DENTAL ANATOMY AND OCCLUSION

TOOTH COMPOSITION & DEVELOPMENT REVIEW

- Basically everything is from Ectomesenchyme except for Enamel, which is from Ectoderm
- A quick review of Odontogenesis

  **Initiation**
  - Induction – interaction between ectomesenchyme and epithelium
    - **6th week**
    - Formation of dental lamina

  **Bud Stage**
  - Proliferation – both dental lamina and underlying ectomesenchyme
    - **8th week**
    - Dental lamina into 10 buds per arch
    - **Shape of tooth is evident**
    - Enamel organ starts to form
    - **Tooth buds of the Maxilla appear 1st!**

  **Cap Stage**
  - Proliferation and Differentiation
    - Morphodifferentiation – change into other shapes
    - Histodifferentiation – branch into different tissues
    - **9-10th week**

  **Bell Stage**
  - Differentiation of Odontoblasts
    - **For the whom the BELL TOMES**
    - **Differentiation** to its furthest extent resulting in 4 different cell types in the bell-shaped enamel organ (makes enamel and Hertwig’s root sheath)
      - OEE – cuboidal
      - IEE – columnar (Think I is next to I)
      - Stellate reticulum – network of star-shaped cells
      - Stratum intermedium – flat to cuboidal
    - **Dental papilla** (makes dentin and dental pulp) differentiate into 2 layers
      - Outer cells
      - Central cells
    - **Dental sac** (makes Cementum, PDL, and alveolar bone proper) increases in collagen fibers
    - **11-12 weeks**
      - Remember enamel organ makes Enamel

  **Appositional Stage**
  - Cells that were differentiated into specific tissue-forming cells begin to deposit the specific dental tissues (i.e. enamel, dentin, cementum and pulp)

  **Maturation Stage**
  - Mineralization begins at the DEJ and continues until total development accomplished, taking approximately 2 yrs to complete

- Enamel

  **Ectodermal Origin**
  - 4 Layers of Enamel Organ
    - Outer enamel epithelium
      - Outer cellular layer
    - Inner enamel epithelium (IEE)
      - Innermost layer
      - Cells will become ameloblasts
    - **Essential for the initiation of dentin formation**
      - *NOTE: In a developing tooth, the junction of the dental papilla and the IEE becomes the DEJ*
    - Stratum Intermedium **Think I is next to I**
• Lateral to inner enamel epithelium

• Essential to enamel formation (nutrients for the ameloblasts of inner enamel epithelium) – during calcification

• Stellate Reticulum
  • Central core and fills bulk of organ
  • Contains lots of intercellular fluid (mucous type rich in albumin) which is lost prior to enamel deposition

➢ After enamel formation, all 4 layers become 1 and form the **Reduced Enamel Epithelium**
  • What is the reduced enamel epithelium made from? Attached epithelial cuff??
  • Very important in forming the **dentogingival jxn**, where the enamel and epithelium meet as tooth erupts
  • This forms initial **junctional epithelium**

➢ 96% inorganic, 1% organic, 3% water

  ➢ Inorganic
    • Hydroxyapatite
      ♦ Calcium and Phosphate
      ♦ Fluoride and Zinc (Minor)
      ♦ Optically clear

  ➢ Organic
    • Protein rich in Proline

➢ Brittle, but can endure 100,000 PSI of pressure

➢ Yellow to grayish

➢ Selectively permeable membrane (water and ions via osmosis)

➢ **Enamel Rods or Prism**
  • Fundamental morphologic primary unit
  • Aligned perpendicularly to the DEJ (except in cervical regions of primary teeth)
    • A chamfer or long bevel is commonly used as a gingival finish line in permanent tooth preparations because the direction of the enamel rods in the region of the CEJ is such that the rods deviate from the horizontal in an apical direction
    • The direction of enamel rods in primary teeth is inclined in an **occlusal direction** in the cervical 1/3 of the crown
    • The direction of enamel rods in permanent teeth in the cervical 3rd of crown is apically
  • 5–12 million per crown
  • Rods increase in diameter as they flare outward “**Tails**” (from 4–8 microns)
  • Begin at the future cusp and spread down the cusp slope
  • Oldest enamel is at DEJ under cusp or Cingulum
    • Good thermal insulator
    • They represent the path of a single ameloblast from CEJ to surface
  • Hunter Schreger bands??
    • Alternating light and dark bands seen in enamel that begin at DEJ and end before they hit the surface
    • Represent areas of enamel rods cut in x-section dispersed between areas of rods cut longitudinally
  • Lines of Retzius
    • As ameloblasts retreat in incremental steps, they create artifact lines
    • Where these lines terminate, they form tiny valleys on tooth surface called **perikymata**
      ♦ The small ridges, perikymata, seen on facial surfaces of canines, are the result of normal development
      ♦ Perikymata are the result of normal enamel apposition
    • A **Neonatal line** exists where enamel was formed before and after birth
      ♦ Found in both perm and prim

➢ **Enamel tufts**
  • Fan-shaped, hypocalcified structures of enamel rods that project from the DEJ into the enamel proper
  • Unknown fxn

➢ **Tunnel Spindles**
  • Elongated Odontoblastic processes (hair-like) that transverse the DEJ from the underlying odontoblasts
  • They are parallel to rods and hypocalcified and arise from DEJ
  • **Tomes fibers**
  • **May serve as pain receptors**
    ♦ **Tomes processes** are from Enamel at the DEJ
    ♦ **Tomes Granular Layer** is found in radicular dentin and lies just beneath the cementum, and distinguishes root dentin from crown dentin

➢ **Enamel lamellae**
  • Defects in the enamel resembling cracks or fractures which **transverse the entire length of the crown** from the surface to the DEJ
  • Contain mostly organic material and may be carious
**Perikymata and lamellae are seen on the surface of enamel, where Tufts are not**

**DEJ**
- Remnant of the onset of enamel formation – from the junction of the dental papilla & IEE
- Ameloblasts secrete enamel matrix as they retreat away from the DEJ, then matrix mineralizes
- Odontoblasts begin dentin formation immediately before enamel formation, by laying down collagen matrix and then moving from the DEJ inwards towards the pulp (newest dentin always closest to the pulp)
- Area at which calcification begins
- Morphology determined at Bell Stage

**Dentin**
- Composition
  - 70% inorganic, 20% organic, and 10% water
  - Test Q says 20-30% organic
- Organic
  - Mostly of collagen fibers, **Type I**
- Inorganic
  - More mineralized than cementum or bone, but less than enamel
  - Hard → soft: enamel → dentin → cementum
  - Calcium Hydroxyapatite
  - Main cell is odontoblast – derived from ectomesenchyme
- Avascular
- More flexible than enamel
- Forms the greatest amount of tooth structure
- Fxn
  - Nutritive
  - Sensory
  - Protective
- Along with pulp tissue, is formed by the dental papilla

**Dentinogenesis**
- Steps
  - The ectomesenchyme influences the oral epi to grow down into the ectomesenchyme
  - Elongation of inner enamel epithelium and differentiation into ameloblasts
- **(making it columnar, but outer is still cuboidal)**
  - This triggers the mesenchymal cells to differentiate into odontoblasts
- Differentiation of Odontoblasts
- Deposition of first layer of dentin
- Deposition of first layer of enamel
- *Deposition of root dentin and cementum
- Mantle Dentin
  - **Peripheral or first layer of dentin adjacent to enamel or cementum**
  - Consists if more coarse fibers (Korff’s) – Think Durff on Golf
- Peritubular Dentin (Intratubular Dentin)
  - Lines each dentinal tubule
  - More mineralized than intertubular dentin
- Intertubular Dentin
  - This is the main bulk of dentin
  - Surrounds peritubular dentin
  - Less mineralized
- Interglobular Dentin
  - Imperfectly calcified matrix of dentin situated between the calcified globules near the periphery of the dentin
  - Each tubule contains a cytoplasmic process (Tomes’ fiber) of an odontoblast
  - **Dead tracts** are tubules with dead cytoplasmic fibers in them

**Primary dentin**
- Laid down before apical foramen closure
- Dentin laid down before birth???

**Secondary dentin**
- Formed after foramen closure
- Slower forming than primary, as functional stresses are placed on tooth
- Following the initial period of functional activity, an appreciable alteration in the size of the pulp chamber is a direct result of deposition of secondary dentin
- Regular and uniform layer
• **There is a sharp change in the direction of tubes at junction of primary and secondary
  • The tubules of secondary dentin are wavy

- Reparative dentin
  - **What indicates Trauma during Dentin Formation????**
  - Forms in response to stimuli produced by carious penetration of a tooth
  - Formed very rapidly in response to irritants like attrition, abrasion, erosion, caries, etc.
  - The tubules of reparative dentin are **twisted**

- Sclerotic dentin
  - From bone and slowly advancing dental caries
  - Tubules become obliterated, which blocks access of irritants

- **All the following are seen dentin except**
  - Tomes granular layer, Odontoblastic processes, **Stria of retzius**, and contour lines of Owen

- **Odontoblasts are mesenchymal origin**

- **Cementum**
  - Formed by cementoblasts from PDL, not from odontoblasts from pulp
  - Slightly softer and yellower
  - Most closely resembles bone, except no Haversian systems or blood vessels
  - **Avascular, No innervation**
  - **Fx**: Compensates for tooth loss
  - Protects from resorption
  - Reparative fxn

- **50% Inorganic, 40% Organic, and 10% Water**
- **Has the Highest Organic Content**
  - Organic
    - Collagen and protein
  - More resistant to resorption than alveolar bone (permits ortho movement of teeth w/o resorption)
    - **2 Types**
      - Acellular
        - No cells
        - Coronal 2/3th
      - Cellular
        - Contains cementoblasts, cementocytes, fibroblasts from PDL and cementoclasts
        - Apical 1/3th
        - Thickest to compensate for attritional wear of the occlusal/incisal surface and passive eruption
  - Cementoid
    - Peripheral layer of developing cementum that is not calcified

- **Pulp**
  - From Dental Papilla
  - Vascular and noncalcified
  - **Composition**
    - **Cells**
      - Fibroblasts (Majority)
        - Q: What cell is most found in pulp of 62 year old? → **Fibroblasts**
      - Odontoblasts → cementoblasts or ameloblasts
      - Histiocytes – fixed macrophages
      - Lymphocytes
      - Undifferentiated Mesenchymal cells (reparative fxn)
        - **NOT Adipocytes**
    - Loose CT (collagen and reticular fibers) → there are no elastic fibers in the pulp
    - Blood vessels & nerves & lymph vessels
      - Blood flow is most like it is in the cranium
    - Ground Substance (water and long carbohydrate chains attached to protein backbones)
  - **Large when tooth first erupts, then gets smaller (usually from progressive trauma)**
    - The size of the pulp chambers of the maxillary first premolars usually decreases with age due to thermal shock, normal physiological & masticatory functions, excessive attrition and abrasion
    - The size of the pulp cavity within a tooth is influenced by the age of the tooth, parafunctional activity of the tooth, & history of the tooth (abrasion, erosion, caries, etc.) –
      - NOT related to sex
      - NOT related to ability of Ameloblasts to form dentin (duh, they don’t; odontoblasts do)
**Function**
- **The primary function of the dental pulp is to form dentin**
- Transmission of pain stimuli
- Production of a defensive reaction when tooth is exposed to irritation
- Does not cause formation of the mesenchyme of the dental papilla
- Does not innervate the enamel
- Pulp does not have function of pressure

**Anatomy of the pulp**
- **Central zone**
  - **Pulp chamber**
    - The space occupied by the dental pulp within the tooth crown
    - The pulp chamber of a mature tooth contains:
      - Blood vessels and nerves
      - **N OT Odontoblasts or enamel lining**
- Lined peripherally by a specialized **odontogenic area** which has the following zones (inner to outer):
  - Pulpal Core – similar to cell rich zone
  - Cell-rich zone – contains fibroblasts
  - Cell-free zone of Weil – capillary and nerve plexus (Plexus of Raschkow)
    - Think Cell Free of Weil has to be next to odontoblasts for Sensory (Hydrodynamic)
      - Odontoblastic layer – contains odontoblasts and lies next to predentin and mature dentin

**Pulp canals**
- **Radicular pulp is continuous with tissues of the periapical area via the apical foramen**
- **Accessory Pulp canals**
  - May be found in the cervical third of the root
  - Contain nervous and vascular tissues
  - May be found in furcation areas of molars
  - Allow the pulp tissue to communicate with the PDL space

**Pain**
- All stimuli to the pulp result in pain sensation (heat, cold, chemicals, touch)
- **Free nerve ending is only type of nerve in pulp, so regardless of source, you get pain**
- Contains both myelinated and unmyelinated nerve fibers
  - Myelinated – sensory
  - Unmyelinated – Motor (regulate size of vessel lumen)
    - **NOT to concerned with speed here**
  - Afferent and sympathetic
  - Proprioception is **NOT** found in pulp

**Pulp capping**
- More successful in young teeth because:
  - Apical foramen is large
  - More cells
  - Very vascular
  - Less fibrous elements
  - More tissue fluid
    - **BUT young pulp does lack a collateral circulation**
  - Old pulp is more likely to have denticle or pulp stone
    - True denticle – complete with tubule and processes
    - False denticle – amorphous in structure – no dentin structure
    - Free denticle – unattached to outer pulpal wall
    - Attached denticle – attached at dentin-pulp interface

**TOOTH TERMINOLOGY**
- Clinical crown
  - Part that is visible in oral cavity – occlusal to the gingival margins
- Anatomic crown
  - Part that is covered by enamel – coronal to the cervical line
    - A V-shaped incipient enamel extension coronoradicularly on a crown may be found in bifurcated areas of any multirooted teeth and commonly on Eskimo teeth
  - May be smaller or larger than clinical crown
    - Larger than clinical crown in gingivitis
    - **Smaller (shorter) than clinical crown in gingival recession**
Occlusal surface
- Chewing surface of posterior teeth

Incisal edge
- Cutting of anterior

Point Angles (4)
- 3 come together

Line Angles
- Anterior (6)
  - Not mesioincisal or distoincisal (because they are rounded)
- Posterior (8)

Ridge
- Any linear elevation on the surface of a tooth
  - Oblique – Mx M1s (& primary Mx M2s)
  - Labial – Canines
    - Buccal – PMs
  - Cervical – Primary teeth
  - Marginal – All teeth
    - The ridge that extends from the distoincisal angle to the cingulum is the distal marginal ridge
    - Triangular – Posterior teeth
    - Transverse – Union of a L triangular ridge of a B cusp & a B triangular ridge of a L cusp

Marginal ridges
- Marginal ridges on adjacent teeth are usually at the same height
  - Occlusocervically, the height of the mesial marginal ridge of a para Mx M1 is the same as the height of the distal marginal ridge of a para Mx M2
  - NOT at the same height on the Distal of Mn PM1 and Mesial of Mx PM2
- When restoring the marginal ridges of posterior teeth, their shape should be
  - Rounded to help form occlusal embrasures and improve food flow (decreases food impaction)
  - Wide enough for strength and to provide an occlusal platform when there are opposing cusps
- The following marginal ridges have little or no contact in centric & eccentric relationships:
  - Mesial of Mx canine (I think Distal of Mx Canine is not getting a contact from the Mn PM1)
  - Mesial of Mn PM1
  - Distal of Mn PM2

Developmental grooves (Primary)
- Sharply defined, shallow, linear depressions
- Separate lobes or cusps
- Buccal/lingual grooves
- Separate cusp ridges from marginal ridges – see Brand book, p.174, for an illustration
- Pits are at the junction

Supplemental grooves (Secondary)
- Small, less distinct, irregularly placed grooves
- Do not demarcate major divisional parts of a tooth
  - The groove that extends from the mesial pit of Mx PMs towards the the MB line angle is the MB secondary groove

Cusp
- Elevation of mound of enamel

Mamelons (Sean – thanks a lot)
- Small, rounded projections on incisors
- Indicative of malocclusion in teenagers & adults
- Anterior open bite is likely in a 10-year-old pt
- Usually 3 mamelons

Tubercle
- Extra formation of enamel
- Cusp of Carabelli (it is NOT formed by a lobe, but it is a tubercle)
- What is the thing called between 2 cusp ridges on a cusp?? ➔ Tubercle? Only answer making any sense

Cingulum
- Bulbous elevation of enamel, from a lingual lobe on anterior
- A cingulum is a complete formation
- Lingual cusp of Mn PM1 similar to growth of Cingulum of a canine ➔ both done by lobes

Sulcus
- Long depression or a V-shaped valley on occlusal surface of a posterior tooth between ridges and cusps

Fossa
- Irregular depression or concavity
• Lingual
• Central
• Triangular

❖ Pits
  ➢ Jxn of developmental grooves

❖ Fissure
  ➢ Narrow channel or crevice
  ➢ Sometimes deep
  ➢ Depth of developmental groove

❖ Embraures
  ➢ (4 per contact)
  ➢ Generally speaking:
    • **Contacting surfaces have Bigger embrasure**
      ➢ Mx ant – L > F
      ➢ Mx ant – F > L – the oddball
      ➢ Posterior – L > F (except between Mx M1 and M2 molars)
  ➢ Where is the **smallest embrasure**???
  ➢ **Incisal embrasure of Mn centrals**, then Incisal of Mx centrals

❖ Buccal/Facial
  ➢ Rounding of the mesiofacial & distofacial line angles contributes to the formation of facial embrasures
  ➢ **The deflective function** of mesiofacial & distofacial line angles protects the facial part of the interdental papilla
  ➢ Is the biggest embrasure of the PM1 and the canine is on the F or L – I think???

❖ Lingual
  ➢ Posterior embrasures are generally larger on the L than on the F w/ the contact w/ in the facial moiety, except between Mx M1 & M2

❖ Occlusal/Incisal
  ➢ **The widest OCCLUSAL is found between Mx canine & PM1** (1979b)
  ➢ **The largest INCISAL is found between Mx lateral & canine** (with Mx canine & PM1 as an option... hmm...) (1996)

❖ Cervical
  ➢ This is the interproximal space
  ➢ The apex of the triangular-shaped boundary of the IP space is the contact area of the adjacent teeth

❖ Fxns
  ➢ Spillways
  ➢ Self-cleansing
  ➢ Protect
  ➢ Stimulate tissue

❖ The **largest incisal embrasure is between Mx lateral & canine** (because canine-PM1 embrasure is not an **incisal embrasure**) → **Posterior embrasures are generally larger on the lingual than on the facial, with the contact area within the facial moiety, except between maxillary M1 & M2**

❖ Arch stability
  ➢ Cusps, root forms, contact areas, & periodontal fibers all contribute to arch stability
  ➢ **NOT Embraures**
  ➢ Other contributors: Facial & occlusal embrasure, and horizontal & vertical overlap

❖ Lobes:
  ➢ One of the primary sections of formation in the development of the crown of a tooth
  ➢ Represented by a cusp in posterior and mamelons and cingula in anteriors
  ➢ Separated by developmental grooves or developmental depressions in anteriors
  ➢ The minimum number of lobes any tooth can develop from is 4
    ➢ **Anteriors**
      ➢ 3 labial, 1 lingual
      ➢ The perm Mx central incisor has 3 mamelons & 4 developmental lobes
    ➢ Premolars
      ➢ 3 Buccal, 1 lingual
        ➢ The lingual cusp of a Mx PM1 is formed entirely by the lingual lobe

注解[p1]: HOPE this means if the contact is on the facial then the embrasure on the lingual is bigger
Except for Mand 2nd PM (3 Buccal, 2 lingual)
• 1st Molars (Mn) –
  • 5 lobes (by each cusp)
• 2nd Molars (Mx M1)
  • 4 lobes (cusp)
• 3rd Molars
  • At least 4 lobes (variations exist)

TOOTH ERUPTION

Eruption
• The movement of the tooth through the surrounding tissue so that the clinical crown gradually appears longer
• NOT Exfoliation (Don’t get clowned)
• Tooth makes its appearance in the mouth when one-half of the root is completed

3 Stages of Dentition
• Primary Dentition (6 ms to 6 yrs)
• Mixed Dentition (6 yrs to 12 yrs)
• Commences with the 1st Perm Molars
• Permanent Dentition (12 yrs+)

Permanent Dental Formula
• I 2/2 C1/1 B2/2 M3/3 = 16 x 2 = 32
• An imaginary animal (I 2/2 C1/1 M2/2) has the same # of anterior teeth as are found in a human’s permanent dentition

Deciduous Dental Formula
• I 2/2 C1/1 M2/2 = 10 x 2 = 20

Succedaneous teeth
• Centrals to 2nd PMs
• When extracting a primary Mx incisor in which the root has been partially resorbed due to pressure from its developing succedaneous tooth, the buccal aspect will usually be longest & attached most securely to the gingiva
• The first evidence of root resorption on a primary incisor is seen on the lingual root surface

Primary Teeth
• All 20 primary teeth – in utero
  • Begin to form about 6 weeks in utero
  • Begin to calcify about 4-6 months in utero
• Primary teeth show calcification in utero during the 2nd trimester
• 1st and 2nd molars show calcification during 5-6 months and completed by 3yrs
• Primary roots are completed
  • 14 months after emergence for Mn
  • Mn teeth erupt from 6-7 months to 20 months
  • 15 months after emergence for Mx
  • Mx teeth erupt from 7 months to 24 months
• Calcification of the roots is normally completed by 3-4 yrs old
  • Remember last tooth comes in at 24 months Primary Mx M2
• At 1.5 yrs, roots are completed for Mn centrals and laterals and Mx Centrals

Primary Calcification Initiation Sequence
• Mn (in weeks)
  • Centrals 14
  • Laterals 16
  • Canines 17
  • M1 15.5
  • M2 19
• Mx (in weeks)
  • Centrals 14
  • Laterals 16
  • Canines 17
  • M1 15.5
  • M2 18
• Hypoplasia of primary teeth limited to the incisal thirds of incisors, incisal tips of canines, and occlusal portion of molars indicates a metabolic disturbance during the prenatal period
• If a women took tetracycline during the second trimester, what teeth would be affected (Week 13-27)
• Primary teeth ONLY
Note: Tetracycline affects teeth erupting 1-2 years after taking it.

- **Eruption Sequence**
  - **Primary Eruption Sequence From the Tooth Bible**
    - Mn central (6)
    - Mn laterals (7)
    - Mx central (7.5)
    - Mx lateral (9)
    - Mn M1 (12)
    - **1 yr, you should have 10 teeth...Unless you’re a girl then @13 months you’ll have 12 teeth!!!**
    - Mx M1 (14)
    - Mn canine (16)
    - Mx canine (19)
    - Mn M2 (20)
    - Mx M2 (24)
  - Deciduous eruption sequence: Central, Lateral, M1, Canine, M2
    - The last primary tooth to erupt is the Mx M2
    - Also last to start and finish calcifying
  - The first primary teeth to erupt are the Mn R & L central incisors
  - At 1 year, a child is expected to have erupted prim Mx & Mn incisors & M1s
    - A parent notices a new primary tooth at 12 months, most likely a Mn M1 (12 month Molar)
    - Prim M2s are expected to erupt shortly after the child’s 2nd birthday
    - Last anterior tooth to calcify
  - Most dramatic change to the Oral Flora occurs → when primary teeth erupt

- **Exfoliation sequence for Primary Teeth**
  - Centrals 6-8 yrs
  - Laterals 7-9 yrs
  - 1st Molars 10-12 yrs
  - Canines 9-12 yrs  **10-11 for Mx canine was the correct answer option**
  - 2nd Molars 10-12 yrs

- **Primate Space**
  - Occur in deciduous dentition
  - Mx: space between laterals & canines
  - Mn: space between canines & M1s
  - NOTE: Spacing always occurs, but these are most noticeable
    - The perm dentition differs from primary in that primary teeth develop arch diastemata
    - Occur in 50% of children
    - Spacing between anterior teeth in the dentition is most frequently caused by growth of the dental arches

- **Permanent teeth**

- **Calcification Initiation Sequence**
  - **Mx**
    - M1 Birth
    - Canines 4-5 months
    - Laterals 10-12 months
    - **The Last Permanent Anterior Tooth of the Mx to initiate calcification is the Lateral @10 months**
    - PM1 18-21 months
    - PM2 2-2.5 years
    - M2 2.5-3 years
    - M3 7-9 years
  - **Mn**
    - M1 Birth
    - Canines 4-5 months
    - Laterals 3-4 months
    - **Don’t get clowned, here it’s the Canine as the last anterior to initiate calcification**
    - PM1 21-24 months
    - PM2 2-2.5 years
    - M2 2.5-3 years
Mx & Mn M1s begin to calcify at birth
- In development of the human permanent dentition, the first teeth to begin calcification are the Mn M1s
- Initiation of calcification for the mandibular central incisors is 3-4 months
- The incisal ridge is the 1st structure to begin to calcify in an anterior tooth
- Perm M3s begin to calcify at 8-10 yrs of age
- Active eruption of teeth occurs after ½ of the root is formed (perm or primary)
- 50% of root calcification is complete at the time of eruption
- The apex is usually fully developed by 2-3 years after eruption

Permanent Dentition Eruption Schedule

<table>
<thead>
<tr>
<th>Typical Eruption Age (yrs)</th>
<th>Range</th>
<th>Maxillary</th>
<th>Mandibular</th>
<th>Calcification</th>
<th>Root Completion</th>
<th>Enamel Completion</th>
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</thead>
<tbody>
<tr>
<td>6</td>
<td>6 to 7</td>
<td>1st molar</td>
<td>central incisor</td>
<td>Birth</td>
<td>9-10 yrs</td>
<td>2.5-3 yrs</td>
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<td>7 to 8</td>
<td>central incisor</td>
<td>3-4 mos</td>
<td>9 yrs</td>
<td>4-5 yrs</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>7 to 8</td>
<td>lateral incisor</td>
<td>3-4 mos</td>
<td>10 yrs</td>
<td>4-5 yrs</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>8 to 9</td>
<td>lateral incisor</td>
<td>10 months</td>
<td>11 yrs</td>
<td>4-5 yrs</td>
<td></td>
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<tr>
<td>10</td>
<td>10 to 12</td>
<td>1st premolar</td>
<td>1.75-2 yrs</td>
<td>12-13 yrs</td>
<td>5-6 yrs</td>
<td></td>
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<tr>
<td>10</td>
<td>10 to 12</td>
<td>1st premolar</td>
<td>1.5-1.75 yrs</td>
<td>12-13 yrs</td>
<td>5-6 yrs</td>
<td></td>
</tr>
<tr>
<td>11</td>
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<td>2nd premolar</td>
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<td>17 to 21</td>
<td>3rd molar</td>
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<td>12-16 yrs</td>
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<td>12-16 yrs</td>
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</tbody>
</table>

CRAP: The third pair of perm teeth to erupt in normal sequence is Mn lateral incisors (1996 Q53)?
- UNLESS, they asked for 3rd pair of succedaneous!!!
  - (Looks like 5th pair to me, unless you go by molars – centrals – laterals, in which case, why specify Mn laterals?)

1st succedaneous to erupt is the Mn central incisor at 6-7 yrs old (don't get clowned – Mn M1 is not succedaneous)
- Permanent max centrals erupt just after at 7-8 yrs
- Permanent max laterals erupt at 8-9 yrs

6 yr old
- Presents with all 20 primary and 4 perm 1st molars
- First sign of mixed dentition → Mx Molars at age 6
- Ordinarily, a 6-year-old would have the following teeth clinically visible:
  - All primary teeth & permanent M1
- 7 yr old (another Q said 6 ½ year old)
  - Presents with 18 primary and 6 perm teeth
- 4 perm molars
- 2 mand perm central incisors
- On a panoramic radiograph of a 7-year-old, the dentist will expect to see all of the following:
  - Primary Mx laterals w/ partially resorbed roots
  - Partially erupted Mx centrals w/ incomplete root closure at the apex
  - Partially erupted Mn laterals w/ incomplete root closure at the apex
  - Fully erupted Mn M1s w/ incomplete root formation & non-closure at the apex
  - Not – fully erupted Mn centrals w/ complete root formation and closure at the apex (it takes 2-3 years)
- At 8 years of age:
  - The teeth normally present are perm central & lateral incisors, primary canines & molars, permanent first molars
  - The Perm Mx M1 has no distal contact (it does have a mesial contact with the primary Mx M2)
At 9 years of age:
- 12 primary teeth remain in the mouth (Primary C9 and 2 Molars per quadrant).

At 10 years of age:
- The permanent teeth expected are central & lateral incisors, first premolars, and first molars (What about Mn Canines??)
- One would expect the root of the perm M1s to be finished forming & calcifying
- One would expect primary tooth ‘H’ (primary Mx canine) to be mobile due to the erupting succedaneous tooth
  - BAD Q, hope you don’t get it
  - CAREFUL, because ‘J’ was also an option, which is the PM2 coming in to replace Primary M2
- The first perm tooth to erupt is generally the Mn M1
  - The earliest indication of a mixed dentition consists of the primary dentition and the Mn M1a
  - The earliest indication is NOT the exfoliation of any primary tooth
- The last perm incisors to erupt are the Mx laterals
- Perm PM1 replaces primary M1
- The earliest age by which the roots of the Mx PM1 are completely formed is 12-13 years
  - Typically eruption is 10, then 2-3 years for root completion
- At age 26, the third molars are fully erupted with a complete root structure
- The perm Mn arch is the only arch (prim or perm) in which the canine erupts before the tooth immediately distal to it
  - In Primary, Remember M1 is the distal tooth and it erupts at 12 months!!!, canines in Mn at 16, Mx at 19 months

3 Cardinal Eruption Rules:
1. Girls teeth erupt BEFORE Boys
2. Mn erupt BEFORE Mx
3. Teeth of slender kids erupt BEFORE fat kids, (so much to get through)

Teeth usually erupt in pairs – one on the left & one on the right

The follicles of the developing permanent incisors are in a position lingual to the deciduous roots

Eruption problems:
- In cases of delayed resorption of primary incisors, the permanent incisors may be expected to erupt lingual to the normal arch form
DENTAL ANOMALIES (new section ⬤) – see Ch 7 of book

- **Dens in dente**
  - Occurs when enamel becomes invaginated
  - Most commonly found in permanent lateral and central incisors
  - Known for giving endo-like symptoms, but no decay on crown, etc.
  - Retarded growth of a portion of a single tooth germ, or the proliferation of a segment of the odontogenic epithelium into the dental papilla

- **Mesiodens**
  - Supernumerary teeth arising in the midline of the maxillae (most common supernumerary)
  - A small, calcified radiopaque mass between the roots of #8 & #9 is most likely due to mesiodens
  - Tooth appears mesial to both maxillary central incisors

- **Concrecence**
  - The cemental union of two fully-formed teeth that were originally separate entities
  - Can be mistaken for subgingival calculus
Fusion
- Union of 2 adjacent tooth buds
- Upon examination, the dentist notices that there is an abnormally wide Mn incisor; further examination reveals that there are only 3 Mn incisors present, most likely due to fusion.

Gemination
- Incomplete splitting of a single tooth germ
- A pt has an extremely wide, notched tooth in the Mn incisor position; clinical & radiographic exam reveals 28 teeth have erupted (4 M3s unerupted), most likely due to gemination.

MISCELLANEOUS

Radiographically
- Anterior Palatine Foramen
  - Radiolucent and circular in shape

Waxing
- Must Consider
  - Guiding (non-supporting) cusps are related to the Interproximal areas or developmental grooves
  - Supporting cusps are related to the marginal ridge and fossae
  - Guiding (non-supporting) cusps overlap facial to mandibular teeth and lingual to maxillary teeth

Attrition
- Facets usually develop on
  - Linguoincisal of Mx centrals
  - Facioincisal of Mn canines
  - Attrition on a Mn Canine, what would the Mesial ridge look like? M ridge would be shorter than D
  - Attrition of a Mx Canine, what would the Mesial ridge look like? M ridge would be longer
  - Linguoincisal of Mx canines
  - Incisal edges of Mn laterals is done with Mx central AND lateral incisors, NOT Canines
  - It with Normal Class I, has wear facets on inner aspect of facial cusp of Mx PM2, these can only be caused by Mx PM2
  - LEAST likely spot for attrition is labioincisal area of Mx lateral incisor

Anodontia
- Complete (usually with Ectodermal Dysplasia)
- Partial
  - Usually 3rds (Max more) > Max laterals > Mand 2nd PMs
  - Rule: if only one or a few teeth are missing, the absent tooth will be the most distal (if molar, then 3rd)

Oligodontia
- Many, but not all teeth
- A developmental abnormality characterized by the presence of fewer than the usual number of teeth

Hypodontia
- Few gone
- Old school classifications
  - Heterodont – Human teeth, or several kinds of teeth, serving a variety of fxns
  - Diphyodont – To produce 2 sets of teeth (perm/prim)
  - Monophyodont – 1 set of teeth
  - Polyphyodont – Teeth being replaced continually (amphibians)
  - Homodont – teeth are all alike
  - A typical nonpoisonous reptile is a homodont (What a lame question?)
  - Hypsodont – long teeth (High crowned)
  - Haplodont – a primitive basic tooth form having a single conical crown and a single root
  - Selenodontic – Longitudinal Mesiodistal Ridge formation (Grazing animals, along with Hypsodontic)

Teratogens affecting Dentofacial Development
- Worse during first trimester

<table>
<thead>
<tr>
<th>Teratogen</th>
<th>Effect</th>
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<tbody>
<tr>
<td>ASA, Valium, Dilantin, Cigarettes</td>
<td>Cleft Lip and Palate</td>
</tr>
<tr>
<td>CMV, Toxoplasma</td>
<td>Microcephaly, Hydrocephaly, Microphthalmia</td>
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<tr>
<td>Ethyl Alcohol</td>
<td>FAS Central mid-face discrepancy</td>
</tr>
<tr>
<td>Rubella Virus</td>
<td>Microphthalmia, Cataracts, Deafness</td>
</tr>
<tr>
<td>X radiation</td>
<td>Microcephaly</td>
</tr>
<tr>
<td>Vitamin D excess</td>
<td>Premature suture closure</td>
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</tbody>
</table>

Dental hypoplasia
- If it occurs, it will be present when the teeth erupt
Tetracycline staining
- A 5-year-old child is treated with large doses of tetracycline over a one year period. The perm teeth least likely to show staining are lateral incisors, canines, and premolars. Perm centrals & M1s are more likely to stain.
  - Kaplan gives this explanation: “Since the child is 5 years old, the teeth erupting at 6 or 7 will be MOST likely to show staining, and those erupting later are less likely. On average, centrals erupt at 7, laterals at 8, canines at 11, PM1s at 9, and M1s at 6.”
  - So most likely stains teeth erupting 1-2 years after tetracycline usage

Hypercementosis
- Excessive calcified tissue formation at the root apices

Ankylosis
- Fusion of the alveolar bone to a tooth
- Also when different tooth obstructs

Dentin islands
- Most common in Mx 2nd PM and in Mn Canine

Caries/Dental decay
- Areas susceptible to caries include pits & fissures, Facial surfaces cervical to the height of contour (Cervical Thirds), & proximal surfaces
- On molars, the L of Mx M1s & H of Mn M1s are most likely to develop caries (due to those fissured grooves)
- Least likely to occur on cusp tips
- Mandibular canine is most likely to resist invasion by caries

Periodontal Disease
- The following morphologic variations tend to accelerate existing periodontal disease
  - Enamel projections, fused roots, and excessively short roots

Malpositioned teeth
- If a Mn PM2 is linguoverted, there is an area of overcontour affecting the lingual gingival sulcus
- linguoversion means the tooth is lingual to the normal position

Supernumerary
- Tendency of teeth to erupt into an empty space; tends to follow extraction of opposing teeth
- An extruded Mn R M3 (Mx M3 extracted) will most often impede a protrusive Mn movement

Anterior open bite
- More common in African Americans
- Can be caused by thumb sucking
  - Protrusion of max incisors
  - Constriction of max arch
  - Lingual inclination of mand incisors
  - Rotation of max laterals
  - Class II Malocclusions
- Can be caused by abnormal swallowing (tongue Thrust)
- Can be caused by mouth breathing
  - Presents with facial gingival of Max bleeding, edematous, and red
  - Midline affected the most

Mx arch is slightly longer than Mn
- Mx ⅔ diameter is 128mm
- Mn ⅔ diameter is 126mm

Nerves:
- 3rd to 1st molars innervated by PSA nerve (from V2)
- 1st molars to PMs innervated by MSA nerve (V2)
- Canines & incisors innervated by the ASA (V2)
- A branch of the cranial nerve V to the tongue may be anesthetized during administration of an IA block (think sensory - CN V)
- the Lingual Nerve

Dryopithecus pattern
- Shows up most clearly in the mandibular first molar
- It’s the name of the ape they think we descended from, blah, blah

Maxillary Molar of early Primate
- Had a trigon made up of 3 cusp MB, ML, DB
- Heart shaped triangular

Rodents (Rodentia)
- Mammalian order with continuously erupting teeth in which apices never form
- How many times do we swallow in one day? 2,000 times a day
- When does a person swallow the most??
- Daytime, when they’re NOT eating
Plain text:

**Primary vs. Permanent Teeth**

- Fewer molars (2 vs. 3) and no premolars
  - Primary teeth have proportionately larger pulp cavities than perm teeth
    - Distinguished by long, pointed pulp horns
- Crowns of primary incisors are shorter incisocervically compared with MD dimension
- Roots:
  - Roots of anteriors taper more rapidly
  - Are comparatively longer & slimmer than perm teeth
  - Are more divergent than perm teeth
  - Root trunks are less pronounced than perm teeth
- Enamel ends abruptly
  - Are whiter than perm teeth
  - Are smaller than perm teeth
- Crown : root Ratio is smaller than perm teeth – meaning they have longer roots
  - Crowns are more bulbous & constricted than perm teeth – appear shorter & fatter than perm teeth
  - Cervical ridges are more pronounced than perm teeth – large facial buldge
- All Prim Molars
  - Differ the most from the perm teeth that replace them (among molars, canines, lateral incisors, central incisors)
    - Lack an identifiable root trunk
- All Prim 1st Molars
  - Cusps:
    - In Max Teeth
      - Prim → MB > ML
      - Perm → ML > MB
    - In Mn Teeth
      - Prim → ML > MB
      - Perm → MB > ML
  - Don’t get clowned → They are opposites in Primary vs. Permanent
    - Distal surface is shorter than the mesial, occlusogingivally
    - Has a transverse ridge
    - Prominent mesial marginal ridge
    - Prominent MB cervical ridge
    - Present with the greatest morphologic deviations from permanent teeth (especially Mn M1)
- All Prim 2nd Molars
  - Larger than M1s & resemble perm M1s
  - Show up after child’s 2nd Birthday (20 months Mn, and 24 n=months Mx)
- Individual Primary Teeth

**Prim Mx Central**

- Shapes
  - M/D view =
  - B/L view =
  - Occlusal =
  - MD dimension is wider than incisocervical dimension
  - Wider MD & shorter incisocervically than perm
  - Straighter incisal edge: SHARPER, more angled incisal edge
  - NO mamelons (same with laterals)
  - Prominent labial AND lingual cervical ridges!!!! [This Q gave teeth A, F, J, L, & T - got clowned by L = Mn M1]
- Most damaged (with Mx laterals) by baby bottle tooth decay
Prim Mn Central
- Shapes
  - M/D view =
  - B/L view =
  - Occlusal =
- Prominent cingulum
- Often has a developmental groove on distal of root
- Has the smallest FL dimension of any crown

Prim Mx Canine
- Shapes
  - M/D view =
  - B/L view = Pentagon
  - Occlusal =
  - 4 lobes
    - 3 facial, and 1 on the lingual
- Widest primary anterior tooth
- Appears wider and shorter than perm
- Crown height is less than MD diameter
- Diamond-shaped crown from facial aspect (Kaplan – differs from the pentagonal outline mentioned above)???
- Prominent cingulum
- Cusp is much longer & sharper than perm canine
- Cusp points distally
- ODD BALL – Mesial cusp ridge is longer than distal cusp ridge (opposite for perm Mx canines)
  - Opposite of what you think for Perm canines and Prim Mn Canines
- Pulp chamber looks pointed at incisal tip

Prim Mn Canine
- Shapes
  - M/D view =
  - B/L view = Arrow-shaped from the facial
  - Occlusal =
  - Smooth labial surface
  - Longer distal incisal ridge than mesial incisal ridge

Prim Max 1st Molar
- Shapes
  - M/D view =
  - B/L view =
  - Occlusal =
  - trapezoidal (peripheral); rectangular (table)
- *Most atypical of all Mx molars*
- Intermediate form between PM and Molar
  - Crown somewhat resembles a perm PM, but the root form is typical of a perm Molar
  - Of primary molars, prim Mx M1 bears the greatest resemblance to a perm PM
    - Due O gives "resemblance to Mx PM" as the correct answer
- Smallest prim molar
  - Bicusp (2 main cusps = MB & ML, 2 indistinct distals)
    - MB cusp > ML cusp
  - Cervical ridge in the MB area – most prominent cervical ridge among primary Mx teeth!!!!
    - The mesial surface is larger than the distal surface
    - From a facial view, BOTH Primary Mx M1 and M2 have a short root trunk
  - The cervical line on the mesial curves slightly toward the occlusal – it does not have a straight cervical line
  - H-shaped occlusal pit-groove area
  - 3 Roots (root structure corresponds to that of perm Mx M1)
    - Number and form of the roots corresponds to Mx M1
    - Short root trunk
  - Does the Prim Mx M1 has a lingual groove??? → NO!!!

Prim Max 2nd molar

Right
Shapes
- M/D view =
- B/L view =
- Occlusal =

Same characteristics as perm Mx M1 except:
- MB cusp is almost same size as ML
- MB pulp horn is longest and largest
- Normally has a Cusp of Carabelli, just like Perm Mx M1
- Most likely primary tooth to have an oblique ridge – (looks like perm Mx M1)
- Has the greatest FL dimension of all primary teeth!!!!!!

The difference between Primary Mx M2 and Permanent Mx M1 is that the primary tooth has a much narrower measurement at the CEJ compared to its contact area
- They are similar in that both crowns converge to the distal and lingual
- NOT that they both have well developed 4 cusps, oblique ridges, well developed marginal ridges, or rectangular outline
- From a facial view, BOTH Primary Mx M1 and M2 have a short root trunk
- Last Primary tooth to erupt
- This is the primary molar that typically has a transverse ridge, oblique ridge, & a DL groove
- 3 Roots
  - Short root trunk
- Primary Mx M2, roots are less curved than Permanent Mx M1

Prim Mand 1st Molar
- M/D view =
- B/L view =
- Occlusal = Rhomboidal peripheral outline; Rectangular table (if you disregard the large MB ridge)
- Unlike any other tooth
- Both Prim Mn M1 and M2 have central and lingual grooves
- Most normally exhibits a Distal Triangular Fossa
- Based on morphology, a Class II MO prep would be the most difficult on a primary Mn M1 (of any teeth)
- Because of HUGE MB pulp horn!
- 4 pulp horns (don’t be thinking that it has 5 just because a Mn M1 has 5)
  - ML cusp is highest & sharpest!!!!!
  - MB and ML make up transverse ridge
- Oval with MB expansion
- Cervical ridge/Bulge in the MB area
  - Which primary tooth has a facial cervical ridge which is so distinctly prominent that it is uniquely different from ALL other teeth? Primary Mn M1!!!!!!!
  - The CEJ is most apically positioned on the mesial 1/3 of the crown of a primary Mn M1
- S Shaped cervical ridge
- The Distal portion is shortest occlusogingivally
- A prominent transverse ridge distinctly separates the mesial portion from the remainder of the occlusal table!!!!!!
- Roots
  - 2

Prim Mand 2nd molar
- M/D view =
- B/L view =
- Occlusal = Closely resembles a perm Mn M1 occlusally
Same characteristics as perm Mn M1 except:
- Has a more prominent facial cervical ridge
- MB, DB, and D cusps of prim Mn M2 are about same size
  - The easiest way to distinguish between primary Mn M2 & perm Mn M1 is comparative size of D cusps
- Not the widest in the cervical like the perm Mn M1 (primary teeth are constricted)

Has 3 occlusal fossae, like a perm Mn M1
5 cusps – does not have 4 cusps (don’t get clowned)
- All 3 buccal cusps are the same size (unlike perm M1)

PERMANENT TEETH

All Teeth:
- CEJ (cervical line) curvature is greater on mesial than distal side
- Facial height of contour is in cervical third
- The only thing that all teeth have is M/D marginal ridges
- Some "All" Rule, w/ exceptions:
  - All teeth have a M and a D marginal ridge
  - All teeth are wider FL than MD except:
    - Mx centrals & laterals
    - Mn molars
- Tilt:
  - All teeth tilt facially EXCEPT Mn PM2 & Mn Ms (tilt lingually)
  - Mn PM1 is Straight up and down
  - All teeth tilt mesially EXCEPT Mx centrals & Mn centrals & laterals (ever so slightly tilted distally)
  - Mx canine has greatest tilt; PMs are the straightest

All Anterior Teeth:
- Incisal edge or 1 cusp
- Cingulum & lingual fossae – 12 teeth have cingula (per dentition i.e. primary/permanent)
  - Cingula centered mesiodistally on: Mx lateral, Mx canine, Mn central
  - Cingula off-centered to the distal on: Mx central, Mn lateral, Mn canine
- Both Facial and Lingual height of contour are in the Cervical 1/3rd
- Marginal ridges parallel to long axis
- 1 root
- Triangular outline viewed from M or D (wedge-shaped from M or D aspect)
  - Trapezoidal outline viewed from B or L (longest uneven side toward the occlusal or incisal)
- Contacts are centered faciolingually
  - Usually mesial edge is sharper than distal (Distal is rounded like letter D & Mesial is pointy like the letter M)
  - The incisal edges & mesial thirds of F surfaces of Mn anteriors generally oppose L surfaces of Mx anteriors w/ in the incisal thirds
  - Viewed from the sagittal plane and progressing anteriorly, the axial inclination of the anterior teeth inclines facially

All Posterior Teeth:
- 2 or more cusps
- Occlusal table with ridges & grooves
  - Occlusal table makes up 55-65% of the BL dimension of the tooth
- Marginal ridges perpendicular to long axis of the tooth
- Facial height of contour in cervical third
  - May be except for Mandibular Molars, which have them at the jcn of cervical and middle
- Lingual height of contour in middle third
  - Except for the Mn PM2s, which have their height of contour in the occlusal 1/3rd
- Mesial marginal ridge more occlusal than distal except for Mn PM1s
- Contacts in middle 1/3
  - Contacts in the Faciolingual direction are located in the Buccal side of the center
  - Are mesially inclined
  - All posterior teeth have rectangular occlusal tables, EXCEPT PM1s, which have trapezoidal occlusal tables
• This is NOT the same as Occlusal outline (aka “crown profile”) – see Kaplan p.549

❖ All Maxillary Posterior Teeth:
  ♦ Wider BL than MD
  ♦ 1st is larger than 2nd (and also 2nd larger than 3rd for molars)
  ♦ Trapezoidal outline viewed from M or D (shortest, uneven side is towards the occlusal)
  ♦ The B cusps of the Mx arch are B to the B cusps of the Mn arch
  ♦ From a frontal plane view, axial inclination of Mx teeth is Buccally
  ♦ Are progressively more buccally inclined as one moves posteriorly
  ♦ From a frontal view, the plane of occlusion of the Mn arch is a concave curve
  ♦ If a root goes into Mx sinus, it is usually from Mx M1
    ♦ A more recent Q: The structure in the Mx alveolar bone that Mx premolar roots occasionally penetrate is the antrum (aka maxillary sinus)

❖ All Mandibular Posterior Teeth:
  ♦ Lingual inclination of buccal surface
  ♦ Rhomboidal outline viewed from M or D – has a design flaw that encourages cusp fracture
    ♦ Kaplan says: Because the crown is rhomboidal, the L surface leans lingually. The overhanging L cusp is not well supported by underlying tooth structure and has a higher tendency to fracture.
  ♦ Facial cusps of Mn posteriors oppose the central fossa line in the Mx dentition
  ♦ In a sagittal view, both anterior (yes, anterior) & posterior teeth are mesially inclined (other options were wrong – 02Q4)

❖ All Incisors:
  ♦ Incisal edge
  ♦ Marginal ridges run parallel to long axis of tooth
  ♦ M & D contact areas are approximately centered faciolingually
  ♦ Are 1st succedaneous teeth to erupt
  ♦ Viewed incisally, the cingulum, lingual fossa, marginal ridges, & mesiofacial developmental depression are visible (not CEJ)
  ♦ On the crown, the facial developmental depressions separate the labial lobes

❖ All Maxillary Incisors:
  ♦ Mesioincisal edge is sharp
  ♦ Distoincisal edge is rounder
  ♦ Distinguish Mx incisors from Mn incisors
  ♦ Both larger than Mn incisors
  ♦ Central is larger than lateral – except root length which could be quite similar
    ♦ Cervical line is greatest of all teeth on mesial side of max. centrals
  ♦ Incisal edge is centered labiolingually
  ♦ Embrasures: L > F
  ♦ Have distinct lingual anatomy & may contain pits
    ♦ Both Mx centrals & laterals are wider MD than LL
    ♦ Mx incisor roots more frequently contain a single root canal than Mn incisors, Mx PM1s, Mx Ms (MB root), Mn Ms (M root)
      ♦ Roots are more rounded than on Mn incisors
  ♦ All Mandibular Incisors:
    ♦ Laterals are larger than centrals; Centrals are smallest of all teeth
    ♦ Incisal edges are lingual to root axis line (Lingual to the LL midpoint)
    ♦ Indistinct cingula w/o grooves and pits
    ♦ Smooth, continuous convexity incisopically
    ♦ Wider LL than MD
    ♦ Embrasures: F > L
    ♦ Alveolar process is thinnest facial to Mn central incisor (good for infiltration injection)
      ♦ In anesthesia of the Mn arch, local infiltration is likely to be effective in the incisor area
    ♦ Proximal Contact
      ♦ Contact occurs in the incisal third
      ♦ Tends to occur equidistant from facial and lingual surfaces

❖ All Canines:
  ♦ 1 cusp
  ♦ Longest tooth in the mouth
  ♦ Favorable crown-to-root ratio
  ♦ Crown very bulky labiolingually
  ♦ Transitional form between anterior & posterior teeth (mesial like incisors & distal like premolars)
  ♦ Longevity (know why)
Labial ridge, developmental depressions, mesial & distal cusp slopes or ridges
- The slight incisocervical concavity on the labial crown surface of the canines that is found in the incisal third, just mesial to the labial ridge is the mesiolabial developmental depression.
- Mesioincisal ridge shorter than distoincisal ridge
- Lingual ridge
  - Anterior of the incisal, one expects to see:
    - Lingual cingulum
    - Lingual fossa
    - Distal cusp ridge
    - Mesiofacial developmental depression (Labial Side)
    - Not the cervical line
- Mesial contact is more incisal than distal contact
- Crown form from labial aspect is pentagonal
- Root has triangular cross section
- Only cusped teeth which feature functional lingual surface rather than a functional occlusal surface

All Premolars:
- 1 buccal cusp
- 1 or 2 lingual cusps
- Transitional between canines and molars in function
- Enamel is thickest in the occlusal third
- Have their long axis most perpendicular to the horizontal plane → Mx & Mn PMs are the most nearly vertically aligned teeth
- The union of the F & L triangular ridges forms a transverse ridge

All Maxillary Premolars:
- B & L cusps of nearly EQUAL heights (but on Mx PM1, the B cusp is slightly larger)
- The L cusp tip is located more mesially than the B cusp tip
- Wider BL than MD (wider BL than Mn PMs, although MD dimension of all PMs is about the same)
- Trapezoidal outline viewed from M or D
- From occlusal view, more rectangle
- Lingual height of contour is midway between the CEJ & the L cusp tip (Dumb way of saying Middle 1/3rd)
- 1st is larger than 2nd
- Roots are more flattened MD than Mn PMs
  - Roots have mesial concavities
- In development, Mx PMs show crown completion at the same time

All Mandibular Premolars:
- Large buccal cusp & very small lingual cusp(s)
- Nearly equal MD & BL
- 1st PM is smaller than 2nd PM
- From proximal view, crown tilts lingually in relation to the long axis of the tooth
- Occlusal table is lingually displaced (Mx PM table is centered FL)
- Rhomboid when viewed from the interproximal
  - Mn PM B cusps are more toward the FL midpoint than are Mx PM B cusps
- From occlusal view, more square
- Mn PMs compared to Mx PMs:
  - Mn have more rounded roots and seldom bifurcated
  - Mn crowns are tilted to the lingual
  - Have crowns much more rounded
  - Mn have less developed lingual cusps
- In development, crown completion of Mn PM1 is 5-6 years; for Mn PM2, crown completion at 6-7 years

All Molars:
- Largest and strongest teeth
- At least 2 buccal cusps
- 1st, 2nd, 3rd, 6 year, 12 year, and wisdom tooth respectively
- 3 to 5 cusps
- 2 or 3 roots
- Are NOT Succedaneous
- DL cusp gets smaller as you go posterior in the arch
- Root canals usually join the pulp chamber apical to the CEJ
3 Root Types:
- Single or 1 Root
  - Incisors
  - Canines
  - Max 2nd PM
  - Mand PMs
- Bifurcating or 2 Roots
  - Max 1st PM (B/P)
  - Mand Molars (M/D)
- Trifurcating or 3 Roots
  - Mx M1s & M2s (MB, DB, P)
  - Some M3s

All Maxillary Molars:
- Wider BL than MD
- Usually 4 cusps: ML > MB > DB > DL
- 2 lingual cusps of different size (again, ML > DL)
- Oblique ridge – extends between the ML & DB cusps
  - Formed by the union of distal cusp ridge of the ML cusp & the triangular ridge of the DB cusp
  - The transverse groove of the oblique ridge connects central & distal pits
  - The ridges that make up the oblique ridge meet near the center of the occlusal surface on a level w/ the marginal ridges
  - Slides through the angled sulcus (DB) found on the occlusal surface of Mx Molars
- The three cusps that form the primary cusp triangle on a Mx molar are the MB, DB, & ML (not DL or Cusp of Carabelli)
- Crowns are either rhomboidal or heart shaped
  - >Rhomboidal when viewed occlusal
  - The crown portion that differs the most in contour and size is the distolingual
- Their arrangement and design allow room for the powerful masseter muscle
- Distolingual Developmental Groove
  - Fissured groove usually exists on L of Max Molars – prone to caries
  - As such, cavity preparations would most frequently have to be extended from the occlusal to the L of Mx molar
- (more so than to the B of Mn molars – don’t get clowned)
- 3 roots (P, MB, DB)
  - Root length: P > MB > DB
  - All Mx roots are inclined distally & lingually EXCEPT the DB root of Mx M1 inclined buccally
- Floor of pulp chamber is triangular (DB, MB, P)
  - The line connecting the MB and P is the longest
  - Apex is formed by the P canal
  - Considering the formation of root and pulp canals, the root canal instrument would be placed from the MB to DB in an apical direction to gain access to the DB root of the perm Mx M1
  - Orifice location
    - MB: under the mesial slope of the MB cusp
    - DB: under the B groove
    - P: slightly distobuccal to the ML cusp tip
- Distinguish between Mx & Mn molars by occlusal outline, arrangement of roots, & number of roots
  - NOT by # of cusps, # of developmental grooves, or size of the crowns

All Mandibular Molars:
- Wider MD than BL
- NO oblique ridge
- Rectangular when viewed occlusally
- Rhomboid when viewed from the interproximal
- 4 or 5 cusps with lingual cusps
- L cups usually same height
- Lingual cusps oppose grooves and embrasures only
- Crowns inclined lingually from proximal view and a little distally relative to long axis of root (15-20% Lingual)
  - Mn molars have long axes positioned with their root apices facial and their crowns lingual
  - Height of contour is at the jxn of the cervical and middle third
- Roots
  - 2 roots (M or D)
• M is very thin MD, wider BL and concave on both M and D
• Pulp horn is higher on M than D
• All Mn roots are inclined distally & facially
• 2 pulp canals almost always in M root
• MB canal curves more than ML
• Larger kidney shaped canal is found in the D root
• Smaller more circular canals are found in M root, because there is 2 of them

Characteristics of Individual Teeth

Maxillary Central Incisor:

- Shapes
  - M/D view = Triangular
  - B/L view = Trapezoidal
  - Occlusal =
- Longest and widest anterior crown
  - Longest of all Crowns – Correction from old card
  - But not as thick labiolingually as the Mx canine
- Average crown length is 10.5mm
- Wider MD than FL (same with Mx lateral incisor)
- Incisocervical & mesiodistal dimensions nearly equal
- Mesioincisal is sharper
- Narrowest incisal/occlusal embrasures of all Mx teeth
- Of all teeth, the greatest incisal curvature of a cervical line is on the mesial surface of Mx centrals (more so than Mn centrals)
- Anatomic features include cingulum, mamelons, marginal ridges & cervical ridges (not triangular ridges or cuspal ridges)
- Incisal ridge of the crown is on line with the center of the root
- Prominent cingulum located off-center toward distal
- Different from Mx lateral in that
  - Has a shallow, broad lingual fossa on the incisal one-half of the lingual surface
  - The cervical outline of the facial surface is a broad curve, sometimes described as part of a semicircle
  - Has a distally located Cingulum (Mx lateral has central Cingulum)
- 3 Mamelons & 4 Developmental Lobes
- Greatest axial inclination relative to occlusal plane (the Mx centrals vary the most from a vertical inclination) – it’s a 28° tilt
  - Wear facets can develop in the linguoincisal area
  - M & D pulp horns are more likely to be found in Mx centrals (than Mn centrals ?), Mn canines, Mx PM1s, or Mn PM1s
  - A cross-section at the CEJ has a round form?? (Book says “rounded triangular” form)
  - Kaplan says: round on cross section, but may show some lingual convergence, with the mesial being longer than the distal
- 1 Root
  - Triangular pulp chamber in x-section, with the base of triangle located facially, apex located lingually, mesial side longer than distal side: the tooth is most likely a Mx central
  - Length is 13mm
  - One root, one canal
  - Among choices of Mx central, Mx PM1, Mx PM2, Mn central, Mn lateral, and Mn PM1, Mx central is LEAST likely to have a divided pulp canal!!!!!!
  - Conical with blunt apex; lends itself well to rotation w/ extraction forceps during surgical removal

Maxillary Lateral Incisor:

- Shapes
  - M/D view = Triangular
  - B/L view =
  - Occlusal =
- Smaller than central, and resembles it
- MD measurement > FL (same with Mx Central incisor)
Different from Mx central in that
- It has a DL groove

Differentiate from Mn lateral by its more pronounced lingual fossa
- Mn lateral is the incisor most likely to have a L groove that extends from enamel to cementum

The DL groove of the Mx lateral is the anatomic feature most likely to complicate root planing

Lingual surface
- Lingual surface is most concave of any of the incisors
- Lingual surface has most distinct anatomy of all incisors
  - Lingual fossa is more pronounced on a Mx lateral than a Mn lateral
  - Marginal ridges are more prominent on the L surface of Mx lateral than other incisors
  - Mx lateral is most likely tooth to have a carious developmental pit on the lingual surface
  - Crest of the Cingulum is slightly distal to the faciolingual bisected – mmmm, because Cingulum is supposed to be centered

Root length relative to crown length
- Root length is equal to or longer than that of Mx central (Only dimension like this)
  - Root is round to ovoid in x-section
  - Root usually deviates to the distal
  - More circular pulp outline in x-section
- Incisal edges are a little more rounded than on central
  - Of the Mx incisors, the distoincisal angle of the lateral is the most convex incisal angle

Tooth most often in an abnormal relation and contact with adjacent teeth in the same arch
- May be absent

LAST anterior to begin to calcify (10 months)
- Among options of Mx canine, Mn canine, Mx central, and Mx lateral, a lingual pit is most common on a Mx lateral
- M3s & Mx laterals have the greatest anatomic variation, variation in tooth mass, variation in crown size & form

Mandibular Central Incisor:
- Shapes
  - M/D view = Triangular
  - B/L view =
  - Occlusal =
- Smallest permanent tooth
- Smooth lingual surface
- Flat facial surface
- Sharp mesioincisal & distoincisal edges
- Incisal Edge
  - Flat incisal edge
  - The incisal edge crosses the tooth parallel & slightly lingual to a plane bisecting the tooth into F & L halves
    - The Mx were just in the middle
    - Intersecting a plane bisecting the tooth into mesial and distal halves at a right angle to that plane
- NOT considered to be wider MD than FL
- Most symmetrical tooth
  - Mn central is usually bilaterally symmetric when viewed labially and incisally
  - Mesial and distal characteristics of the Mn central are most difficult to distinguish – hardest tooth to distinguish R/L
- Look at CEJ to determine M or D
- Cingulum is centered
  - Contact Mx centrals during protrusion and lateral protrusion
  - First succedaneous teeth to erupt
  - In ideal ICP, the distoincisal aspect will contact with the Lingual fossa of Mx central, NOT distal marginal ridge
  - The lingual cervical line positioned more apically than facial cervical line
    - (Also same as Mn Laterals, NOT Mn Canines or Mx anteriors)
- Root
  - Shortest root of all Mn teeth
  - Thin MD & wide FL
- Ovoid on x-section
- Concavities on both M & D surfaces *(this one gets used over & over again)*
  - Also, M of Mn Molars and MB of Mx Molars
- **Most common lower anterior with multiple canals!!**
  - **(CAREFUL, Mandibular Canine is most likely anterior with multiple roots!! Or in other words Bifurcated)**

**Root canal:**
- A cross section at midroot of a perm Mn central is likely to show that the pulp cavity is flattened mesiodistally

**Mandibular Lateral Incisor:**
- **Shapes**
  - M/D view = Triangular
  - B/L view =
    - Occlusal =
  - Slightly larger than central incisor, wider MD than Mn central
  - Mesioincisal edge sharper than distoincisal
  - Cingulum slightly off center to the distal
  - Mesial marginal ridge slightly larger
  - Distal contact area slightly cervical to level of mesial contact area (incisal 1/3)
  - Viewed incisally, the crown looks twisted on the root base so that the distal is curved toward the lingual
    - This is the feature that is the most reliable criterion for differentiating perm Mn centrals from laterals
  - The incisal edge follows the arch curvature in relation to the faciolingual axis
  - Viewed proximally, the greatest curvature of both the F & L outlines will be in the cervical 1/3 of the crown
    - The greatest FL crown curvatures extend ≤ 0.5 mm F or L beyond the FL diameter of the root
      - Not a big step up from cementum to enamel
  - Wear facets on the incisal edges of Mn laterals are caused by occlusion w/ Mx centrals & laterals
  - **Root**
    - Small ½ with 2 canals
    - Concavities on both M and D surfaces
    - Very narrow MD – Ovoid root in x-section
    - **Larger than central root in all directions**

**Maxillary Canine:**
- **Shapes**
  - M/D view = Triangular
  - B/L view = Pentagonal
  - Occlusal = Diamond
- **Longest tooth; longest root**
  - **BUT Longest Crown is Mx central > Mn Canine > Mx Canine**
  - Wider FL than MD – has the largest FL dimension of all anterior teeth
    - The only ones wider MD are Mx centrals and laterals
  - Bulky crown w/ prominent ridges
    - Wider MD dimension of the crown on the facial than lingual
    - Mx canine has the greatest labial convexity of all anterior teeth
  - Least often extracted (along with Mn canine)
  - When viewed from incisal, mesial and distal outlines are asymmetrical
    - BOTH Canines have a longer Distal MR
      - **Remember Primary Mx Canine is the only one with Longer MR**
    - When viewed from incisal, cusp tip is Facial and Mesial
    - When viewed from incisal, There is a distal portion that exhibits some concavity in the facial outline
• NOT thinner mesially!

- Gingival pits/grooves, although not type traits, are common features
- Incisal margin occupies at least one-third of the crown height
  - When viewed from the facial, M and D margins are NOT parallel
  - THINK Mn Canine is more Parallel (i.e. Straight margins)

- Intermediate form between anterior & posterior tooth

- Sharp cusp tip (before wear)
  - The middle facial lobe (of the 4 developmental lobes) is the lobe that includes the cusp tip
  - In occlusion, the cusp tips do not make contact, because the tips line up with the facial embrasures

- COMPARED TO THE MN CANINE:
  - Mx cusp tip is more nearly centered over the root when viewed from the labial
  - NOTE: When viewed from the mesial, a line bisecting the root from the apex passes lingual to the cusp tip
  - In other words, Mx canine cusp tip is displaced facially in a F/L direction, where Mn is lingually
  - Again, Remember Buck tooth flare up top
  - OPPOSITE to Mn, which has its cusp tip displaced linguually
  - Mx crown shorter than Mn crown (but Mx still longer overall)
  - Mx cingulum more pronounced than Mn
  - Mx lingual anatomy is more distinct than Mn
  - BULKIER in Both Directions
    - Mx crown is wider MD than Mn
    - Mx crown is wider FL than Mn
    - Mn crown makes contacts more incisally than Mx!!!!!!
  - THINK IM vs JM
    - Mn crown has a straighter mesial border (viewed from facial)

- The cusp tip horizontally overlaps a Mn anterior & a posterior tooth
  - Mx canine is the only tooth with the potential to contact both anterior & posterior antagonists
  - Wear facets on the L surface of a perm Mx canine can be caused by contact with Mn canine & PM1
  - Enamel on the facial surface extends farther apically than the lingual

- Normal lingual anatomy:
  - Cingulum, L ridge, M & D fossae, M & D marginal ridges
  - NOT prominent developmental grooves & NOT L cusp!!!!!!!
  - There is some evidence of developmental grooves
  - Don’t get clowned, Development Depressions are on the facial
    - The structure immediately mesial to the DL fossa is the lingual ridge
    - The structure immediately distal to the ML fossa is the lingual ridge (believe it or not)
    - The M & D fossae meet the proximal surfaces of the tooth at the M & D marginal ridges
    - The structure immediately mesial to the ML fossa is the M marginal ridge

- The most likely anomaly of a Mx canine is a lingual tubercle ?? (agenesis, dwarfed root, peg crown, root bifurcation)

- Well developed lingual anatomy, ridges and fossa
  - Marginal ridges are heavy & prominent
  - Mesial & distal concavities/fossae are frequently found
  - Distal portion of the facial surface displays some concavity (viewed from incisal)

- Cingulum is centered MD

- Height of contour of both labial & lingual is in the cervical third

- How to distinguish between R & L Mx canines:
  - The mesioincisal angle is less rounded than the distoincisal angle
  - The curvature of the cervical line (CEJ) is greater on the mesial than the distal
  - The mesial surface is straighter than the distal surface (distal surface is more convex than mesial)
  - Mesioincisal cusp ridge is shorter than distoincisal – so, cusp tip is not centered over the root center (mesiodistally)

- From a proximal view, the Mx canine tends to be positioned in the arch with its axis most nearly vertical
  - (This is from among answer choices Mx canine, Mx lateral, Mx central, Mn lateral, Mn central)
  - NOTE ≠ PMs were not an option, all incisors are flared (Look at the All PMs section for some clarity)

- Pulp cavity has its widest dimension faciolingually in the cervical third of the crown (vs. middle third of the root, crown, etc.)
  - SEE PICTURE
  - Another Q: In the cervical third of the root (vs. apical third of root, incisal third of crown, etc.)
  - In a MD x-section, the pulp cavity is pointed at its incisal limit

- Root
  - One root, one canal
  - Least likely tooth to have two roots (among Canines & PMs)
- Root has M & D concavities – D is more distinct
- More oval pulp outline in x-section
- Longest
- Canine eminence – making it the thickest in the cervical 1/3rd
- Roots of Mx canines dictate alveolar wall morphology, although they are under bone

- Left Mesial of Max Canine

- Mandibular Canine:
  - Shapes
    - M/D view = Triangular
    - B/L view = Pentagonal
    - Occlusal = Diamond
  - Long, narrow crown (the only larger dimension on Mn canine than Mx canine is incisocervical)
  - Longest crown of all perm teeth – Toss up with Mx Central
  - Crown is distally inclined relative to the root
  - Its greatest FL measurement < its greatest MD measurement (Same as Mx canine)
  - Less sharp cusp tip (before wear)
  - Cusp is displaced lingually (differentiate from Max canine, when looking from incisal)
  - The mesial cusp ridge shorter than distal – so, cusp tip is not centered over the root center (mesiodistally)
  - Has greater bulk distal to a BL bisecting plane than mesial to the plane – it’s the transition tooth !!
    - The Mx Canine Does NOT have a difference in bulk (M or D)
  - Height of contour: cervical third for labial & lingual (at the level of the cingulum)
  - Labial and lingual ridges less developed, great for caries resistance
    - This is the tooth most likely to resist invasion by caries
  - Flatter labial surface than on Mx
  - Lingual surface
    - Relatively flat in the fossa area
    - Poorly developed in the marginal ridge area
    - Poorly developed in the cingulum area
    - The lingual crown surface is the narrowest MD (among labial or lingual crown surfaces of Mx/Mn canines)
  - Facial outline (viewed from proximal) is made up of one continuous arc & differs from the outline of a Mx canine
    - Remember Mx Canine has 3 facial planes
  - Mesial outline (viewed from facial), from the contact area to the root apex, relatively straight
    - Mesial axial surface is almost parallel to long axis of tooth
  - Wear facets are likely to develop incisal 1/3 of the labial surface of a Mn canine
  - Root
    - Anterior tooth most likely to have a bifurcated root (facial & lingual)!!
    - In x-section at the CEJ, the root is best described as ovoid, but wider mesiodistally at the labial
      - Irregularly oval
    - Developmental depression may appear on mesial root surface
    - Often has a divided pulp (2 canals) – more often than Mx canine, Mx central, L root of Mx M1, DB root of Mx M2

- Maxillary 1st Premolars:
  - Shapes
    - M/D view = Trapezoidal
    - B/L view = Pentagonal
    - Occlusal = Hexagonal
  - B surface has a prominent buccal ridge – running axially
  - B surface is wider than L surface
  - L cusp is mesially displaced
  - B cusp is distally displaced
• B cusp slightly to the distal
  • BUT Mx PM2 has B cusp offset to the mesial!!!
  • So, the mesial cusp ridge is longer than the distal cusp ridge – the only PM w/ this feature

- Largest of all PMs
  • Has a greater cervico-occlusal crown height than Mx PM2, Mn PM2, Mx M1 or M2, Mn M2
- Clinically, a Mx PM1 has four point angles with one point angle located at each of the four corners of the occlusal surface
- Steepest cusp inclines (well, steeper than Mn PM2, Mx M1, Mn M1 or M2)
  - Deep Sulcus, meaning steep cusp angles
- Mesial contact is towards the mesiofacial line angle – it’s with a Canine
- Widest of all PMs, but still greater BL than MD
  • Mesial marginal developmental groove & mesial crown concavity on the cervical
- B cusp slightly longer than L cusp
  • BOTH Mx PM1 and Mx PM2 have L cusps offset to the mesial, but B cusps differ
  • In a CUSP TO FOSSA contacting relationship in ICP, Mx PM1 is most likely to articulate w/ Mn PM1
  • NOT both Mn PM1 and PM2 (Don’t get clowned)
  • Picket Fence Pulls it into the Distal Fossa!!!

- Occlusal pattern has deep sulcus and long central groove (relative to PM2), but fewer supplemental grooves (than PM2)
  • Think Biggest PM has to be stretched so it doesn’t look wrinkled

- 2 roots! (The ONLY PM w/ 2 roots) – as such, Mx PM1 has a bifurcation
  • Also has two pulp horns
  • When viewed from proximal, the axial inclination of roots appears MOST vertical
  • Among PMs, Mx PM1 generally poses the greatest problem when root canal therapy, extraction or apicoectomy is being considered
  • Easiest to perforate
  • There are sharp demarcations between pulp chambers & pulp canals in Mx PM1s – due to 2 roots
  • This is not the case for any anterior teeth or other premolars
  • More likely to present w/ 3 roots than Mn central, Mx canine, Mn canine, Mx PM2, or Mn PM2
  • BUT 1 cusp is higher, would they be? -> 2 Buccal, 1 Lingual
  • CAREFUL, even though the Lingual is larger
  • More common problem when extracting -> leaving a root tip

- Mx PM1 differs from Mn PM2
  • It has 2 roots
  • Has a longer central developmental groove
  • Presence of a mesial marginal developmental groove
  • BUT it is the same in that both have a lower L cusp than B cusp (only slightly on Mx)

• Maxillary 2nd Premolar:
  • Shapes
    • M/D view = Trapezoid
    • B/L view = Pentagonal
    • Occlusal = Rounded (Hexagon)
  • B cusp slightly to the mesial
    • BUT Mx PM1 has B cusp offset to the distal – so from the buccal both cusps merge together!!!
    • L cusp inclined mesially, just like Mx PM1
    • Difficult to tell M from D
    • Crown is wider FL than MD
Less prominent buccal ridge

Smaller than 1st PM

More rounded occlusal table than PM1

Proximal contact with PM1 is facial to mesiodistal line bisecting the crowns

B & L cusps nearly equal in size and are in-line

- Both are offset to the mesial
  - Distal buccal cusp ridge is longer than mesial buccal ridge (opposite of PM1)
- No mesial groove & concavity

Characterized by the presence of a short central groove – has more supplemental grooves than PM1

Known as the “wrinkled”, occlusal appearance when compared to PM1

(Good comparative features between Mx PM1 & PM2)

Roots

- 1 root

Mandibular 1st Premolar

- Shapes
  - M/D view = Rhomboidal
  - B/L view = Pentagonal
  - Occlusal = Diamond (like the canine)
- Smallest of all PMs
- Most resembles a canine – transitional tooth
- 2 cusps
  - But, Mn PM1 is the only PM that frequently only has one pulp horn (think of the weak-sauce L cusp)
  - Cusp may have varying forms (from person to person)
  - Long, sharp B cusp – centered directly over the root
  - Mesial cusp ridge is shorter than the distal cusp ridge (No B cusp more mesial) – Just like Canine
  - L. cusp is also more mesial
  - Very small L cusp, non-functioning – L cusp contacts no Mx tooth in ideal ICP
  - L. cusp is ~2/3 the height of the B cusp
- L cusp is similar in development to the cingulum of a canine
- Only PM that has a B cusp w/ triangular ridge so uniquely prominent as to frequently separate its mesial pit from its distal pit
- HENCE, need for 2 different Preps
- Usually no central groove, but may have pits
  - May have a central pit (but Mn PM2 has one more often)
- Both M & D marginal ridges have little or no contact in ICP
- More prominent B ridge than 2nd PM
- In the Mn arch, the greatest lingual inclination of a crown from its root is seen in Mn PM1!!!!!!
- Masticatory function similar to that of canine
- Facial Masticatory mucosa (attached gingiva) is the smallest
- Mesial lingual developmental groove makes mesial marginal ridge run at a 45 degree angle
  - REMEMBER, MesioLINGUAL developmental groove for Mn (because it’s by the tongue)
  - Mesio marginal developmental groove for Mx
  - This makes it the only posterior tooth that has higher distal marginal ridge than mesial marginal ridge
  - More occlusal surfaces can be seen from the mesial than from the distal in a Mn PM
  - The groove originates in an occlusal pit & extends onto a proximal surface
  - Mesial marginal ridge is same height as distal marginal ridge of Mn PM2
- 1 Root
  - Has a shorter and pointed apex
  - Shape of pulp chamber -> oval, & wider faciolingual than mesial-distal
  - Broaders faciolingual than lingually
  - Usually free of marked distal curvature
  - Frequently seen with slight concave areas on M & D surfaces
  - Not flattened faciolingually
  - If a 2nd pulp canal is present, it is most likely found lingual to the 1st canal
  - A bifurcation is the most common root anomaly on Mn PM1 (not dwarfing, elongation, concrescence or trifurcation)
  - The pulp chamber morphology of the FACIAL makes it most susceptible to exposure
    - The Lingual Angulation of the crown forces us to make an angle prep, so we don’t hit the chamber

Roots

- 1 root

Left OR Right
Mandibular 2nd Premolar:

- **Shapes**
  - M/D view = Rhomboidal
  - B/L view = Pentagonal
  - **Occlusal** = Pentagonal
    - **CAREFUL** Tests before 98 say Square (Maybe for the H version w/ only 2 cusps????)

- **L Height of Contour is OCCLUSAL 1/3rd (THE ONLY ONE TO HAVE IT!!!!)**

- **Most congenitally missing PM**
  - May have 3 cusps; B > ML > DL
    - If Mn PM is not an option, Maybe Mx M2
      - B cusp is centered M/Distally
        - DIFFERENT THAN up top, where they converged

  - B cusp is shorter than for Mn PM1

- **L cusps are functional**
  - Wider on L than B
  - L surface is wider MD than for Mn PM1

- **Frequently has central pit; other PMs do not**
  - **ML groove or trapezoidal**

- **Differences between Mn PM2 & Mx PM2:**
  - The tip of the L cusp of the Mn PM2 is closer to the lingual border of the crown – Hence Occlusal HOC
  - The occlusal outline of the Mn PM2 is more nearly square
    - Mx PM2 is more rounded occlusally – rounded hexagon, where this is a Pentagon

  - **The root of the Mn PM2 is more circular in cross section**
  - The B & L cusps of the Mx PM2 are more nearly the same height – More so than Mx PM1
  - The Mx PM2 crown outline (viewed from mesial) is a trapezoid with the short parallel side at the cervix
    - Whereas Mn PM2 is Rhomboidal

- **Mental foramen is located most closely to Mn PM2**
  - Another Q. Usually situated nearest the apices of Mn PM1 AND PM2

- **1 Root**
  - Thicker and longer than PM1
  - Longer, with blunted apex
  - Rounded root, lends itself well to rotation w/ extraction forceps during surgical removal (also Max central incisor)

- **ONLY PM with NO mesial root depression**

- **Occlusal schemes**
  - **Y-type**
    - The PM w/ the occlusal groove pattern that may simulate the letter "Y" is Mn PM2
    - 5 lobes, 3 cusps
    - 2 L cusps & 1 facial cusp (F > ML > DL)
      - This means the Mn PM2 is the only PM that usually has 2 L cusps
    - Shorter and wider than PM1
    - **Square occlusal**
      - *Because of this scheme, the Mn PM2 frequently has a central pit* (the other PMs do not)
    - **The total # of pits (3) on the occlusal surface of Mx M1 is the same as is found on a Y-type Mn PM2**
      - The only premolar that may exhibit 3 occlusal pits
    - **H-type**
      - 4 lobes, 2 cusps
      - More common than U-type
  - **U-type**
    - 4 lobes, 2 cusps
    - Central developmental groove can look like a U or crescent
    - So, Mx PM2 is the tooth most likely to possess a crescent-shaped central developmental groove
中央发育沟是新月形的，向近中和远中方向延伸。

**SIDEBAR: Leong PM**

- Dens Evaginatus most commonly on Mn PM2
- May contain a pulp horn

**Maxillary 1st Molars:**

- **Shapes**
  - M/D view = Trapezoid
  - B/L view = Trapezoid
  - Occlusal = rhomboid
- **Cornerstone of Mx arch**
- **Largest permanent tooth – NOT Mn M1**
- **Broader lingually than buccally** (Unlike any other perm)
  - Has a MD measurement greater lingually than facially
  - This makes the lingual embrasures associated with the Mx M1 relatively small
- **Cusp of Carabelli on ML cusp** (5th cusp)
  - The Carabelli or fifth cusp on a permanent Mx molar is found on the ML lobe of M1
- **ML cusp is the largest and longest** cusp of perm Mx teeth!!!
- **DL cusp is largest D cusp of max molars**
  - The most significant difference in the occlusal surface anatomy of Mx M1, M2 & M3 is the DL cusp gets progressively smaller
- **Central groove runs from mesial pit to central pit on the occlusal table**
  - The central pit is formed at the bases of the triangular ridges of the ML, MB, and DB (not DL)
  - There are 3 pits in Mx M1 (Same as Mn PM2 Y type)
- **Oblique ridge**
  - The occlusal surface is usually distinctly divided by a ridge from the ML to the DB cusp
  - Forms the distal boundary of the central fossa
  - Passes through the DF sulcus (or angular sulcus) of permanent Mn M1
  - Opposes the developmental groove between the DF and D cusps of Mn M1
- **Mesial contact area when viewed from the mesial is usually facial to the center of the crown F/Lingually**
  - CAREFUL, distal contact is centered – Just like anteriors
- **The M border is broader than the D border**
- **Both Mx M1 and M2 have Mesial Inclination**
- **Distal surface has pronounced cervical concavity** – hard to adapt a matrix band (Along with Mesial of Mx 1st PM)
- **There is also a Mesial concavity** that requires special attention when removing calculus deposits (Mx PM1 has one, too)
- **2nd Perm to erupt after Mn M1s**
- From the distal aspect, one can see 4 cusps
  - Occlusal contact should be anticipated on the L slope of the F cusp, the F slope of the L cusp, and L slope of the L cusp (but not the F slope of the F cusp)
- **Roots** – two facial, one lingual
  - Tripod splayed out, whereas Mx M2 are closer together
  - Triangle formed by the orifices of the canals, the line connecting the P (L) to the M is the longest
  - Roots of Mx M1 are equal or longer than roots of Mx M2
  - All 3 visible from Buccal
  - Root length/size: P > MB > DB
  - **P**
    - Is the largest, longest and strongest
    - (3rd longest of Max after canine and 2nd PM root)
    - Wider MD, than BL
  - Often has concavities/depressions on facial and lingual surfaces of the root
    - **Longitudinal depression on the lingual, Concave on the buccal**
    - Viewed from B, in line with B groove
    - Viewed from L, in line with the midpoint of MD diameter
  - **DB**
    - Usually has 1 root canal
• The shortest and smallest root
• **Little thicker B/L than M/D**
• Sharp apex
• **More inclined distal than 2nd Max Molar**

**Inclined Buccally**
- **MB**
  - Flattened MD and has root depressions on both its M & D surfaces
  - Thicker B/L than mesiodistally
  - Blunted apex
  - Often has MB1 and MB2 (60%)
    - If a Mx M1 has a 4th canal, it is located in the MB root — MB root can have 2 canals
    - MB2 is just L to the orifice to the MB Canal
  - Pulp horns of MB (and ML, if present) – usually higher than D or P
    - The pulp horns most likely to be accidentally exposed in a Class II prep are MB & ML
      - **ML comes with a MB 2 canal**
- **Furcations**
  - **Distance from cervical line (from farthest to closest): D > F > M**
    - Remember Mx Molars have Bifurcations (F/L) and Mx Molars have TRIfurcations (F/ML/D)
  - Has a B developmental groove, starting at furca and ending at CEJ
  - If a root goes into Mx sinus, it is usually from Mx M1

**Maxillary 2nd Molars:**
- **Shapes**
  - M/D view =
  - B/L view =
  - Occlusal =
    - At cervical level = Irregularly Triangular
- **Parotid Duct (Stenson’s) opens opposite to Mx M2**
- **Smaller than 1st**
  - No Cusp of Carabelli
  - Smaller oblique ridge
  - DL cusp is smaller than Mx M1
  - DL can be absent – this means that Mx M2 can have 3 cusps w/ a central pit (also Mx PM2 and Mx M3)
  - DL groove is shorter than on Mx M1
  - MB line angle is most acute (viewed from occlusal) – due to rhomboidal shape (MB & DL are acute)
  - B broader than L – **Think you turned Heart Shaped**
  - More angular than 1st Molar
- **Both Mx M1 and M2 have Mesial Inclination**
  - B groove is shorter and does NOT have a pit
  - The most constant & valuable trait to differentiate among Mx M1, M2 & M3 is the relative position of the DL groove
- **Roots**
  - **Shorter than roots of Mx M1**
  - Closer together (more potential for fusion)
  - Have a greater distal inclination and have longer root trunk
  - The axial inclination of the P root of Mx M2 is distal & lingu al
  - P is straighter than P of Mx M1

**Maxillary 3rd Molars:**
- **Shapes**
  - M/D view =
  - B/L view =
  - Occlusal = Heart shaped (Most often)
- **Most often congenitally missing tooth (along w/ Mn M3s, of course)**
- 3 or 4 cusps (small or sometimes missing DL cusp, making it heart shaped with the apex lingu al)
Among options of Mx M1, Mx M3, Mn M1, & Mn M3… Mn M3 most frequently has 3 cusps

- No Cusp of Carabelli
- THE 1 constant ➔ Always have BL wider than MD
- Roots fused
  - The Mx tooth exhibiting the greatest statistical variation in root alignment is M3
- The MB is noticeably larger than the DB
- Shortest permanent tooth
- Oblique ridge is often absent
- May have paramolar attached
- Crown tapers more from B to L
- Has one single antagonist in ICP (NOTE: Mn centrals also occlude with only 1 tooth)
- In a normal dentition, maxillary teeth having single antagonists are the M3s
- Strange & extra anatomy (usually undersized anomalies)
  - Maxillary tooth exhibiting the greatest statistical variation in root alignment

Mx M3

Left M3

Mandibular 1st Molars:
- Shapes
  - M/D view = Rhomboid
  - B/L view = Trapezoid
  - Occlusal = Pentagonal
- Cornerstone of perm dentition
- MD dimension > BL dimension (Only slightly says the answer)
- Has the longest MD measurement of all perm molars
- When viewed sagitally, Mn M3s have their long axes at an angle least perpendicular to the occlusal plane
  - DON’T get clowned, because Mn M2 still has its roots set back most distally
- Most often restored, extracted or replaced
- 5 cusps
  - 3 buccal (MB, DB, D) & 2 lingual (ML, DL)
    - 3 cusps can be seen from the buccal
      - Where is the Distal cusp located??? ➔ Distofacial
    - All about the same size: MB is the largest cusp & D is the smallest cusp
      - The distal pulp horn is the smallest on this tooth
      - The second largest Cusp is the ML
        - Lingual cusps are higher and more pointed
        - The position & height of L cusps of Mn M1 accommodate working movement
        - The L surface of each L cusp possesses a slightly convex shape in the occlusal third
        - 5 cusps = 5 pulp horns
        - 5 cusps = 5 triangular ridges (95% sure)
        - Distal cusp projects into the distal fossa of the Mx M1
    - The largest proximal crown surface of a Mn molar is the mesial of Mn M1
    - Buccal pits in the buccal groove – common place for caries
      - Crooked central groove in MD course
- 4 Grooves on Mn M1
  - 1 central, 2 Buccal grooves (B & DB); 1 Lingual groove
  - The developmental groove between the distofacial cusp & the fifth cusp of a perm Mn M1 is the distofacial
  - The Number of developmental grooves distinguishes Mn M1 from Mn M2 4 for M1 and 3 for M2
- Of all molars, the mesial fossa of the Mn M1 is most distinctly separated from the remainder of the occlusal table by a transverse ridge (not to be mistaken with the oblique ridge of Mx Mxs)
- Both marginal ridges have developmental grooves
- Roots
  - 2 Roots, usually [canals 2 mesial canals] – 2 roots means Mn M1 has a bifurcation
    - Furcations are B and Lingual
  - Roots incline distally
  - Pulp chamber is wider MD than FL
  - Have Longitudinal grooves on Both M and Distal surfaces of Mesial root
    - BUT no longitudinal groove on the Distal of the Distal root
  - What distinguishes Mn M1 mesial root from Distal root? ➔ Larger, 2 canals, biconcave
Mesial root of Mn M1 is typically very thin MD, much wider FL, and concave on both M & D surfaces (also MF of Mx M1)
- Mesial root has a strong distal curvature in the apical 1/3
- In a mid-root x-section, the mesial root of Mn M1 is larger than any other Mx or Mn M1 root
- The distal is smaller than mesial (D before M!!)
- Are strongly compressed in a MD direction
- The root trunk of the perm Mn M1 is equal in length to the mesial furcation of Mx M1
- Which was the shortest distance to furcation from CEJ

Mandibular 2nd Molars:
- Shapes
  - M/D view =
  - B/L view =
  - Occlusal = Rectangular
- Cusps
  - Cusps are of approximately equal size
  - CAN see the Lingual cusps from the Facial view as a little taller (SEE PIC BELOW)
  - Perm M2 differs from perm M1 in number of cusps
  - The DB cusp is the “centric holding cusp” of this tooth, and it occludes in the central fossa of Mx M2
- Viewed from the occlusal, the greatest FL diameter of Mn M2 is located in the mesial 1/3 of the crown
- Most symmetrical
- Exception → More occlusal surface is visible from D than M
- Facial has slight cervical dip, Lingual does not
- 3 developments grooves (from occlusal aspect) – Central, Buccal, and Lingual
  - B groove extends half way down B surface – Hello, buccal pit anyone?
  - L groove barely extends onto L surface
  - B & L grooves form right angles with central groove – makes a “+” shaped occlusal surface
  - Central groove – straight groove
- More secondary grooves than Mn M1
- Has large MB cervical expansion (like primary M1)
- Viewed from the occlusal, the greatest FL diameter of a perm Mn M2 is located in the mesial third of the crown
- Root
  - 2 roots (M & D) Distal is smaller – again, D before M!
  - Closer together & inclined more distally than Mn M1 roots
  - Longer root trunk

Mandibular 3rd Molars:
- Shapes
  - M/D view =
  - B/L view =
  - Occlusal = Ovoid
- 4 or 5 cusps
- Bulbous crowns that taper M to D
- Calcification begins at 8-10 yrs
- Extra grooves
- MB cusps are wider/longer than DB
- Rectangular form – MD dimension of the crown is greater than the BL
- Premolar w/ shallowest central fossa
- Oversized anomalies are more common, undersized more common in Max M3s

This Q comes from the 2001 Pilot:
- Q: A radiograph of tooth #32 shows two well-formed roots. When sectioning this tooth to separate the roots & simplify extraction, which of the following best describes how the cut should be made?
- A: Bucco-lingually through the crown & furcation

Root
- Marked distal inclination of root trunk
- Roots fused and shorter
- Long root trunk

ROOTS REVIEW

Mx

- Anterior
  - Virtually always have one root & one canal
  - Centrals
    - Newly erupted have 3 pulp horns
    - Least likely to have divided pulp canal (among Mx PM1, Mn cent, Mn Lat, and Mn PM1)
    - Pulp outline is somewhat triangular at cervical level
    - Pulp chamber is wider M/Distally
      - Mesial and distal pulp horns are MOST likely
    - Mid-root is round
  - Laterals
    - Newly erupted have either 0 or 2 pulp horns
    - Pulp outline is round for both sections
  - Root length is the only dimension that is the same or bigger than Mx central
  - Canine
    - Pulp chamber has the greatest faciolingual width of any anterior tooth
    - Longest root canal
    - Least likely tooth to have two roots (among Canines & PMs)
      - F/L longitudinal section has the pulp cavity its widest dimension in the cervical third
      - Mid-root is round
      - Cervical cross section is ovoid, wider labiolingually

Posterior

- Premolars
  - PM1:
    - 70% – 2 canals
    - 2 pulp horns, buccal is larger
    - Possibility of 3 Roots (2 Buccal/1 Lingual)
    - Sharp demarcation between chamber and canals
    - Lingual canal is slightly wider, even though lingual root is usually small
    - Cervical cross section is Kidney shaped with concave side on M
    - Mid-root is figure 8 shaped, lingual canal still slightly larger
  - PM2:
    - 30% – 2 canals, usually just branches into 2 foramina in the apical third
    - 2 horns, B is larger
    - Cervical cross section is oval
      - But remember, it still has a root depression → MAND PM2 is only PM that DOES NOT have a mesial root depression
    - Mid-root is ovoid and wider BL than MD

- Molars
  - M1:
    - MB1&2, DB, Palatal
      - 60% MB2 canal
    - Always assume there is an MB2, unless you don’t find it (the root is so wide)
  - NO pulp horn for cusp of Carabelli

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MB and ML pulp horns are most susceptible to exposure
-
- Cervical cross section is rhomboid
- Mid-root has 3 roots, M with 2 canals
- Functions closest to the CEJ = Mesial more than Facial more than Distal is Farthest
- Palatal
  - P root has a buccal curvature
  - P root has a concave lingual surface
  - Often has concavities/depressions on facial and lingual surfaces of the root
    - Longitudinal depression on the lingual, Concave on the buccal

- M2
  - DL pulp horn is smaller than M1 to match DL cusp size decrease
  - When compared to M1, M2 roots are greater in distal inclination
  - The axial inclination of the P root of Mx M2 is distal & lingual
  - Opposite to Mandibular M1 and M2, where M1 has greater distal inclination
  - When crown is heart shaped, cervical cross section is more triangular
- M3
  - Varies

- Mn
  - Anteriors
    - 70-90% are normal
    - 10-30% 1 canal with branching into 2 canals
    - 1-2% 2 fully formed root canals
  - Centrals
    - NO pulp horns
    - Cervical cross section is Thin M/D, Wide F/L, and Concave on both M/D surfaces (see both pics)
    - Mid-root is still ovoid, but canal is more constricted
    - 60% – 1 canal
    - 40% – 2 canals – look for double PDL space
      - Often the canals join apically – will usually heal if you seal off one canal
      - Very few of the two canal cases do not join apically
  - Laterals
    - NO pulp horns
    - Cervical cross section is ovoid
    - Mid-root is still ovoid, but canal is more constricted
  - Canines
    - 6% with 2 complete root canals
    - Occasionally 2 roots (Labially and Lingually)
    - Cervical cross section is ovoid (irregularly oval)
      - Ovoid and wider M/D on the labial
      - Another Q: Flattened in a M/D direction
    - Mid-root is ovoid
  - Premolars
    - PM1:
      - 25% – 2 canals (or more)
      - Fast-beak phenomenon: apically the canal space disappears – means you have 2 canals
      - During Endo on PM1, you suspect a second canal, MOST likely on LINGUAL, just like Canine
      - 2 pulp horns, large pointed B horn, small rounded L horn
        - Sometimes L is missing, and then would look like a canine
      - Broader facially than linguall
      - Usually free of marked distal curvature
      - Frequently seen with slight concave M/D
      - Cervical cross section is ovoid
      - Mid-root cross section is round
    - PM2:
      - 5% – 2 canals
      - 2-3 Pulp horns (Y type have 2 lingual pulp horns) with B a lot larger
      - Cervical cross section is ovoid
Mid-root cross section is ovoid

**Molars**
- Always 2 mesial canals
  - 30% have only 3 canals
  - 70% have 2 distal canals, for a total of 4
- M1
  - 4-5 Pulp Horns
    - mesial 2 are about the same size, distal 2 are about the same, but the MB is a lot bigger than the DB
    - Pulp horns likely to be exposed in newly erupted Mn M1 are BOTH MF and ML
    - D horn is sometimes large enough to detect (usually only in newly erupted)
    - Cervical cross section follows crown shape with 5 humps in the chamber (Pentagonal)
    - Mid-root is usually elongated kidney of M with 2 canals and concave toward distal, then D root has 1
canal kidney shaped with concave toward M
    - Watch for C shaped canals in distal root
    - Mesial root is very thin M/D, much wider F/Lingually and concave on both M/D surfaces
    - Mesial root has the greatest mid-root cross section of any first molar root
- M2
  - still usually 2 canals in M root
  - usually just one canal per D root
- M3
  - varies, but usually same as M2

**CONTACTS**

- **Contacts**
  - All embrasures are greater on the Lingual EXCEPT
    - Mn anterior (to the mesial of the Canine)
  - Viewed from occlusal, all posteriors have contacts slightly buccal to the faciolingual midpoint
    - EXCEPT DISTAL OF MX M1
  - Also, slightly to the facial from the center of the proximal surface
  - Viewed labially, anterior teeth have contacts in the incisal to middle 1/3, except for the D contact of Mn canines
  - All permanent incisors have M and D contact areas approximately centered faciolingually
  - Viewed from facial, the proximal contacts are as follows:
    - Max teeth
      - be sure to count each one;
    - **H**: Incisal 1/3rd
    - **J**: Junction of Incisal/Middle 1/3rd
    - **M**: Middle 1/3rd
  - NOTE: Mn centrals & laterals and Mn laterals (? ? ?) have distal contacts apical to their mesial contacts (so do Mn canines)
  - Maxillary central & lateral IP contact
    - The contact is centered faciolingually
    - NOT incisocervically
    - The lingual embrasure is wider/larger than the facial embrasure
    - There was a “PBL” type question that basically stated the orthodontist would want the distal proximal contact of the Ms central and the lateral to be in the incisal 1/3rd, (IN reality, it should be Junction)
  - Mn incisor IP contact
    - Contact tends to occur equidistant from F & L surfaces
    - Contact occurs in the incisal third of the crown
  - Mn Canine and Mn PM1
    - Centered faciolingually
    - The facial embrasure is smaller than the lingual
    - In the incisal third
  - Mandibular posteriors
    - In the Mn posterior segment of the arch, the contacts of Mn PM2 & all 3 Mn molars are aligned in a straight line
    - This is not the case in the Ms arch
    - Proximal contact of posterior teeth creates wear patterns that eventually cause reduced IP embrasure spaces
    - The following anterior teeth have a distal contact area in a more apical position than the mesial
The contact area does:
- Prevent food impaction
- Form embrasures
- Stabilize the dental arch
- Protect the periodontium

It does NOT:
- Distribute occlusal forces
- Protect mucosal tissues
- Provide spillways, maybe the embrasure does
- Guide food toward the occlusal surface
- Guide food over the free margin of the gingiva

Loss of the contact area can result in drifting of teeth, food impaction, bone loss, damage to the interdental papilla, unfavorable occlusion.

Contact areas between posterior teeth in normal alignment aid in preventing mesial and distal drift.

When two proximal surfaces diverge from an area of contact, lingual, facial, occlusal & cervical embrasures are formed.

A proximal surface is always next to an adjacent tooth (hence, “proximal”).

**OCCLUSION**

WHEN THE TEETH DON’T MOVE

- **Occlusal table**
  - Area of a tooth bordered facially & lingually by crests of the cuspal ridges of F & L cusps, and mesially & distally by crests of the marginal ridges
  - Normally makes up 55-65% of H/L tooth dimension

- **Overbite (vertical overlap)**
  - Is when incisal edges are w/in incisal third of mand incisors

- **Overjet (horizontal overlap)**
  - Pt with overjet has?? \(\rightarrow\) Decreased anterior disclusion??

Determinants of Occlusion
- **Posterior**
  - R/L TMJ and suspensory ligaments and condyles
- **Anterior**
  - Teeth (occlusal surfaces)
  - Neuromuscular system
    - Programmed by teeth and what nature/man do to them

- **4 Determinants of design for restoring complete and functional occlusal surface**
  - Amount of vertical overlap – allows you to make the cusps bigger and fossa deeper
  - Contour of articular eminence
  - Amount & direction of lateral shift in working condyle
  - Position of tooth in arch

Equilibration (Occlusal Adjustment) Principles:
- Maximum distribution of stress
- Forces borne on long axis
- Change surface to surface flat contacts to point-to-surface
  - We want DOTs not Smudges
  - Involves
    - Discing
    - Odonto-, Enamelo-, Coronoplasty

- **CR**
  - Relationship of bones of the upper and lower jaws w/o tooth contact

- **CO (ICP)** is slightly anterior to CR

**Ligament Guided**

- **CO (ICP)**
  - Relationship between Max and Man occlusal surfaces that provides the Maximum Inter-locked Position MILP
  - Tooth Guided
  - Determined by tooth contacts
  - The VDO is smallest in a position of maximum intercuspation
ICP supports the mouth during “empty mouth swallowing”
- During non-masticatory swallowing, the teeth are usually in contact in ICP
- Rinses the mouth of saliva and helps moisten oral structures
- Masseter muscles contract and the tip of the tongue touches roof of mouth
- Tooth contacts are longer duration during swallowing than chewing

RCP
- When the Mn moves from ICP (MILP, maximum interlocking position?) to a more posterior position, any tooth contact that occurs is called a retrusive contact.
- Placing the Mn in a retruded path of closure usually results in (meaning you stop at Retruded Contacts)
  - Increased VDO, increased horizontal overlap (of incisors?), and decreased vertical overlap
- In a retruded contact position, the Mn central does not contact any tooth.
- Terminal Hinge Axis
  - The center of rotation for the mandible when it opens from retruded contact position.

Rest (postural) position of Mn
- Muscle guided – occurs when muscles of mastication are in tonic equilibrium
- Determined exclusively by the behavior of the mandibular musculature
- Usually there is no teeth contact
- Occurs the neuromuscular system has the least amount of activity
- If the mandible were forced into CR from the rest position, the pt’s reflex neuromuscular defense would resist the applied force.

Freeway Space or Interocclusal distance
- Results from Rest Position of the Mn
- When mandible is at physiological rest, the space that exists between the teeth, (should be no contact)
- Averages between 2-6mm
- All 8 muscles of mastication plus supra and infrahyoids are in equilibrium

Angle Classes of Occlusion
- *Determined by MB cusp of Mx M1
- Class I (70%)
  - MB cusp line up with MB groove
  - In terms of cusp/fossa relationship, the DB cusp of the Mn M1 rests in the central fossa of Mx M1
  - Mx centrals overlap Mn centrals
  - Mn canine lies in embrasure between Mx canine and PM1
  - Mn posteriors are positioned more lingually & mesially than Mx posteriors
  - Mn posteriors are positioned more facially & distally than Mx posteriors (hey, it was a question)
    - Which may occur in class I pt
      - ANSWER was NONE of these:
        - Cross tooth balance
        - Bilateral tooth contacts in excursives
        - Posterior tooth contacts in protrusive movements

  - If you move from a postural position to ICP, you will be using the temporalis (last bit of closure)
  - Class II (25%)
    - MB cusp between Mx M1 & PM2
    - Mn incisors occlude even more posterior
    - In a protrusive movement (in a Class II relationship), Mn canines articulate w/ canines, if you are thinking Class II shift back
    - Mn PM1 lies between Mx PM1 & PM2
    - Mx canine is mesial to Mn canine
    - MB cusp of Mx M2 would articulate in the central fossa of the Mx M2, NOT the normal marginal ridge area
    - Increased Decrease Condylar Distance, OR Increase Decrease of Bennett Angle
      - One of these 2, game time decision ??
  - Class III (<5%)
    - MB cusp falls between Mx M1 & M2
    - Chin protrudes
    - Mn incisors overlap anterior to Mx incisors
      - A patient w/ a true or pseudo-Class III (Angle) occlusal relationship has no incisal guidance
      - As the Mn retracts, the Mx laterals contact Mn canines & laterals
    - In a Class III malocclusion, the MB cusp of Mn M1 occludes in the mesial fossa of Mx PM2
    - Mx canine is distal to Mn canine
    - Often found when Mx arch is larger than Mn arch

[ 注解 ]
[M15]: Increase condylar distance/
Guiding cusps = Balancing = Non-supporting = Non-centric = Shearing
- Mand Lingual, Max Buccal

Supporting cusps = Working = Stamp = Centric (NOTE: This changes with posterior crossbite pts)
- Mn Buccal, Mx Lingual
  - Centric stops are areas of contact that a supporting cusp makes with opposing teeth
  - i.e. ML cusp of max molar with central fossa
- 5 Characteristics
  - Contact opposing in ICP
  - Support VDO of the face
  - Nearer to the faciolingual center of the tooth
  - Outer incline has potential for contact
  - Broader, more rounder cusp ridges

- In centric occlusion, opposing contact may be expected at B slopes of L cusps of Mx posterior teeth

Posterior crossbite:
- Mx facial & Mn lingual cusps are considered supporting cusps
- In a working movement, the inner aspects of Mx L cusps may contact ('inner' means twd the tooth midline, not 'inner' as in toward the lingual)

Anterior crossbite:
- When Mx & Mn incisors are in crossbite, the contacting surfaces are Mx lingual & Mx facial

Supporting cusps vs. Guiding cusps
- Supporting cusps make fossa or marginal ridge contact
- Supporting cusps of the same quadrant line up with each other
- Guiding cusps overlap facial to Mn teeth & lingual to Mx teeth
  - NOTE: Mx F cusps & Mn L cusps (Guiding or non-supporting cusps) require sufficient occlusal length & horizontal overlap for soft tissue protection
  - Horizontal & vertical overlapping of teeth afford some degree of protection for lips, cheeks & tongue

PICKET FENCE – (get your incisal edge/cusp tip stuff down)
- Teeth occluding only 1 tooth in opposite jaw:
  - Mn centrals
  - Mx M3s (Don’t get clowned by Mn M3s in a question!)

Maxillary
- Mx lateral opposes incisal edge of Mn lateral & canine, but, opposes no teeth at its mesial edge!!!!
- Cusp tip of Mx canine is in direct alignment w/ a facial embrasure of the Mn teeth
- Mx posterior teeth oppose F & L inclines of F cusps, and F inclines of L cusps (not L inclines of L cusps)
- L cusps of Mx posterior teeth oppose marginal ridges and central & distal fossae
- B cusps of Mx posterior teeth oppose grooves & embrasures (meaning buccal grooves, not central grooves)
- L cusps of Mx PMs contacts the distal fossa of respective PMs (Mx PM2 → distal fossa of Mn PM2)
- F cusps of Mx PMs oppose Mn PM & tooth distal to it
  - Mx PM1 opposes Mn PM1 & PM2
    - Distal marginal ridge of Mx PM1 is in contact w/ the mesial ridge of the F cusp of Mn PM2
      - In LEFT lateral movement, the L cusp of Mx RIGHT PM1 may appear to pass toward the tip of Mn PM2
  - Mx PM2 opposes Mn PM2 & M1
  - In a CUSP TO FOSSA contacting relationship in ICP, Mx PM1 is most likely to articulate w/ Mn PM1
    - (This is due to the lingual inclination of Mx PM1 – Mn PM2 is not involved in a CUSP TO FOSSA manner)
- ML of Mx molars goes to central fossa
  - ML cusp of the perm Mx M1 opposes the central fossa of Mn M1
  - ML cusp passes through the LINGUAL sulcus if its on the same side as the working movement
  - ML cusp of LEFT Mx M1 slides through the sulcus between DB and D cusps on Mn M1 during a RIGHT working movement
- DL goes to distal marginal ridge of same numbered Mn molar and mesial marginal ridge of tooth distal to it
  - DL cusp of Mx M1 opposes the mesial marginal ridge of Mn M3
  - DL cusp of Mx M2 opposes the mesial marginal ridge of Mnx M3 & the distal marginal ridge of Mn M2
  - MB cusp of Mx M1 opposes the B groove of Mn M1
    - NOTE: it’s the triangular ridge of this cusp, not the cusp ‘tip’ that opposes the groove DON’T GET CLOWNED
    - But, in a more recent question, it was the ‘tip of the MB cusp’ of Mx M2 that opposes the B groove of Mn M2
    - In left working movement, the MB cusp of Mx right M2 will pass through, NOTHING, it’s the buccal cusp
  - DB cusp of Mx M1 opposes DB developmental groove of Mn M1!!!!
    - DB groove also serves as escape for ML in non-working
The DL cusp of Mx M2 has the potential to oppose the mesial portion of Mn M3.

Oblique ridge of Mx M1 opposes the DB groove on Mn M1!!!!!!

(The prior 3 lines work great together, since the DB cusp connects through the oblique ridge to the ML cusp)

**Mandibular**

- Mn central opposes Mx central only – distoincisal aspect of Mn central opposes the lingual fossa of Mx central
- Mn centrals contact Mx centrals during protrusion and lateral protrusion
  - It is important to check protrusion when restoring the incisal edge of an anterior tooth
- Mn lateral opposes the distal marginal ridge of a Mx central, mesial marginal ridge of Mx lateral, and maxillary lateral incisor 2-3 mm cervically to the incisal edge
- Mn canine (incisal 1/3 of facial surface) opposes a Mx lateral & Mx canine at the approximation of their marginal ridges
  - An older question gave ‘opposes the incisal embrasure between Mx lateral & canine’ as the correct answer, but in this question (1989Q63), that answer option was available and was incorrect
  - The mesial cusp ridge of a perm Mn canine opposes the distolingual of the Mx lateral
- B cusp of Mn PM1 contacts the mesial marginal ridge area of the Mx PM1
- L cusps of Mn molars oppose grooves & embrasures (meaning lingual grooves, not central grooves)
- ML cusp of Mn molar opposes the lingual embrasure of the same numbered Mx molar and tooth mesial to it
- ML cusp of Mn M2 opposes the embrasure between Mx M1 & M2
- DL cusp tip of Mn M1 has no antagonist
  - ***D cusp of Mn M1 projects into the distal fossa of Mx M1
- DB cusp of Mn molar opposes the central fossa
  - MB cusp of Mn molar opposes the mesial marginal ridge of the same numbered Mx molar and the distal marginal ridge of the tooth mesial to it
  - MB cusp of Mn M1 opposes the occlusal embrasure between Mx PM2 & M1
  - MB cusp of Mn M2 opposes the mesial marginal ridge of Mx M2
  - B cusp of PM1 lies directly below the contacting area of Mx canine & PM1
  - B cusp of PM2 opposes the mesial marginal ridge of the Mx PM2

**Class II Picket Fence**

- In a patient with a Class II, Division I angle occlusal relationship in maximum ICP, the MB cusp of Mn M2 articulates with the central fossa of Mx M2

WHEN THE TEETH ARE MOVING

- **3 Planes of Movement**
  - Frontal (up/down)
  - Horizontal (side/side)
  - Sagittal (forwards and backwards)

- **5 Factors of Mandibular movement**
  - Initiating Position (CR)
    - Most stable and most easily reproduced
  - Types of Motion
    - Rotation
      - When the mouth is open to any given degree, there is more interocclusal distance anteriorly than posteriorly because of the rotary nature of the opening movement
      - 1st ~20mm of opening is rotational; then translational
    - Translational
      - Occurs when the Mn moves from a maximum intercuspal position to a maximum protruded position
      - ***NOTE: When the mandible is opened beyond the point where the condyle begins to translate, the meniscus glides downward and forward on the articular eminence
      - Opening the mouth maximally from retruded position causes the Mn to rotate, then translate

- Direction of Motion
  - 3 Planes
  - Degree of movement
  - Clinical significance of movements
    - Each pt may have different relationships

**Mandible is a Class III lever** – like a shovel
Fulcrum – Condyle
Force – Muscles
Workload – Teeth

Functional Occlusion

- All contacts during chewing, swallowing, or normal actions
- Parafunctional
  - Those made outside normal range, may create wear facets or attrition
  - Bruxing, clenching, nail biting, thumb sucking, check biting
  - Jaw closure in parafunction varies from masticatory function in the following ways:
    - Teeth seldom, if ever, contact in mastication
    - Teeth are in tight contact during parafunction
    - Masticatory cycles are vertical and cyclic

Parafunctional

- Border Movements LOOK OVER PULLINGER’S HANDOUT

Sagittal Plane – Posselt’s Envelope (ABOVE)
- The final movement of the Mn in tooth closure is directed by the cusp-fossa relationship of opposing teeth
- The maximum intercuspal position is the most superior point #4
- Postural or rest position is that black dot right under #3,4
- Retruded contact position is #4
- Terminal Hinge axis is #6F
- Masticatory Cycle of mandibular central incisor is #5
- Curve #7 is the pathway for a maximum opening – both rotatory & translational (NOT a border movement)
- From which point to which point is there the greatest change in anterior guidance? I think from 3 → 2 (OR from CR (3) to Edge to Edge Contact (2)
- Intercuspal position is determined almost exclusively by tooth contact
- The maximum opening position is the most inferior
- In a normal diagram in the sagittal plane, initial occlusal contact in RCP occurs at a more inferior position than ICP at #4
- Mastication of food occurs primarily in lateral contacting movement
  - In 90% of the population, the average distance from 3→4 is ~1.25mm (ICP is anterior to RCP)
  - In the other 10%, 3=4 (RCP = ICP)
  - The left border above is the protrusive opening path

Frontal Plane
- Viewed anteriorly, chewing stroke (masticatory movement) vertical & tear drop in appearance (RIGHT)
- In Frontal Plane there is Posterior contacts only on “A”
- Canines are cusp tip to cusp tip on “B”

Horizontal Plane (Gothic Arch)
- This records the position of the Mn anterior teeth, in assessing condylar movement via the lateral pterygoids
  - The diamond shape results from 1) L lateral, 2) L lateral w/ protrusive, 3) R lateral, 4) R lateral w/ protrusive
  - Points 5 & 6 in the figure on the right (below) represent the R & L lateral contacting positions, respectively
  - The apex of the horizontal plane Gothic arch tracing represents CR (OR POINT 1 Below)
Diagram shows (1999 Q 197 – SEE RIGHT)

- Horizontal component of movement from retruded contact position (1) to ICP (2)
- Anterior component of movement from ICP (2) to maximum protrusive position (4)
- Lateral component of movement from retruded contact position (1) to ICP (2)
- Mandibular movements occurring laterotrussively
  - This diagram does NOT show Vertical component of any of the movements.

Centric Relation

**Bennett Movement** = Lateral shift = Immediate side shift

- Best described as a bodily shift of the mandible in the direction of the working condyle.
- Occurs during the earliest stage of lateral movement.
- Influences the MD position of the cusps on all molars:
  - That's how you know where to wax up your cusp tips.
- The greatest influence of Bennett movement is potentially on the working side teeth in lateral movement.
  - Wrong answers include: on posterior teeth in RCP, ICP, or during protrusion.
- When an exaggerated Bennett component is present in lateral jaw movement, it will have its greatest potential for interference with the MD positioning of cusp tips.
- Most influences the lingual concavity of the maxillary anterior teeth and the cusp height and groove direction of the posterior teeth. (2001 Test, but before we had Anterior Guidance, what gives???)

**Bilateral Balanced Occlusion**

- The stable simultaneous contact of opposing upper and lower teeth in centric relation position with a smooth bilateral gliding contact to any eccentric position within the normal range of mandibular function, developed to lessen or limit tipping or rotation of the denture bases in relation to the supporting structures.

**Unilateral Balanced Occlusion**

- AKA Group Protected or Group Function Occlusion.
- If you extract the mandibular canine, you then would have only posterior group function.
- The idea is to eliminate all Non-working contacts.
- In unilateral balanced occlusion, contact between upper B & lower B cusps, along with simultaneous contact between upper L & lower L cusps, will most likely occur in laterotrussive movement.

**Mutually Protected Occlusion (MPO)**

- Includes Anterior and Canine Guidance.
- None of the posterior teeth contact on the non-working side when the Mn moves laterally.
- Anterior teeth disclude all posterior teeth in eccentric movements.
- Condyles are in their most superoanterior position in closure.
- Axial loading of occlusal forces occurs in closure.
- Posterior teeth contact more heavily than anterior teeth.
  - In laterotrusion, the posterior teeth disclude the anterior teeth; in protrusion, the anterior teeth disclude the posterior teeth.

**Anterior Guidance** (anterior coupling)

- Results from both horizontal and vertical overlap.
- Provides protection in disclusion of posteriors.
- Plays the greatest role in disoccluding the posterior in latero-protrusive movements.
- Anteriors have mechanical advantage because they are farther away from the fulcrum, so better leverage to offset the closing musculature.

**Canine Protected Occlusion**

- Only canine is involved in MPO.

**Curve of Spee**

- Best described as the anterior-posterior curvature of the occlusal surfaces of the teeth, as seen in a facial view.
  - Mx arch is convex; Mn arch is concave.
- Another: The line beginning at the tip of the canines & following the F cusps of posterior teeth (viewed from the facial).
Curve of Wilson
- Tilting of the Mn posteriors lingually makes the Mn arch concave & the Mx arch convex, when viewed from the front

Compensating Occlusal Curvature or Sphere of Monson
- The 3D curvature of the occlusal plane, which is the combo of Wilson and Spee
- The line beginning at the tip of the incisors and following the facial cusps of the posterior teeth as viewed from the facial aspect

Axial Position
- Which describes the relationship of the teeth with the vertical axis?
  - Spee, Wilson, Monson, or Axial inclination (Position)
  - Normally described in terms of the root’s inclination, which means that the crown is normally inclined in the opposite direction

Cusp Height Potential
- Less vertical overlap, shorter the cusps must be
- Greater vertical overlap, longer the cusps may be
  - Increased overlap allows for higher cusp ridges and deeper fossae
- Less horizontal overlap of anteriors, longer the cusps may be
  - Greater horizontal overlap, shorter the cusps must be

Teeth articulation
- The following are alterable factors in tooth articulation:
  - Incisal guidance, compensating curve, cusp-fossa relationship, & posterior tooth morphology (not postural position)

EXCURSIVES
- NOTE: Lateral movements are an asymmetrical Mn movement (retrusion, protrusion are symmetric movements)

Laterotrusion = Working movement
- In a lateral excursion, the teeth that ideally provide the predominant guidance through the full movement are the canines
- The lingual cusps of a Mn M1 must be restored to accommodate working movement
- From R lateral relation to centric: DB cusp of Mn M2 moves through the buccal groove of R Mx M2
- During a working movement, the F cusp ridges of the Mx PM1 on the working side oppose the distal cusp ridge of Mn PM1 & the mesial cusp ridge of Mn PM2
- In a R laterotrusive movement, the L cusp of R Mx PM2 passes through the embrasure between R Mx PM2 & M1

Mediotrusion = Non-working = Balancing movement
- On Mn M1, the DF groove serves as an escapeway for the ML cusp of the Mx M1 during non-working Mn movements
- The non-working condyle moves downward, forward & medial
- The non-working pathway of Mx cusps on Mn posterior teeth is toward the distofacial
- In a patient with a left canine protection, the ML surface of the R Mx M1 contacts the DB surface of the R Mn M1 during a left lateral excursion. This contact is a non-working side interference
- On the non-working side in an ideal occlusion, interfering contacts on posterior teeth will be located on the inner incline of Mx & Mn supporting cusps
- When moving the Mx from ICP to a R lateral relation, the L cusp of L Mx PM1 moves through the F embrasure between the L Mn PM1 & the L cusp of #5 breaks off during trauma, this is most likely due to a left mediotrusive movement
- In a L lateral movement, the L cusp of the R Mx PM1 may appear to pass toward the B cusp of the Mn PM2

Protrusion
- The most likely Mn movement that occurs in breaking a Mn central incisor is a protrusive movement? (’01 Pilot)
- Dumb Q: In protrusion, which way do the Mx cusps go? Nowhere, but maybe it was “posterior relative to the Mn cusps”

Condylar movement
- A bilaterally symmetrical condylar movement
- Lateral pterygoids are primary mover
- The condyle moves forward and carries the disk with it
- The underside of the meniscus moves distally relative to the superior surface of the condyle
  - The disk tends to be tilted in a superior-inferior fashion on the condyle
- Mn incisors
• Make contact w/ Mx incisors in protrusive & lateral protrusive movements (but NOT working/nonworking)
• In a protrusive contacting movement, Mx laterals contact the Mn laterals & canines
• In a protrusive movement, the F cusp tip of Mn PM2 has the potential to contact the DF cuspal incline of Mx PM1
• When a protrusive Mn movement (anterior teeth edge-to-edge) is achieved, the Mn M1 has the potential to contact Mx PM2 AND M1

Protrusive pathway
• The protrusive pathway of Mn cusps on Mn posterior teeth is toward the mesial
• Remember arrows on the Mn teeth tell exactly where the Mandible is going.
• Arrows on the Mn teeth are in opposite to actual direction of mandibular movement

Lateral checkbite record
• Using the lateral checkbite record to set a respective condylar inclination implies that:
  • The non-working side condyle has moved anteriorly & medially

SURROUNDING STRUCTURES

TMJ

TMJ structural elements:
• Condylar process, articular disc, capsular ligament, & joint cavities (not sigmoid notch)
• The TMJ has two synovial cavities
• Dense avascular fibrous CT covers the articulating osseous structures of the TMJ
• There are also a few elastic fibers present
• Glenoid fossa – an oval cavity/depression in the temporal bone, anterior to the auditory canal

The joint:
• A bilateral (complex) diarthrosis between 1) the articular tubercle/eminence of the temporal bone & 2) the Mn condyle
• One Q said: What type of joint is the TMJ? Ans: an atypical diarthroidal joint (atypical due to lack of hyaline cartilage)

Condyles:
• Oblong processes, wider mediolaterally than anteroposteriorly
• Concave anterior aspect (fovea pterygoidea)
• Articulating surface is the superoanterior aspect – slightly convex

Movements:
• Retrusive – both condyles move upward & back into the Mn fossa
• Protrusive – both condyles move forward & down the articular eminence
• Lateral contacting mvmt:
  • Working side – condyle merely rotates
  ➢ In laterotrusion, the working condyle rotates along a vertical axis and translates laterally (a little, right?)
  • Non-working side – condyle moves downward, forward & medially
• Lateral protrusive mvmt:
  ➢ Working side – condyles move forward & downward
  • Non-working side – condyle moves forward & downward & medially
  • ***See p. 587 in Kaplan for pictures – I think this could be a don’t get clowned thing

The articular disc:
• Is the tissue intervening between the articulating bones of the TMJ
• Effectively divides the TMJ into two separately functioning compartments
• The disc is attached laterally to the Mn condyle
  • Collateral Ligaments
    ➢ The disc (meniscus) is moved forward principally by the lateral pterygoid muscle
    • Some fibers of the lateral pterygoid m. attach to the anterior border of the disc
    • Kaplan says: “the medial & lateral” corners of the articular disc are directly attached to the poles of the condyle via the collateral ligaments
    ➢ As the mouth is opened widely, the articular disc moves anteriorly in relation to the articular eminence, but distally in relation to the condyle
    ➢ In the sagittal plane, the posterior border is the thickest section of the articular disc
Joint spaces:
- **Upper compartment:**
  - The space between the disc and the articular fossa & eminence
  - More recent Q: The superior joint cavity of the TMJ is bordered by the Mn fossa & the superior surface of the disc
  - Translation occurs here
- **Lower compartment:**
  - Rotation of the condyle primarily occurs in the inferior joint space

Ligaments:
- **Temporomandibular (lateral) ligament**
  - Has an outer oblique portion which limits the extent of jaw opening and initiates translation of the condyle down the articular eminence
  - With a fracture of the left condyle, the condylar head remains in the mandibular fossa due to the TM ligament
    - Prevents posterior & inferior displacement of TMJ
  - During lateral Mn movement, the articular disc is tightly attached to the condylar head by the collateral ligaments
  - When the cusp tips of left Mx & Mn canines are placed in contact, the right condyle is positioned down the slope of the articular eminence
  - Ligaments associated w/ the TMJ serve to protect surrounding & supporting tissues from damage
- **Collateral ligament**
  - Medial and lateral connectors from the disc to the condyle
    - Restricts the movement of the articular disc away from the condyle during function
    - Another Q: Discal ligaments (synonyms) restrict the movement of the disc away from the condyle during fx
    - During lateral Mn movement, the articular disc is tightly attached to the condylar head by the collateral ligaments

What’s under the fibrocartilage? Periosteum??
- Undifferentiated Mesenchym or Hyaline Cartilage??

A projection of the facial surfaces of Mn molars would be medial to the anterior border of the ascending ramus
The condyle on the working side generally rotates about a vertical axis and translates laterally (rotation is the 1st movement)
Innervated by PAM: Posterior deep temporal, auriculotemporal, masseteric

**MUSCLES**
- Mandible position
  - Mn ALWAYS deviates to the side of the injury
    - Lateral pterygoid muscle (mandible deviation)
    - Hypoglossal nerve (tongue deviation)
  - Mn *postural* position is determined almost exclusively by the behavior of the Mn musculature
    - So it’s not alterable
- Primary Muscles of Mastication (4 Pairs)
- **Temporalis**
  - *Origin:* Lateral surface of temporal bone
  - *Insertion:* Coronoid process of Mn
  - *Anterior fibers elevate the Mn (close the mouth)*
  - *Posterior fibers contraction retracts the mandible*
    - Temporalis muscle is the principal retractor of the Mn
    - They are assisted by the anterior and posterior bellies of digastric muscle
- **Masseter**
  - *Origin:* Zygomatic arch
  - *Insertion:* Lateral side of angle of Mn
  - *Closes the mouth (elevator of Mn)*
  - The most powerful muscle of mastication? (1999 Exam.pdf #177 & 02 #178– what about temporalis?)
- **Medial Pterygoid**
  - *Origin:* Medial surface of lateral pterygoid plate, pyramidal process of palatine bone & tubercle of Maxilla
  - *Insertion:* Medial side of angle of Mn
  - *NOTE:* the masseter & medial pterygoid position the condyle in the most superior anterior position
- **Lateral Pterygoid**
  - *Superior head:*
    - *Origin:* Infratemporal surface of sphenoid bone
    - *Insertion:* TMJ capsule & disc [SUPERIOR HEAD];
  - *inferior head:*
    - *Origin:* Lateral surface of lateral pterygoid plate
    - *Insertion:* Condyle of Mn
  - NOT an elevator of Mn
  - Simultaneous contraction: depress (open) & protrude the jaw
  - Unilateral contraction: side-to-side movement of Mn
  - Contraction results in moving the mandible in opposite direction of contracted muscle (working movement)
    - [right muscle contraction moves Mn to the left]
    - Contraction of both simultaneously results in protrusion
    - Lateral pterygoids are the prime movers to a protrusive position
    - Contraction produces a forward movement of the condyle from the articular fossa
  - Contraction also opens the jaw
    - Assisted by the anterior bellies of digastric and [styrohyoid]
    - Brings the articular discs and condyles down and anterior
      - When the incisal edges of the anterior teeth are placed in end-to-end contact, the Mn condyles have moved downward & forward
- **Subsidiary Muscles**
  - **Buccinator**
    - Compresses the cheek holding food under the teeth
  - **Suprahyoid Muscles (4)**
    - **Contract to raise the hyoid bone during swallowing**
      - In swallowing, downward displacement of the Mn is prevented by contraction of the masticatory muscles
      - Also, teeth come into occlusal contact & the tip of the tongue touches the roof of the mouth
      - Assist lateral pterygoid in depressing the mandible (Opening the mouth)
      - Assist Posterior fibers of Temporalis during retraction
      - Stylohyoid
        - Pulls the hyoid [superiorly and posteriorly] during swallowing
        - Fixes the hyoid bone for infrahyoid action
      - Digastric
        - Anterior belly
          - Opens mouth (depresses Mn)
          - *Arises from trochlea* of hyoid bone & inserts into digastic fossa of Mn
          - Innervated by mylohyoid branch of V₃
        - Posterior belly
Fixes the hyoid bone for infrahyoid action
- Arises from mastoid process & passes through trochlea of hyoid bone
- Innervated by digastric branch of VII

- Mylohyoid
  - Elevates the hyoid bone
  - Raises the floor of the mouth (for swallowing)
  - Depresses Mn when hyoid is fixed
  - Inserts into the mylohyoid line on the medial side of the Mn
    - Moves in an upward slanting direction to the posterior
    - In the Mand M2/M3 area, the root apices are inferior to the mylohyoid line
      - Apices of Mand PM1/PM2 are superior to the mylohyoid line
  - Innervated by mylohyoid branch of V3

- Geniohyoid
  - Depresses Mn
  - Can also help to retract Mn
  - Works with mylohyoid
    - **Both genio and mylohyoid form floor of the mouth
      - Innervated by C1 via CN XII

- Infrahyoid Muscles (4) [Strap Muscles]
  - Depressors of the larynx and the hyoid bone
  - Lie between deep fascia and visceral fascia covering the thyroid gland, trachea, and esophagus
  - Innervated by ansa cervicalis (motor plexus from the Ventral rami of C1-3)
    - Thyrohyoid
      - Pulls the hyoid downward and raises the larynx
    - Sternohyoid
      - Pulls the hyoid downward
    - Sternothyroid
      - Pulls the larynx downward
    - Omohyoid
      - Pulls the hyoid downward

- Extrinsic Tongue Muscles (4) pg 405 Netter’s H&N anatomy
  - Genioglossus
    - Genial tubercle to dorsum of tongue
    - Protrudes the tongue and Depresses the tongue
      - The muscle fibers that extend into the lingual frenum are from the genioglossus
      - Also has inferior fibers that connect the tongue to the hyoid
  - Hyoglossus
    - Greater and lesser horn (cornu) of the hyoid bone to lateral aspects of the tongue
    - Depresses the lateral sides of the tongue
  - Styloglossus
    - Styloid process to lateral aspects of the tongue
    - Retracts and elevates the tongue
  - Palatoglossus
    - Palatine aponeuroses to the side of the tongue
    - Elevates the posterior tongue and closes the oropharyngeal isthmus
      - (aiding in the initiation of swallowing)
    - Does not retract the tongue

- Intrinsic Tongue Muscles (3)
  - Alter shape of tongue
    - Longitudinal
      - Shortens tongue (curls tip)
    - Transverse
      - Narrows tongue
    - Vertical
      - Flattens and broadens tongue

- Mastication
  - Incision – By incisors
- Prehension (grasping) – by the canines
- Fissuration – by PMs and Ms
- The masticatory function of incisors & canines is primarily biting

**PERIODONTIUM**
- Comprised of 2 functional units:
  1. Gingival Unit
     - Free gingiva + attached gingiva + alveolar mucosa
     - Lined by masticatory mucosa
  2. Attachment apparatus
     - = Cementum + PDL + Alveolar bone proper
     - NOTE: a question gives cementum, PDL & bundle bone as the correct answer (not lamina dura) – see below
     - What protects the attachment apparatus
     - Anterior teeth might be responsible for disarticulating the posterior teeth in paretunctional grinding

**MUCOSA**
- Oral Mucosa is either keratinized or non-keratinized
  - Keratinized
    - Strata basale, spinosum, granulosum, corneum
  - Non-keratinized
    - Strata basale, spinosum
- Lamina propria
  - Dense CT of variable thickness
    - CT papillae – carry BVs & nerves
    - Epithelial rete pegs are found between the CT papillae
- Submucosa
  - CT of variable thickness/density
  - Contains glands, BVs, nerves, adipose tissue
- Types of Oral Mucosa
  - Masticatory Mucosa
    - Free gingiva (some), hard palate, attached gingiva, interdental gingiva, dorsum of tongue
    - The hard palate submucosa contains adipose tissue anteriorly & glands posteriorly
    - NOTE: the hard palate also has long rete pegs
    - Keratinized
      - Orthokeratinized – true keratin, NO nuclei, Uneven surface --- Dentures??
      - Parakeratinized – keratinized cells retain their nuclei – Masticatory Gingiva??
    - Thick, dense, firm lamina propria
    - Of Mn teeth, the facial masticatory mucosa (attached gingiva) is narrowest on PMl
  - Non-masticatory Mucosa = Lining or Reflective Mucosa
    - Free gingiva (some), lips, cheek, vestibule, alveolar mucosa, floor of mouth, soft palate, ventral tongue
    - Nonkeratinized
    - Thin, movable
    - Specialized Mucosa
      - Covers the dorsum of the tongue and taste buds
- Vermilion border
  - Transition zone vs. Skin of the lip
  - Keratinization ends
  - Longer papillae carrying large capillary loops
  - Fewer sebaceous glands
  - No sweat glands
- Sideneote: the # of melanocytes per unit area of mucosa does not vary between races; the difference is in cellular activity

**GINGIVA**
- Gingival fibers
  - Collagen fibers that provide support for the marginal gingiva including the interdental papilla
  - Found w/in the Free Gingiva
  - Continuous with the CT fibers and are often considered part of the ligament (PDL)
- Types (5)
  - Circumferential (circular) fibers
    - Encircle the tooth around the most cervical part of the root and insert into the cementum and lamina propia of the free gingival and the alveolar crest
Resist rotational forces

Transseptal fibers
- Extend from tooth to tooth coronal to the alveolar crest & are embedded into cementum of adjacent tooth
  - Occurs through the Interproximal segment of the alveolus
  - NOT via the facial aspect of the alveolus
- Not on the facial and no attachment to the alveolar crest
  - These are not PDL fibers (apical, oblique, principal, transverse, & interradicular fibers are PDL or principal fibers)
- Maintain dental arch integrity

Dentogingival fibers
- From the cementum apical to the epithelial attachment and course laterally and coronally into the lamina propria of the gingival

Dentoperiosteal fibers
- From the cervical cementum over the alveolar crest to the periosteum of the cortical plates of bone

Alveologingival fibers
- Insert in crest of alveolar process and spread out through the lamina propria into the free gingiva

- Apical, Oblique, Horizontal & Alveologingival fibers are attached to bone

Gingival apparatus
- Term used to describe the 5 gingival fiber types and the epithelial attachment

Gingival ligament
- Includes the dentogingival, alveologingival, and circumferential fibers

Free gingiva (aka Marginal gingiva)
- Collar of tissue that is not attached to the tooth or alveolar bone
- 1-3mm wide and forms the soft tissue wall of the gingival sulcus next to the tooth
- Described as forming the wall of the gingival sulcus
- Extends from free gingival groove to gingival margin/crest
  - (The free gingival groove is what gives the gingival roll it’s appearance – it’s the one Jake & Boom-Boom overaccentuate – separates the free gingiva from the attached gingiva)
- The healthy free gingiva aids in the self-cleansing process by adhering closely to the tooth surface below the height of contour of the cervical enamel
- NOTE: If the cervical enamel ridge is too great, it will adversely affect the self-cleaning quality of a dentition

Structures:
- Gingival Margin
  - Top edge or crest
  - 1mm band of gingiva that forms immediate collar around the base of the tooth
  - Hence Marginal Bleeding

- Gingival Sulcus
  - Areas between the unattached gingiva and the tooth (Popcorn kernels)
  - Above jxmal epithelium, continuous with, but structurally different
  - Epithelium is non-keratinized (same w/ gingival col)
  - Then your PMNs couldn’t get out!!
  - Healthy sulcus should NOT have rete pegs (rete pegs indicates inflammation)

- Epithelial attachment (Junctional epithelium)
  - Joins the gingiva to the tooth
  - Normally follows curvature of CEJ
    - Does NOT normally stay at the same level throughout adult life
  - Inner layer of cells of junctional epithelium attaches gingiva to tooth
  - Hemidesmosomes & Internal basal lamina are referred to as the epithelial attachment
  - Not applied in places in place of the tooth’s periodontium
  - The junctional epithelium is thin & non-keratinized
  - Susceptible to bacterial metabolite breakdown
  - Lymphocytes & plasma cells are routinely seen in the bottom of the gingival sulcus

- Interdental Papilla
  - Portion of the free gingiva that fills the gingival embrasures (below contact area)
  - Tent-shaped
  - Consists of 2 papillae that are connected by the concave-shaped interdental col
    - Interdental col
    - Conforms to the shape of the contact area
    - Not present in teeth w/o contact
Non-keratinized
- Small proximal contact areas with firm well-formed interdental papillae tend to decrease caries susceptibility when occlusal and environmental factors are favorable.
- When restoring coronal structure, the creation of excessively round buccoproximal line angles tends to create abnormal function with the interdental papilla.
- Deflective fxn of mesiofacial and distofacial line angles protects the interdental papilla.
- The interdental papilla between the Mand 2nd PM and 1st Molar is the shortest.
- (all other answer choices were anterior to this answer – what about between the molars?)

Incisive Papilla
- The elevation of gingival tissue directly lingual to embrasure between Mx central incisors.

Free Gingival Groove
- Separates the free gingiva from the attached gingiva.

Attached Gingiva
- Part of the gingiva that is attached to the underlying periosteum of the alveolar bone and to the cementum by CT fibers and epithelial attachment.
- Present between the free gingiva and the more movable alveolar mucosa.
- Stippled
- Extends from Mucogingival jxn to free gingival groove.
- The attached gingiva on the facial of the Mand 1st PM is very narrow.

Mucogingival Jxn
- Separates the attached gingiva and the alveolar mucosa.
- Joints lining mucosa and masticatory mucosa.
- Separates Keratinized from Non keratinized

<table>
<thead>
<tr>
<th>Attached Gingiva</th>
<th>Alveolar Mucosa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stippled, firm, thick</td>
<td>Thin, loosely attached to periosteum</td>
</tr>
<tr>
<td>No separate Submucosa, hard palate?</td>
<td>Well-defined submucosa</td>
</tr>
<tr>
<td>Immobile</td>
<td>Mobile</td>
</tr>
<tr>
<td>No glands, except posterior of hard palate</td>
<td>Many small glands present</td>
</tr>
<tr>
<td>Epithelial ridges high</td>
<td>Epithelial ridges low</td>
</tr>
<tr>
<td>Epithelium thick, keratinized</td>
<td>Epithelium thin, non-keratinized</td>
</tr>
</tbody>
</table>

PERIODONTAL LIGAMENT

STOP
- General Info:
  - 0.2mm wide
  - Widest in the cervical region—narrowest in the middle region.
  - Thickness depends on:
    - Age (thickness decreases 0.1mm in old age—from deposition of cementum and bone).
    - Stage of eruption.
    - Fxn of the tooth.
  - In loss of function:
    - PDL narrow — it becomes taut like yarn.
    - Regular arrangement is lost.
    - PDL becomes a thin MB w/ irregularly arranged fibers.
    - Cementum may become thicker.
  - In occlusal trauma:
    - Alveolar bone is resorbed.
    - PDL is widened (PDL space enlarges) — inflammation.
    - Tooth becomes loose.

- Health & ability of PDL to resist occlusal force depends on:
  - Anterior teeth have slight or no contact in ICP.
  - The occlusal table is less than 60% of the overall FL width of the tooth.
  - The occlusal table of the tooth is generally at right angles to the long axis of the tooth.
  - Crowns of Mn molars are inclined about 20° toward the lingual
  - Derived from the dental sac.
    - (which makes the entire attachment apparatus- cementum, PDL, and alveolar bone proper).
    - Forerunner of the PDL in mandibular development is the Dental Sac.
• Connects to cementum and alveolar bone (Directly adjacent)
• Contains remnants of Hertwig’s root sheath (Rests of Malassez—called cementicles when calcified)
• Sharpey’s Fibers – terminal portion
  ♦ **Diameter greater on bone side vs. cementum**

• PDL contains:
  ♦ Cells
  ♦ Blood vessels
    ♦ Periosteal blood supply is the major source of blood to the PDL
      ♦ Also gingival arteries & arteries of the periapical area
  ♦ Lymphatics
  ♦ Extracellular substance of fibers (gingival and principal)
    ♦ Mostly collagen
    ♦ **Type I & III**
  ♦ Ground substance
    ♦ Mostly proteins and polysaccharides
  ♦ **Oxytalan fibers**
    ♦ Related to the microfibrillar component of elastic fibers
    ♦ Run parallel to root surface

• **Fxn of PDL:**
  ♦ Physical: **Support**
    ♦ Attachment of tooth to bone via principal fibers
  ♦ Formative
    ♦ Formation of CT components by activities of CT cells (cemento-, fibro-, and osteoblasts)
  ♦ Remodeling
    ♦ By activities of CT cells (blast vs. clast of above cells)
  ♦ Nourishing
    ♦ Through blood vessels
  ♦ Sensory
    ♦ By Trigeminal nerve
    ♦ Proprioceptive and tactile sensitivity
  ♦ **DOES NOT** help to maintain the epithelial attachment
  ♦ If you bite on a popcorn kernel, what causes relaxation of the jaw???
    ♦ Mechanoreceptors in the PDL (Mesencephalic Nucleus)

• **Principal Fibers (5)**
  ♦ Main structural elements w/in the PDL
  ♦ There are NO elastic fibers in the PDL
  ♦ **Composed of Type I collagen**
    ♦ Collagenous ONLY
  ♦ Classified as belonging to general group of alveolodental fibers
  ♦ Apical
    ♦ Offer initial resistance to tooth movement in occlusal direction
  ♦ Alveolar crest fibers
    ♦ From cervical cementum of the tooth to the alveolar crest
    ♦ Fxn to **counterbalance the occlusal forces** on the more apical fibers and resist lateral movement
  ♦ **Oblique fibers (33%)**
    ♦ Insertions into the cementum and extend apically and obliquely into the alveolus
    ♦ Most resistant fibers to forces along the long axis of the tooth (masticatory)
    ♦ Protects tooth from apical pressure
    ♦ Reduce the probability of forceful impaction into the alveolus because of a blow to the crown
    ♦ Group of fibers most likely to be found in the middle 1/3rd of root
  ♦ Horizontal Fibers
    ♦ Perpendicular from alveolar bone to the cementum and **resist lateral forces**
  ♦ Interradicular fibers
    ♦ Only in multi-rooted teeth
    ♦ Extend from cementum in furca are to bone w/in furca area

**ALVEOLAR PROCESS**
  ♦ Part of alveolar bone that houses teeth
  ♦ 2 Main Parts:
1) Alveolar Bone Proper
   ♦ AKA Cribiform Plate, Tooth Socket, or Lamina Dura
   ♦ Immediately surrounds root of the tooth to which the PDL fibers attach
   ♦ Has minute openings for vascular and nerve components (called Cribiform plate or lamina dura)
   ♦ 2 layers of Bone:
     ➢ Compact lamellar bone
     ➢ Layer of bundle bone – layer PDL fibers insert into this bone
       ☑ Tooth attachment via Cementum, PDL, AND Bundle Bone

2) Supporting Alveolar Bone
   ♦ Bone which surrounds the alveolar bone proper and gives support to the socket
   ♦ 2 Types of Bone
     ➢ Cortical plate – compact bone – forms the outer and inner plates of alveolar process (thicker in Mn)
     ➢ Spongy Bone – fills in area between cortical plates,
       ☑ NOT present in interior or in radicular bone of maxillary posterior as the cortical plate fuses with the cribiform plate

IN SHORT ➔ From tooth
   ♦ Cementum ➔ PDL ➔ Bundle Bone ➔ Lamellar Bone ➔ Cortical Plate ➔ Spongy Bone ➔ Cortical Plate

The ratio of organic to inorganic material is approximately the same in alveolar compact & spongy bone

Normal interosseous architecture is influenced to the greatest extent by the level of adjacent CEJs (because the level of the CEJs determines the height at which the PDL attaches to cementum)

During eruption of perm teeth, alveolar bone is resorbed & deposited intermittently

In health, the height of the IP alveolar crest is related to the position of the cementoenamel lines of adjacent teeth !!!!!

Alveolar crest & interdental septum can be altered by:
   ➢ Tooth rotation, drifting, tilting, or eruption
   ➢ When viewed occlusally, the alveoli of R & L Mn central/lateral incisors tend to be aligned nearest to a straight line

What causes formation of the alveolar process?
   ➢ Formation of teeth
   ➢ W/o teeth there is no process

Retromolar pad
   ➢ A slight elevation of gingival tissue, normally found posterior to the most posterior Mn molar tooth

Nasopalatine canal
   ➢ Its opening is located at the anterior midline of the palate
   ➢ Circular

ARTICULATOR Qs
random stuff added from recent Files
   ➢ Most important thing in checking excursive ➔ Lateral checkbite
   ➢ Most important in checking protrusion ➔ Condylar inclination

whats most important when checking articulation of teeth !!!!!
   ➢ bennet angle
   ➢ condylar inclination
   ➢ ICP contacts – I put this
   ➢ Horizontal angle
   ➢ Lateral check bite

What most important thing in mounting maxilla to articulator
   ➢ bennet angle
   ➢ condylar inclination
   ➢ ICP contacts
   ➢ Horizontal angle
   ➢ Lateral check bite
   ➢ Facebow record – I put this

What most important thing in checking excursive
   ➢ bennet angle
   ➢ condylar inclination
   ➢ ICP contacts
   ➢ Horizontal angle
   ➢ Lateral check bite
   ➢ Facebow record

What most important thing in checking protrusive
   ➢ bennet angle
- **condylar inclination** – I put this
- ICP contacts
- Horizontal angle
- Lateral check bite
- Facebow record

You change the settings on the condyle of the articulator on BOTH sides, what movement does it affect?
- Left lateroprotrusive
- Right lateroprotrusive
- Left medioprotrusive
- Right Mediointrusive

**Right laterotrusive** – this is what I put because it was the only one different from all the rest as it wasn’t **lateroPROtrusive**

- adjusting condylar angle on articulator directly effects what movement on the excursive: posterior guidance (closer to articular eminence) or **Ant guidance (protrusion)**