lower lip
procumbency, retropositioned
mandible, or a low hyoid bone
position*

- **Extraoral evaluation**
 - TMJ: clicking, popping, crepitus
 - Muscle palpation: masseter, temporalis, medial and lateral pterygoid, SCM, trapezius
 - Habits: clenching, grinding
- **Dental Evaluation**
 - Angle's Classification
 - Canine classification
 - Dentition: missing teeth, delayed eruption, impactions, eruption pattern, etc.
 - Crowding: slight (< 4mm), moderate (4-8mm), severe (>8mm)
 - Incisor positions, Overbite, Overjet & Crossbite
 - CR-MIP discrepancy?
 - Occlusal curve (Curve of Spee)
 - Arch form, Crowding, Rotations, Arch asymmetry
 - Midlines and frenum attachments
 - Oral hygiene, oral habits, periodontal status & patient attitude

Orthodontic Cast Evaluation

- Presence or absence of teeth: Look at # of teeth, stage, development, supernumerary, transposition
- Angle Classification
- Tooth morphology and size
- Space Analysis
 - Transitional dentition: we want to be able to estimate the size of the un-erupted canines and premolars because they are smaller than the primary molars that they replace
 - Moyer's mixed dentition analysis:

- The size of the un-erupted canines and premolars is predicted from the knowledge of the size (mesiodistal width) of the **mandibular incisors** that have already erupted into the mouth early in the mixed dentition.
- Note: the mandibular incisors are measured to predict the size of maxillary as well as mandibular teeth.
- Tanaka and Johnston
 - Maxilla

$$\frac{\text{Sum of M-D widths of Mand. Incisors}}{2} + 11 = \text{Estimated size of canine/ premolars on one side of the maxillary arch}$$

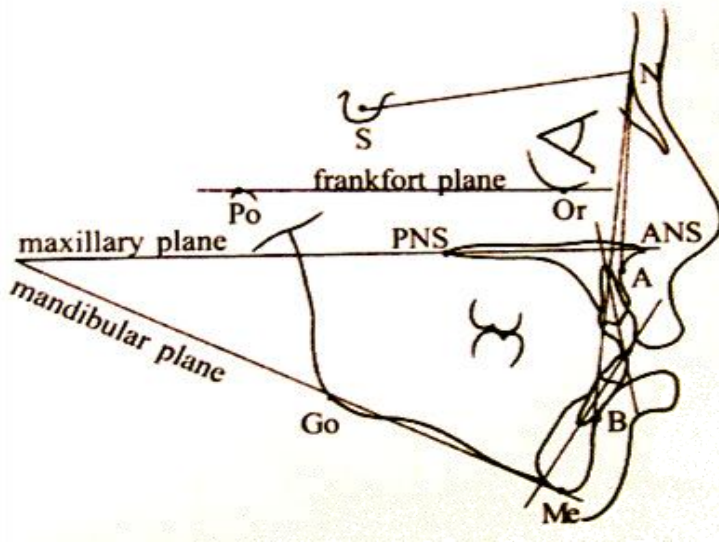
- Mandible

$$\frac{\text{Sum of M-D widths of Mand. Incisors}}{2} + 10.5 = \text{Estimated size of canine/ premolars on one side of the mandibular arch}$$

- Tooth size/arch perimeter discrepancy (space available minus space required)
 - If discrepancy is negative → crowding
 - If discrepancy is positive → spacing
- If patient is in mixed dentition:
 - Multiply estimate of canines / premolars as described above by 2, then add the mesial-distal width of the incisors within that arch to get "space required"
 - Measure actual arch length in straight line from mesial of the 1st molar to mesial canine, then mesial canine to mesial central incisor on both sides and add all measurements together for "space available"
- If patient is in permanent dentition:
 - Measure mesio-distal dimensions of each incisor, canine and premolar and add together for "space required"
 - Measure actual arch length in straight line from mesial of the 1st molar to mesial canine, then mesial canine to mesial central incisor on both sides and add all measurements together for "space available"
-
- Sagittal dental relationships: overjet, occlusal plane
- Vertical dental relationships: overbite, submerged teeth, super-erupted teeth
- Transverse dental relationships: crossbites, midlines, rotations
- Mand/Max tooth proportions
 - Bolton Analysis:
 - Anterior: the sum of the mesial distal widths of the 6 mandibular anteriors divided by the sum of the mesial distal widths of the 6 maxillary anteriors
 - Normal proportion: 77.2%
 - Overall: the sum of the mesial distal widths of 12 mandibular teeth (1st molar to 1st molar) divided by the sum of the mesial distal widths of 12 maxillary teeth (1st molar to 1st molar)

- Normal proportion: 91.3%

Cephalometrics



-Anterior Nasal Spine (ANS)

-**point A**: innermost part on contour of premaxilla btw ANS and incisor tooth
 -**point B**: innermost part on contour of mandible btw incisor tooth and bony chin

-**Nasion (N)**:

-**Sella (S)**: midpoint of sella turcica

-**Porion (Po)**: outer upper margin of external auditory canal

-**Menton (Me)**: most inferior part of mandibular symphysis

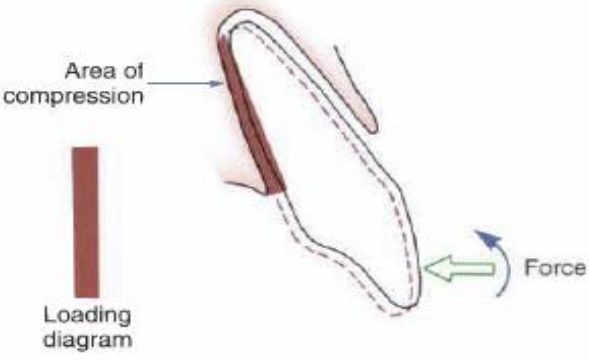
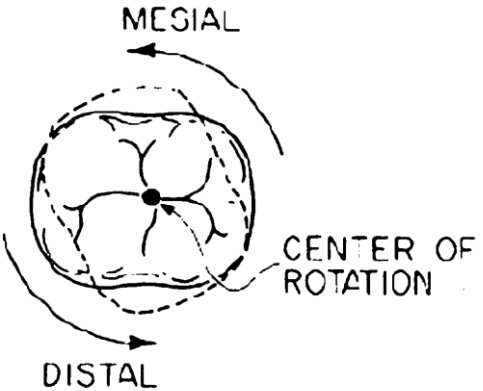
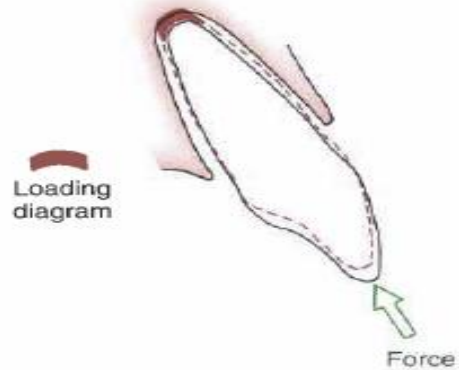
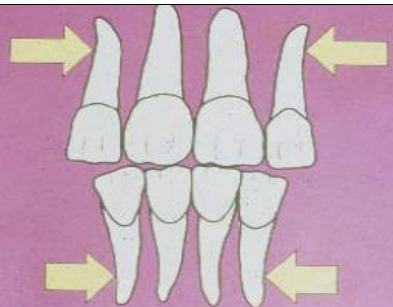
-**Gonion (Go)**: lowest most posterior part on mandible with teeth in occlusion

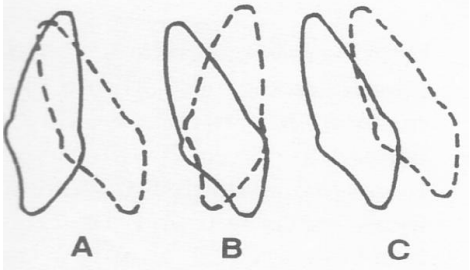
-**Orbitale (Or)**: lowest point of orbit

Cephalometric Measurement	Greater Than Mean	Less Than Mean
SNA (degrees)	Prognathic maxilla	Retrognathic maxilla
SNB (degrees)	Prognathic mandible	Retrognathic mandible
ANB (degrees)	Skeletal class II	Skeletal class III
Palatal plane to Mand. Plane (degrees)	Hyperdivergent / clockwise grower	Hypodivergent / counter-clockwise grower
SN-Mand plane (degrees)	Hyperdivergent / clockwise grower	Hypodivergent / counter-clockwise grower
ANS-Me (mm) / N-Me (mm) = (%)	Long lower face height	Short lower face height
Mx incisor to NA (degrees)	Proclined maxillary incisors	Retroclined maxillary incisors
Mx incisor to NA (mm)	Protruded maxillary incisors	Retruded maxillary incisors
Mn incisor to NB (degrees)	Proclined mandibular incisors	Retroclined mandibular incisors
Mn incisor to NB (mm)	Protruded mandibular incisors	Retruded mandibular incisors
Mx incisor to Mn incisor (degrees)	Retroclined incisors	Proclined incisors

Tooth movement

Types of tooth movement		
Simple tipping	-one point force on the crown -tooth rotates around center of resistance -crown moves mesially or distally	

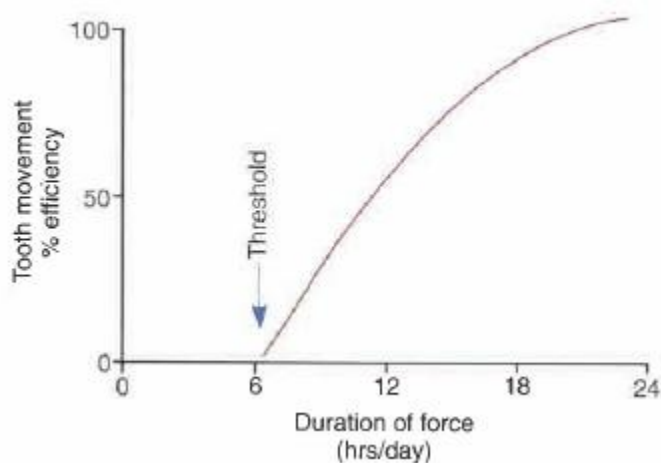
Translation	-bodily movement of tooth	 The diagram shows a tooth with a red area at the crown labeled 'Area of compression'. A green arrow labeled 'Force' points to the right. A red vertical bar labeled 'Loading diagram' is shown to the left of the tooth.
Rotation	-around the long axis of the tooth -often requires supracrestal fiberotomy to prevent relapse.	 The diagram shows a cross-section of a tooth with a central dot labeled 'CENTER OF ROTATION'. Curved arrows indicate rotation. The top is labeled 'MESIAL' and the bottom is labeled 'DISTAL'.
Intrusion	-moving the tooth into the bone -requires light force b/c force is concentrated over small area of root apex	 The diagram shows a tooth with a red area at the crown labeled 'Loading diagram'. A green arrow labeled 'Force' points upwards towards the root apex.
Extrusion	-moving the tooth "out" of the bone (implies that the bone comes with the tooth)	
Uprighting	-Root tip moves mesially or distally into correct alignment	 The diagram shows a set of teeth with yellow arrows pointing inwards from the sides, indicating the movement of the root tips into alignment.

Torque	-buccolingual movement of the root	
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- Teeth with incomplete root formation CAN be moved, but a light force must be applied, otherwise dilacerations will occur

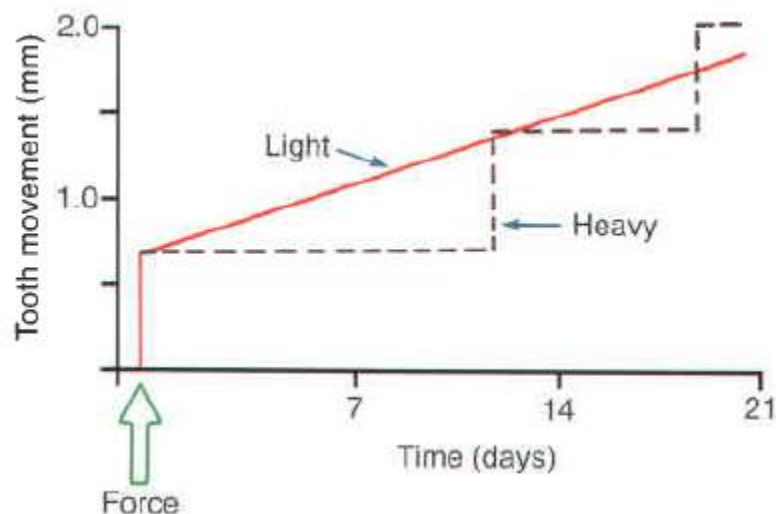
Efficiency of tooth movement

- Continuous force for 24 hrs/day produces most efficient tooth movement
- Continuous force must be applied for at least 6hrs for tooth movement to occur



Biology of Tooth Movement

- Normal tooth/PDL function
 - Teeth/PDL experience force of 10-500 N during mastication
- Orthodontic movement – When an orthodontic force is applied, one of two things occur:



- *Heavy force* – delays tooth movement by causing a lag period
- *Light force* -- Smooth, continuous movement of teeth; ~2mm of tooth movement/ 3wk period

Physiologic response to sustained pressure against a tooth		
Time	Heavy pressure	Light pressure
<1 sec	PDL fluid incompressible, alveolar bone bends, piezoelectric signal generated	PDL fluid incompressible, alveolar bone bends, piezoelectric signal generated
1-2 sec	PDL fluid expressed, tooth moves w/in PDL space	PDL fluid expressed, tooth moves w/in PDL space
3-5 sec	Blood vessels within PDL occluded on pressure side	Blood vessels w/in PDL partially compressed on pressure side, dilated on tension side; PDL fibers and cells mechanically distorted
Minutes	Blood flow cut off to compressed PDL area	Blood flow altered, O ₂ tension Δ, prostaglandins and cytokines released
Hours	Cell death in compressed area	Metabolic Δ: chemical messengers affect cellular activity, enzyme levels change: ↑ cAMP levels detectable, cellular differentiation begins w/in PDL
3-5 days	Cell differentiation in adjacent marrow spaces, resorption begins No tooth movement can occur until resorption has been completed (Lag period)	2 days: tooth movement beginning as osteoclasts/osteoblasts remodel bony socket
7-14 days	Resorption removes lamina dura adjacent to compressed PDL → tooth movement occurs	

Deleterious effects of orthodontic forces

- Mobility
- Pain
- Tissue inflammation
- Effect on the pulp
- Root resorption

Interceptive Orthodontics

- Indications:
 - Growth modification of class II or class III
 - Crossbite / maxillary constriction - want to expand before the sutures close
 - Huge overjet - to prevent trauma
 - Open bite (habit control) at age of 5
 - Excessive crowding - may need serial extractions
 - Early tooth loss: space maintenance
- Consists of functional appliances, head gears, habit control. No braces and brackets, need specific objectives during pubertal growth spurt

- Advantages:
 - Psychosocial issues – better self image
 - Easier second-phase treatment
 - Remove abnormalities that impede growth
 - Possible avoidance of surgery
- Disadvantages:
 - One-phase therapy is as effective as two-phase therapy
 - Long treatment time – possible patient burn out

Serial Extractions

- For large space discrepancies (> 10mm per arch)
 - 1) Extract primary incisors
 - 2) Extract primary canines to allow permanent incisors to erupt and align
 - 3) Extract primary 1st molars to encourage eruption of permanent 1st premolar (before permanent canines erupt)
 - 4) Extract permanent first premolar to allow permanent canine to erupt and align

Characteristics and Treatment of Malocclusion

	Characteristics
Class II	- Convex profile - Division I: proclined or normally inclined max incisors, usually with overjet, and hyperdivergency - Division II: retroclined maxillary incisors, usually with deep bite, and less convex profile - Retruded chin and/or prognathic maxilla - Acute nasolabial angle (if prognathic maxilla) - Increased incisor show at rest and smiling (normal 2-3mm)
Class III	- Concave profile - Strong chin - Flat midface or sunken in look - Obtuse nasolabial angle - Deficient zygomatic, paranasal, infraorbital areas - Decreased max incisor show / increased mandibular incisor show - Reduced upper lip length - Crossbite tendency - Decreased attached gingiva for mand anterior - Absence of max laterals, peg laterals - Often familial pattern / genetic predisposition. - True class III: proclined max incisors and retroclined mand incisors
Pseudo Class III	- Anterior crossbite (though able to move into edge to edge incisor relationship) - Retroclined max incisors and proclined mand incisors - Often skeletal class I - CO-CR discrepancy - Etiology i. Dental interferences: anterior most likely ii. Supernumerary on max iii. Over-retention of 1st teeth iv. Inclination of teeth

Molar uprighting

- Indications:
 - Early loss of teeth in adult patients with loss of dentolaveolar bone
 - Extensive alveolar ridge resorption
 - Severely tipped molars
 - Periodontal involvement of the mesial root of the molar to be uprighted
- Advantages:
 - Improves distribution of occlusal forces
 - Decreases amount of tooth reduction required for parallel abutments
 - Decreases possibility of perio, endo, or more complex prosth procedures
 - Increases durability of restorations due to better force distribution
 - Improves perio environment by eliminating plaque-retentive areas
 - Improves alveolar contour
 - Improves crown: root ratio
- Complications:
 - Open bite and loss of anterior guidance
- Sequencing of procedure
 - Separate → band → upright → complete perio surgery → complete restorative tx
 - Tx time: 6-12mo
 - Allow 2-6mo stabilization time after uprighting (longer if perio surgery is involved)

Pediatric dentistry

General Concepts

- Definitions
 - Primate space:
 - Mesial to Max primary canine
 - Distal to manD primary canine
 - Leeway space: space difference between the mesial-distal width of the (primary 2nd, 1st molars & canine) and the (perm 1st & 2nd PM and canine).
 - Max: 0.9mm/side or 1.8mm/arch
 - Mand: 1.7mm/side or 3.4mm/arch
 - Incisor liability: the difference in the mesial-distal width of the (permanent incisors) and the (primary incisors to include interdental spacing).
 - Max: 7.6mm
 - Mand: 6.0mm
 - Early mesial shift: occurs when the 1st perm molars erupt and cause a mesial shift into the primate spaces.
 - Late mesial shift: occurs when the 2nd permanent molars erupt and cause a mesial shift of the 1st perm molars into the Leeway space.
- Tips for Behavior Management
 - Tell, show, do
 - Modeling with older siblings
 - Stabilize patient's head
 - Keep your eyes on the patient's eyes – blind exchange of instruments
 - If the parent comes back to the operatory with the child – they must be a “silent partner”
 - Give options to the child, but don't ask if it is “ok” to do something – he/she will say no
 - Positively reinforce helpful behaviors only
 - Use distraction and voice control as needed
- Clinical Tips
 - Palpable lymph nodes until ~ 12 yrs old (but should not be fixed)
 - Attention span of 3 yr old is about 9-15mins (add 3-5 mins per year)
 - Kids have lower BP, higher pulse and RR
 - Position child high in chair
 - No contacts between primary teeth until ~age 3-4 yrs → start flossing!!
 - Pediatric FMX = 2 BW (once there are posterior contacts: ages 4+) + 2 occlusal
 - Periapical films if suspected pathology
 - Kids can't expectorate until ~age 4-6 yrs (about the time they can tie their shoes)
 - IANB should be at occlusal level
 - Mental block is between 1st and 2nd primary molars
 - Max dose of 2% lidocaine is 2mg/lb; always warn child not to bite the “numb” cheek or lips
 - Nitrous Oxide: use flow rate of 6L/min at 33% Nitrous and no food (risk of aspiration) for 4 hours prior
- Pediatric Dictionary
 - Cotton roll = “tooth pillow”
 - Handpiece = “water sprayer”
 - Rubber dam = “tooth raincoat”
 - Rubber dam clamp = “tooth ring”
 - Saliva ejector = “Mr. Thirsty”
 - Local anesthetic = “sleepy juice”
 - Explorer = “tooth counter”
 - Etch = “blue shampoo”

Stages of Embryonic Craniofacial Development

Stage	Time	Related Syndrome
Germ layer formation	Day 17	- Fetal alcohol syndrome
Neural tube formation	Days 18-23	- Anencephaly
Cell migration	Days 19-28	- Hemifacial microsomia - Treacher-Collins - Limb abnormalities
Primary palate formed	Days 28-38	- Cleft lip and/or palate - Other facial clefts
Secondary palate formed	Days 42-55	- Cleft palate
Final differentiation	Day 50 – birth	- Achondroplasia synostosis syndromes (Crouzon's, Apert's)

Eruption Sequence

- General trends
 - Girls before boys
 - Mandible before maxilla
 - Eruption times are +/- 6 months
 - The eruption sequence (in general) for the primary dentition is central incisor, lateral incisor, 1st molar, canine, 2nd molar
 - When a tooth clinically erupts in the mouth, $\frac{1}{2}$ - $\frac{2}{3}$ of the root structure has usually developed
 - The length of time for root completion of primary tooth – 18m post eruption
 - Length of time for root completion of permanent tooth – 3y post eruption

- Primary

	Enamel Complete	Eruption	Root Complete
Mandibular centrals	2.5 mo	6 mo	1.5 yrs
Mandibular laterals	3 mo	7 mo	1.5 yrs
Maxillary centrals	1.5 mo	7.5 mo	1.5 yrs
Maxillary laterals	2.5 mo	9 mo	2 yrs
Mandibular 1 st molars	5.5 mo	12 mo	2.5 yrs
Maxillary 1 st molars	6 mo	14 mo	2.5 yrs
Mandibular canines	9 mo	16 mo	3 $\frac{1}{4}$ yrs
Maxillary canines	9 mo	18 mo	3 $\frac{1}{4}$ yrs
Mandibular 2 nd molars	10 mo	20 mo	3 yrs
Maxillary 2 nd molars	11 mo	24 mo	3 yrs

* **Rule of 4s** 4 teeth erupt every 4 months beginning with 4 teeth at age 7 months

** Initiation of primary tooth formation begins around 6 weeks in utero, while calcification of all primary teeth begins between 4-6 months in utero

- Permanent

	Enamel Complete	Eruption	Root Complete
Mandibular 1 st molars	2.5 – 3 yrs	6-7 yrs	9–10 yrs
Maxillary 1 st molars	2.5 – 3 yrs	6-7 yrs	9–10 yrs
Mandibular centrals	4-5 yrs	6-7 yrs	9 yrs
Maxillary centrals	4–5 yrs	7-8 yrs	10 yrs
Mandibular laterals	4–5 yrs	7-8 yrs	10 yrs
Maxillary laterals	4–5 yrs	8-9 yrs	11 yrs
Mandibular canines	6-7 yrs	9-10 yrs	12-14 yrs
Maxillary 1 st premolar**	5-6 yrs	10-11 yrs	12-13 yrs
Mandibular 1 st premolar**	5-6 yrs	10-12 yrs	12-13 yrs
Maxillary 2 nd premolar**	6-7 yrs	10-12 yrs	12-14 yrs
Mandibular 2 nd premolar**	6-7 yrs	11-12 yrs	13-14 yrs
Maxillary canines	6-7 yrs	11-12 yrs	13-15 yrs
Mandibular 2 nd molars	7-8 yrs	11-13 yrs	14-15 yrs
Maxillary 2 nd molars	7-8 yrs	12-13 yrs	14-16 yrs
Mandibular 3 rd molars	-	17-21 yrs	-
Maxillary 3 rd molars	-	17-21 yrs	-

*Formation of all permanent teeth begins between birth and 2.5 yrs

**Premolars often violate the general trend of mandible before maxilla

Anticipatory Guidance

<i>6-12 months old</i>	- Eruption of first primary tooth: mandibular central incisors - First dental visit: by 1st birthday or within 6 mo. of first tooth erupting - Teething: infants may have signs of systemic distress that include rise in temperature, diarrhea, dehydration, increased salivation, skin eruptions, and GI disturbances. To reduce symptoms, increase fluid consumption, use non-aspirin analgesic, and use teething rings to apply cold pressure. If symptoms persist contact physician to rule out upper respiratory ear infection - Oral hygiene: parent brushing with “smear” of fluoridated dentifrice - Assess fluoride status - Habits: pacifier or thumb-sucking - Nutrition • Breast-feeding: studies indicate that breast milk is not cariogenic; however prolonged unrestricted nursing has been implicated in early childhood caries once the child has starting taking solid food • Nursing bottle: infants should never be given a bottle to serve as a pacifier, if parents insist on using a bottle while the child is sleeping, the contents should be water. - Injuries: primary tooth trauma
<i>12-24 months old</i>	- Completion of the primary dentition, occlusal relationships, arch length - Discuss development – space maintenance, bruxing*, primate spacing - Assess fluoride status - Oral hygiene: parent brushing with a” smear” of fluoridated dentifrice - Nutrition: infants should be weaned from bottle, juices should only be offered from a cup, discuss cariogenic diet, frequency of sugars, plaque - Injures: home child-proofing and car seats
<i>2-6 years old</i>	- Loss of first primary tooth, eruption of first permanent tooth - Molar occlusion classification - Assess fluoride status - Oral hygiene: child begins brushing under supervision (~6years old) with a “pea-sized” amount of fluoridated dentifrice, sealants - Habits: help break habit of non-nutritive sucking if not already stopped - Nutrition: discuss cariogenic diet, frequency of sugars, plaque - Injuries: sports, bike helmets, car seat

* Bruxing is common and perfectly normal in the primary dentition

Dimension Changes in the Dental Arches

- Maxillary intercanine width increases by ~6mm between ages 3-13 and an additional 1.7 between ages 13-45.
- Mandibular intercanine width increases ~3.7mm between ages 3-13 and then decreases by 1.2mm between ages 13-45 → late mandibular crowding

Caries Risk Assessment

	Low	Moderate	High
Physical, developmental, mental, sensory, behavioral, or emotional impairment	No	-	Yes
Impaired saliva	No	-	Yes
Frequency of dental visits	Regular	Irregular	None
Child has decay	No	-	Yes
Time lapsed since last cavity	>24 months	12-24 months	<12 months
Wears braces or orthodontic appliance	No	-	Yes
Parent or sibling has decay	No	-	Yes
Socioeconomic status	High	Middle	Low
Frequency of between-meal exposure (snacks / drinks other than water)	0	1-2	>3
Fluoride exposure	Fluoridated toothpaste, drinking water and/or supplementation	-	Non-fluoridated water, non-fluoride tooth paste, no supplementation
Frequency of daily brushing	2-3	1	<1
Visible plaque	Absent	-	Present
Gingivitis	Absent	-	Present
Areas of demineralization (white spots)	0	1	>1
Enamel defects or deep pits/ fissures	Absent	-	Present
Radiographic enamel caries	Absent	-	Present
Strep mutans level	Low	Moderate	High

*Overall risk assessment based on the single highest indicator (eg 1 indicator in the high category classifies the child as high risk overall)

Plaque Score

- Measurement of the state of oral hygiene by recording calculus and plaque findings on the following 4 surfaces:

- Buccal surface of #3 or A
- Buccal surface of #8 or E
- Lingual surface of #19 or K
- Lingual surface of #24 or O

SCORE	CRITERIA
0	No plaque
1	Plaque in gingival 1/3 of tooth
2	Plaque in gingival 2/3 of tooth
3	Tooth entirely covered in plaque

- The calculus and plaque findings for each surface are scored from 0-3 according to the above criteria. The scores from the 4 surfaces are added together to give the patient's plaque score.

Frankl Scale

Frankl Scale	Behavior	
Category #1 (- -)	Definitely negative. Child refuses treatment, cries forcefully, fearfully, or displays any agitated, overt evidence of extreme negativism.	Combative, thrashing, verbal, unable to be restrained, need to terminate procedure.
Category #2 (-)	Negative. Reluctant to accept treatment and some evidence of negative attitude (not pronounced).	Slightly combative, verbal, slightly agitated, able to be restrained and procedure safely completed
Category #3 (+)	Positive. The child accepts treatment but may be cautious. The child is willing to comply with the dentist, but may have some reservations.	Quiet, not combative, cooperative, nonverbal.
Category #4 (+ +)	Definitely positive. This child has a good rapport with the dentist and is interested in the dental procedures.	Happy, helpful

Fluoride

- Mechanism of action
 - The primary effect is via local action
 - Studies show no benefit from prenatal fluoride supplementation
 - Pea-sized smear of Fluoride toothpaste recommended for children < 2yrs
 - Effects:
 - Increased resistance to demineralization
 - Increased remineralization via fluoro-apatite formation
 - Decreased cariogenicity of plaque by blocking bacterial glycolysis (fluoride inhibits bacterial enolase)

- Dosage Recommendations for Supplementation

	Fluoride Concentration in Water Supply		
AGE	<0.3ppm	0.3-0.6ppm	>0.6ppm
Birth – 6 mo	0	0	0
6 mo – 3 yrs	0.25mg/day	0	0
3 yrs – 6 yrs	0.50 mg/day	0.25mg/day	0
6 yrs – 16 yrs	1.0 mg/day	0.50 mg/day	0

* Recommended concentration in water supply: 1ppm, max. 4ppm

**Acute fluoride toxicity: nausea, vomiting, hypersalivation, abdominal cramping, diarrhea

- Prescriptions for fluoride supplementation:

<i>3 year old patient</i>	<i>8 month old patient</i>
Sodium Fluoride 0.25mg tablets Disp: 180 tablets Sig: Chew one (1) tablet, swish, and swallow after brushing at bedtime. Nothing by mouth for 30mins after	Sodium Fluoride Solution 0.5mg/ml (0.25mg Fluoride ion) Disp: 50ml Sig: dispense 0.5ml of liquid in mouth before bedtime

- Methods of Delivery

- Age 0-3 yrs: varnish – watch for pine nut allergy!
- Age 3-6 yrs: Gel/Foam in trays or varnish (preferable to avoid toxicity)
- Age 6-12 yrs: Gel/foam in tray plus fluoride tooth paste and / or fluoride rinse

- Toxicity

- Probable toxic dose: 5mg / kg
- Certain lethal dose: 16-32mg F / Kg
- Treatment:
 - If ingestion is <8mg / Kg – give milk and monitor
 - If ingestion is >8mg / Kg – induce vomiting, give milk and/or TUMS, and take to the hospital

Sealants

- General information

- Pit and fissure caries account for approx. 80% of all caries in young adults
- Isolation is key factor in clinical success (retention) – so use the rubber dam!

- When to use sealants:

- Deep pits and fissures
- Increased caries risk
- Incipient caries in pits and fissures

*Applies to both permanent and primary teeth, in both children and adults

- Recommendations

- Resin sealants should be the first choice materials
- Sealants should be applied with 1-bottle system bonding agent (eg Optibond Solo)
- Mechanical prep of enamel is not advised
- Use 4-handed technique when possible
- Monitor and reapply sealants as needed

Ellis Fracture Classification

- Applies to both primary and permanent teeth
- Fractures are often considered to be complicated or uncomplicated based on whether the fracture affects the pulp or not
- Take xray from 2 views in order to see the fracture

FRACTURE	DEFINITION	Treatment of Primary Teeth	Treatment of Permanent Teeth
Infraction	Craze lines in enamel; Concussion may be significant	Observation	Observation
Class I	Simple fracture of crown; Fracture in enamel only	Smooth off rough edges and resin restoration, if tooth fragment available it can be re-bonded	Smooth off rough edges and resin restoration, if tooth fragment available it can be re-bonded
Class II	Fracture of crown into dentin	<i>Initial visit:</i> wash, place Ca(OH)_2 if close to pulp, cover with glass ionomer and a resin bandage (quick resin restoration – may not look perfect) – may do regular restoration if time permits <i>Follow up 4-6 wks:</i> Place final resin restoration	<i>Initial visit:</i> wash, place Ca(OH)_2 if close to pulp, cover with glass ionomer and a resin bandage (quick resin restoration – may not look perfect) – may do regular restoration if time permits <i>Follow up 4-6 wks:</i> Place final resin restoration
Class III	Extensive fracture of crown into pulp	Pulp cap with Ca(OH)_2 or partial pulpotomy. Extract if necessary	Closed Apex - Options: direct pulp cap, partial pulpotomy, full pulpotomy, or pulpectomy depending on size of exposure and time elapsed since fracture – small/recent → partial, big/not recent → pulpectomy Open Apex - Any size, < 48hrs since fracture → pulpotomy (aiming for apexogenesis) - Any size, > 48 hrs since fracture → pulpectomy (aiming for apexification) → likely need RCT later.
Class IV	Fracture that includes both the crown and root	Extract	Same as Class III
Root Fracture	Horizontal or oblique fracture affecting only the root More apical fracture → prognosis ↑	If coronal segment is displaced, extract only that segment	Reposition coronal segment and verify position radiographically Splint for 4 weeks – 4 months . Monitor pulp 1 year – do RCT to fracture line if needed – or extract

*These guidelines may differ from class notes – keep this in mind for exam purposes

Displacement Injuries

- 1 wk follow-up: assess mobility, percussion/palpation sensitivity, color changes
- Take first xray 1 month after displacement injury
- If ankylosis is suspected, do not place gutta percha in the canal—place ZOE because it resorbs

INJURY	DEFINITION	Treatment of Primary Teeth	Treatment of Permanent Teeth
Concussion	No mobility or displacement but tender to palpation/percussion	Observation	Monitor pulpal condition for at least 1 year
Subluxation	Mobility of tooth w/o displacement	Observation	Stabilization with flexible splint up to 2 weeks
Luxation	Tooth displacement or dislocation	<i>Extrusive</i> - <3mm: carefully reposition, or observe allowing for spontaneous alignment - >3mm: extract <i>Intrusive</i> - apex displaced toward / through labial bone plate: observe for spontaneous repositioning (2-4mo) - may need RCT if tooth necrotic - apex displaced into developing tooth germ: extract <i>Lateral</i> - No occlusal interference: observe allowing for spontaneous repositioning - If occlusal interference: use local anesthesia and reposition with combined labial/palatal pressure - Severe displacement: extract	<i>Extrusive:</i> - gently reposition tooth into socket and use flexible splint for 2 weeks, monitor pulpal condition. <i>Intrusive:</i> - <u>Closed apex</u>: reposition with ortho or surgery ASAP. Pulp will likely be necrotic so do RCT and leave Ca(OH)₂ in canal. - <u>Open apex</u>: allow spontaneous repositioning to occur, if no movement within 3 weeks, use rapid ortho repositioning <i>Lateral:</i> - disengage from bony lock with forceps and gently re-position, stability for 4 weeks with split, monitor pulpal condition
Avulsion	Complete removal of tooth from socket	Do not re-implant (increased risk of ankylosis)	<i>Extra-oral dry time <60mins</i> - <u>Closed apex</u>: rinse root with saline, re-implant, and splint for 2 weeks. RCT 1 week later - <u>Open apex</u>: soak in doxycycline, rinse off debris, re-implant, and splint for 2 weeks. Monitor vitality and RCT only if needed <i>Extra-oral dry time >60 mins</i> - <u>Closed apex</u>: Remove PDL with gauze, soak in fluoride then re-implant and splint for 4 weeks. CaOH RCT can be done before re-implantation or 2 weeks later – expect ankylosis and a solid implant site - <u>Open apex</u>: Remove PDL with gauze, soak in fluoride then re-implant and splint for 4 weeks. CaOH RCT can be done before re-implantation or 2 weeks later – expect ankylosis

Other Considerations with Dental Trauma

- Pulp vitality testing is not reliable in recently traumatized teeth—wait 3 MONTHS to test
- Give 2 week course of antibiotics (doxycycline if >12 or penicillin) with all avulsions
- Non-dental Considerations
 - Head trauma or Loss of consciousness – refer to hospital if hx blurred vision, vomiting, disorientation, or memory lapse
 - Lacerations – may need to suture soft tissue
 - Abuse – Dentists are mandated reporters, but also must be tactful with this issue
 - Tetanus status – may need tetanus booster
 - DPT booster necessary every 10yrs
- Possible Dental Sequelae: pulp death, calcification, resorption, ankylosis, color changes

Pediatric Pulp Therapy

- General concepts
 - Pulp capping
 - Indirect pulp capping – done in primary teeth for same indication as permanent teeth, that is with caries near but not involving the pulp.
 - Direct pulp capping – low success rate in primary teeth, do pulpotomy instead
 - Apexification – a procedure in which we plug the apex of a cleaned and shaped canal with MTA or calcium hydroxide. Wait 6mo-1yr to allow the dentinal walls to form secondary dentin, then obturate that canal. Done when a **pulpectomy** was performed on a tooth with an **open apex**. Non-vital tooth.
 - Apexogenesis – a procedure in which calcium hydroxide over a vital pulp stump (aka deep pulpotomy), allowing for continued radicular pulp vitality and continued root formation. Done when a **pulpotomy** was performed on a tooth with an **open apex**. Vital tooth.
 - Never put calcium hydroxide in the coronal pulp chamber following a pulpotomy (typically done with formocresol) as it leads to internal resorption. Instead, fill the coronal pulp chamber with ZOE/IRM.
 - If ankylosis is suspected, do not place gutta percha in the tooth. Place ZOE/IRM because it resorbs over time, and the site could be use for an implant in the future.

Pain Control

Analgesics	Recommended dosage (oral)	Advantages	Disadvantages	How supplied
Acetaminophen	10-15 mg/kg Q4-6h	Antipyretic and analgesic	No anti-inflammatory action, mild pain relief	- Drops: 80 mg/0.8 ml - Suspension: 160mg/5ml - Chewable tabs: 80mg tabs - Tablets: 325, 500 mg
Aspirin (salicylates)	10-15 mg/kg Q4-6h	Anti-inflammatory, Good pain relief, Moderate pain, Antipyretic	Gastric irritant, may impair clotting, associated with Reye Syndrome	- Suspension: 60mg/5ml - Chewable tabs: 65mg - Tabs & other preps
Ibuprofen	5-10 mg/kg Q6-8h	Anti-inflammatory, Good pain relief, Moderate to severe pain, Antipyretic	Gastric irritant, may impair clotting	- Suspension: 100mg/5ml (by prescription) - Tabs: 200mg
Naproxen	3-7 mg/kg Q8-10h	Anti-inflammatory, Good pain relief, Severe pain	Gastric irritant, may impair clotting, delayed onset	- Suspension: 125mg/5ml - Tabs: 250, 375, 500 mg
Acetaminophen w/ codeine (All by prescription)	Codeine: 0.5 mg/kg 7-12y: 24mg q4-6h 3-6y: 12mg q4-6h	Good pain relief, Severe pain, antipyretic	Constipation cramping, potentiate the CNS or respiratory effects of sedative agents, contraindicated with head trauma	- Suspension: 12mg/5ml Cod. with 120mg Tylenol - Tabs: 300mg Tylenol Plus varied dose of codeine (#1: 7.5 mg Cod, #2: 15 mg Cod, #3: 30 mg Cod, #4: 60 mg Cod)

Note: 5mL = 1 tsp

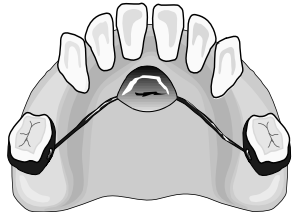
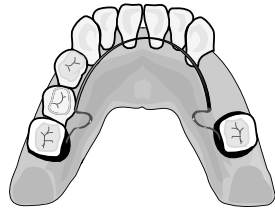
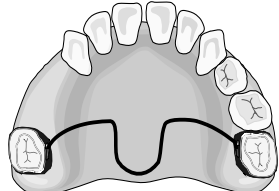
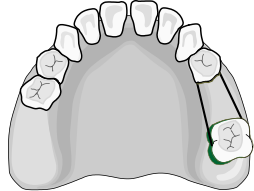
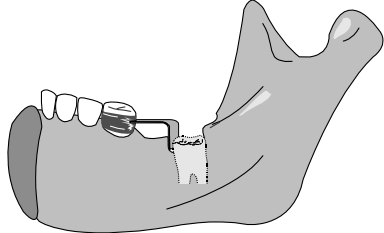
Pediatric Procedures

	Indication	Armamentarium	Procedure
NPI/recall exam	- New patient - Recall patient	- Basic kit - Cavitron - Hand scalers - Dental floss - Patient mirror - Prophylaxis angle and prophylaxis paste	- Review/complete in Axium: Histories, Exam, Caries Risk Assessment, Hard tissue charting - Radiographs (BW every 12mo) - Review OHI - Remove supragingival plaque & calculus - Polish with prophylaxis paste - Call instructor to check - Apply Fluoride varnish or foam
Fluoride treatment	- Hypersensitive areas - Newly erupted teeth - Arrested early caries	- Fluoride varnish	- Lightly dry teeth with 2x2 gauze - Apply varnish directly to teeth with brush - Use floss to ensure that varnish reaches interproximal areas - Application time 1-4min - Varnish sets in contact with intra-oral moisture - AVOID crunchy foods for 2-4hrs - AVOID brushing the night of application
		- Fluoride foam	- Fill tray 1/3 full - Dry tooth surfaces - Have pt bite down on tray for 60sec-4 mins - Chew slightly for interprox coverage - Remove excess with saliva ejector - AVOID food/drink for 30min
Sealants	- Questionable or confirmed enamel caries, without proximal caries - Presence of deep pits/ fissure or increased risk for caries	- Ultraseal XT - Etch - Optibond and brush - Light cure gun - Rubber dam and clamp or cotton rolls / dri-angle - Floss - Basic or composite cassette - Topical and local anesthetics - Handpiece and finishing burs - Articulating paper	- Review medical and dental history - Quick exam of dentition, confirm plan for sealants, call instructor to begin - Decide if using rubber dam (with clamp vs. floss) or cotton roll isolation and isolate tooth - Etch tooth for 15 sec, wash and lightly dry - Apply optibond, air thin and cure for 20 seconds. - Apply thin layer of ultraseal to central groove and spread sealant to get all pits and fissures - Light cure sealant for 20 seconds - Check occlusion and remove any high spots – occlusion is less vital in sealants due to unfilled nature of the resin, so the bite can wear in over time.
Pulpotomy	- Primary teeth with	- Handpiece	- Review medical and dental history

	carious pulpal exposure, only if pulp is healthy or reversible pulpitis	- 330 burs - Amalgam cassette - Local anesthesia - IRM - Rubber dam & clamp - Cotton pellets - Formocresol	- Quick exam of dentition, confirm plan for pulpotomy, call instructor to begin - Anesthetize patient and isolate tooth - Use 330 bur remove the roof of the pulp chamber by joining pulp horns - Amputate coronal pulp with spoon excavator and achieve hemostasis with cotton pellets over 5 minutes - Remove cotton pellets from chamber and replace with formocresol dipped cotton pellets – allow to sit 5mins - Remove formocresol pellets and mix IRM. Once IRM is doughy, pack into pulp chamber and level occlusal surface. - A stainless steel crown will need to be placed on top – SEE NEXT PROCEDURE
Stainless Steel Crown	- Extensive loss of tooth structure in primary molar - Following pulp therapy - Interproximal decay that extends beyond the line angles	- Handpiece - Diamond burs - Correctly sized crown - Contouring pliers - Crimping plier - Crown scissors - Glass Ionomer cement (Ketac) - Local anesthesia - Rubber dam / clamp	- Review medical and dental history - Quick exam of dentition, confirm plan for SSC, call instructor to begin - Anesthetize and isolate tooth - Remove caries, reduce occlusal surface ~1mm, proximal reduction with no ledge at margin (Featheredge) - Attempt to seat crown – add buccal and lingual reduction if necessary, and crown should snap in if it fits - Trim crown margins if extensive blanching or over extension - Use contouring and crimping plier to adapt crown margin closely to tooth structure - Activate and mix cement, place in crown and seat crown - Have patient bite on cotton roll, then ensure reasonable bite

Space Maintenance

- Indications
 - want $\frac{1}{2}$ - $\frac{2}{3}$ of root formation of permanent tooth when extracting primary, otherwise need space maintainer
 - Loss of 1st primary molar prior to the eruption of 1st permanent molar
 - Loss of 2nd primary molar
 - Loss of primary canine (Except if loss due to arch length discrepancy)
- Uses for different types

Maxilla	Mandible
Nance – constructed of two bands, one on each side of the arch, connected by 36 mil wire with an acrylic button that sits on the palatal rugae. 	Lower Lingual Holding Arch – constructed of two bands, one on each side of the arch, connected by 36 mil wire that runs around the lingual side of the arch. 
Transpalatal Arch – constructed of two bands, one on each side of the arch, connected by 36 mil wire running across the palate without touching it, away from the incisors. More hygienic but may allow mesial tipping. 	Band and Loop – used to maintain the space of a single tooth, made from an orthodontic band or stainless steel crown and 36 mil round wire. 
Band and Loop – used to maintain the space of a single tooth, made from an orthodontic band or stainless steel crown and 36 mil round wire. 	Distal Shoe – Used to maintain the space of a single primary 2nd molar, made from an orthodontic band or stainless steel crown, round wire, and a flat piece of stainless steel that extends to the distal contact of the lost tooth, and 2mm below the marginal ridge of the 1st permanent molar, acting as a guide plane for the erupting 1st permanent molar. 

Oral Radiology

Physics and Chemistry of Radiology

- The X-Ray Tube
 - Cathode (-): source of electrons, composed of a tungsten filament and molybdenum focusing cup
 - Anode (+): tungsten target embedded in a copper stem. Electrons from the cathode are directed onto a specific area of the anode called the focal spot, which serves to generate x-rays. Dental x-ray machines use a stationary anode, while medical machines use a rotating design.
- Variables Affecting Beam
 - Exposure time: increasing exposure time = more photons emitted, but the distribution of photon energies remains the same.
 - Tube Current (mA): increasing current = more photons emitted, but the distribution of photon energies remains the same.
 - Tube Voltage (kVp): increasing voltage = more photons emitted and each photon has a higher mean and peak energy, giving the image a less contrast (more shades of gray).
 - Filter: aluminum sheet placed in the way of the beam to remove low energy photons that don't contribute to the image. Lowers patient dose.
 - Collimation: a collimator is a metal barrier with an aperture in the middle to reduce the size of the beam, thus reducing patient dose. It also improves image quality by reducing scattering.
 - Inverse Square Law: beam intensity at the object is inversely proportional to the square of the distance from the source.
- Developing Films
 - Developing solution:
 - Contains hydroquinone, which converts exposed silver halide crystals to black metallic silver while producing no effect on the unexposed crystals
 - Also contains antioxidant preservative such as sodium sulfate, an accelerator such as sodium carbonate, and a restrainer such as potassium bromide
 - Fixing solution:
 - Contains a clearing agent such as sodium or ammonium thiosulfate that dissolves and removes the underdeveloped silver halide crystals
 - Also contains an antioxidant preservative such as sodium sulfate, an acidifier such as acetic acid, and a hardener such as potassium alum
 - Fixing time is always at least double the developing time.
- Digital Film
 - Rigid types of sensors: Charge-coupled device (CCD) and CMOS (complementary metal oxide semiconductor). Today CMOS is the most widely used.
 - CCD & CMOS: consists of a silicon chip with an active array of rows and columns called pixels (taking the place of silver crystals). The pixels are 80% more sensitive to radiation than conventional film. Main advantages are lower patient dose of radiation and immediate imaging
 - We can also get digital radiographs by scanning conventional radiographs

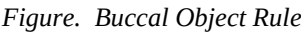
Indications for Radiographs

	Child with Primary Dentition	Child with Transitional Dentition	Adolescent with Permanent Dentition (prior to 3 rd molars)	Adult Dentition or Partially Edentulous	Edentulous
New Patient	Selected occlusal/ PAs and/or BWs if contacts closed.	BWs plus Panoramic or selected PAs	BWs with Pan or selected PAs – FMX if signs of disease	BWs with PAN or selected PAs – FMX if signs of disease	Selected films based on signs and symptoms
Recall Patient with clinical caries or increased risk for caries	BW's every 6-12 months			BW's every 6-18 months	Not Applicable
Recall Patient with no clinical caries and not at increased risk for caries	BW's every 12-24 months		BW's every 18-36 months	BW's every 24-36 months	Not Applicable
Recall Patient with periodontal disease	Clinical judgment				Not Applicable
Patient for monitoring of growth and development	Clinical judgment			Usually not indicated	
Patient with other circumstances including, proposed or existing implants, pathology, restorative/ endodontic needs, treated periodontal disease and caries remineralization	Clinical judgment				

*A new full mouth series (FMX) may be obtained every 5 years for recall patients

Radiology Techniques

- **Paralleling:** the film is positioned parallel to the long axis of the tooth, while the beam is directed at a right angle to the long axis of the tooth and the film.
 - Pros: decreased chance of distortion and greater ease determining angulation of cone
 - Cons: film holder may impinge on soft tissue
- **Bisecting Angle:** Film is placed on the lingual surface of the tooth, as close as possible. The beam is directed at a right angle to the imaginary plane that bisects the angle formed by the long axis of the tooth and the film.
 - Pros: alternative used when paralleling technique not possible
 - Cons: increased risk of distortion and harder to determine angle of the cone
- **Buccal Object Rule:** Take one radiograph of the object in question and note its position to surrounding structures. Then shift the tube to take an x-ray of the same area from a different angle, again noting the objects relation to surrounding structures (usually the teeth). If the object moved (from one radiograph to the second) in the same direction in which the tube was shifted, the object is deep (lingual) to the surrounding structures. If the object moved in the opposite direction as the tube shift, then the object is superficial (buccal) to the surrounding structures.



- ## Radiograph Quality

Problem	Common Causes
Light Radiographs	- Underdeveloped: temp too low or time too short - Depleted / diluted / contaminated developer solution - Excessive fixation - Underexposed: mA, kVp, or exposure time too low
Dark Radiographs	- Overdevelopment: temp too high or time too long - Inadequate fixation – giving a brown color - Accidental exposure to light - Overexposed: mA, kVp, or exposure time too high
Insufficient Contrast	- Underdeveloped - Underexposed/Overexposed - kVp too high
Film Fog	- Improper safe lighting in dark room - Overdeveloped - Contaminated solutions - Deteriorated film
Blurring	- Patient movement - Double exposure
Partial Images	- X-ray tube not aligned with film (cone cut)

- Paralleling technique
- Film holders
- Collimated beam
- Long cone (longer distance between x-ray source and object)
- Short distance between object and film

Differential Diagnosis for Oral Radiology

Radiolucencies

Unilocular: Pericoronal

Hyperplastic dental follicle
Dentigerous cyst
Eruption cyst
Odontogenic keratocyst
AOT

Poorly-Defined

Periapical granuloma
Hematopoietic bone marrow defect
Osteomyelitis

Multifocal

Cemento-osseous dysplasia
Nevoid basal cell carcinoma syndrome
Multiple myeloma

Unilocular: Periapical

Periapical granuloma
Periapical cyst
Periapical cemento-osseous dysplasia

Well-Defined

Torus / exostosis
Retained root tip
Condensing osteitis
Idiopathic osteosclerosis
Pseudocyst
Odontoma
Cemento-osseous dysplasia

Unilocular:

Other Locations

Lateral radicular cyst
Nasopalatine duct cyst
Lateral periodontal cyst
Residual cyst
Odontogenic keratocyst
Central giant cell granuloma
Stafne bone defect

Multilocular

Odontogenic keratocyst
Ameloblastoma
Central giant cell granuloma

Radiopacities

Well-Defined

Torus / exostosis
Retained root tip
Condensing osteitis
Idiopathic osteosclerosis
Pseudocyst
Odontoma
Cemento-osseous dysplasia

Poorly Defined

Cemento-osseous dysplasia
Condensing osteitis
Sclerosing osteomyelitis
Fibrous dysplasia

Multifocal

Florid cemento-osseous dysplasia

Mixed Radiolucent / Radiopaque Lesions

Well-Defined

Cemento-osseous dysplasia
Odontoma

Poorly Defined

Osteomyelitis

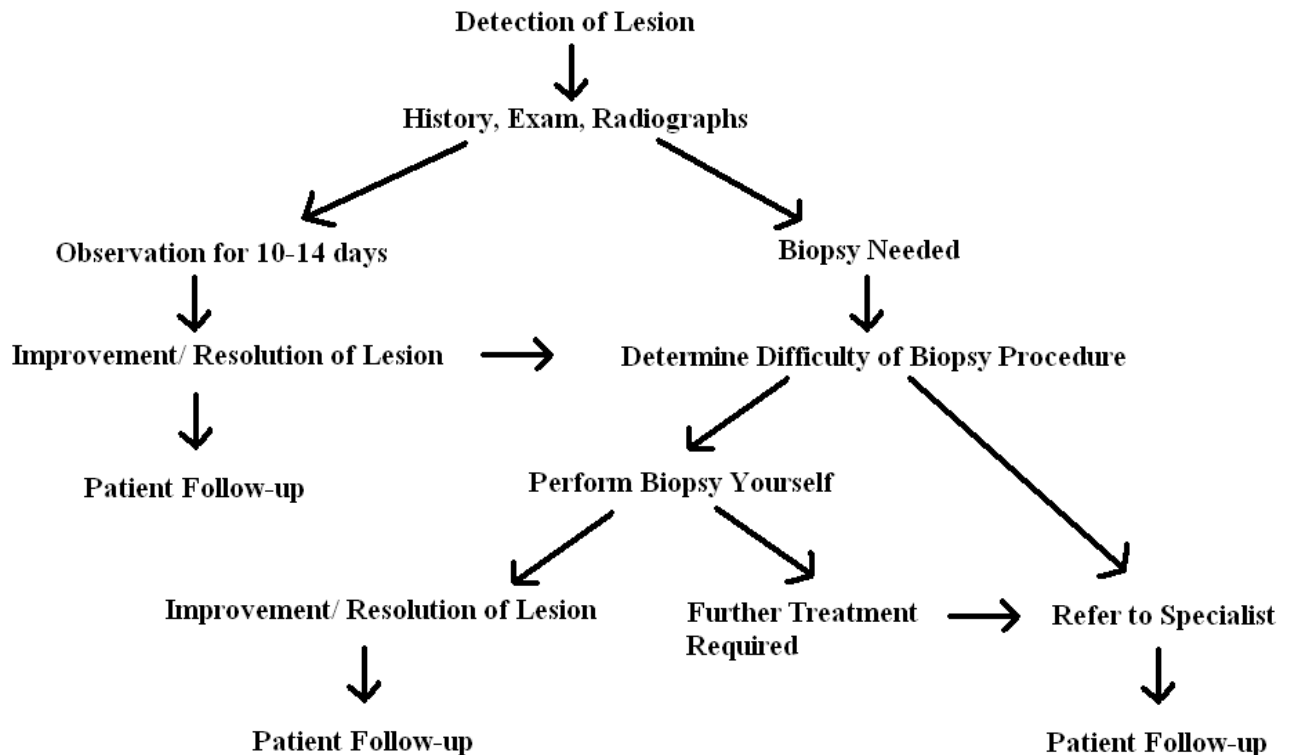
Multifocal

Florid cemento-osseous dysplasia

Oral Pathology

General Concepts

- Definitions
 - Macule – Focal area of color change, not elevated or depressed
 - Papule – Solid, raised lesion which is <5mm in diameter
 - Nodule – Solid, raised lesion which is >5mm in diameter
 - Vesicle – superficial blister 5mm or less in diameter, usually filled with clear liquid
 - Plaque – large elevated lesion with flat surface
 - Bulla – large blister >5mm in diameter
 - Ulcer – lesion characterized by loss of the surface epithelium and some underlying CT
 - Sessile – a growth where the base of the lesion is the widest part
 - Pedunculated – a growth where the base of the lesion is narrower than the widest part
 - Papillary – a growth exhibiting numerous surface projections
- Decision tree for treatment of oral lesions:



Biopsy

- Types of Biopsy:
 - Cytology
 - Exfoliative – Collection of cells (usually tumor cells) that spontaneously shed from the body. Used only as an adjunct procedure due to unreliability.
 - Brush – Using a special brush to collect epithelial cells from a lesion. Often used as a screening tool or for monitoring patients with chronic mucosal changes (leukoplakia, lichen planus, post-irradiation, etc.)
 - Pros: can be done chair side, without anesthesia, minimal discomfort, and is superior to exfoliative cytology
 - Cons: collects only cells and does not give tissue architecture necessary to stage and grade a lesion.
 - Aspiration – Using a needle and syringe to penetrate a lesion and aspirate fluid and / or cells. It is done on lesions thought to contain fluid and on intraosseous lesions before surgical exploration
 - Incisional – Surgically removing only part of a lesion for examination. Used when the area of question is difficult to excise, extensively large (>1cm diameter), in a hazardous location, or when there is suspicion of malignancy
 - Excisional – Surgically removing of the entire lesion plus a perimeter of normal tissue surrounding the lesion. Used with smaller lesions (<1cm) and that appear to be benign.
- Indications for biopsy
 - Any lesion that persists for more than 2 weeks with no apparent cause
 - Any inflammatory lesion that doesn't respond to treatment after 10-14 days or of unknown cause
 - Persistent hyperkeratotic changes
 - Lesions that interfere with function
 - Any persistent mass, either visible or palpable under relatively normal tissue
 - Bone lesions not specifically identified by clinical or radiographic findings
 - Any lesion with characteristics of malignancy: see below.

Oral Cancer

- Epidemiology
 - 34,000 Americans will be diagnosed this year and cause over 8000 deaths
 - Possible risk factors: Age (>40), smoking, alcohol, HPV infections, and UV radiation
 - The fastest growing population with oral cancer is non-smokers under age 50
- Characteristics of malignancy:
 - Ulceration that does not heal
 - Leukoplakia or erythroplakia or leukoerythroplakia
 - Induration: lesion and surrounding tissue is firm to touch
 - Bleeding with gentle manipulation
 - Duration: lesion exists for longer than 2 weeks
 - Fixation: lesion feels attached to surrounding structures
 - Rapid growth rate
 - Other symptoms may include dysphagia, pain, and hoarseness
 - Most frequent locations: floor of mouth and tongue

- Stage/Grade

Stage (TNM system)	Grade
<i>Primary Tumor Size (T)</i> - T0: no evidence of primary tumor - T1S: only carcinoma <i>in situ</i> at primary site - T1: tumor <2cm at greatest diameter - T2: tumor is 2-4 cm at greatest diameter - T3: tumor >4cm in diameter - T4: massive tumor >4cm in diameter <i>Regional Lymph Node Involvement (N)</i> - N0: no clinically positive nodes - N1: single positive homolateral node <3cm in diameter - N2: single positive homolateral node 3-6cm in diameter or multiple positive homolateral nodes with none >6cm - N3: Massive homolateral node, bilateral nodes, or contralateral nodes <i>Distant Metastases</i> - M0: no evidence of distant metastasis - M1: distant metastasis is present	Grade I: well differentiated Grade II: moderately differentiated Grade III: poorly differentiated Grade IV: undifferentiated Hallmark of de-differentiation/dysplasia is pleomorphism, which includes: variations in cell size and shape, hyperchromatic nuclei, increased nuclei-cytoplasm ratio, irregularly shaped nuclei, large nucleoli, coarse or lumpy chromatin

- Diagnostic procedures / devices available:
 - Biopsy
 - Chemiluminescence: Vizilite Plus TBlue 630
 - Spectroscopy: VELscope
 - Optical Coherence tomography: Imalux
 - Photosensitizers (also can be a treatment modality)

Pathogens of Caries Periodontal Disease and Pulpal Infections

	Microorganisms
Dental Caries	Early Lesions Streptococcus mutans Lactobacilli Late Lesions Corynebacterium species Actinomyces species Lactobacilli Streptococci
Periodontal Disease	Prophyromonas gingivalis Prevotella intermedia Actinobacillus actinomycetemcomitans Fusobacterium species Capnocytophaga species
Pulpal Infections	Primary endo: anaerobes Porphyromonas species Bacteroides melaninogenica Actinomyces Fusobacterium species Peptostreptococcus species

Differential Diagnosis for Oral Pathology

Color Changes

White Lesion: Can Scrape Off

Pseudomembranous candidiasis
Burn
Toothpaste / mouthwash reaction
White coated tongue

White Lesion: Can't Scrape Off

Linea alba
Leukoedema
Leukoplakia
Tobacco keratosis
Lichen planus
Nicotine stomatitis

Yellow Lesions

Fordyce granules
Superficial abscess
Accessory lymphoid aggregate
Lymphoepithelial cyst
Lipoma

Red and White Lesions

Erythema migrans
Candidiasis
Lichen planus
Burns
Actinic cheilitis
Nicotine stomatitis
Erythroleukoplakia

Red Lesions

Pharyngitis
Traumatic erythema
Denture stomatitis
Erythematous candidiasis
Erythema migrans
Angular cheilitis
Burns
Erythroplakia

Blue/Purple Lesions

Varicosities
Submucosal hemorrhage
Amalgam tattoo
Mucocele / ranula
Eruption cyst
Salivary duct cyst
Hemangioma
Kaposi's sarcoma

Brown/Gray/Black Lesions

Racial (physiologic) pigmentation
Amalgam tattoo
Black-brown hairy tongue
Melanotic macule
Smoker's melanosis
Melanocytic nevus
Malignant melanoma

Surface Alterations

Vesiculoerosive/ Ulcerative Lesions:

Short Duration & Sudden Onset

Traumatic ulcer
Aphthous stomatitis
Recurrent herpes
Primary herpetic gingivostomatitis
Necrotizing ulcerative gingivitis
Burns
Erythema multiforme
Herpangina

Vesiculoerosive/ Ulcerative Lesions:

Chronic

Erosive lichen planus
Squamous cell carcinoma
Mucous membrane pemphigoid
Traumatic granuloma

Papillary Growths

Hairy tongue
Papilloma
Inflammatory papillary hyperplasia
Verruca vulgaris
Leukoplakia (some variants)
Squamous cell carcinoma

Masses / Enlargements by Location

Tongue

Irritation fibroma
Squamous cell carcinoma
Mucocele

Gingival / Alveolar Mucosa

Parulis/ Fistula
Epulis fissuratum
Pyogenic granuloma
Peripheral ossifying fibroma
Peripheral giant cell granuloma
Irritation fibroma

Hard / Soft Palate

Palatal abscess
Denture fibroma
Salivary gland tumor
Kaposi's sarcoma
Nasopalatine duct cyst

Floor of Mouth

Mucocele / ranula
Sialolith
Squamous cell carcinoma
Lymphoepithelial cyst

Upper Lip

Irritation fibroma
Salivary gland tumor
Salivary duct cyst

Lower Lip

Mucocele
Irritation fibroma
Squamous cell carcinoma

Multiple Lesions

Kaposi's sarcoma
Neurofibromatosis

Buccal Mucosa

Irritation fibroma
Lipoma
Mucocele

Midline of Neck

Thyroid gland enlargement

Lateral Neck

Reactive lymphadenopathy
Epidermoid cyst
Lipoma
Infectious mononucleosis
Metastatic carcinoma
Lymphoma

Temporomandibular Disorders

General Concepts

- TMD is a collection of musculoskeletal disorders of the head and neck. Classic triad of TMD signs: Limited ROM, pain on palpation, findings on auscultation
- 40-70% of the population have symptoms/signs of TMD
 - 22% have facial pain
 - 30-45% have jaw joint sounds
 - ~7% have symptoms severe enough to require treatment
- TMD is associated with occlusion, personality, history of trauma, but none directly cause TMD
- 80% of patients respond to conservative treatment while 20% are refractory and demand invasive therapy (arthrocentesis, arthroscopy...)
- History of TMD
 - **Costen** (1926) – pain in and around jaw joint was related to overclosure of the mandible and could be corrected with bite correction. Supported by Stuart. Posselt solidified the connection between TMJ dysfunction and occlusion around the same time.
 - **Swartz** – theory on the role of stress in TMJ dysfunction
 - **Laskin** – coined the term “myofascial pain dysfunction syndrome”
 - **Farrar and McCarty** (1970) – rekindled interest in the disc position as a major etiologic factor causing TMD that ushered in an era of TMJ surgery to correct disc position
 - **Dawson** – proposed treating the occlusion to CR to decrease TMJ arthralgia. McCarty also proposed treating to CR but so as to decrease the activity of the superior head of the lateral pterygoid which many had credited as the culprit in causing anterior disc displacement
 - **Witzig and Spaul** – proposed orthodontics to provide a mandibular position which is more open and forward to reduce TMD
- Chronic pain – defined as pain of 6 or more months in duration. Signs of chronic pain include hyperalgesia, allodynia, and spontaneous pain

Etiologic Factors in TMD: predisposing, initiating, or perpetuating

- Trauma: macro (MVA) vs. micro (bruxism)
- Occlusion (ant open bite, OJ > 6-7mm, RCP-ICP slide > 2mm, crossbite, >4 missing post teeth)
- Female gender
- Orthodontics (questionable cause of or treatment for TMD)
- Joint laxity
- Disc position (On MRI, 30% of asymptomatic individuals have “abnormal” disc position). DD does not increase osteoarthritic changes
- Lateral pterygoid hyperactivity
- Psychosocial factors (stress, anxiety, depression)

Diagnostic Categories for TMD

(55% Myofascial pain, 14% DD, 7% OA, 6% Migraine, 5% trigeminal Neuralgia, 12% Other):

- **Congenital or developmental disorders:** aplasia, hypoplasia, hyperplasia, neoplasia
 - **Joint (arthralgia)-** Dx with preauricular pain on palpation, ROM, joint loading
 - Disc displacement
 - With reduction – reproducible joint noise, imaging reveals disc displacement that reduces during opening but no osteoarthritic changes, deviation on opening to the affected side initially but returns to midline upon full opening
 - Without reduction
 - Acute – persistent marked limited opening (<35mm) with history of sudden onset, deflection to the affected side on opening, imaging reveals disc displacement without reduction and no osteoarthritic changes
 - Chronic – history of sudden onset of limited opening that occurred more than 4 months ago, imaging reveals disc displacement without reduction and no osteoarthritic changes
 - Dislocation (open lock or subluxation) – inability to close the mandible with radiograph revealing condyle well beyond the eminence
 - Inflammatory conditions
 - Synovitis and capsulitis – TMJ pain increased by palpation of TMJ, loading TMJ during function, and imaging that does not reveal osteoarthritic changes
 - Polyarthritides – no identifiable etiologic factor, pain with function, point TMJ tenderness, limited ROM secondary to pain, imaging reveals extensive osteoarthritic changes
 - Osteoarthritis
 - Primary (deterioration of subchondral bone due to overloading of joint) – no identifiable etiologic factor, pain with function, point TMJ tenderness, and imaging that reveals extensive osteoarthritic changes (subchondral sclerosis, osteophyte, or erosion)
 - Secondary (deterioration of subchondral bone due to trauma, infection or polyarthritides) – identifiable disease or associated event, pain with function, point TMJ tenderness, and imaging that reveals extensive osteoarthritic changes (subchondral sclerosis, osteophyte, or erosion)
 - Ankylosis
 - Fibrous – Limited ROM, marked deviation to affected side, marked limited laterotrusion to contralateral side, imaging reveals absence of ipsilateral condylar translation
 - Bony – extreme limited ROM when condition is bilateral, marked deviation to affected side, marked limited laterotrusion to contralateral side, imaging reveals bone proliferation and absence of condylar translation
 - Fracture
 - **Arthralgia Treatment:** Anti-inflammatory (NSAID, Medrol dose pack), painfree diet, joint wagging, lateral ROM then vertical, orthosis
 - For DD, treat off disk if: pain free at rest, absence of pressure, hx of frequent locking, significant psychopathology
- **Muscle (myalgia)-** Dx with: dull aching pain, limited ROM, trigger point, hypersensitive area

- Myofascial pain – regional dull aching pain, aggravated by masticatory muscle function, trigger points that increase or refer pain
- Myositis – pain in a localized muscle following injury or infection, diffuse tenderness over entire muscle, increased pain with muscle use, limited ROM due to pain or swelling
- Myospasm – acute pain at rest and with function, continuous muscle contraction causing marked decrease in ROM
- Local Myalgia - includes multiple pain disorders of which there are no diagnostic criteria
- Myofibrotic contracture – limited ROM, unyielding firmness on passive stretch, little or no pain, may have history of trauma/ infection
 - **Myalgia Treatment:** Stretching exercises, orthosis, muscle relaxant, analgesic, habit control, trigger point compressions, botox

Bruxism

- Definitions
 - American Academy of Orofacial Pain – sustained contractions of the jaw muscles accompanied by tooth contact
 - American Sleep Disorder Association – a parasomnia defined as a periodic stereotyped movement disorder characterized by grinding or clenching the teeth during sleep
 - Okeson 3rd Ed Treatment of Temporomandibular Disorders – occurs during all stages of sleep by more in stages 1 and 2, average length is 3-6 seconds
 - Parker Mahan Facial Pain 2nd Ed. – Clenching involves masseter and temporalis muscles while bruxing involves pterygoids, occur about 10 seconds per hour
- Epidemiology of Bruxism
 - 6 to 20% in general population
 - 70-90% of TMD patients
 - Women > men
 - Bruxism decreases with age
- Etiology of Bruxism
 - Medications: some SSRI's (Prozac, Zoloft, Paxil), dopaminergic drugs (L-Dopa), fenfluramine (anorexia), compazine (nausea)
 - Stress
 - Personality(?): Rugh and Solberg found no correlation between personality and bruxism, while Fisher did
- Clinical Findings
 - Abnormal tooth wear due to abrasion
 - Dental injury (fractures, hypermobility, etc)
 - Hyperkeratotic lesions on mucous membranes of cheeks
 - Tongue indentations
 - Hypertrophy of masseter and temporalis muscles
 - Pain, tenderness, fatigue or stiffness in the muscles of mastication
 - TMJ problems
 - Grinding sounds reported by bed partner
- Treatment of Bruxism
 - Splints
 - Behavioral (e.g. biofeedback)
 - Physical Therapy – treats pain associated with bruxism, not the bruxism
 - Medication – Valium, Robaxin, baclofin, klonopin, elavil (TCAs)
 - Hypnosis – based solely on case reports

Occlusal Appliances

- *Passive* – unloads joint, disoccludes the teeth, resulting in reduced dental proprioceptive input to the masticatory neuromuscular system
 - Flat plane – most commonly used, all teeth covered by or in contact with, can be maxillary or mandibular, adjusted to CR or to CO
 - Maxillary in CR or CO
 - Design: buccal cusps of mandibular posteriors and canines contact flat acrylic surface, shallow anterior and canine guidance
 - Indications: bruxism, myofascial pain, disc displacement without reduction, TMJ osteoarthritis, determining maxillomandibular relationship prior to restorative treatment
 - Contraindications: severe occlusal irregularities, excessive anterior open bite, overjet, or overbite, disc displacement with reduction
 - Mandibular in CR or CO (Tanner appliance)
 - Design: lingual cusps of maxillary posterior teeth and canines contact in flat acrylic surface, shallow anterior and canine guidance
 - Indications: same as above but allows use in excessive overjet or open bite
 - Contraindications: bruxism with perio compromised teeth, severe occlusal irregularities, excessive overbite
 - Anterior bite plane – appliance for the maxillary arch that covers anteriors and uses wire clasps for retention
 - Design: mandibular incisors and canines contact flat acrylic in CR, no occlusal contact in posterior teeth in CR or in excursions
 - Indications: determining maxillomandibular relationship prior to restorative work, or any indication for flat plane where occlusal irregularities or anterior tooth positions precludes the use of full coverage flat plane splint.
 - Contraindications: extended use especially in bruxers
 - Mandibular bilateral – passive version covers mandibular posterior teeth and has a stainless steel bar as a major connector between the two segments of the appliance
 - Design: disoccludes the teeth with flat acrylic functional surface
 - Indications: occlusal dysfunction with extreme angle III skeletal/dental
 - Contraindications – due to inherent occlusal instability, only use in select cases
 - Pivotal – this is a modification of the bilateral mandibular appliance
 - Design: bilateral occlusal contact of the mesiolingual cusps of the maxillary first molars with a flat acrylic surface, excursions guided by working side 1st molar
 - Indications – initial treatment of myofascial pain, same risks as bilateral mandibular appliance
 - Sagittal – segmental appliance that covers the maxillary arch and has expansion screws between segments, where activation of screws produces tooth movement but can't control root torque like in ortho, the advantage is it disoccludes tooth inclines during movement
 - Design: same as maxillary flat plane with moving anterior segment
 - Indications: occlusal dysfunction related to anterior trauma
- *Active* – has inclines that occlude with the opposing dental arch, that guide the mandible into a predetermined position
 - Mandibular bilateral – active version covers mandibular posterior teeth and has a stainless steel bar as a major connector between the two segments of the appliance
 - Design: lingual cusps of maxillary posteriors occluding in cuspal imprints

- Indications: occlusal dysfunction due to strong anterior guidance producing posterior condylar position (e.g. angle class II div 2), occlusal support in cases with extreme malocclusion or osteoarthritis
 - Contraindications – due to inherent occlusal instability, only use in select cases
- Mandibular repositioning (maxillary or mandibular (MORA)) – trains neuromuscular system to posture the mandible forward, requires full time wear over 4-6 months, usually results in posterior open bite that will need to be stabilized via ortho, FPD, or removable prosthetics. Full time wear to change maxillomandibular relationship in the treatment of disc displacement with reduction or part time wear to treat disc displacement with reduction “off the disc” in order to reduce pain, can also be used for aggressive osteoarthritis
 - Design: anterior reverse incline and cuspal imprints that guide mandible
 - Indications: Preauricular pain, DD with reduction, painful click, feels better forward.
 - Contraindications: myofascial pain or if must bring teeth beyond edge-to-edge to remove click
- Sagittal – segmental appliance that covers the maxillary arch and has expansion screws between segments, where activation of screws produces tooth movement but can’t control root torque like in ortho, the advantage is it disoccludes tooth inclines during movement
 - Design: same as mandibular repositioning appliance
 - Indications: maintaining mandibular position following orthopedic repositioning

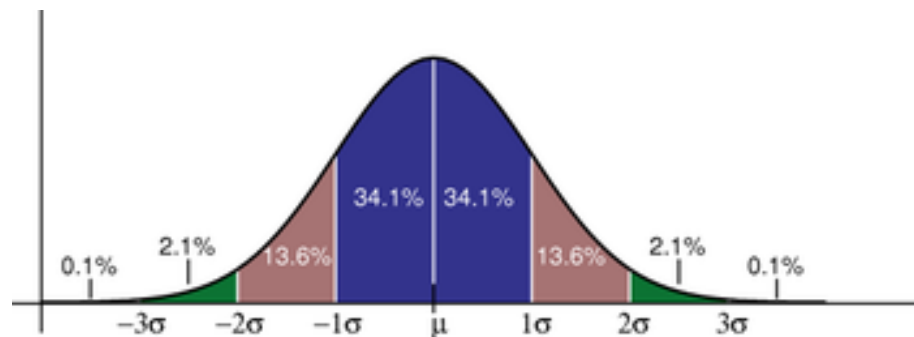
Biostatistics

General Definitions

- **Population** – all people in a defined setting or with certain defined characteristics
 - **Parametric** – numerical characteristic of the population, usually fixed and unknown
- **Sample** – a subset of people in the defined population
 - **Statistic** – numerical characteristic of the sample, varies from sample to sample
- **Distribution** – grouping the results along a number line
- **Variable**
 - **Ordinal** – possible groups have some intrinsic order (e.g. smoker, former smoker, and non-smoker)
 - **Nominal** – possible groups have no intrinsic order (e.g. blue eyes vs green eyes)
 - **Continuous** – numerical values (e.g. temperature, height, weight)

Data Description

- **Frequency** – the number of a characteristic in the sample or population (e.g. 4 women, 6 men).
 - **Histogram** – one way to visualize a distribution, but be careful not to misrepresent your data with bin size (which indicates how precise your measurements are)
- **Measures of Central Tendency:**
 - **Mean** - average
 - **Median** – midpoint within the range of values
 - **Mode** – most common value
 - **Variance** – the sum of the squared deviations from the mean
 - **Standard Deviation** – the square root of the variance, the spread of the distribution or the average distance the observations are from the mean. High number means flat distribution, low number means peaked distribution.
- **Normal Distribution** – unimodal, continuous, symmetric around the mean, mean = median = mode, 95% of observations fall within 1.96 standard deviations from the mean.



- **Central Limit Theorem** – even if the distribution of our sample may be non-normal, if we take enough samples, and use those means to make a distribution, our average sample will be normal.
- **Standard Error** – the standard deviation of the distribution of all the sample means
- **Confidence Interval** – is the mean + 1.96(standard error) and the mean – 1.96(standard error). So looking at the distribution of sample means, we can say assuming infinite sampling, 95% of the 95% CI of the sample means will fall within 1.96 standard deviation of the mean

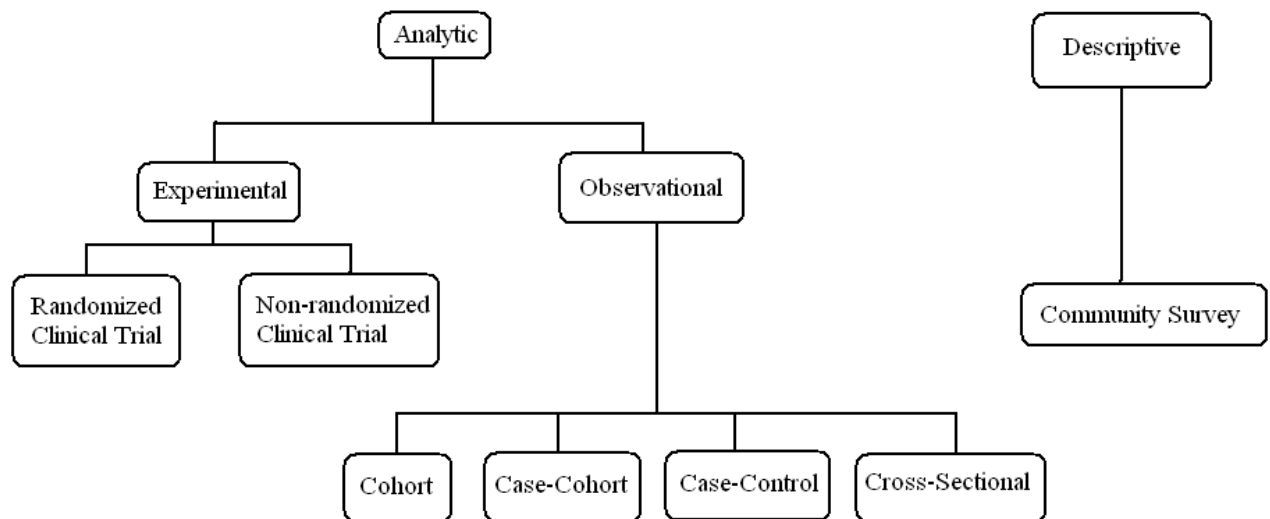
Bias and Confounding

- **Bias** – systematic error, which would continue to exist even if the sample size became infinitely large. Many occur at any stage of inference that to produce results that depart from true values.
 - **Selection Bias** – when the sample group does not accurately represent the population
 - **Measurement Bias** – when measurement methods are different in different groups or when the quality of measurement is different between groups
 - **Confounding Bias** – when an extraneous variable correlates with both independent and dependent variables and is not an intermediate step in the pathway between the variables. These variables are often unknown, but we can control for confounding through:
 - Randomization – can protect against unknown confounders, but can only be used in experimental studies
 - Restriction – limits subjects to specific criteria, but also makes it hard to get adequate samples sizes
 - Matching
 - Individual – uses similar individuals for both test and control groups
 - Frequency – uses similar proportions of certain characteristics for both test and control groups.
 - Stratification – separating a sample into several sub samples at the analysis stage
 - Multivariate analysis (modeling)
- **Random error** – reduces to zero with an infinitely large sample size

Measures and Hypothesis Testing

- **Prevalence** – total cases in the population at a given time/ total population at risk
- **Incidence** – new cases in the population over a time period/ total population at risk during that time period
- **Sensitivity** – percent of people with the disease that test positive. High value is desirable for ruling out disease (therefore it has a low false negative rate).
- **Specificity** – percent of people without the disease that test negative. High value is desirable for ruling in disease (therefore it has a low false positive rate).
- **Positive Predictive Value** – percent of positive results that are true positives
- **Negative Predictive Value** – percent of the negative results that are true negatives
- **Accuracy** (validity) – the trueness of the test measurements, reduced by systematic error
- **Precision** (reliability) – consistency of a test, reduced by random error
- **Null Hypothesis** – the hypothesis of no difference
- **Alternative Hypothesis** – the hypothesis that there IS some difference
- **Odds Ratio** – the odds of having the disease in the exposed group divided by the odds of having the disease in the unexposed group.
- **Relative Risk** – Relative probability of getting a disease in the exposed group compared to the unexposed group

Study Designs



- **Randomized Controlled Trial** – an interventional study where the subjects are randomly allocated to a test or control group. The subjects and researchers may be aware of the assignments (open) or unaware of the assignments (blinded)
 - **Single Blind** – subject does not know assignment but researcher does
 - **Double Blind** – both the subject and the researcher do not know the assignments
 - **Triple Blind** – generally means that the subject, researcher, and the person administering the treatment (e.g. the pharmacist) are unaware of assignments
- **Non-randomized Controlled Trial** – an interventional study where the subjects are assigned to groups by some means other than random
- **Cohort** – a form of longitudinal study where sample selection is based on exposure, comparing a group of people that share a particular characteristic (e.g. people born in 1955) to those that do not, in order to assess causality of one variable on another. It does this by looking at incidence (new cases) over a set period of time.
 - **Prospective study** – defines the cohort before hand and analyzes data using relative risk
 - **Retrospective study** – defines the cohort afterward and analyzes data using odds ratio
- **Case Control** – study sample is selected by outcome and used to identify factors that contribute to a condition by comparing subjects who have that condition to those that do not, but are otherwise similar. Its retrospective (uses odds ratio) and non-randomized nature limits power.
- **Cross-Sectional Study** – study sample collected on either exposure or outcome, during which you collect data from a group of people at a set point in time to assess prevalence. These studies can strengthen or weaken the correlation but can not show causality (which came first).
- **Community Survey** – a study that attempts to ascertain the prevalence of a condition in a fixed geographic region or otherwise defined group.
- **Case Study** – an in-depth, long term examination of a single case.

Choosing a Statistical Test

Exposure	Outcome				
	Binary	Nominal Categorical (>2 categories)	Ordinal Categorical (>2 categories)	Non-normal Continuous	Normal Continuous
Binary	Chi square or Fisher' Exact	Chi square or Fisher' Exact	Chi square, Fisher's Exact, or Mann-Whitney U	Mann-Whitney U	T-test
Nominal Categorical (>2 categories)	Chi square or Fisher' Exact	Chi square or Fisher' Exact	Chi square, Fisher's Exact, or Kruskal Wallis	Kruskal Wallis	ANOVA
Ordinal Categorical (>2 categories)	Chi square or Fisher' Exact	Chi square or Fisher' Exact	Spearman Rank or Kruskal Wallis	Spearman Rank or Kruskal Wallis	Spearman Rank, ANOVA, or Linear Regression
Non-normal Continuous	Logistic Regression	?	Spearman Rank	Spearman Rank	Spearman Rank, or Linear Regression
Normal Continuous	Logistic Regression	?	Spearman Rank or Linear Regression	Spearman Rank or Linear Regression	Pearson or Linear Regression

Appendix A: Specific Diseases in Oral Radiology/ Oral Pathology

Developmental Abnormalities of the Maxillofacial Region

	General Information/ Epidemiology	Clinical / Radiographic / Histological Findings	Treatment / Prognosis / Associations
Fordyce Granules	- Sebaceous glands found in the oral mucosa - Found in 80% of the population - More common in adults	- Multiple yellow-white papules on buccal mucosa/ lateral portion of lip vermillion - Asymptomatic	- No treatment indicated
Leukoedema	- Unknown cause - More common in blacks: found in 70-90%	- Diffuse grayish-white, milky appearance of the mucosa, surface appears "folded"/ wrinkled - Lesion does not rub off - Usually bilateral buccal mucosa - Disappears when cheek is stretched	- No treatment indicated
Ankyloglossia	- Short / thick lingual frenum, resulting in limited tongue movement - 1.7-4.4% of neonates - 4X more common in boys	- Wide spectrum of severity - May contribute to problems with periodontal health, speech, and/ or breathing	- Usually no treatment is necessary, but my do frenectomy after age 5 in severe cases
Lingual Thyroid	- Failure of the thyroid gland to descend properly - 10% of people have small amount of asymptomatic ectopic tissue - Symptomatic (rare) lingual thyroids 4-7X more common in women	- Appears as vascular mass - Symptoms develop during puberty, pregnancy, and menopause - Most common symptoms: dysphagia, dysphonia, and dyspnea - Diagnosis best with thyroid scan, biopsy usually avoided due to risk of bleeding	- Asymptomatic: no treatment needed except follow-up - Symptomatic: hormone suppressive therapy, surgical removal, or ablation are options - 1% risk of malignancy
Fissured Tongue	- Numerous grooves/ fissures on tongue - Unknown cause - 2-5% of the population	- Multiple grooves/fissures on dorsal surface ranging from 2-6mm deep, large central fissure - Usually asymptomatic, may have mild soreness or burning	- No treatment indicated - Associated with geographic tongue - May be a component of Melkersson-Rosenthal syndrome
Hairy Tongue	- Hair-like appearance on dorsal surface of tongue - 0.5% of adults - Cause unknown, maybe related to smoking, antibiotics, poor oral hygiene, radiation, fungus or bacteria over-growth	- Marked accumulation of keratin on filiform papillae, most commonly along the midline - Usually brown, yellow, or black as a result of pigment producing bacteria or staining - Usually asymptomatic, by may have gagging or bad taste	- Eliminate predisposing factors and scrape/ brush the tongue
Varicosities	- Abnormally dilated and tortuous veins - More common with age	- Most common type is the sublingual varix: multiple bluish-purple blebs, asymptomatic - Less common type are solitary varices found on lips and buccal mucosa: firm, non-tender, bluish-purple nodules - Rare instances of secondary thrombosis	- Sublingual varicosities: no treatment indicated - Solitary varices need to be surgically removed to confirm diagnosis, following secondary thrombosis, or for esthetics

Exostoses	- Localized bony growths arising from cortical plate - Most common in adults	- Buccal exostoses: bilateral row of hard nodules, asymptomatic unless overlying tissue is irritated - Palatal exostoses: develop on lingual aspect of maxillary tuberosities, usually bilateral, more common in males - May appear on radiograph	- May need to be removed if chronically irritated, in the way of dental prosthesis, or interfering with oral hygiene/ function
Torus Palatinus	- A form of exostosis - More common in Asian and Inuit populations, and twice as often in females	- Bony hard mass found in midline of hard palate - Usually asymptomatic, but overlying tissue may become irritated - Usually not seen on routine x-rays	- May need to be removed if chronically irritated, in the way of dental prosthesis, or interfering with oral hygiene/ function
Torus Mandibularis	- A form of exostosis - Not as common as the palatal tori - More common in Asian and Inuit populations, and slightly more in males	- bony mass along the lingual aspect of the mandible above the mylohyoid line, near premolars - 90% bilateral - Usually asymptomatic, but overlying tissue may become irritated	- May need to be removed if chronically irritated, in the way of dental prosthesis, or interfering with oral hygiene/ function
Palatal Cyst of Newborn/ Epstein Pearls/ Bohn's Nodules	- Epstein Pearls: on median palatal raphe; Bohn's Nodules: scattered all over hard palate – terms often interchanged - 65-85% of neonates	- Small, 1-3mm white or yellowish papules – of epithelial origin - Histology shows keratin filled cysts lined with stratified squamous epithelium	- No treatment indicated
Nasolabial Cyst	- Unknown cause - Most common in adults, 4-5 decade of life - 3:1 female to male	- Appears as swelling in upper lip, lateral to midline – results in elevated ala of the nose - Usually unilateral - May cause nasal obstruction or interfere with a denture, pain uncommon unless lesion infected - Histology: cyst wall lined by pseudostratified columnar	- Complete surgical excision via intraoral approach recommended - Recurrence rare
Nasopalatine Duct Cyst	- Most common non-odontogenic cyst of oral cavity: ~1% of population - Most common in 4-6th decade of life	- Presents as swelling in the anterior palate with drainage and pain, can be long standing and intermittent, but many are also asymptomatic - Radiograph: well circumscribed radiolucency in or near midline of anterior maxilla, round/ pear shaped with sclerotic border, usually 1-2.5cm in diameter - Highly variable histology – usually more than one type of epithelium	- Treated with surgical enucleation – biopsy first since radiograph is not diagnostic and other benign and malignant lesions can mimic this cyst - Recurrence rare
Median Palatal Cyst	- Difficult to distinguish from nasopalatine cyst and may actually represent a posteriorly placed Nasopalatine duct cyst.	- Firm swelling in midline of hard palate, posterior to papilla – must have clinical expansion of palate, if not then lesion is nasopalatine cyst - Usually asymptomatic, but may have pain or expansion - Radiograph: well circumscribed radiolucency in midline or hard palate, about 2x2 cm - Histology: lined with stratified squamous epithelium	- Surgical removal - Recurrence rare

Epidermoid Cyst	- Common cyst of the skin that often arise after inflammation of hair follicle - More common in males	- Present as nodular, fluctuant subcutaneous lesion, may or may not have inflammation - Most often found in acne-prone areas of head/ neck/ back - Histology: lined with stratified squamous epithelium that resembles epidermis	- Usually treated with conservative surgical excision - Associated with Gardner Syndrome
Dermoid Cyst	- Generally classified as a benign cystic form of teratoma - Most common in kids/ young adults	- Slow growing, usually painless, doughy mass that retains pitting after pressure and can become secondarily infected - Generally occur as sublingual swelling in midline floor of mouth - If above geniohyoid muscle – it can displace tongue and create difficulty breathing, eating, or speaking, If below geniohyoid, it may cause submental swelling that looks like “double chin”	- Treated by surgical removal
Lymphoepithelial Cyst	- Rare lesion arising from oral lymphoid tissue (Waldeyer’s ring)	- Presents as small submucosal mass, usually <1cm diameter, firm or soft, white/yellow in color that often contains cheesy keratinous material in the lumen - Usually asymptomatic - Most frequently in floor of mouth	- Treated with surgical excision

Abnormalities of Teeth

	General Information/ Epidemiology	Clinical/ Radiographic/ Histological Findings	Treatment/ Prognosis/ Associations
Turner's Hypoplasia	- Enamel defect seen in permanent teeth caused by inflammatory disease/ trauma in overlying primary tooth	- Vary from focal areas of white/ yellow/ brown discoloration to that involving the entire crown - Most frequently involves premolars and maxillary incisors	- Composite restorations, veneers, crowns
Fluorosis	- Enamel defect due to excessive ingestion of fluoride	- Fluoride increases retention of amelogenin proteins in enamel leading to hypomineralization - Critical period between age 2-3 - Effect is dose dependent - Appears white, chalky with areas of yellow/brown discoloration	- Composite restorations, veneers, crowns
Transposition	- Correct number, but incorrect position	- Most commonly involve maxillary canines and 1st premolars	- No treatment necessary
Hypodontia	- Too few teeth - 3-8% of population excluding 3rd molars - More common in females - Anodontia is rare – usually associated with ectodermal dysplasia	- 3rd molars most commonly absent, then either 2nd premolars or lateral incisors - Uncommon in primary dentition, usually mandibular incisors when present	- Associated with numerous hereditary syndromes - Treatment variable
Hyperdontia/ Supernumerary Teeth	- Too many teeth - More common in Asians and in males - Distodens: fourth molars - Mesiodens: extra maxillary incisor - Natal teeth: teeth present at birth	- Most cases are single-tooth hyperdontia/ unilateral - Most common site is in maxillary incisor region (mesiodens)	- Associated with numerous hereditary syndromes - Treatment variable
Dens Evaginatus	- Accessory cusp(s) - More common in Asians	- A cusp-like elevation of enamel located in the central groove or lingual ridge of the buccal cusp or a permanent molar or premolar - Usually bilateral and more common in the mandible - May have pulp	- Seen in association with shovel shaped incisors - No treatment indicated
Dens Invaginatus	- Deep surface invagination of the crown or root, lined with enamel - 2 forms: coronal (more common) and radicular	- Most often affects permanent maxillary lateral incisors - Depth varies – Type I is an invagination confined to crown, Type II extends below CEJ, and Type III extends through the root, it may also resemble a tooth within a tooth: “dens in dente”	- Treat by restoring; endo if necessary
Taurodontism	- Enlargement of the body and pulp chamber of multi-rooted tooth	- Varying severity, maybe unilateral or bilateral, and affects permanent teeth more frequently - Involvement of premolars disputed	- Associated with many syndromes and cleft lip/palate - No treatment indicated

Hypercementosis	- Non- neoplastic deposition of excessive cementum - More common with age	- No clinical signs/symptoms - On radiograph it appears as thick/ blunted roots - May be isolated or involve many teeth, but premolars most often affected teeth	- Associated with Paget's disease of bone, supraeruption, apical periodontal infection, occlusal trauma - No treatment indicated
Ankylosis	- Fusion of cementum or dentin to surrounding alveolar bone with loss of PDL space	- Most commonly ankylosed tooth is primary second molar, with the permanent second premolar then failing to erupt - Percussion of tooth yields dull sound - Occlusal plane is altered with continued eruption of non- ankylosed teeth and growth of the alveolar process	- Associated with hypodontia
Amelogenesis Imperfecta	- A group of inherited conditions with altered enamel structure, in the absence of other systemic disease - Ectodermal defect	- Thin (often absent) enamel, easily damaged and susceptible to decay - Affects both permanent and primary dentition - Hypoplastic: properly mineralized, but inadequate deposition of matrix - Hypomaturation: matrix laid down properly, and begins to mineralize but doesn't do so completely – appears mottled/ opaque - Hypocalcified: matrix laid down properly but no significant mineralization occurs - Hypomaturation-hypoplastic: combination of the two defects	- Main problems are esthetics increased prevalence of caries, sensitivity, and loss of VDO – treatment is to address these issues
Dentinogenesis Imperfecta	- Inherited developmental disturbance in dentin, in the absence of other systemic disease - More common in people of English/ French decent - Mesodermal defect	- Both dentitions are affected - Blue/purple/brown translucent or opalescent discoloration - Type I – dentin abnormalities AND osteogenesis imperfecta - Type II – most common type (only dentin affected, no bone fractures) - Type III – like type two with variation (multiple pulp exposures) - On radiograph: teeth have short bulbous crowns, cervical constriction, narrow roots and obliterated pulp chamber	- Most patients are candidates for full dentures or implants by age 30
Dentin Dysplasia	- Dentin hereditary defect in dentin formation in the absence of other disease	- Type I: Rootless teeth - Type II: coronal dentin dysplasia – looks like dentinogenesis imperfecta	- Oral hygiene must be established

Pulpal and Periapical Disease

	General Information/ Epidemiology	Clinical/ Radiographic/ Histological Findings	Treatment/ Prognosis/ Associations
Periapical Granuloma	- Chronic inflammation at the apex of a root - May arise as the initial periapical pathology or as reactivation of a previous periapical abscess	- Most are asymptomatic, but pain can develop during exacerbation - Appears as radiolucency, well or ill defined, of variable size around apex – root resorption not uncommon	- RCT or extraction
Periapical Cyst (Radiolar Cyst)	- Inflammatory response leading to epithelial lined cyst at apex of tooth - Nearly impossible to differentiate RADIOGRAPHICALLY from periapical granuloma	- Usually asymptomatic, but when large enough it can cause swelling, mobility, or sensitivity - Radiographically identical to periapical granuloma and root resorption is common - Can involve deciduous teeth – often primary molars	- RCT or extraction
Lateral Radicular Cyst	- Inflammatory response leading to epithelial lined cyst lateral to tooth	- Radiolucency along the lateral aspect of the tooth	- RCT or extraction and/or surgical excision
Residual Cyst	- A cyst arising after incomplete removal of inflammatory tissue at the time tooth extraction	- Round to oval radiolucency of variable size within the alveolar ridge at the site of a previous tooth extraction – may have calcification in the lumen as cyst ages	- Surgical excision
Periapical Abscess	- An accumulation of inflammatory cells at the apex of a tooth - Can arise as the initial pathology or as an acute exacerbation of chronic inflammatory lesion	- Usually painful with extreme sensitivity to percussion, with swelling of the tissues - may also have generalized symptoms of infection: fever, malaise, etc. - Radiographs can show thick PDL and an ill-defined radiolucency - Progresses through path of least resistance: soft tissue or bone - May see sinus tract/ parulis	- Need to localize and drain, possibly give antibiotics
Cellulitis	- The acute and edematous spread of an acute inflammatory process - Two dangerous forms: Ludwig's Angina and cavernous sinus thrombosis - Occurs when periapical abscess can not establish drainage	- Ludwig's Angina: when infection enters submandibular space and it can spread to retropharyngeal space and then to the mediastinum – it causes massive swelling in the neck (usually unilateral), pain, general symptoms of infection, protrude tongue – may also result in airway obstruction - Cavernous sinus thrombosis: infection involving canine space that spreads to the periorbital area – causes swelling, vision changes, general symptoms of infection – may result in brain abscess	- Ludwig's Angina: maintain airway, incision and drainage, antibiotics, eliminate source of infection - CST: surgical drainage, antibiotics, and extract offending tooth

Osteomyelitis	- Inflammatory process of the medullary spaces or cortical surfaces of bone - More common in males and in the mandible	- Acute: infection spreads faster than the body can respond – presents with general symptoms of infection, significant sensitivity soft tissue swelling near area, radiograph may be show ill defined radiolucency or be unremarkable; possible parathesia, drainage, or fragment of necrotic bone (sequestrum) - Chronic: the body produces granulation tissue in response, to wall off infection – may present with pain, swelling, drainage, sequestrum, tooth loss, or fracture, radiographs show patchy ragged radiolucency with central opaque sequestra	- Acute: antibiotics and drainage - Chronic: antibiotics and surgical intervention
Diffuse Sclerosing Osteomyelitis	- An ill-defined and controversial diagnosis that encompasses a group of presentations - Most common in adults	- Has similarities to its localized variant (condensing osteitis) - More common in mandible - Pain and swelling not usually present. - Radiographs show areas of increased radiopacity around sites of chronic infection	- Treat the adjacent foci of chronic infection – sclerosis remodels in some patient but persists in others
Condensing Osteitis	- localized areas of bone sclerosis associated with apices of teeth with pulpitis/ pulpal necrosis - More common in kids and young adults	- Well circumscribed radiopaque mass around apex of tooth – entire root outline is always visible – different from cementoblastoma - mandibular 1st molar most commonly involved	- Treatment involves resolution of the odontogenic infection - 85% of cases regress
Alveolar Osteitis (Dry Socket)	- Loss of the blood clot that forms after extraction - Occurs in 1-3% of all extractions, but 25% for impacted 3rd molars - More common in older ages groups, oral contraceptive use, smokers, presence of infection, or traumatic extraction	- More common in mandible - Appears as exposed bone that is very painful, foul odor, swelling, and lymphadenopathy that develops 3-4 days post op	- Irrigation and socket is packed with obtundent and antiseptic dressing, which is changed every 24hrs for first 3 days then every 2-3 days until pain gone

Infections

	General Information/ Epidemiology	Clinical/ Radiographic/ Histological Findings	Treatment/ Prognosis/ Associations
Pseudomembranous Candidiasis/ “Thrush”	- Fungal infection with <i>Candida albicans</i> - Immune status and oral environment contribute to risk of infection	- Presents as creamy white plaques, removable, burning sensation, and foul taste - Most common on buccal mucosa, palate and tongue	- Associated with antibiotic therapy or immunosuppression - Antifungal medication
Median Rhomboid Glossitis/ Central Papillary Atrophy	- Form of erythematous candidiasis	- Red well demarcated zone in midline posterior dorsal tongue - Usually asymptomatic and chronic	- Antifungal medication
Angular Cheilitis	- Candida infection (Staph aureus also frequently involved) at the corners of the mouth - More common in adults with reduced VDO	- Red, fissured lesions at the corners of the mouth, raw feeling, severity waxes and wanes	- Antifungal medication
Denture Stomatitis	- A form of erythematous candidiasis found in denture/ RPD patients	- Characterized by varying degrees of erythema and petechiae on denture bearing areas of the maxilla, usually asymptomatic	- Antifungal medication
Herpetic Gingivostomatitis	- The most common form of acute primary HSV infection (90% are HSV1) - Most common in kids 6mos to 5 years old, with average age around 2 yrs	- Abrupt onset , cervical lymphadenopathy, chills, fever, nausea, and sore mouth lesions - Oral lesions develop as numerous pinhead vesicles and collapse into small red lesions with ulceration, adjacent lesions may coalesce - Very contagious and inoculation of the eyes can lead to blindness	- Acetaminophen plus fluids - Antiviral medications
Recurrent Herpes/ Herpes Labialis	- Re-activation of herpes virus	- Prodromal symptoms include pain, itching, burning, warmth, or erythema about 6-24 hours prior - May occur either at the site of primary inoculation or areas of epithelium supplied by the same ganglion – most commonly at vermilion border - Lesions appears as multiple small erythematous papules that form into clusters of fluid filled vesicles, that rupture and crust within 2 days	- Antiviral medications
Epstein-Barr	- Member of the herpes virus group that causes infectious mononucleosis	- Virus infects B-cell and some epithelial cells	- Associated with oral hairy leukoplakia, Burkitt’s Lymphoma, and nasopharyngeal carcinoma

Physical and Chemical Injuries

	General Information/ Epidemiology	Clinical/ Radiographic/ Histological Findings	Treatment/ Prognosis/ Associations
Linea Alba	- “White line” cause by chronic irritation – very common	- Usually bilateral white line on the buccal mucosa at the level of the occlusal plane	- No treatment indicated
Amalgam Tattoo	- Benign blue-gray discoloration cause by amalgam particles becoming embedded in the soft tissues	- Vary in size, usually blue-gray in color, asymptomatic, and are visible on radiograph	- No treatment indicated, unless it is an esthetic issue, also monitor for change

Allergic and Immunologic Diseases

	General Information/ Epidemiology	Clinical/ Radiographic/ Histological Findings	Treatment/ Prognosis/ Associations
Recurrent Aphthous Stomatitis	- Common ulcerative lesion – particularly in students in professional school - 3 types: Major (22%), Minor (54%), and herpetiform (4%)	- 1 or more painful ulcers lasting 7-14 days, located on movable mucosa, NOT seen on hard palate, dorsal tongue, or gingival - Major: Very painful, >1 cm, often affect oropharynx, may leave scar - Minor: ulcers <1 cm, oval, grayish yellow necrotic center with erythematous edges, painful, may have lymphadenopathy	- Associated with B12/folate deficiencies, Crohn’s disease - Treatment: analgesics
Erythema Multiforme	- A vesiculobullous disease of varied involvement of the skin and membranes - More common in young men - Unknown cause but immune system involved	- Prodrome: low grade fever, headache 3-7 days before lesions - Precipitating factors include infection (HSV most common), emotional stress, and drug allergy - Appears as erythematous mucosal patches that necrosis and evolve into large shallow ulcerations, lip involvement can be severe with hemorrhagic crusted lesions, gingiva/ hard palate usually spared - Stevens Johnson Syndrome often confused with erythema multiforme – but SJS involves head and trunk and more linked to medication rather than infection	- Steroid therapy
Pemphigus Vulgaris	- Blistering disorder of the skin, caused by antibodies binding to the cells of the epidermis - Most common between age 30 and 50, and in people of Jewish descent	- Severe oral vesicles and ulcerations, may also have inflammation - Oral lesions often first manifestation of disease	- High dose systemic steroids or chemotherapy (methotrexate)
Lichen Planus	- Common inflammatory disease of buccal mucosa or skin - More common in women	- Wickham’s Striae – lace like white lines, often bilateral and symmetric - Cause unknown - Usually asymptomatic, but may have burning sense	- Biopsy at initial presentation to get baseline - Either no treatment or topical steroid therapy, but don’t expect it to go away

Epithelial Pathology

	General Information/ Epidemiology	Clinical/ Radiographic/ Histological Findings	Treatment/ Prognosis/ Associations
Squamous Papilloma	- HPV 6 and 11 found in half of oral papillomas	- Appears as papillary mass that results from benign proliferation of stratified squamous epithelium, - Most often on tongue and lips - Soft painless pedunculated nodule with numerous finger like projections – cauliflower appearance, white or slightly red or normal color, usually solitary, < 0.5 cm in size	- Conservative surgical excision, recurrence unlikely
Focal Epithelial Hyperplasia	- Caused by HPV - More common in kids	- Usually multiple, soft, non-tender, flattened papules in clusters, same color as oral mucosa	- Spontaneous regression may occur - Conservative excision may also be performed - No known malignant transformation potential
Oral Melanotic Macule	- Discoloration, produced by focal increase in melanin - 2:1 female predilection, average age is 43	- Flat, tan-brown macule, usually <7mm diameter, asymptomatic - Most common site is vermillion zone of lower lip	- No treatment indicated, unless biopsy needed or an esthetic concern
Leukoplakia	- A white patch or plaque that can't be diagnosed as any other disease, clinical diagnosis of exclusion. If pathology report says leukoplakia, pathology report is incorrect. - More common with age - 5 main types: Thin, Thick, Granular, Verruciform, and Proliferative Verrucous	- Typically considered to be pre-cancerous or pre-malignant - 70% found on lip vermillion, buccal mucosa, or gingiva - 90% of dysplastic lesions on tongue, lip vermillion, or oral floor - Thin leukoplakia – rarely dysplastic, less white in color - Thick leukoplakia – thicker, distinctly white, may be leathery on palpation - Granular/nodular leukoplakia – increased surface irregularities - Verruciform leukoplakia – presence of white/blunt projections - Proliferative Verrucous Leukoplakia – multiple keratotic plaques with rough surface projections, usually progresses to squamous cell carcinoma within 8 years, female predilection and minimal association with tobacco	- Monitor for 2 weeks and/or biopsy, and/or surgical excision depending on diagnosis
Erythroplakia	- Red plaque that can't be diagnosed as any other condition - More common in older men ~70 years of age	- All true erythroplakia demonstrate: significant epithelial dysplasia or frank carcinoma - May occur in conjunction with leukoplakia, then referred to as erythroleukoplakia - Most common on mouth floor, tongue, and soft palate	- Monitor for 2 weeks and/or biopsy, and/or surgical excision depending on diagnosis

Tobacco Keratosis	- Lesion that results from use of chewing tobacco - More common in young men	- White plaque with velvety feel located on the mucosa that is in direct contact with tobacco – no pain, ulceration - Usually takes 1-5 years to develop - Gingival recession, increased dental caries, and a black-brown extrinsic stain on hard tissue may accompany the lesion - Increased risk of oral cancer	- Cessation of habit, biopsy
Nicotine Stomatitis	- Mucosal change on hard palate caused by heat from pipes or reverse smoking habits	- Diffusely gray or white palate with numerous slightly elevated papules, with punctuate red centers	- Completely reversible with cessation of habit
Actinic Cheilitis	- Labial counterpart of actinic keratosis - Premalignant	- Appears mottled and dry, opalescent with slightly elevated white or gray plaques that can not be scraped off - Caused by UV radiation in sunlight	- Excision
Squamous Cell Carcinoma	- Most common oral cancer - 6th most common cancer in males, 12th most common in females - More common in men - Risk increases with age, tobacco use, alcohol consumption, radiation, iron deficiency, oncogenic viruses, immunosuppression	- Varied clinical presentation: soft tissue mass, papillary character, ulcerated, white/ red patch, rubbery lymphadenopathy, loose teeth, trismus, and/or parathesia - Early lesion not very painful but may become more severe with progression - Destruction of underlying bone may show “moth eaten” radiolucency with ill defined borders – similar to osteomyelitis - Lip vermillion vs intraoral (most common on tongue, oral floor)	- Potential for metastasis - Lip vermillion: treated with surgical excision - good prognosis (5 year survival >95%) - Intraoral: treated with surgical excision, radiation, or both – 5 yr survival ~76% with no metastasis, 41% with cervical node involvement, and 9% with metastasis

Salivary Gland Pathology

	General Information/ Epidemiology	Clinical/ Radiographic/ Histological Findings	Treatment/ Prognosis/ Associations
Mucocele	- Common lesion resulting from rupture of salivary gland duct with mucin spilling into surrounding tissue - Often result of local trauma, despite lack of hx - Most common in young adults - Not a true cyst b/c lacks epithelial lining	- Dome shaped mucosal swelling, size varies, fluctuant, often bluish with translucency - Most common on lower lip >60%, lateral to midline	- Some rupture spontaneously and heal - If chronic may require surgical excision and sent for histology to rule out salivary gland tumor
Ranula	- Term for mucoceles that occur in the floor of the mouth	- Dome shaped mucosal swelling, size varies, fluctuant, often bluish with translucency - Located on floor of mouth	- Treatment consists of removal of feeding sublingual gland (if large) and/ or marsupialization (if small)
Salivary Duct Cyst	- Unlike the mucocele, this is a true cyst - More common in adults	- Dome shaped mucosal swelling, size varies, fluctuant, often bluish with translucency - Presents as asymptomatic swelling - Arise in major (parotid) or minor (floor of the mouth) glands - If on floor will look blue, arise next to submandibular duct	- Conservative excision - Partial/total removal of gland for major cysts
Sialolithiasis	- Calcified structures that develop within the salivary duct system - Cause unclear	- Sialoliths within major salivary glands can cause episodic pain, especially during meals - Typically appear as radiopaque masses, but not all visible radiographically - Most often develop in submandibular gland ducts - Occlusal radiograph most useful for stone in terminal Wharton's duct	- Small sialoliths may be treated with massage - Larger sialoliths often need to be removed surgically
Sialadenitis	- Inflammation of the salivary glands - May arise from infectious causes (mumps, staph, etc) or non-infectious causes (Sjogren's, sarcoidosis, radiation therapy, allergens)	- Most common in the parotid gland - Appears as tender swelling (mumps is bilateral), may be associated with general symptoms of infection when infection is the cause	- Depending on etiology: treatment may include antibiotics, surgical drainage, surgical removal
Pleomorphic Adenoma	- Most common salivary gland tumor - The term pleomorphic adenoma is an attempt to describe the tumor's unusual histopathologic features – however the actual cells are rarely pleomorphic	- Benign lesion - Painless, slow growing (over years), firm mass - Histologically composed of mixture of glandular epithelium and myoepithelium within a mesenchyme-like background	- Surgical excision, 95% cure rate - Don't enucleate, high recurrence rate. - Risk of malignant transformation may be as high as 5% (carcinoma ex pleomorphic adenoma)

Mucoepidermoid Carcinoma	- Most common salivary gland malignancies - Rarely seen in 1st decade but is still the most common malignant salivary gland tumor in children	- Most common in parotid gland - Appears as an asymptomatic swelling, may develop facial nerve palsy as lesion progresses - Minor gland tumors may resemble mucocele, bluish tinge - May also exist as intra-osseous lesion	- Treatment varies depending on grade/ stage - Intra-osseous lesions need surgical removal and radiation
Warthin's tumor	-	- Parotid gland - 50's - Male 7:1 - Benign, slow growing, soft, painless mass - Can be bilateral	- Excise, rare recurrence

Soft Tissue Tumors

	General Information/ Epidemiology	Clinical/ Radiographic/ Histological Findings	Treatment/ Prognosis/ Associations
Fibroma/ irritation fibroma	- Most common "tumor" of the oral cavity - A reactive hyperplasia of fibrous connective tissue in response to local irritation/ trauma - Most common age 30-60, 2:1 female	- Can occur anywhere in mouth, but most common buccal mucosal along the occlusal plane - Smooth surfaced pink sessile nodule, may appear white due to hyperkeratosis, asymptomatic	- Conservative surgical excision and submit for histological exam
Giant Cell Fibroma	- True tumor, not associated with irritation - 60% occur in first 3 decades of life	- Asymptomatic nodule, surface often appears papillary	- Conservative surgical excision and submit for histological exam
Epulis Fissuratum	- Tumor-like hyperplasia of fibrous connective tissue that develops in association with the flange of an ill fitting denture - Pronounce female predilection	- Single or multiple folds of hyperplastic tissue in the alveolar vestibule – usually firm and fibrous - Usually found on the facial aspect of the ridge	- Surgical removal with microscopic examination – remake/ reline ill fitting denture
Inflammatory Papillary Hyperplasia	- Reactive tissue grown usually developing beneath a denture – some classify as part of the denture stomatitis - Related to ill-fitting denture, poor denture hygiene, or constant wear	- Usually on the hard palate, beneath the denture base - Asymptomatic, erythematous mucosa that has a papillary surface	- Removal of denture for early lesions, antifungal therapy may improve condition for more advanced lesions, but may prefer to excise hyperplastic tissue before making new denture
Pyogenic Granuloma	- Common non-neoplastic growth, thought to be response to irritation - Not a true granuloma - More common in kids and young adults with definite female predilection (especially during pregnancy)	- Smooth or lobulated, usually pedunculated, surface ulcerated, color ranges from pink to bright red to purple depending on lesion age, usually painless, but often bleeding - 75% occur on gingiva	- Surgical excision with submission for histologic exam - If found during pregnancy, treatment deferred until parturition

Peripheral Giant Cell Granuloma	- Relatively common tumor like growth of the oral cavity - Reactive lesion to local irritation/ trauma – may represent soft tissue counterpart to central giant cell granuloma	- Occurs exclusively on the gingival or edentulous alveolar ridge, most smaller than 2cm - Nodule, often more bluish purple than pyogenic granuloma - If difficult to determine whether lesion is peripheral or central – work up for hyperparathyroid may be indicated - Proliferation of multinucleated giant cells in matrix of plump ovoid and spindle shaped mesenchymal cells	- Surgical excision and submit for histologic exam
Peripheral Ossifying Fibroma	- Relatively common tumor gingival growth that is consider to be reactive, not neoplastic - More common in teens and young adults, 2/3rd occur in female	- Occurs exclusively on the gingiva as a nodular mass emanating from the interdental papilla, color is red to pink, surface frequently ulcerated	- Surgical excision and submit for histologic exam and Sc/Rp
Lipoma	- Benign tumor of adipose - Most common mesenchymal neoplasm - Oral lipoma rather rare	- Smooth, soft surface, nodular mass, possible yellow hue - Most common in buccal region	- Surgical excision and submit for histologic exam
Neurofibroma	- Most common type of peripheral nerve neoplasm - More common in young adults	- Arises from mix of cell type including schwann cells and perineural fibroblasts - Slow growing, soft, painless lesion - Most common on tongue and buccal mucosa – occasionally intra-osseous	- Surgical excision and submit for histologic exam – also evaluate patient for possible neurofibromatosis
Hemangioma	- Benign, most common, tumor of infancy with rapid growth phase followed by gradual involution. - Most cannot be recognized at birth, but arise during 1st 8 weeks of life	- Single lesions usually located on head & neck, appearing as raised and bosselated with strawberry color - Color changes to dark purple as lesion matures - Firm to palpation	- About 50% resolve by age 5, 90% by age 9; thus tx often involves only monitoring - For problematic hemangiomas tx alternatives are available
Kaposi's Sarcoma	- Vascular neoplasm by HHV 8 with 4 clinical presentations: Classic, Endemic, Iatrogenic immunosuppression-associated, and AIDS-related	- Classic: oral lesions rare - Endemic: found in Africa - IIA: most often in organ transplant recipients - AIDS-related: found on hard palate, gingival, & tongue appearing as flat, brown/reddish purple zones that develop into plaques or nodules. Pain, bleeding & necrosis may occur.	- Varies with presentation type - May include radiation, surgical excision, and/or systemic chemotherapy
Traumatic Neuroma	- Lesion caused by injury to a peripheral nerve (often a surgical procedure)	- Most commonly found in mandibular mucobuccal fold adjacent to the mental foramen - Usually a small nodule, firm, moveable, well encapsulated, painful “electric” on palpation	- Surgical excision - Multiple neuromas on the lips, tongue or palate may indicate patient has MEN

Lymphangioma	- Benign hamartomas of lymphatic vessels	- Occur on skin or mucous membrane, most commonly on the tongue - Appear as raised bubbly nodules/vesicles, asymptomatic, soft, variable size, range in color	- First aspiration to rule out hemangioma - Then surgical excision - No malignant transform
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Bone Pathology and Fibro-Osseous Lesions

	General Information/ Epidemiology	Clinical/ Radiographic/ Histological Findings	Treatment/ Prognosis/ Associations
Paget's Disease of Bone	- Abnormal bone resorption & deposition resulting in weakening & distortion - Unknown etiology - More common in older white males	- Slowly progressive - Usually asymptomatic although bone pain or worsening arthritic symptoms may be present - May be mono- or polyostotic - Vertebrae, pelvis, skull, and femur commonly affected (jaw involvement is 17%) - Radiograph shows decreased bone density & altered trabecular pattern; may form patchy, sclerotic areas with a "cotton wool" appearance - May resemble cemento-osseous dysplasia	- Use analgesics for pain relief - PTH antagonists (calcitonin & bisphosphonates) to reduce bone turnover - Increased risk for osteosarcoma
Central Giant Cell Granuloma / Giant Cell Tumor	- Lesion considered non-neoplastic (controversial) - Types: Aggressive and Non-aggressive - Most cases non-aggressive type	- Most common in anterior mandible, and often cross midline - Histo: large giant cells in cellular mesenchymal background - Usually asymptomatic with expansion of affected bone, sometimes with breakage of cortical plate; may have pain or paresthesia	- Curettage - Recurrence rates from 11% to >50% - Aggressive lesions may be treated pharmacologic alternatives
Simple Bone Cyst	- Benign bone cavity devoid of epithelial lining - Most common between ages 10 & 20 and found in the long bones	- When in jaws most commonly in premolar & molar areas of mandible - Usually asymptomatic swelling with rare pain/paraesthesia - Radiographically appears as well delineated radiolucent defect with dome-like projections that scallop between roots of teeth	- Jaw SBCs are treated by curettage & histologic examination to differentiate from OKC and cystic ameloblastoma
Fibrous Dysplasia	- Developmental tumor-like condition with normal bone replaced by collection of fibrous connective tissue - Etiology: post-zygotic GNAS 1 gene mutation	- Can be poly- or monostotic - Monostotic represents 80-85% of all cases, with the jaws commonly affected - Painless, slow-growing swelling more commonly in maxilla - Radiographic appearance is a poorly demarcated, fine, ground-glass opacification	- Small lesions can be surgically resected - Large lesions are more surgically problematic

Cemento-Osseous Dysplasia	- Most common fibro-osseous lesion, but diagnostic criteria under debate - Non-neoplastic - 3 types: focal (90% female), periapical (black females most often affected), and florid (most common in black females as well)	- Focal: single site involved, more common in posterior mandible, usually asymptomatic, radiographically it varies from radiolucent to radiopaque with thin radiolucent rim, well defined - Periapical: more common as multiple lesions in periapical region of anterior mandible, associated teeth vital, asymptomatic, radiographically well circumscribed radiolucencies that may develop mixed radiodensity over time - Florid: Multifocal, commonly bilateral and in both maxilla and mandible, asymptomatic, radiographically well circumscribed radiolucencies that may develop mixed radiodensity over time	- For early lesions, regular recall/ monitoring and good home care - Advanced lesion more difficult to manage
Ossifying Fibroma	- True neoplasm - Relatively rare, but definite female predilection	- May resemble focal cemento-osseous dysplasia radiographically - Most common in premolar/ molar region of the mandible, small lesions asymptomatic, large lesions are painless swelling of bone - Radiographically well defined and unilocular, may have sclerotic border, usually mixed radiodensity	- Enucleation or surgical resection
Osteoma	- Benign tumors made of cancellous bone	- Almost exclusively found in craniofacial skeleton - May arise on surface of bone (periosteal) as polypoid or sessile mass or may be in medullary bone (endosteal) - Usually asymptomatic, solitary lesion, slow growing, may create condylar deviation, pain, or limited mouth opening - Radiographically well circumscribed sclerotic mass	- Observation or Conservative surgical excision
Osteoblastoma/ Osteoid Osteoma	- Benign neoplasm of bone that arise from osteoblasts - Closely resembles cementoblastoma and many refer to them both as osteoblastomas – the only difference being the	- Osteoblastoma – pain is common, not relieved by aspirin, greater than 2cm in size radiographically a well- or ill-defined radiolucent lesion with areas of mineralization - Osteoid Osteoma – closely related to the osteoblastoma, pain is	- Local excision and curettage

	- cementoblastoma is fused to the tooth - Osteoblastomas 1% of bone lesions	common and is relieved by aspirin, less than 2cm in size, radiographically well defined radiolucent defect surrounded by a zone of sclerosis, may have small radiopaque nidus	
Osteosarcoma	- Most common malignant tumor of the bones (excluding those of hematopoietic origin)	- 7% of all osteosarcomas occur in jaws, swelling, pain, loosening of teeth, paresthesia, nasal obstruction - Radiographically a symmetric widening of the PDL space, osteophytic bone production on the lesional surface leading to sunburst appearance, dense sclerosis, radiolucent with ill defined borders, root resorption present	- Radical surgical resection, radiation, and chemotherapy - 30-50% 5 yr survival, metastases from jaws rare
Ewing's Sarcoma	- Distinctive primary malignant tumor of bone - 90% of tumors show translocation of chromosome 11 and 22 - 80% occur under age 20, more common in whites	- Jaw involvement is rare, but mandible more than maxilla - Pain and swelling are most common symptoms – fever, paresthesia, and loose teeth may also be present - Radiographically an irregular “moth-eaten” bone lesion with ill defined margins, cortical destruction may give “Onion skin” appearance	- Combined therapy that includes: surgery, radiation and multidrug chemotherapy - 40-80% 5 yr survival

***Metastases to the jaws most commonly originate from primary carcinomas of the prostate, breast, kidney, thyroid, or lung (mnemonic Pb Ktl or “lead kettle”).**

Odontogenic Cysts

	General Information/ Epidemiology	Clinical/ Radiographic/ Histological Findings	Treatment/ Prognosis/ Associations
Dentigerous Cyst/ Follicular Cyst	- Originates by separation of follicle from around the crown or unerupted tooth - Account for about 20% of all cysts of the jaws - Can resorb roots	- Most commonly on mandibular 3rd molars, can have central, lateral or circumferential orientation - Often asymptomatic swelling of bone, pain may develop if infected - Radiographically: well defined, unilocular radiolucency around	- Careful enucleation with possible removal of the unerupted tooth - Can marsupialize which will decompress cyst, reducing the size, then excise cyst less

		crown of unerupted tooth - Large dentigerous cysts are uncommon, will usually present with ameloblastoma or OKC	invasively
Eruption Cyst	- The soft tissue analogue to the dentigerous cyst - Results from separation of follicle from crown of tooth as the tooth erupts through the soft tissue - Most common in kids under age 10	- Soft, often translucent swelling of the gingival mucosa overlying an erupting tooth - Most common in permanent 1 st molars and maxillary incisors - Mand and max deciduous central incisors	- Cyst usually ruptures spontaneously or rarely needs simple excision to allow speedy eruption of the tooth
Odontogenic Keratocyst	- Non inflammatory cyst that arises from the dental lamina; has an “innate growth potential, similar to a benign tumor” and likes to grow in the length of bone; keratinized epithelium lining - More common in teens and young adults - Can resorb roots, but less commonly than dentigerous	- Usually asymptomatic lesion, 90% of which occur in the posterior mandible - Radiographically a radiolucency with a cortical border that can be smooth or scalloped, can be uni or multilocular - Large lesion associated with pain, swelling, drainage - Grows in an A-P direction without expansion of bone (unlike dentigerous cyst)	- Resection, curettage, marsupialization, surgical excision - May be a part of Basal Cell Nevus Syndrome - High propensity for recurrence
Gingival Cyst of the Newborn	- Small superficial keratin filled cysts that are found on the mucosa of infants - Very common	- Small, usually multiple, whitish papules on the mucosa overlying the alveolar process of neonates - More common in the maxilla	- No treatment indicated
Gingival Cyst of the Adult	- Uncommon lesion that is considered to be the soft tissue counterpart to the lateral periodontal cyst - More common in 5 th -6 th decades	- Most common in mandibular canine/ premolar area (60-75%) - Usually on facial gingival or alveolar mucosa – appearing as painless domelike swelling with bluish-gray color	- Simple surgical excision
Lateral Periodontal Cyst	- An uncommon developmental cyst that occurs lateral to root surface – not the same as a lateral radicular cyst, which is inflammatory in nature	- Usually asymptomatic - Most commonly occurs in mandibular canine/ premolar/ lateral incisor region of the mandible - Radiographically appears as well defined radiolucent area lateral to the root of a vital tooth – may occasionally appear polycystic	- Conservative enucleation, no recurrence
Calcifying Odontogenic Cyst/ Gorlin Cyst	- Uncommon lesion that shows considerable diversity in histology and clinical behavior - No age predilection - Can resorb and displace adjacent roots	- Predominately intra-osseous lesion, most commonly in anterior of maxilla or mandible - Radiographically: a unilocular well defined radiolucency, although can be multilocular, has radiopaque structures within lesion - Histology shows ghost cells	- Simple enucleation, low recurrence
Glandular odontogenic cyst	Rare developmental cyst, aggressive, has glandular features, middle-aged	- Mandible, crosses midline, expansion, pain, multilocular, well-defined	- Enucleation, high recurrence, so sometimes en bloc resection indicated.

Odontogenic Tumors

Epithelial Origin

	General Information/ Epidemiology	Clinical/ Radiographic/ Histological Findings	Treatment/ Prognosis/ Associations
Ameloblastoma	- The 2nd most common Odontogenic tumor - 3 types: solid/multicystic (86%), unicystic (13%), and peripheral (1%) - Multicystic: more common in black adults - Unicystic more common in age 10-20 yrs	- Multicystic: painless expansion of jaw, ~ 85% occur in mandible, mostly in molar-ascending ramus area, radiographically a multilocular radiolucent lesion, “soap bubble w/ honeycomb loculations”, cortical expansion, resorption of roots, associated with unerupted 3rd molar - Unicystic: 90% in posterior mandible, usually asymptomatic, radiographs show a sharply circumscribed radiolucency surrounding crown of unerupted mandibular 3rd molar, resembles follicular, primordial, residual, dentigerous, and radicular cysts -- sometimes has scalloped margins - Peripheral (extraosseous): non-ulcerated, sessile or pediculated lesion of gingival or alveolar mucosa, mandibular predilection, resembles pyogenic granuloma or fibroma, usually painless	- Multicystic: Optimal treatment controversial and ranges from simple enucleation to en bloc resection -- Recurrence rate of curettage is 50-90%, marginal resection 15% - Unicystic: enucleation - Peripheral: excision - Less than 1% of ameloblastomas become malignant
Malignant Ameloblastoma/ Ameloblastic Carcinoma	- Malignant Ameloblastoma – a tumor that shows histopathologic features of an ameloblastoma at both primary tumor and metastatic sites w/o features of malignancy - Ameloblastic Carcinoma – an ameloblastoma that has cytologic features of malignancy at primary tumor, or in any metastatic deposits	- Metastases most often found in lungs. Cervical lymph nodes 2nd most common metastasis site. - Similar to non metastasizing ameloblastomas, but usually more aggressive, lesions have ill-defined margins & cortical destruction - Ameloblastic carcinoma histology shows increased nuclear/cytoplasmic ratio, nuclear hyperchromatism, mitoses, necrosis	- Poor prognosis
Adematoid Odontogenic Tumor (AOT)	- WHO classifies as Mixed Odontogenic tumor - 66% of cases between age 10-19, 2:1 female - “2/3 tumor” 2/3 in females, teens, anterior maxilla, impacted cuspid.	- Slow growing usually asymptomatic but large lesions cause expansion of bone, 2:1 maxillary, anterior predilection, rarely > 3cm - Usually discovered when checking why a tooth has not erupted - 75% appear as well circumscribed unilocular radiolucency surrounding crown of an unerupted tooth, usually a canine (Follicular type), Less frequently it may appear as radiolucency between erupted teeth (extrafollicular type),	- Enucleation, never recurs

		fine “snowflake” calcifications	
Clear Cell Odontogenic Tumor/ Clear Cell Carcinoma	- Rare jaw tumor	- Some patients complain of pain & bony swelling; others are asymptomatic, aggressive tumor, either jaw affected - Unilocular or multilocular radiolucencies; margins often ill-defined - Histology shows characteristic clear cells - clear cell filled with glycogen, no mucin, no amyloid	- Aggressive course, with structure invasion & tendency to recur, radical surgery, lung & lymphatic metastases may occur.
Calcifying Epithelial Odontogenic Tumor/ Pindborg Tumor	- Rare peripheral tumors - 30-50 year old	- Painless slow-growing swelling, 2:1 mandible (usually posterior) - Multilocular, lytic defect with scalloped margins, may be entirely radiolucent, or contain calcified structure of varying size & density. - Frequently associated with an impacted tooth, usually mandibular 3rd molar. - Less aggressive than ameloblastoma	- Conservative resection, low recurrence rate
Squamous Odontogenic Tumor	- Rare benign neoplasm	- Painless to mildly painful gingival swelling often associated w/ tooth mobility, some patients have had multiple SOTs involving multiple quadrants of the mouth - Radiographs shows triangular defect lateral to root/roots of teeth, sometimes suggesting vertical periodontal bone loss, may be ill-defined, or have a well-defined sclerotic margin, most are small	- Conservative local excision or curettage

Ectomesenchymal Origin

	General Information/ Epidemiology	Clinical/ Radiographic/ Histological Findings	Treatment/ Prognosis/ Associations
Odontogenic Fibroma	- Rare and controversial lesion, 2:1 female - May be central or peripheral	- Central: generally maxillary lesions are in anterior and mandibular lesions located in posterior, radiographically a well defined, small unilocular radiolucency often associated with periradicular area of unerupted tooth, sclerotic border, root resorption of associated teeth, may cause root divergence - Peripheral: a firm slow growing sessile gingival mass, soft tissue counterpart of central odontogenic fibroma, usually on facial gingival of mandible	- Central: Enucleation - Peripheral: local excision
Granular Cell Odontogenic Tumor	- Rare tumor	- Usually asymptomatic, may present with bony expansion, mandibular predilection	- Curettage

		- Well demarcated radiolucency, may have small calcifications	
Odontogenic Myxoma	- Usually found in young adults	- Small lesions are usually asymptomatic, large lesions present as painless swelling - Usually posterior mandible - Uni- or multi-locular radiolucency, “soap-bubble” pattern, wispy trabeculae resemble cob-webs, may displace teeth or resorb roots	- Curettage or excision
Cementoblastoma	- Closely resembles osteoblastoma and many refer to them both as osteoblastomas – the only difference being the cementoblastoma is fused to the tooth	- 67% have pain and swelling, 75% in mandible, 90% in molar/pre-molar region, 50% involve 1st molar, rarely primary teeth - Radiopaque mass fused to root of tooth, surrounded by thin radiolucent rim	- Extraction of associated tooth

Mixed Origin

	General Information/ Epidemiology	Clinical/ Radiographic/ Histological Findings	Treatment/ Prognosis/ Associations
Ameloblastic Fibroma	- Most common in patients younger than 20, male predilection	- Small tumors, usually asymptomatic, large tumors have swelling, 70% of tumors are in posterior mandible - Uni-locular radiolucency with well defined margins, may be sclerotic, 75% involve unerupted tooth	- Conservative therapy initially, recurrence 43%, may develop into malignant ameloblastic fibrosarcoma
Ameloblastic Fibro-Odontoma	- Average age ~10	- Tumor with features of ameloblastic fibroma that also contains enamel and dentin, thought to be early stage odontoma, usually asymptomatic, most in posterior mandible - Well-circumscribed unilocular radiolucency, may have calcifications, often associated with unerupted tooth	- Curettage
Ameloblastic Fibrosarcoma	- Malignant form of ameloblastic fibroma, but only mesenchymal portion is malignant	- Patients have pain and swelling, 4:1 in the mandible - Ill defined destructive radiolucency	- Radical surgical excision
Odontoma	- Most common Odontogenic tumor - Average age ~14 Two types: - Compound – more common, multiple small tooth like structures - Complex – conglomerate of enamel/ dentin bearing no resemblance to a tooth	- Not considered true neoplasm, majority asymptomatic, usually diagnosed when teeth fail to erupt, large lesions (> 6cm) can expand jaws, maxillary predilection (compound in anterior maxilla, complex in posterior of either jaw) - Compound type appears as collection of tooth like structures surrounded by radiolucent zone, - Complex type appears as calcified mass that could be mistaken for an	- Simple excision

		osteoma or other calcified bone lesion, Either can often be associated with unerupted tooth	
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Appendix B: Systemic Medical Conditions and Syndromes

Condition	Description/ Notes
Pregnancy	Overall, dental care is safe during pregnancy. Dental treatment should be coordinated among the patient's prenatal health care and oral health care providers. It is safe to undertake oral diagnosis during the first trimester, including diagnostic radiographs. Necessary treatment can be provided throughout pregnancy, however the ideal treatment period is between the 14 th and 20 th week. When treating pregnant patients have them lie in the left lateral decubitus position to avoid compressing the IVC. Be aware that pregnant patients are at an increased risk for periodontal disease. Also keep an eye out for pyogenic granulomas ("pregnancy tumors").
Diabetes	Over 7% of U.S. adults have diabetes mellitus, putting them at risk for associated vascular diseases such as MI, stroke, ESRD, retinopathy, and foot ulcers. To decrease the risk of these complications patients & care takers should aim for an A _{1c} <7. Diabetes also effects oral health (periodontitis). Interestingly, periodontal disease itself contributes to poor glycemic control. Also, a recent survey found that diabetics are smokers than are non-diabetics, even after controlling for age, sex, race, and education level. Diabetics are also at a greater risk for orofacial infections, e.g. mucomycosis. Many diabetics are on daily aspirin therapy for macrovascular disease; find out and remember to mention this to oral surgery.
Hypertension	Hypertensive patients should have their BP taken prior to significant dental procedures. Although an extensive review by Bader et al. (2002) concluded that epinephrine in local anesthetic VERY rarely resulted in adverse outcomes, many practitioners believe that hypertensive patients should receive no more than 0.04mg of epinephrine. However, remember the importance of pain control when treating hypertensive patients, as it will increase BP significantly. Complications of antihypertensive treatment in orthostatic hypotension, xerostomia, dry mouth, gingival overgrowth, lichenoid reactions, and burning mouth symptoms. It is also important to be aware of patients taking non-potassium sparing diuretics, as epinephrine use can potentially decrease potassium, leading to dysrhythmias. Also, long term use of NSAIDs by decrease the effectiveness of certain antihypertensive agents; this is less of a problem with short term NSAID use.
Hepatitis B	About 2% of the U.S. population, and 1/3 rd of the world's population, is a chronic carrier of the hepatitis B virus. Infection dramatically increases the risk of cirrhosis and hepatocellular carcinoma. Injection drug use and unprotected sex are the most common modes of transmission; however the source of infection in 30% of adult cases cannot be identified. Transmission can also occur through exposure to infected blood and blood-tinged fluids (including saliva). Hepatitis B vaccinations are available.
Asthma	Asthma affects more than 100 million people, and 17 million of those live in the U.S. By 2020 it is expected that the number affected in the U.S. will increase to 29 million. Most asthmatics don't die from their affliction, but many do – as high as 5,000 annually. Asthma is an obstructive pulmonary disease. Factors leading to airway obstruction in asthma include airway smooth muscle spasm, alterations in respiratory secretions with mucous plugging of smaller airways, and inflammation. Atopy is the strongest risk factor for developing asthma. Precipitating allergens include smoke, dust mites, animal fur, pollens, molds, and other airborne irritants – including acrylic and other dental materials. <i>Find out what causes your patients' asthma.</i> Oral health changes in patients with asthmas include an increased rate of caries development (b₂ agonists decrease salivary flow), oral mucosal changes (due to nebulized corticosteroids), gingivitis (inhaled steroids & mouth breathing), and orofacial abnormalities.

Epilepsy	A chronic neurological disorder characterized by recurrent seizures. Dilantin (Phenytoin) is an antiepileptic agent that has been associated with the development of gingival hyperplasia. <i>Grand mal</i> epilepsy characteristically involves an aura, loss of consciousness, and finally tonic-clonic seizure. The patient has entered status epilepticus, a medical emergency, if the seizure lasts longer than 5 minutes or repeats without an interictal return to baseline clinical state.
Chronic Heart Failure	Occurs when the heart's ability to provide blood to the body is insufficient to meet metabolic demands, or these demands can only be met if cardiac filling pressures are abnormally high. Coronary atherosclerosis, MI, valvulopathy, hypertension, congenital heart disease, and cardiomyopathies can all lead to heart failure. Because of improved treatment for cardiac diseases and an aging population, the incidence of heart failure is increasing. Follow a stress reduction protocol when treating these patients, and monitor BP and oxygen. Patient positioning is an important consideration; it is more appropriate to treat heart failure patients in the semi-supine or upright position. Be aware of the patient's medications (see <i>HYPERTENSION</i>). Acute pulmonary edema is a severe form of left-sided heart failure, caused by rapid accumulation of fluid in the lung.
Down's Syndrome	Trisomy 21 affects 1:800 births, with risk increasing with maternal age. Most are mild to moderately mentally retarded, i.e. with IQ ranges from 50-70 or 35-50, respectively. Characteristic dysmorphic features of Down syndrome that affect the head and neck region include brachycephaly, upslanting palpebral fissures, epicanthic folds, Brushfield spots, flat nasal bridge, mid-face retrusion, folded or dysplastic ears, small ears, open mouth, protruding tongue, furrowed tongue, narrow palate, abnormal teeth, delayed dental eruption, short neck, and excessive skin at nape of the neck. Those with Down syndrome have an increased risk for periodontitis. Most persons with trisomy 21 are cooperative patients. In general, dental care for persons with developmental disabilities is lacking. Although providing care to such individuals can be challenging, those who have developed the skills to do so find it very rewarding. To learn more about providing care to this underserved population visit (www.nidcr.nih.gov/OralHealth/Topics/DevelopmentalDisabilities)
Cleft Lip and Palate	(CLP) prevalence is 1:700-1000 births. It is most common in Asian and Native American descent, and least common in those of African descent. Isolated cleft palate prevalence is 1:2000. Associated problems include embryological abnormalities, postsurgical distortions, hearing and speech impairment, other congenital anomalies, and dental anomalies. Treatment involves coordination among the oral and ENT surgeons, orthodontist, speech therapist, and psychologist.
Sickle Cell Anemia	An inherited disease in which RBCs become crescent shaped in hypoxic conditions, which causes small blood clots and "pain crises". The sickling process is a result of abnormal hemoglobin (HbS) production within the RBCs. The abnormal HbS is a result of a single nucleotide substitution mutation (thymine replaces an adenine) on the beta chain, which results in a glutamic acid being replaced by a valine. - Sickle trait (heterozygous for HbS) is carried by 10% of the African American population, with 0.2% having the homozygous disease. More common in females - Dental radiographs show marked loss of marrow spaces and trabeculae. Osteosclerotic areas are also noted in the midst of large radiolucent marrow spaces. However, the lamina dura is unaffected.
Multiple Myeloma	Primary malignant neoplasm of bone characterized by progressive destruction of the marrow with replacement by plasma cells - Clinical – men 2:1, 40-70 years of age, pain in lumbar or thoracic region, vertebrae, ribs and skull most frequently involved - Radiographs show "punched out" radiolucencies of involved bones - Lab – hypergammaglobulinemia (IgG), Bence-Jones proteinuria - Poor prognosis
Lymphomas	A group of tumors arising in lymphoid tissue. When confronted with a neck swelling you should have lymphoma and metastatic carcinoma in the differential. Lymphomas are classified as Hodgkin's (Reed-Sternberg cell with "owl-eye" nucleus) and Non-Hodgkin's (poorer prognosis).

Leukemia	A mutation where the WBCs remain in an immature form, multiply uncontrollably, and fail to fight infection. Accumulation of these cells in the bone marrow reduces the production of RBCs and platelets, which if untreated can overwhelm the bone marrow, enter the bloodstream, and invade other parts of the body (lymph nodes, spleen, liver, CNS) - Acute lymphocytic leukemia (ALL) - o Most common type in kids - o Most responsive to therapy - o Clinical - rapid onset (a few months): sudden high fever, weakness, malaise, anemia, lymphadenopathy, bone/joint pain, petechiae and ecchymoses in skin and mucous membranes - o Lab – numerous null cells, leukocytosis (30,000 – 100,000 per cu. Mm) - o Untreated patients die in 6 mos. - Acute myelogenous leukemia (AML) - o Most malignant type - o Most likely type to present with oral involvement - o Most common in adults - o Clinical - rapid onset (a few months): sudden high fever, weakness, malaise, anemia, lymphadenopathy, bone/joint pain, petechiae and ecchymoses in skin and mucous membranes - o Lab – numerous null cells, leukocytosis (30,000 – 100,000 per cu. Mm) - o Untreated patients die in 6 mo., Contain myeloblasts with Auer rods - Chronic lymphocytic leukemia (CLL) - o Least malignant type - o Most common in adults - o Clinical - slower onset and progression, with less devastating course, insidious weakness and weight loss, petechiae and ecchymoses, repeated infections - Chronic myelogenous leukemia (CML) - o Clinical - slower onset and progression, with less devastating course, insidious weakness and weight loss, petechiae and ecchymoses, repeated infections - o Lab – more mature leukocytes, Philadelphia chromosome and low alkaline phosphatase
Scleroderma	Disease (can be localized or systemic) affecting the connective tissue of the skin, joints, blood vessels and internal organs caused by progressive tissue fibrosis, inflammation, and occlusion of the microvasculature via production of type I and type III collagen. - Radiographs show abnormal widening of the PDL space (like in osteosarcoma), may also show bilateral resorption of the angle of the ramus or complete resorption of the condyles/coronoid process
Lupus Erythematosus	(LE) is the most common connective tissue disease in the U.S. It is an immunologically mediated condition, and typically manifests as one of three subtypes, systemic (SLE), chronic cutaneous (CCLE), or Subacute cutaneous (SCLE). SLE is the most serious, with a 15-year survival rate of 75%. Average age of SLE diagnosis is 31, with women affected 9x more than men. A malar (“butterfly”) rash is typical of SLE. SLE is a multisystem disease that can affect the skin, blood, brain, heart, and kidneys. Oral manifestations of lupus are usually identical to erosive lichen planus; however, unlike LP these lesions rarely occur in the absence of skin lesions.
Addison’s Disease	is adrenal cortical insufficiency. It occur idiopathically, or result from adrenal infection or autoimmune disease. The classic oral manifestation is melanotic hyperpigmentation of the buccal mucosa. JFK had Addison’s.
Hyperparathyroid	A rare disorder caused by hyperplasia or neoplasm of the parathyroid gland(s). Increased PTH results in hypercalcemia. Radiographic manifestations include loss of the lamina dura, a ground glass appearance, and multilocular radiolucencies (“Brown tumor”).

Hemophilia	Hemophilia A (classic hemophilia), Hemophilia B (Christmas disease), and von Willebrand’s disease are compared in the following table. <table><tr><td>TYPE</td><td>DEFECT</td><td>INHERITANCE</td><td>FINDINGS</td></tr><tr><td>Hemophilia A</td><td>Factor VIII deficiency</td><td>X-linked recessive</td><td>Abnormal PTT</td></tr><tr><td>Hemophilia B</td><td>Factor IX deficiency</td><td>X-linked recessive</td><td>Abnormal PTT</td></tr><tr><td>von Willebrand’s disease</td><td>vWF → abnormal platelets</td><td>Autosomal dominant</td><td>Abnormal BT, abnormal PTT</td></tr></table> The severity of the disorder depends on the extent of the clotting factor deficiency. On occasion normal activity results in deep hemorrhage that may involve muscles, soft tissues, and joints (hemarthrosis). Aspirin is usually contraindicated for patients with these disorders. Good oral hygiene / dental care is especially important for these patients, so as to avoid developing problems requiring surgical intervention. If surgery is necessary, be sure to consult with the patient’s PCP.	TYPE	DEFECT	INHERITANCE	FINDINGS	Hemophilia A	Factor VIII deficiency	X-linked recessive	Abnormal PTT	Hemophilia B	Factor IX deficiency	X-linked recessive	Abnormal PTT	von Willebrand’s disease	vWF → abnormal platelets	Autosomal dominant	Abnormal BT, abnormal PTT
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Hereditary Ectodermal Dysplasia	A group of hereditary conditions in which 2 or more ectodermally derived structures fail to develop. The best known type is hypohidrotic ectodermal dysplasia, which seems to show an X-linked inheritance pattern. Reduced number of sweat glands causes heat intolerance in affected individuals. Other features of this condition include sparse hair, periocular hyperpigmentation, and mild midfacial hypoplasia. Patients also usually have a reduced number of teeth (oligodontia or hypodontia, and rarely anodontia) and conically shaped crowns.																
Pagets Disease of Bone (Osteitis Deformans)	Chronic bone disorder in which bones become enlarged and deformed. More common in males and rarely found in people < 40 years of age. The cause is unknown. - Clinical – slow development of pain in affected area, deformity of bones, susceptibility to fractures, headache and hearing loss - Radiographs show “Cotton wool” appearance, teeth have pronounced hypercementosis, and loss of lamina dura - Lab tests show increases alkaline phosphatase - Treated with calcitonin or antimetabolites - Patients are predisposed to developing osteosarcomas																
Gardner’s Syndrome	A polyposis syndrome that presents with multiple polyps of the large intestine that inevitably progress to colon cancer (adenocarcinoma). Initial onset is during early puberty. Other findings include development of multiple epidermoid cysts on the face, scalp, or extremities, multiple impacted and supernumerary teeth, multiple jaw osteomas with “cotton wool” appearance, multiple odontomas																
Nevoid Basal Cell Carcinoma Syndrome	Disorder characterized by oral, systemic, and skeletal anomalies, with a predisposition for skin cancers. Findings include: multiple basal cell carcinomas, other benign cysts and tumors, multiple OKCs, rib anomalies (bifid rib), hypertelorism, congenital blindness, mental retardation, dural calcification (of falx cerebri), agenesis of corpus callosum, congenital hydrocephalus, and hypogonadism																
Pernicious anemia	A relatively common, chronic, progressive, megaloblastic anemia caused by lack of secretion of the intrinsic factor, which is necessary for adequate absorption of Vit. B12 (required for maturation of erythrocytes). - Clinical – sore painful tongue (atrophic glossitis), angular cheilitis, tingling/numbness of the extremities, dysphagia, odynophagia																
Erythroblastosis fetalis	When Rh-negative mother has Rh-positive fetus, the mothers Rh antibodies cross the placenta and destroy fetal RBCs, leading to anemia. (this can also occur with ABO blood group incompatibilities																

	(which is actually more common than the Rh incompatibility) - Teeth have green/blue/brown hue and enamel hypoplasia may occur
Multiple Endocrine Neoplasia (MEN) Syndrome	- Type I – consists of tumors or hyperplasia of the pituitary, parathyroids, adrenal cortex and pancreatic islets - Type IIa – parathyroid hyperplasia or adenoma, but no tumors of the pancreas. However, these patients often have pheochromocytomas of the adrenal medulla and medullary carcinoma of the thyroid - Type IIb – mucocutaneous neuromas (most constant feature), pheochromocytomas of the adrenal medulla and medullary carcinoma of the thyroid *the most significant feature of MEN is the development of medullary carcinoma of the thyroid as it has the ability to metastasize and cause death.
Crouzon	A.k.a. craniofacial dysostosis, is the most common of the craniosynostoses. It is associated with an FGFR2 mutation, and is characterized by premature closure of cranial sutures (craniosynostosis); the most severely affected patients demonstrate premature closure of all sutures, resulting in a “cloverleaf skull” (kleeblattschadel) deformity. Patients with Crouzon syndrome show midface hypoplasia, crowding of the maxillary dentition, and lateral palatal swellings that produce pseudocleft. Surgical intervention may be necessary to relieve increased intracranial pressure.
Apert	A.k.a acrocephalosyndactyly is caused by an FGFR2 mutation, and is also characterized by craniosynostosis. Patients typically demonstrate acrobrachycephaly, or tower skull. Severe cases show the kleeblattschadel deformity. Midface hypoplasia, ocular proptosis, and syndactyly are also present. Surgical intervention may be necessary to relieve increased intracranial pressure.

Appendix C: Adjusting Occlusion

The techniques outlined below are for minor adjustments to occlusion. For more complex occlusal issues, such as prematurities or discrepancies in CO / CR, adjustment in crossbite (posterior and anterior), you should consult with faculty and current dental literature before adjusting.

Goals for Occlusal Adjustment

- To provide multidirectional, unrestricted smooth gliding contact patterns
- To provide similar incisal and cuspid guidance for both sides
- To eliminate interferences or provide guidance on the balancing side

Technique for Adjusting Excursive Interferences

- Locate contacts in centric occlusion, working side interferences, and protrusive interferences using articulating paper
- Elimination of working side occlusal interferences during lateral excursion should be done by following Schuyler's "BULL" principle – only grinding the lingual inclines of buccal cusp of maxillary teeth and the buccal inclines of the lingual cusps of mandibular teeth. Grinding the other cusps will lead to alteration of centric stops. Do not grind on the lingual surface of lingual cusps of maxillary teeth or the buccal surface of buccal cusps of mandibular teeth.

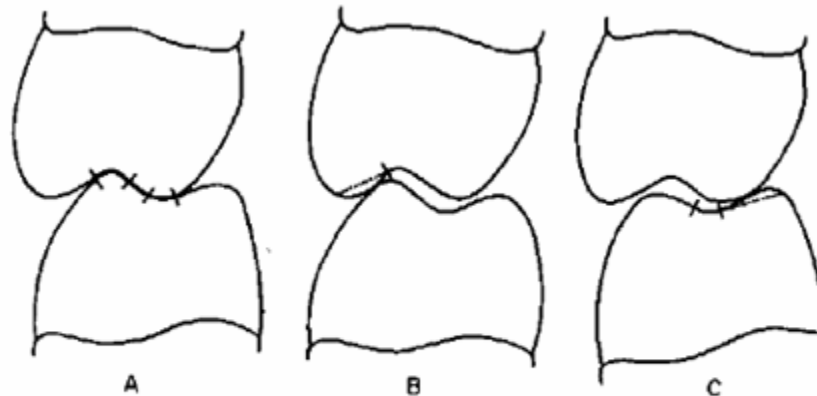
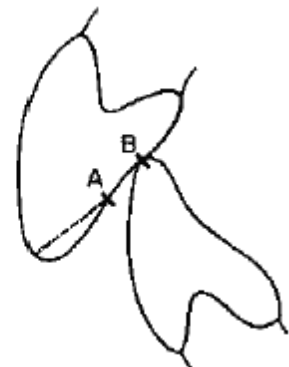


Figure 13-10. Correction of occlusal interferences on the working side of lateral excursions. A, Contact relation in centric occlusion. B, Dotted line on lingual incline of maxillary buccal cusp indicates correct grinding of occlusal interference. C, Dotted line on buccal incline of mandibular lingual cusp indicates correct grinding for removal of occlusal interference.

- Interferences between maxillary and mandibular anterior teeth should be corrected by grinding on the lingual aspect of the maxillary incisors and cuspids along the path of interference. There should never be posterior contacts in protrusive excursion.

Figure 13-13. Correction of interferences between maxillary and mandibular anterior teeth during lateral or protrusive excursions. Point A indicates initial contact in protrusive excursion. Point B indicates centric occlusion stop. Dotted line indicates grinding incisally from point of initial contact to remove interference.



- Balancing side interferences are those that occur between maxillary and mandibular supporting cusps and their occlusal inclines, so great care must be taken not to alter centric stops when grinding on these cusps. Some centric stops may have to be sacrificed to eliminate interferences but all centric contact points should never be ground away on any particular tooth.

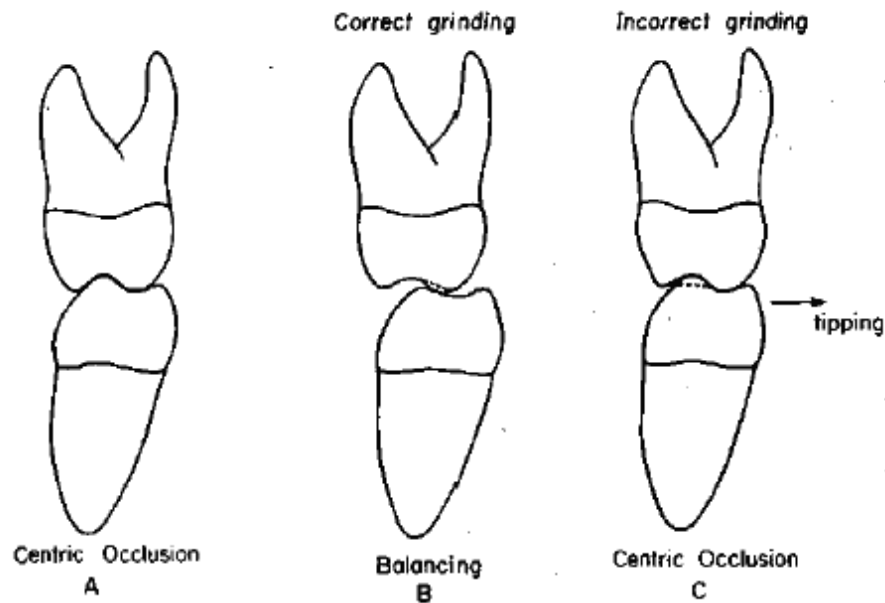


Figure 13-14. Correction of balancing side interferences. A, Contact relations in centric occlusion. B, Occlusal interference in balancing. Dotted line indicates correct grinding to remove interference and preserve stability. C, Grinding of the buccal mandibular cusp as indicated by the dotted line may cause the molar to tip lingually and the balancing side interference to recur.

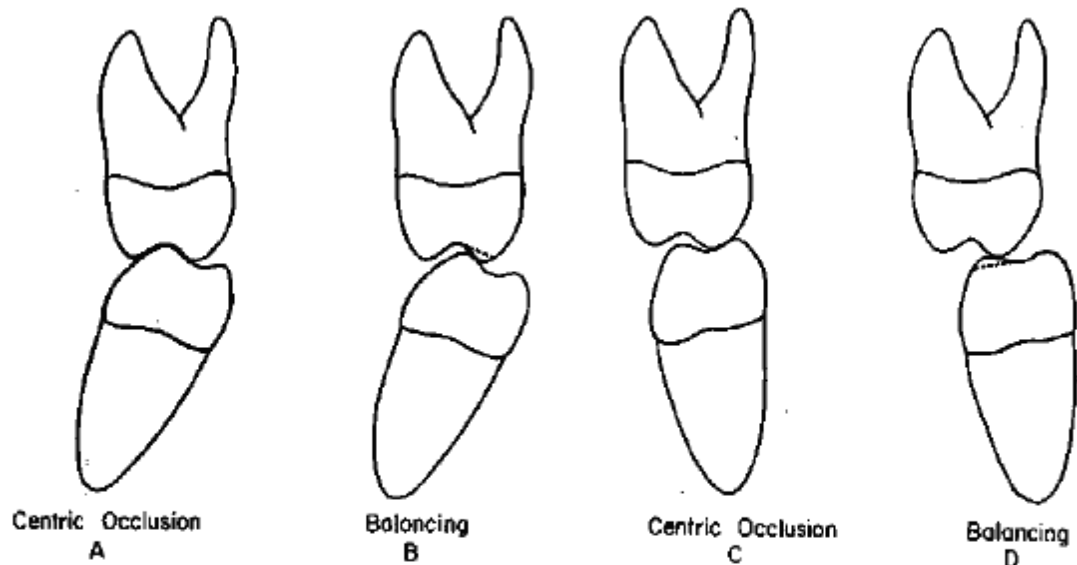


Figure 13-15. A and B, Correction of balancing side interference when posterior mandibular tooth is tipped lingually. A, Contact relations in centric occlusion. B, Correct grinding to remove the interference is indicated by dotted line on the buccal incline of the maxillary lingual cusp. C and D, Correction of balancing side interference when posterior mandibular tooth is tipped buccally. C, Contact relations in centric occlusion. D, Correct grinding of the buccal cusp of the mandibular molar is indicated by the dotted line.

Appendix D: Articulators

Features

- Condylar inclination – normally set to 30 degrees
- Bennett angle – ranges between 7.5 – 30 degrees (mean of ~15 degrees), but can be set to the patient using lateral or protrusive interocclusal records.
- Intercondylar distance
- Anterior guidance – custom guidance with acrylic resin or mechanical guidance with adjustable table.

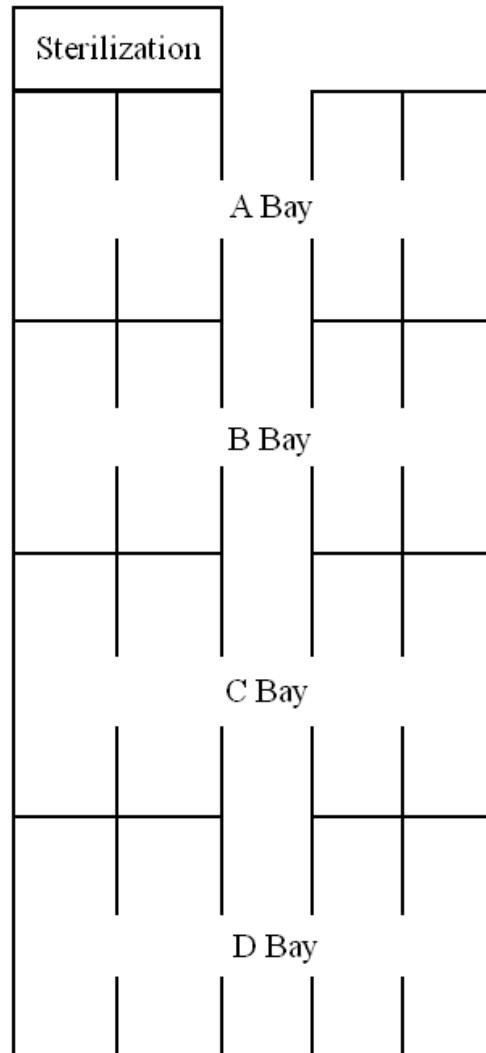
Articulator Types

- Non-adjustable: casts mounted in MI
 - Pros: inexpensive and quick
 - Cons: only 1 occlusal contact position and no eccentric movements
 - Uses: when patient has adequate anterior guidance with complete posterior tooth disocclusion, typically for single crowns
- Semi-adjustable:
 - Features
 - Condylar inclination – Increase condylar inclination = increase cusp height
 - Lateral condylar guidance (Bennett angle) – increase laterotrusive movement = wider laterotrusive/mediotrusive pathway angle
 - Intercondylar distance – Increase intercondylar distance = narrower laterotrusive/mediotrusive pathway angle
 - Pros: minimal intraoral adjustments required and used for routine restorative work
 - Cons: more time needed for mounting and records, more expensive
 - Uses: when patient's anterior guidance does not disocclude posterior teeth or when restoring anterior guidance
- Fully-adjustable
 - Features
 - Condylar inclination – duplicates condylar guidance and curvature of these movements, exact dimensions of cusp height and fossa depth
 - Lateral condylar guidance (Bennett angle) – exact characteristics of orbiting condyle, can duplicate immediate and progressive sideshift
 - Intercondylar distance – records precise distance in the patient
 - Pros: capable of reproducing precise condylar movements, minimizes adjustments in extensive restorative case and precise fit of restorations
 - Cons: considerable time required and expensive
 - Uses: full mouth reconstruction or increasing VDO

Appendix E: Clinic Map

Window Side

- Impression Trays
- Prophy heads and paste
- Alginate impression materials



Wall Side

Crown/ Bridge

- TempArt, TempBond, Duralay
- Benda brushes and dappen dishes
- Post, post drills, and Built-It
- Retraction cord and Hemodent
- PVS impression material and adhesive
- Articulating paper and shim stock
- Fit Checker, PIP

Endo/ Perio

- Fuji triage, UltraCal, syringes and needles
- Hand files and paper points
- Gutta percha: master and accessory cones
- Bleach, RC prep, canal sealer, endo ice
- Hydrogen peroxide
- Coe-Pak, sutures, scalpels, sterile gauze

Operative

- Rubber dam
- Composite, sealants, flowable
- Dycal, Vitrebond, Etch, Optibond
- Wedges, matrix bands, sectional matrix
- Prisma gloss paste and polishing heads

Other Materials

- Sterilization will provide
 - Cassettes available: basic, amalgam, composite, crown and bridge, perio surgery, endo, hand piece, rubber dam
 - Endo Specific: Apex locator and hooks, Touch-n-Heat, or Obtura
 - Cavitron and cavitron tips
 - Other: bite blocks, disposable mirrors, rubber damn clamps, finishing burs, amalgam burs, crown and bridge burs, and acrylic burs
- You must provide:
 - Curing light
 - Shade guide(s)
 - Loupes
 - Intra-oral Camera
 - Endo Specific: endo ring and endo bur block

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