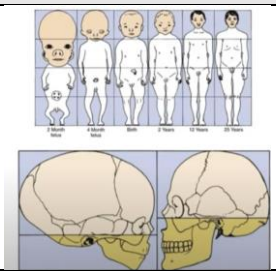
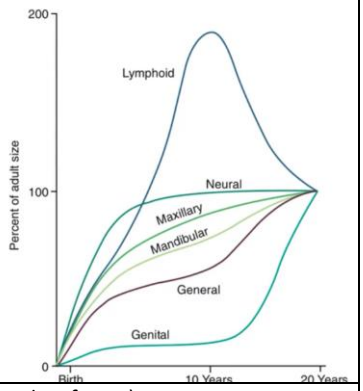
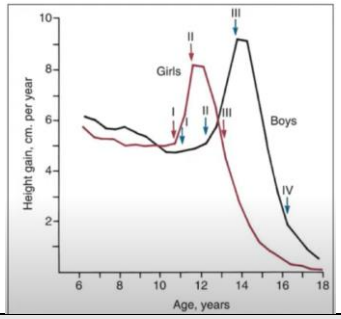
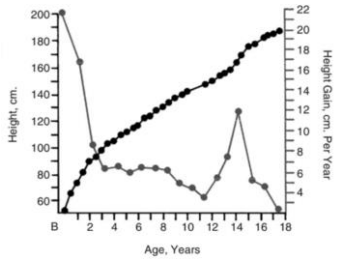
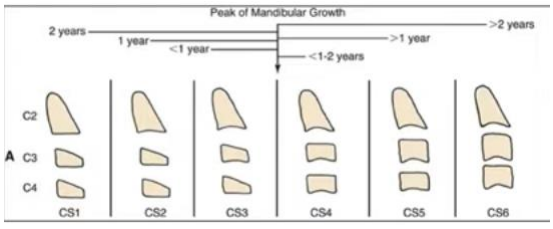
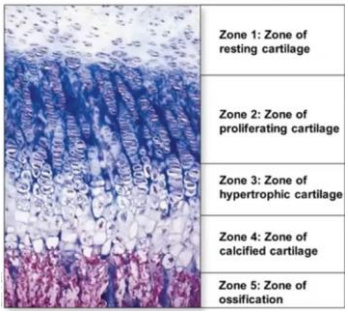
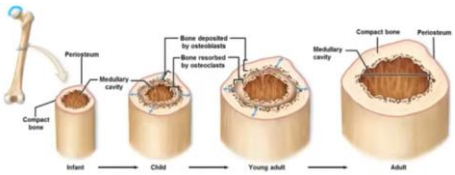
Mental Dental – Ortho

Growth and Development

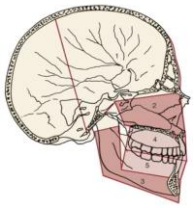
Patterns of Growth and Development	
Cephalocaudal Growth Gradient	= Body parts closer to the cranium grow faster earlier while parts further from the cranium grow more later on "Brain blazes trail, and everything else needs to catch up later" - Maxilla fully matures before the mandible as it is closer to the cranium 
Scammon's Growth Curves	- Lymphoid Tissues - Neural Tissues - Maxilla - Mandible - General Body tissues - Genital tissues *Neural and lymphoid tissues grow lots really early on and taper or ↓ until pubertal growth spurt* **Also note that the Maxilla follows closer to the Neural growth curve vs Mandible is closer to General Body Tissues-> Because its closer to the brain (Cephalocaudal growth gradient) 
Human Growth Curves - Distance - Velocity	*Distance Curve* = Tracks actual height each year (like the marking your height on the doorframe) *Velocity* = Change in height (rate of change) Growth Spurts: - Girls peak ~ 12years old (9-13) - Boys Peak ~14 years old (12-17)  
Growth Timing	
Chronologic Age	Not the most accurate
Dental Age	= State of dental development (how many teeth do they have) - Also a poor method
Skeletal Age	*CVM Staging (Cervical-Vertebral Maturation) -> Can use lateral Ceph or Pan to assess this*  *Hand Wrist Method* - Not as popular anymore
Biologic Age	Based on markers of maturation - 1st menstruation - 2nd Sex characteristics - Breast development ***Best indicator for maturity****

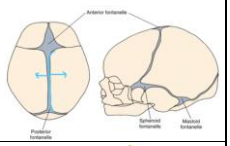
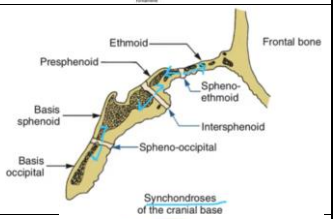
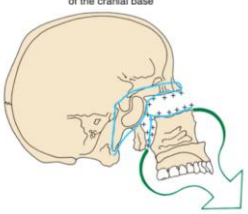
How does Growth Happen?

Sites	**Centers**
= Location where growth is occurring - Sutures, Surfaces, Mandibular Condyles etc	= Site that has the ability to control its own growth - Synchondroses are the only true growth centers in the head

Modes of Growth	
Endochondral Ossification	= Interstitial Growth - Growth from the ***inside*** -> results from increased length of bones - Under more genetic control ***Cartilaginous model becomes replaced by bone****  - Chondrocytes nestled within cartilage - Hyperplasia and rapid mitotic division of cells - Hypertrophy of the cells (cells get bigger) - Calcification and mineralization begins, and cells begin to die - Osteoblasts secrete osteoid to create bone ***Where***: - Epiphyseal plates of long bones - Synchondroses of the cranial base - Condylar cartilage of the mandible
Intramembranous Ossification	= Appositional Growth - Growth from the ***outside*** -> results in ↑ thickness/diameter of bone  -W/ more circumferential lamellae = ↑ diameter. But Osteoclast remodelling keeps the thickness uniform Influenced more from environmental stressors **Location**: - Sutures, Surfaces of cranial vault, maxilla etc
Growth Theories **All 3 theories kinda worth together	
Suture Theory	= Direct genetic control determines how bone will grow and sutures are the growth centers - Mostly ***debunked*** - Sutures are reactive, not proactive -> therefore they are sites
Cartilage Theory - Some evidence for this	= Cartilage pushes and pulls things apart. - Cartilage is the growth center and bone follows
Functional Matrix - Good evidence to this	= Environmental growth control - Chewing speaking etc cause the nasal and oral cavities to get bigger - Soft tissue matrix = growth center and bone/cartilage follows

Craniofacial Growth



Cranial Vault (1)	= Top of skull that encases the brain - At birth the bones are separated by loose CT (Fontanelle) -> allows the head to pass through the birth canal Intramembranous ossification at fontanelles and sutures + internal and external surfaces - Growing brain pushes the cranial bones apart during development 
Cranial Base (2)	= Ethmoid, Sphenoid, and Occipital Bones (These begin as cartilage) - Endochondral Ossification occurs at synchondroses **<u>Synchondroses</u>**: - Intersphenoid -> Inactive by 3yrs - Spheno-ethmoid -> Inactive by 7 - Spheno-occipical -> Inactive later 
Maxilla (4)	= Intramembranous ossification at sutures: - Posterior and Superior to maxilla Resorption of the anterior maxilla Apposition at the Palate, alveolar ridges and tuberosity Result: ***Downward and forward translation*** away from the cranial base 

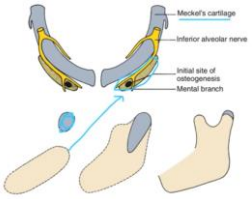
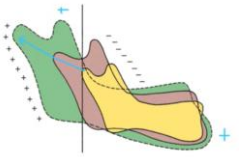
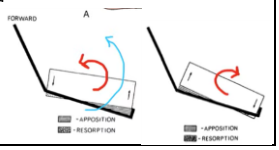
Mandible (3)	Embryonic development, lateral to 1st Pharyngeal arch (***<u>Meckles Cartilage</u>***):
	
	Intramembranous ossification -> Creates embryonic Ramus and mandible (beside Meckles cartilage)
	Endochondral Ossification -> Creates Condylar cartilage, this cartilage persists as a growth site as the mandible grows down and forward
	- The ramus and Condyle then fuses at 4 months in utero
	
	Meckels Cartilage disintegrates to form the malleus and Incus of the ear, and sphenomandibular ligament
	- Is not replaced by bone
	 
	
	<u>In the Adult Mandible:</u>
	- Endochondral ossification as condylar cartilage proliferates and produces bone
	- Intramembranous ossification occurs to remodel the surface
	  - Resorption on the anterior ramus
	  - Apposition on the posterior ramus, chin, coronoid and alveolar ridges
	 
	Results:
	- Downward and forward growth pattern
	
	<u>Growth Rotation</u>
	- Can rotate open, or closed
	- If Condylar growth = same rate as molar eruption -> Down and Forward
	- If condylar growth > molar eruption -> Closing rotation
	  - Short Face, Deep Bite tendency
	- If condylar growth < molar eruption -> Opening rotation
	  - Long Face, Skeletal open bite tendency
	 

TABLE 2.1 **Growth of Craniofacial Units**

Growth	Cranial Vault	Cranial Base	Maxilla	Mandible
Sites	Sutures (major) Surfaces (minor)	Synchondroses Sutures (laterally)	Sutures Surfaces: apposition remodeling	Condyle Ramus Other surfaces
Centers	None	Synchondroses	None	None
Type (mode)	Mesenchymal	Endochondral Mesenchymal (lateral only)	Mesenchymal	Endochondral (condyle only) Mesenchymal
Mechanism	Pressure to separate sutures	Interstitial growth at synchondroses	Cartilage push (cranial base) Soft tissue pull Cartilage pull? (nasal septum)	Soft tissue pull (neurotrophic?)
Determinant	Intracranial pressure (brain growth)	Genetic (at synchondroses) Cartilage pull (at lateral sutures)	Soft tissue pull (neurotrophic?)	Soft tissue pull (neurotrophic?)

Craniofacial Abnormalities

5 Stages of Embryonic Craniofacial Development

	Stage	Time (in Utero)	Abnormalities
Neural Crest Problems	1. Germ Layer Formation	Day 17	Fetal Alcohol Syndrome
	2. Neural Tube Formation	Days 18-23	Anencephaly
	3. Migration of Neural Crest Cells	Days 19-28	Hemifacial microsomis Treacher Collins Syndrome (Mandibulofacial dysostosis)
Lack of Fusion	4. Organ System Formation	Days 28-38 (Week 4-5)	Cleft Lip
	4a. Primary Palate	Week 6	Cleft Palate
	4b. Secondary Palate	Week 6	
Suture Problems	5. Final Differentiation of Tissues	Day 50-Birth	Crouzon's Syndrome (Craniosynostosis), Achondroplasia

Types of Birth Defects

Syndrome	= Pattern of anomalies that occur together in a predictable fashion due to single etiology (usually genetic) - Like a recipie from a cookbook
Sequence	= Group of related anomalies that stem from s single major anomaly that alters the development of its surrounding structures - Like a row of dominoes

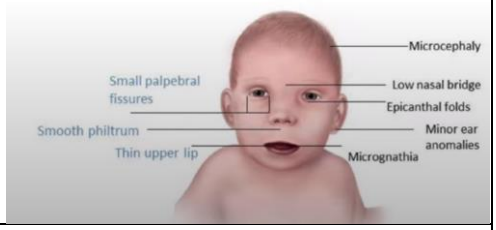
Abnormalities

Fetal Alcohol Syndrome

Cause:
- Exposure to high levels of ethanol during early development

S/S
- *CNS problems* -> Deficiency in neural plate tissues (abnormal brain development and microcephaly -> small head)
- *Midface deficiency* -> Smooth philtrum, thin upper lip, small parpebral fissues
- ↑ chance of *cleft lip*

Teratogen = any agent that interferes with early development



Treacher Collins Syndrome (mandibulofacial dysostosis

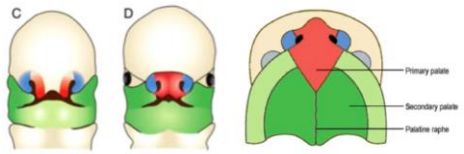
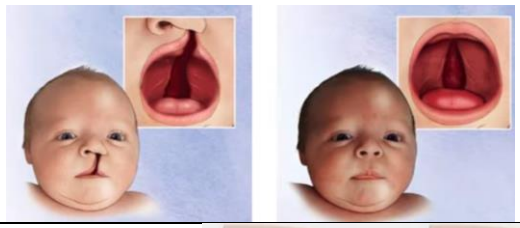
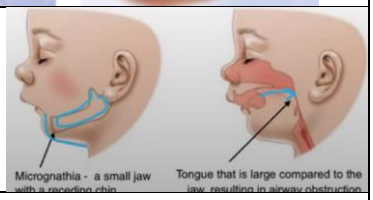
= Genetic mutation altering development of neural crest cells affecting the development of facial bones and tissues

S/S:
- Underdeveloped mandible
- Downslanted palpebral fissures
- Cleft Palate (35%)
- Microtia (Small Ear)

Hemifacial Microsomia

= Loss of neural crest cells during migration

S/S:
- Ear and mandibular ramus are deficient on the affected side

Trisomy 21 (Downs Syndrome)	= Non-disjunction leading to extra chromosome 21 **S/S:** - Midface Deficiency - Upslanted palpebral fissures - No ↑ caries risk - ↑ perio risk 
Cleft Lip & Palate	Cleft = failure of fusion of tissues during early development **Cleft Lip**: - Weeks 4-6 weeks in utero - Lack of fusion btwn Medial Nasal Prominence + Maxillary Prominence Anteriorly - Usually off midline, and usually unilateral (can be bilateral though) **+/-** **Cleft Palate**: - Weeks 6-8 in utero - Lack of fusion btwn Medial Nasal Prominence + Maxillary Prominence Posteriorly - Primary Palate carries Lateral incisor to lateral incisor -> This is why cleft palate Patients typically are missing their laterals - Complete Cleft Palate -> Primary and secondary palate both fail to fuse *Tend to be Class III w/ deficient maxilla  MNP= medial nasal prominence LNP= lateral nasal prominence MP= maxillary prominence 
Pierre Robin Sequence	1. Micrognathia (small Mandible) -> 2. Glossoptosis = backwards displacement of the tongue posteriorly -> 3. Cleft Palate (tongue displacement prevents the fusion) -> 4. Breathing and feeding difficulties 
Crouzon Syndrome	Autosomal Dominant inheritance **Craniosynostosis** = Early closure of skull sutures - Usually premature fusion of both sutures at top of skull + Maxilla ***S/S:*** - Brachycephalic (Short Skull) - Midface deficiency - Frontal bossing (prominent forehead) - Hypertelorism = Wide separated eyes - Proptosis = Bulging eyes - Class III Occlusion 
Alpert Syndrome (Acrocephalosyndactyly)	Autosomal Dominant Inheritance Craniosynostosis as well - Similar features to Crouzon…except (see below) **S/S:** - Acrocephalic (Tall Skull) - Byzantine Arch (narrow palate with high vault) - Syndactyly (Fusion of fingers and toes) 
Hurler & Hunters Syndrome (Mucopolysaccharidosis)	= Build up to Glycosaminoglycans (GAGs) in lysosomes due to enzyme deficiency "Hurl…vomiting…GAG"

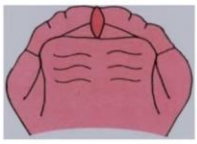
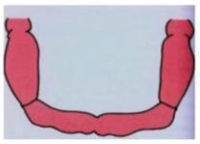
Development of Occlusion

4 stages:

Gum Pad Stage
(Birth to 6 months)

Ends with the eruption of the 1st primary tooth
Future positions of teeth can be seen in elevations and grooves present on the alveolar ridges

- ***Lateral Sulcus*** (more prominent groove) separates primary canine from primary 1st molar

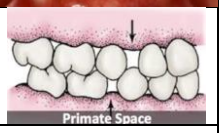
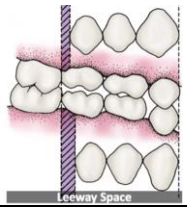



Primary Dentition
(6m to 6yr)

First Primary tooth coming in to first Permanent tooth coming in

Typically:

- Minimal OB and OJ (sometimes edge to edge)
- Spacing is normal

Interdental Spacing	= Space between primary incisors - Normal space -> Permanent incisors fill the gaps when they erupt. Without this space we get permanent crowding 
Primate Spacing	*Max*: Between Primary Lateral and Canine *Md*: Betwwn Primary canine and 1st primary molar 
Leeway Spacing	= Difference of the combined M-D width of primary C, D, E and the M-D with of the Permanent 3, 4, 5 - This gains us space -> Permanent premolars are smaller than the primary molars they replace ***Mx***: 1.5mm per side (3mm total) ***Md***: 2.5mm per side (5mm total) 

Primary Molar Relationships:

- Relationship of the Mandibular terminal plane to the maxillary terminal plane
- Terminal plane is what guides the Permanent 6's and can be used to predict the Molar occlusion

Mesial Step	**Flush Terminal Plane**	**Distal Step**
(49% of cases) - Leads to Class I, but could also be Class III (10% chance) 	(37% of cases) - Likely leads to End-End, but also Class I, II or III (Wild card) 	(14% of time) - Leads to Class II almost 100% 

Mixed Dentition Stage
(6yrs – 12 yrs)

Ends with the exfoliation of the last primary tooth

- Interdental, Primate and Leeway spaces all close
- Molar relationship will "transition" to Class I, II, III -> From the Terminal plane relationship

Ugly Ducking Stage

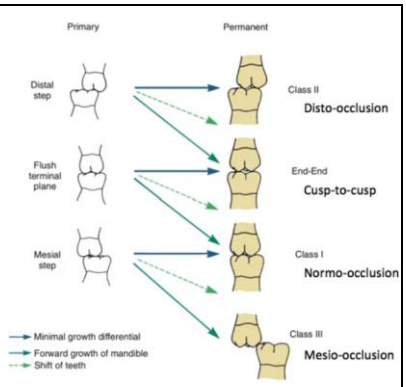
- 11-12 years old
- Hallmark = Diastema between 11, 21 (≤ 2mm)
- Space is closed with the mesial eruption of the max. canines -> If Diastema is >2mm then the canines may not close it fully

Anterior Transition

- Permanent tooth buds are ***Lingual*** and ***Apical*** to the primary counterparts
- Incisors tend to erupt lingually -> EXCEPT for Max. Centrals (Pushed labially by the tongue and they erupt)
- Canines tend to erupt labially as well

Posterior Transition

- Permanent 1st molars are guided into position by the terminal plane
- Flush Terminal plane becomes Class I by differential teeth shift and differential jaw growth
  - ***E***arly mesial shift of 1st molars to close the primat***E*** space (around 6 years old)
  - **L**ate mesial shift of the 2nd molars to close **L**eeway space (around 12 years)
  - Late mandibular growth (cephalocaudal growth pattern)



Mixed Dentition Space Analysis

Compares space available and space required for incoming permanent teeth (predict M-D width of the unerupted buccal segment = 3, 4, 5) -> Arch Dimension (Space available) vs Tooth Dimension (Space required)

- Crowding = "-"
- Spacing = "+"

Need ***Lower* 4 incisors all erupted before you can do this method**

Tanaka-Johnston Method	= Sum width of mandibular incisors (put into equation) - *Maxillary: Sum of 4 Md incisors/2 + 11* = 1 buccal segment - *Mandibular: Sum of 4 Md incisors/2 + 10.5* = 1 buccal segment
Moyer's Method	= Sum with of Mandibular incisors -> Refer to the prediction table

Permanent Dentition (12 years – death or edentulism)

= Only permanent teeth in arch

Curvatures:

- Curve of Spee = Sagittal plane
- Curve of Wilson = Frontal plane

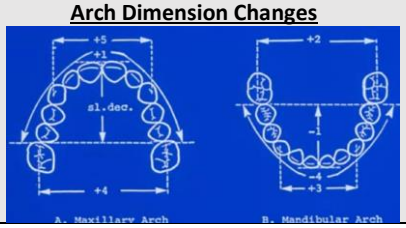
Ideals:

- OB: 10-20%
- OJ: 1-3mm
- Occlusion: Class I

Late Lower Incisor Crowding:

- Anterior crowding that progressively gets worse in 20's-40's -> Due to late mandibular growth. This growth results in added pressure on lower incisors from the lip which tips them lingually to escape the lip

Arch Dimension Changes



Inter-canine width (Cusp tips of 3-3)	= ↑ as permanent teeth erupt (Particularly in labial and lateral eruption of the canines) - Stabilizes once canines have erupted (Age 10-12)
Inter-molar width (6-6)	= ↑ as molars erupt then stabilizes - More expansion in the Max Vs Md because Upper molars erupt divergently while lower erupt convergently
Arch Length	= ↓ during transition from mixed to permanent - Leeway space closes as the 1st molars migrate mesially

Arch Perimeter	= ↑ in Max, ↓ in Mand. during transition from mixed to permanent
	- Combination of labial + lateral eruption of the canines (expands the arch) and the loss of Leeway space.
	  - More Leeway in the Mand = overall ↓ arch perimeter
	  - Less Leeway space in Max but more lateral eruption of canines = overall ↑ in arch perimeter

Diagnostics and Tx Planning

Ackerman-Profit Diagnostics

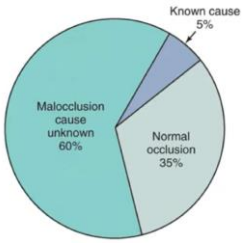
Category	What it assesses
Facial Proportions and Esthetics	Lip Posture Smile Arc
Alignment and Symmetry	Crowding Spacing Rotations
Transverse	Posterior Crossbite Midline
Anteroposterior	Overjet Angles Class
Vertical	Overbite Curve of Spee

Orthodontic Exam

Teeth (Intraoral)

Malocclusion

- Broad term, referring to "bad" bite
- 15% of adolescents and adults have severe crowding -> Carries genetic disposition as it relates to tooth vs arch size



Etiology

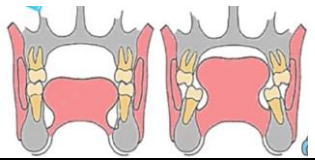
Molar Classification

1. *Class I Normal occlusion (30-35%)*
   - Max 1st molar MB cusp in the B groove of Md 1st molar
   - All teeth are aligned nicely in the arch
2. *Class I Malocclusion (50-55%)*
   - Same Angle Class I
   - Teeth do not line up along the arch of occlusion (rotations, spacing, crowding)
3. *Class II Malocclusion (15%)*
   - Mx 1st molar is too far forward, or mand. 1st molar is too far back
   - Teeth may or may not be nicely arranged
     a. Subdivision 1 = Proclined U1's, excess OJ
     b. Subdivision 2 = Retroclined or Upright U1, Excess OB
4. *Class III Malocclusion (1-5%_*
   - U6 is too far posterior, or L6 too far anterior

Incisor Overlap

Overjet **Normal: 2-3mm**	**Overbite** **Normal: 1-2mm**
- Horizontal overlap - Labial surface to labial surface btwn L1 and U1 (just the thickness of the U1 provides 2-3mm) - Excess (>3mm) or Reverse (L1 infront of U1) 	- Vertical overlap - Incisal edge to incisal edge - Deep (Excess OB) or Open (space btwn incisal edges) 

Crossbite

Anterior (AKA Reverse Overjet)	**Posterior (AKA Scissor Bite)**
= Max. anterior teeth are lingual to the mandibular anterior teeth 	= Max. posterior teeth are *lingual* to the mandibular, or are completely *buccal* to the mandibular teeth 

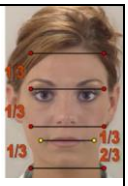
Bolton Analysis

= Measures tooth size discrepancy by comparing U and L teeth

- Teeth that are too large may need Interproximal Reduction (IPR)
- Teeth that are too small may need buildups

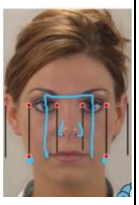
Face (Extraoral)

Vertical 3rds



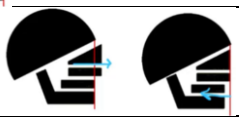
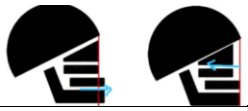
- Upper 3rd -> Hairline to glabella
- Middle 3rd -> Glabella to subnasale
- Lower third -> Subnasale to menton
  - Asymmetric growth of mandible can change this, this is mostly what is changed with ortho

Horizontal 5th



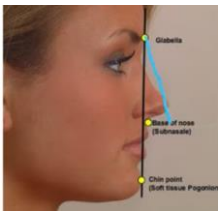
- Middle 5th -> Inner canthus to inner canthus
  - This line should be in line with the ala of the nose
- Medial two 5ths -> Inner canthus to outer canthus
  - Interpupilary distance should correspond with the commissures of the lips
- Outer two 5ths -> outer canthus to lateral helix
  - Should be coincident with the gonial angle of the jaw

Skeletal Classifications

Class I	Jaws well-related to N-Vertical 
Class II	Prognathic/protrusive maxilla (10%) Retrognathic/retrusive mandible (85%) Combination of both (5%) 
Class III	Prognathic Mandible (20%) Retrognathic Maxilla (60%) Combination (20%) 

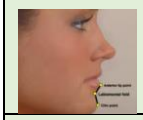
Facial Profile

- Facial plane formed by glabella, subnasale, and soft tissue pogonion



1. Straight -> Usually Class I
2. Convex/Posterior Divergence -> Usually Class II
3. Concave/ Anterior Divergent -> Usually Class III

Profile Angles

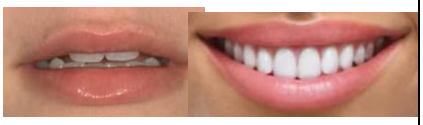
Nasolabial Angle 	= Between Nose and upper Lip - Should be: 90°
Mentolabial Angle/Fold 	= Btwn lower lip and chin - Should be 120°
Cervicomental Angle 	= Btwn chin and neck - Should be 90-120°

Lips (3 P's)

Position 	= Rickets E Plane (line drawn between nose and chin) - Lower lip should be behind, Upper lip should be on the line - Protrusive or Retrusive lips
Posture	= Lip competence at rest - Competent or incompetent - Incompetent = 3-4mm separation at rest + Mentalis strain on closure 
Proportions	= How much vermillion is shown? - Thick lips or thin lips

Incisor Display

- At Rest: 2-4mm show is ideal
- On Smile: 75-100% incisor w/ 1-2mm gingival show is ideal



Buccal Corridors

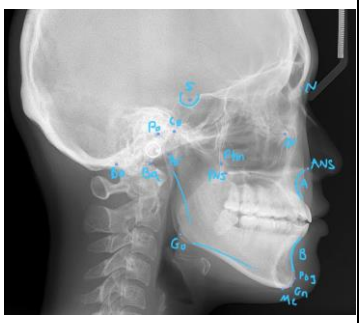
= Dark space between Max posterior teeth and corner of the mouth upon smiling

- Wide = lots of space
- Medium
- Narrow = very little space

Radiographic (Ceph)

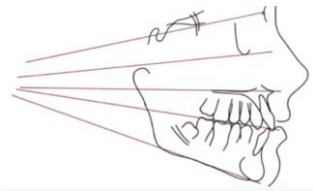
Reference Points:

Bolton Point (Bo): Highest point in the upward curvature of the occipital bone
Basion (Ba): Lowest point of the anterior margin of Foramen Magnus (points towards the Dens, or C2)
Articulari (Ar): Inner section between zygomatic arch and posterior border of ramus
Porion (Po): Highest point of the external auditory meatus
Condylion (Co): Post posterior superior point on the condylar head
Pterygomaxillary fissure (Ptm): Base of fissue that runs along the back of the maxilla
Sella (S): Midpoint of sella turcica
Orbitale (Or): Inferior portion of the orbit
Na (N): Anterior point of the nasal bone
Anterior Nasal Spine (ANS): Sharp projection of the maxilla anteriorly
Posterior Nasal Spine (PNS): Usually below ptm, sharp projection of the palatal bone
A Point: Inner most point on the contour of the maxillary bone
B Point: Inner most point on the contour of the mandible
Pogonion (Pog): Most anterior point of the chin
Menton (Me): Most inferior point of the chin
Gnathion (Gn): Point in between Me and Pog
Gonion (Go): Midpoint of the contour of the angle of mandible



Reference Planes:

- S-N: Cranial Base
- Po-Or: Frankfort Horizontal
- ANS-PNS: Palatal Plane L6-L1:
- Occlusal Plane
- Go-Gn: Mandibular Plane



****Sassouni Analysis* ->** These should all intersect at the back of head (Occiput)**

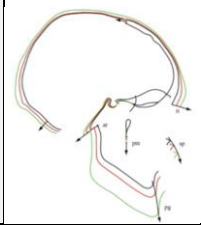
- If they intersect earlier -> Hyperdivergent
- If they intersect later -> Hypodivergent

Ceph Analysis

= Evaluate relationship of the jaws and dental units to each other

SNA	= Maxilla to Cranial Base - Large angle = Prognathic Max - Smaller angle = Retrusive
SNB	= Mandible to cranial base - Larger Angle = Protrusive - Smaller Angle = Retrusive
ANB	= Maxilla to mandible - ≤0° = Class III - 2° = Normal Class I - ≥4 = Class II

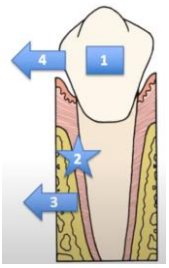
Ceph Superimposition



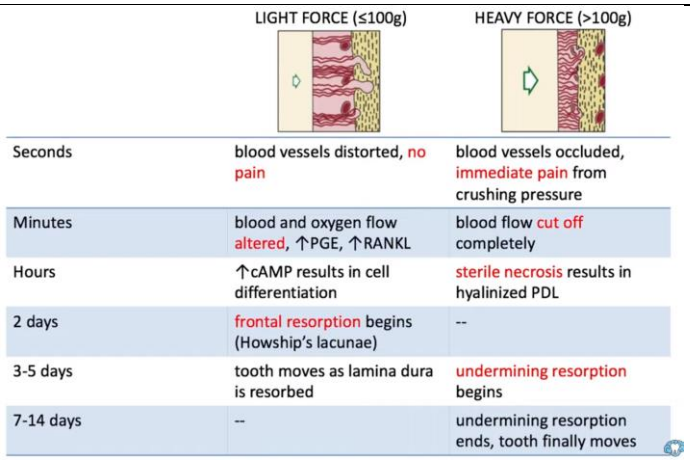
= Evaluate the skeletal and dental changes that occur over time -> Due to growth or Tx

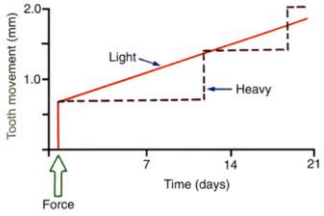
Biology of Tooth Movement

1. Apply force to the tooth
2. PDL is stressed
    a. Compression side: ↑ Osteoclasts = Resorption
    b. Tension side: ↑ Osteoblasts = Apposition
3. Bone remodels
4. Tooth Moves



Force Magnitude

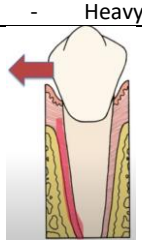




Resorption

- Light force: Frontal/Direct resorption -> Steady movement, ↓ pain
- Heavy Force: Undermining/Indirect resorption

Force Distribution

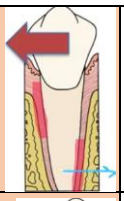


= Amount of force delivered to a tooth and the area of PDL over which the force is distributed are important to determining the biologic effect

Force/Area = Pressure

- Every PDL ligament has some sweet spot of pressure that stimulates cells without completely occluding the blood vessels

Uncontrolled Tipping

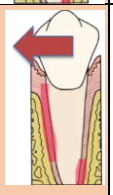


= Crown goes in the direction of force, but root goes in the opposite
- Heaviest pressure on the root apex and crest of the alveolar bone

Ideal Force: 50g
- 50% of the force is on one side and 50% on the other

Example: Finger Springs, Round light wires

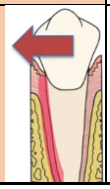
Controlled Tipping



= Tooth is both partially tipped and also partially translated
- Root apex doesn't tip opposite to the same degree as in uncontrolled

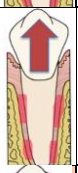
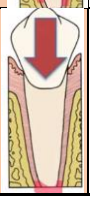
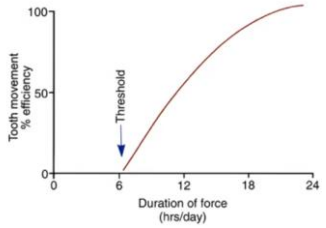
Ideal Force: 75g
- 75% of the force is being felt on 1 side, and 25% on the other

Bodily Movement

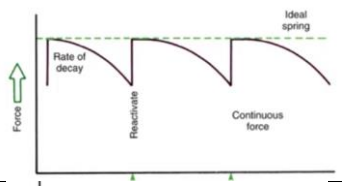
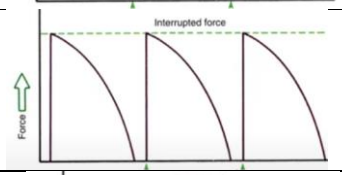
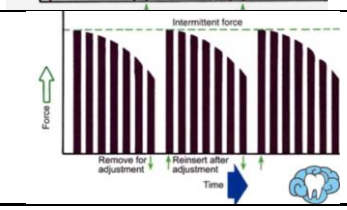


= Crown and root are being moved at same rate in the same direction
- Entire PDL is loaded, so there is equal compression along 1 side of the root

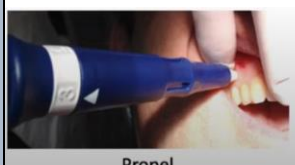
Ideal Force: 100g
- 100% of the force is being felt on 1 side

	Root Torque 	= Crown barely moves, and the root moves in the direction of the force - Ideal uprighting force: 75g
	Rotation 	= Rotation about long axis of the tooth - Compresses the areas similar to in tipping due to irregularly shaped roots - - Ideal rotating force: 50g
	Extrusion 	= Pulling tooth gently out of its socket - Compresses the areas similar to tipping due to irregularities in root shape - Ideal Extruding Force: 50g
	Intrusion 	= Pushing a tooth gently into its socket - Exceptionally light force down the long axis of tooth - Ideal Intruding Force: 10g
Force Duration		- Threshold for tooth movement is 4-8hrs (this is how long it take cAMP to build up enough to amplify the inflammatory response to actually move the tooth) - Only an issue for appliances that are removable

Force Decay:

Continuous		- Force stays constant (slight decrease as tooth moves, but it is reset with re-activation of the wire Ex: Light Wire
Interrupted		- Force slowly declines to 0. Decays faster than continuous, mostly due to materials Ex: Elastic chain
Intermittent		- Force abruptly declines to 0 whenever the patient takes out the appliance Ex: Clear Aligners

Adjuncts

Regional Acceleratory Phenomenon	****Altering inflammatory response to ↑ tooth movement**** *Regional* = Inflammation at both the cut site and adjacent bone *Accelerator*y = Intensified bone response due to agitated inflammatory mediators  Propel  Wilckodontics **Propel**: Punches holes in the bone through gingiva **Wilkodontics**: Full thickness flap is raised, punching holes and then covering with bone graft followed by applying ortho force

Deleterious Effects

*More force = more negative side effects

Mobility	= PDL temporarily widened - Controlled inflammation - This gets out of hand when compounded with uncontrolled inflammation -> This is why we don't do ortho while Pt has Periodontitis
Pain	PDL undergoes necrosis, ischemia and remodeling
Inflammation	= Usually from poor OHE - Rarely does it come from nickel allergy
Pulp	= Loss of vitality - Only associated with traumatized teeth and really extreme movement
Root Resorption	= Cementum adjacent to the hyalinized PDL can undergo resorption - Happens in basically every case, but in 3% does it become an issue **Risks**: - Heavy Force - Larger defects - Apical Defects - Genetics - Single Roots - Traumatized teeth - Movement into the cortical plate

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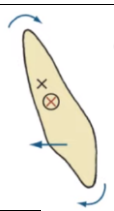
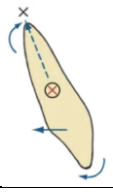
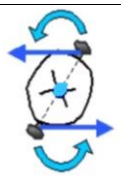
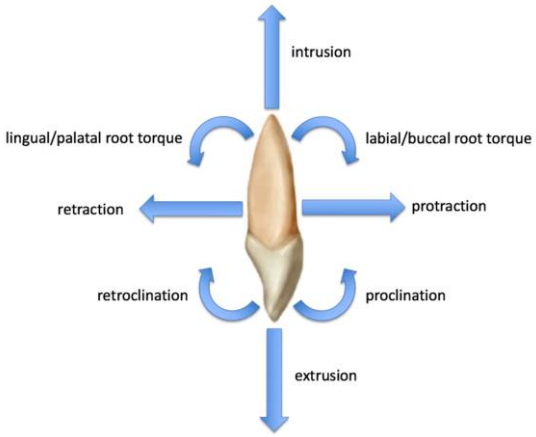
Mechanical Principles of Tooth Movement

Center of Resistance	= ***Fixed Point*** that a force must pass through in order to move the object in a straight line - In a free floating object, it corresponds with the center of mass Teeth are not floating in free space -> Center of resistance is around the center of the root (Half way between the alveolar crest and the apex of the root) - Periodontally Compromised tooth -> CoR moves more apically - Apical Root Resorption -> CoR moves more coronally
Center of Rotation	= ***Unfixed*** point around which an object rotates - Point which a body appears to have rotated when compared between the initial and final position - Depends on where the force is being applied *****Because the Center of Resistance of a tooth is inaccessible clinically, orthodontic movements use the Center of rotation around the brackets more *****
Moment (M_f)	= Tendency of a force to cause a body to rotate about a specific axis - Measured at some distance from the center of resistance Moment = Force x Distance
Couple (M_c)	= Pair of equal and opposite noncollinear forces - Creates pure rotation - Needs 2 points of contact (Square wire in ortho bracket) M_c = Force of 1 point x distance between 2 forces

First Order	= Rotation
Second Order	= Angulation
Third Order	= Inclination

Tooth Movements

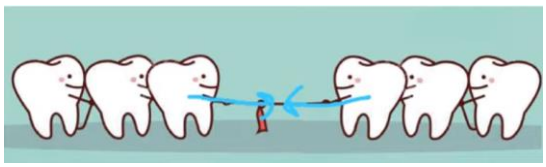
Uncontrolled Tipping - Finger Spring	$M_c/M_f = 0$ - No couple here = Center of rotation is slightly apical to center of resistance - Crown moves in the direction of force and root goes the opposite 
Controlled Tipping - Brackets	M_c/M_f = Between 0-1 - $M_c > M_f$ = Center of rotation is moved apically away from the center of resistance - Root stays where it is and the crow tips in the direction of the force 
Bodily Movement	$M_c/M_f = 1$ - $M_c = M_f$ = Tooth moves bodily (translates) and the center of rotation is displaced infinitely far away from the center of resistance (Because there is no rotation) - Move the crown and root equally in the same direction 
Root Torque	$M_c/M_f > 1$ - $M_c > M_f$ = Root apex moves more than the crown and the center of rotation is displaced in the other direction - Crown barely moves and the root moves in the direction of force - Very hard to accomplish 
Rotation	M_c/M_f doesn't exist - $M_f = 0$ = Rotation of the rooth is about its long axis - Center of rotation is at the center of resistance, this is caused by the couple moment alone 



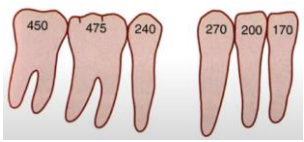
Anchorage

= Resistance to unwanted tooth movement

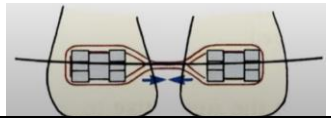
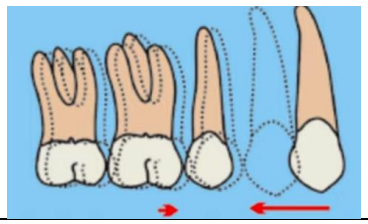
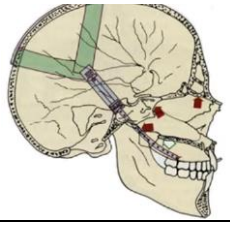
- Based off Newton's 3rd law -> for every action there is an equal and opposite reaction
- Light Force has a less anchorage toll -> Less unwanted tooth movement to worry about



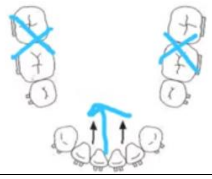
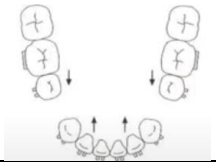
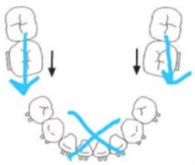
***Winner of the "Tug of war" depends on the PDL surface area**



➔ The anterior teeth have ↓ PDL surface area and will thus move more than the posterior unit

Reciprocal Anchorage	= If both units have equal anchorage values (PDL surface are is the same btwn two units) -> They will both experience equal and opposite tooth movement - Movement of 1 tooth can be pitted against the same contralateral tooth/unit -> Like in Diastema Closure 
Reinforced Anchorage	= Adding more teeth to anchor unit so the reaction force is distributed over ↑ PDL area - Headgear can be used to augment anchorage, but poor Pt compliance and heavy intermittent forces are not awesome  
Skeletal Anchorage	= TADs (Temporary Anchorage Devices) -> act like ankylosed teeth - Bone screws/plates - Particularly useful for distalizing and/or intruding molars Earliest age: 11 -> bone has matured enough  

Anchorage Demand

Maximum Anchorage	= No movement of the posterior teeth, and distalizing/retroclining the anteriors  Ex: 1st premolar Exo + anchor on both molars
Moderate Anchorage	= Equal movement between posteriors and anteriors  Ex: 1st premolar exos + Anchor only 1 molar. Anterior and Posterior meet in the middle
Minimum Anchorage	= No movement of the anterior teeth and mesializing the posteriors  Ex: 2nd premolar Exo / Skeletal anchorage

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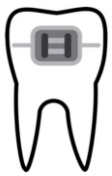
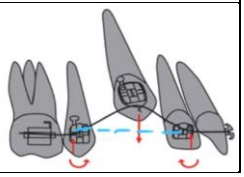
Orthodontic Wires & Brackets



Wire = Does all the work

Bracket = Tooth handle that allows the wire to grab the tooth

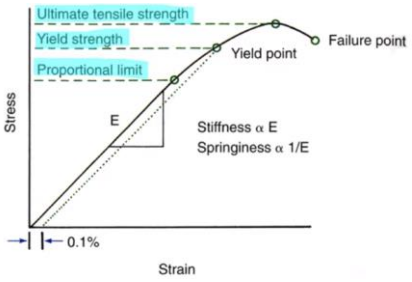
2 Phases of the orthodontic wire:

Activation	= ***Loading*** - The amount of force applied to engage the wire into the bracket slot -> putting the wire in the mouth
De-Activation	= ***Unloading*** - Letting the wire return to its original shape -> This applied the force that moves the tooth 

Mechanical Properties

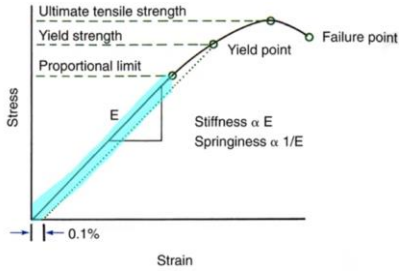
Definitions are kind of separate depending on if you are referring to Loading or Unloading

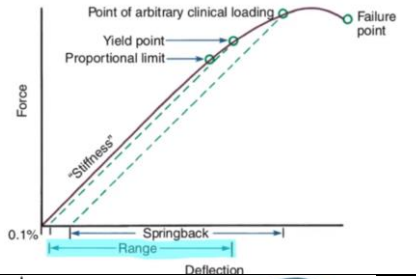
Strength = Stiffness x Range

<table>
<tr><th></th><th>Loading</th><th>Unloading</th></tr>
<tr><td>Strength</td><td>= How easily it will break</td><td>= How much force it can deliver
- Stronger the wire, the higher potential it has to deliver more force</td></tr>
<tr><td></td><td colspan="2">Strength is related to 3 points on the stress strain curve:
 

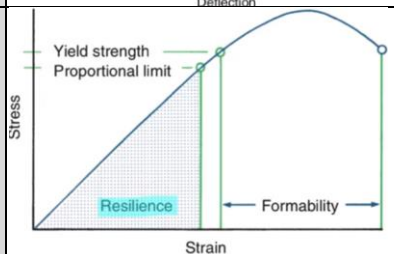
<u>Proportional Limit:</u>
- Point where linear relationship ends. Wire will no longer bounce back to original shape beyond here

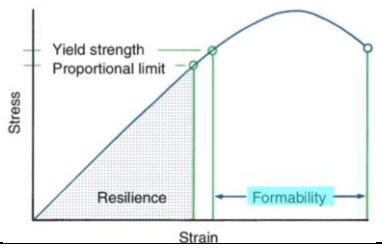
<u>Yield Strength:</u>
- Measurable permanent deformation begins here
- Do not want to reach this during loading of the wire

<u>Ultimate Tensile Strength</u>
- Maximum stress the material can handle while loading, or the maximum force it can deliver while unloading</td></tr>
<tr><td>Stiffness</td><td>= How flexible it is</td><td>= How much force it will deliver as it returns back to its original shape</td></tr>
<tr><td></td><td colspan="2"> 

= Slope of the elastic portion of the stress-strain curve
- The steeper the slope is = Stiffer the wire
- Shallower the slope = more flexible</td></tr>
<tr><td>Range</td><td>= How far you can deflect the wire while maintaining its elasticity</td><td>= How far (and how long) the wire will remain active for</td></tr>
<tr><td></td><td colspan="2"> 

= Horizontal axis of the Force-Deflection curve up until the Yield Point
- If you deflect beyond this point, it will not return to its original point

Long range: More active for longer time
Short range: Active for less time, will need to recall the patient sooner</td></tr>
<tr><td>Resilience</td><td colspan="2"> 

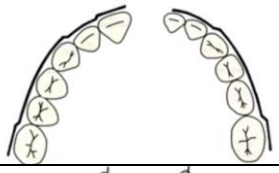
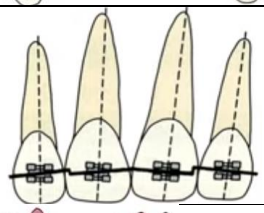
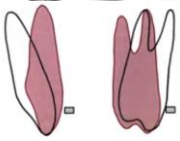
= Area under stress-strain curve, up to the proportional limit
- Represents energy storage capacity of the wire
- Amount of plastic deformation the wire can tolerate</td></tr>
<tr><td>Formability</td><td colspan="2"> 

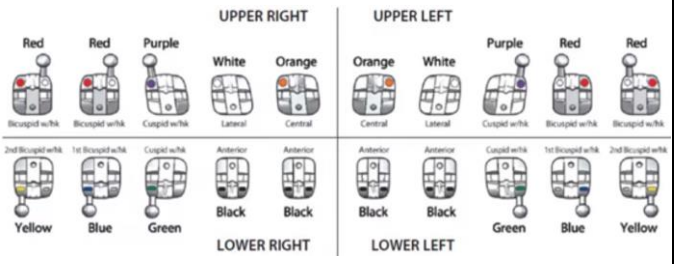
= Area under the stress-strain curve from yield strength to the failure point
- Amount of permanent deformation the wire will tolerate before it breaks</td></tr>
</table>

Wire Material and Geometry

- ↑ Strength and Stiffness: NiTi (Weakest, most flexible) < TMA < SS (Strongest and stiffest)
- ↑ Diameter = ↑ strength, ↑ stiffness, ↓ Range
- ↑ Length (between brackets) = ↑ range, ↓ strength, ↓ stiffness
- Rectangular is stronger and stiffer than round
- Beam is stronger and stiffer than cantilever

Brackets

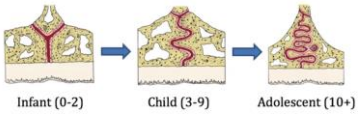
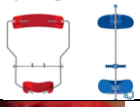
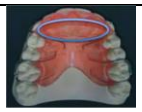
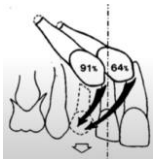
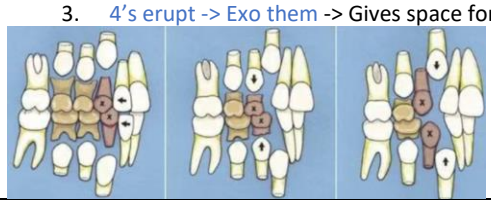
<table>
<tr><th colspan="3">Original Edgewise Brackets</th></tr>
<tr><td colspan="3">Edgewise = slot is open horizontally</td></tr>
<tr><td>1st Order Bend</td><td>  </td><td>Bucco-lingual position</td></tr>
<tr><td>2nd Order Bend</td><td>  </td><td>Mesiodistal position</td></tr>
<tr><td>3rd Order Bend</td><td>  </td><td>Bucco-lingual inclination</td></tr>
<tr><th colspan="3">Preadjusted Edgewise Brackets</th></tr>
<tr><td>Prescriptions</td><td colspan="2">Each bracket has its own “prescribed” tooth. The 1st, 2nd, and 3rd order bends are built into the shape of the bracket itself so you don’t need to bend the wire at all

Important that the bracket is placed in the center of the facial surface of the clinical crowd for it to do its prescribed action
  </td></tr>
<tr><th colspan="3">Types of Brackets</th></tr>
<tr><td>Metal Brackets</td><td>  </td><td>- Unaesthetic
- Made of SS
- Elastics hold the wire in place within the slot</td></tr>
<tr><td>Ceramic Brackets</td><td>  </td><td>- More esthetic (can match the tooth shade) -> usually chosen by adult patients
- More brittle and prone to fracture though
- ↑ friction between the bracket and wire makes it harder to adjust wire position</td></tr>
<tr><td>Self-Ligating Brackets</td><td>  </td><td>- Built in door locks the archwire into the slot -> don’t need the ligature/elastics as in metal brackets
- ↓ friction between elastic and bracket -> Potential ↓ Tx time as a result
- More Expensive</td></tr>
</table>

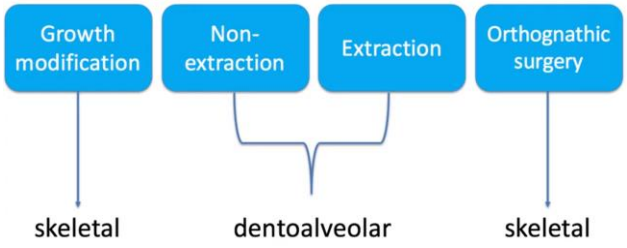
Early Treatment (Phase I)

= During Mixed Dentition

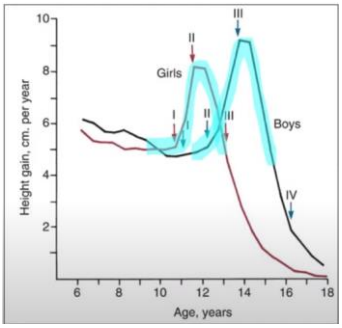
Purpose	- Improve overall oral environment (improve malocclusions etc) - Correct problems that are easier to fix early (Take advantage of growth, compliance, and pliable sutures) - ↓ complexity of Tx in the permanent dentition phase

Posterior Crossbite	Transverse issue -> typically a narrow maxilla **** Tx early if there is a functional shift as it can cause skeletal asymmetry as Pt grows into a malocclusion**** - If no functional shift -> can Tx later Tx: Palatal Expansion (Quad Helix, Hyrax etc) - As Pt gets older the suture becomes harder and hard to expand so Tx early 
Anterior Crossbite	AP Dimension -> can be 1 or a few teeth, or the entire sextant  A few teeth (Dental issue likely) -> Results in wear and gingival strain (Recession) - Tx: 2x4 braces or an active retainer (finger spring etc) Full Underbite (Skeletal Class III Malocclusion) - Tx: Reverse Pull Headgear 
Severe OJ	AP Dimension issue - ↑ Risk of Trauma - Psychosocial, esthetic concern  Tx: 2x4 appliance (tip anterior teeth back) or Class II Headgear to slow maxillary growth at sutures
Anterior Open Bite	Causes: - Thumb Sucking Habit - Narrow Maxilla w/ posterior crossbite - Proclined Max. incisors and retroclined mandibular incisiors - Tongue Thrust Habit - Pt positions tongue anteriorly during swallowing - Proclined incisors w/ generalized spacing  Tx: Habit appliance (Tongue Cage)
Palatal Impingement (Deep Bite)	Can cause: - Pain and discomfort - Soft tissue trauma and damage to gingival attachment   Tx: - Maxillary Bite Plate (Thick acrylic that protects the top of the mouth and intrudes the lower anteriors)
Impacted Teeth	3rd Molar = #1 impacted tooth Max. Canines = #2 impacted tooth - Around 10 you should be able to feel the bulge of erupting canine, and primary C should be getting mobile **Kurol's Rule:** - Canines NOT past the midline of the lateral incisor = 91% chance of eruption - Canines beyond the midline of the lateral incisor = 64% chance of eruption  **3 H's:** - How **High** is it? - Is it **Horizontal**? - **Has** it crossed the midline of the lateral
Moderate Crowding (> 4mm)	**Not a huge deal in mixed dentition because leeway space** - Don't Exo teeth in mixed dentition   Tx: -> Focused on maintaining space for permanent dentition - Lip Bumper, LLHA
Severe Crowding > 8mm	Mostly in cases in of small jaw and large teeth Tx: - Serial Exo -> C-D-4 (consecutive removal of primary teeth to facilitate the unimpeded eruption of permanent teeth **Contraindicated if Pt has a skeletal deficiency** Process: 1. Start when Maxillary permanent laterals are erupting and we see a lack of space -> Exo C's 2. Exo D's -> Encourage the eruption for 1st permanent premolar (wait until root is mostly developed) 3. 4's erupt -> Exo them -> Gives space for Perm. Canines to erupt in good position and in attached gingiva 

Comprehensive Tx and Appliances



Growth Modification



Successful only during periods of growth

- Girls: 8-13
- Boys: 10-15

Generally Speaking:

Class II

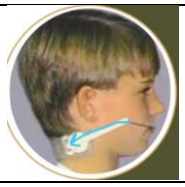
- Headgear restrains max growth
- Functional appliances stimulate mandibular growth

Class III

- Reverse headgear stimulates maxillary growth
- Chin cup restrains mandibular growth

Headgear

- Best **pre-pubertal**
- Modifies Growth -> Needs to be warn 12-14hrs per day to be useful (Compliance!)

High Pull/Occipital Headgear - Class II	*Skeletal*: Restrains Maxillary forward growth *Dental*: Intrudes and distalizes Upper molars ***Best for Class II Open Bite*** - Class II: Restrains maxillary growth - Open Bite: Intrudes Posterior teeth 
Low Pull/Cervical Headgear - Class II	*Skeletal*: Restrains Maxillary forward growth *Dental*: Extrudes and distalizes upper molars ****Best for Class II Deep Bite**** - Class II: Restrains maxillary growth - Deep Bite: Extruding molars 
Reverse-Pull Headgear (Facemask) - Class III	= Forward Pull on Maxilla *Skeletal*: Stimulates forward growth, Clockwise rotation of the mandible *Dental*: Protraction of U1, Retraction of L1 ****Best for Class III Maxillary Deficiency**** - Do it as soon as U1 and 1st molars erupt -> want the maxillary sutures to be as pliable as possible 
Chin-Cup - Class III	= Restrains mandibular forward growth (in animal models) - Not very effective in humans **Best for Class III mandibular excess** 

Functional Appliances

- Best during the Ascending portion of the growth spurt
- Influences the normal function of the mandible -> Typically places the mandible in a protrusive position (Class II)

Bionator

- Removable Appliance

= Plastic between teeth guides the patient into an advancement of the mandible (So teeth can clean the block of plastic)

- Labial bow also holds the lips back from retracting the teeth

Pros: Simple, durable, readily accepted by Pts's

Activator

- Removable

= Lingual flanges contact the lingual mucosa near the lower molars and encourages forward mandibular posture to prevent impingement on the floor of mouth

- More uncomfortable than Bionator and not as well received

Twin Block

- Can be fixed or removable

= Inclines on upper and lower blocks forces pt to advance mandible in order to close

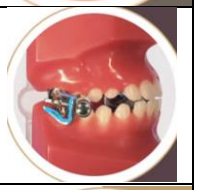
Pros: Provides more mandibular changes

MARA (Mandibular Anterior Repositioning Appliance)

- Fixed Appliance

= Much like the twin block the pt needs to reposition their mandible in order to close

Pros: Less bulky, more durable, and more stable than herbst
Cons: ↓ mandibular advancement vs twin block and herbst



Herbst

- Fixed Appliance

= Piston and tube device (adjustable) the passively pushes the mandible forward as the mandible forward as patient closes -> Not taking advantage of the pt's musculature to do the work

Pros: No compliance needed
Cons: Easily breaks

Others

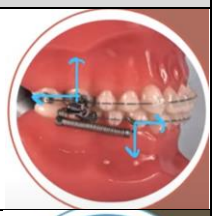
- These are more Dento-alveolar modifiers vs growth modifiers

Forsus

- Fixed Appliance

= Pushrod spring pushes the teeth

Pros: Non-compliance is a non-issue, More maxillary restriction (Vs Herbst)
Cons: Requies heavy upper and lower archwires



Pendulum

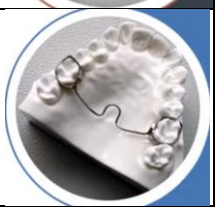
- Fixed Appliance

= Banded to the Max 1st molars -> Distalizes and de-rotates molars

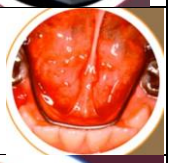
- Acrylic button on the palate w/ coils the push the molars back

Pros: Non-compliance
Cons: Effects to the upper arch only

Dent-Alveolar Appliances

Palatal Expanders - Best during Ascending portion of growth spurt (while sutures are pliable)	
Schwarz (Split Plate)	Removable - Bad for non-compliant patients, transverse expansion can relapse very fast = Jackscrew in the center, parents turn the key to expand (1 turn = 0.25mm expansion) - Mostly dental tipping, tipping teeth out **Only use for mild posterior crossbite** 
W-Arch	Fixed - Banded to the molars = Compressed spring, activated when put in the mouth - Delivers a few hundred grams of force -> slow expansion *Pros*: - More effective, comfortable and efficient than Schwarz (Split Plate) 
Quad Helix	Fixed - Banded to molars = 4 helical loops (2 anterior and 2 posteriors). Similar to the W arch, but the loops allow us to dictate if we want more or less force in the anterior or posterior (depending how the loops are activated) 
Hyrax - Popular today	Fixed - Bands on the 1st Molars and 1st premolars = Involves jackscrew expander (1 turn a day can provide 100N of force) *Pros*: Effective skeletal expansion *Cons*: Bulky and more difficult to place, remove, hygiene, compliance (needs continued activation at home) 
Haas	Fixed = Same as Hyrax except it has 2 acrylic pads to contact palatal mucosa (maximizes the expansion) *Pros*: More skeletal expansion *Cons*: Really Really hard to keep clean 
Transpalatal Arch (TPA)	= Usually used for transverse anchorage to keep the arch width steady - Can be modified to expand though 

Mixed Dentition Appliances

Mixed Dentition Appliances	
Nance	= Used for the Upper Arch - Space maintainer (Prevents mesial drifting of molars) or anchorage during movement to prevent mesial movemetn of molars 
Lower Lingual Holding Arch (LLHA)	Similar to Nance but for mandible - Wire rests along the lingual of the mandibular incisors (works better than the acrylic button as in the Nance) Prevents mesial drifting of molars and lingual tipping of anteriors 
Lip Bumper	Used on the lower arch - Labial wire attaches to tubes on the molar bands -> Acrylic bumper relieves the lower lip pressure from the incisors and transmits it to the molars - Tips the molars back and proclines the lower anteriors 

Permanent Dentition Appliances

Aligners	- Clear and Removable = Series of trays manufactured according to a prescription written and to be warn by the patient - Bonded attachments are often required to help in specific tooth movements 
Braces	- Fixed (Obviously) Technique - Enamel prophy -> Pumice removes the dental pellicle and ↑ wettability for bonding - Etch -> Allows micromechanical bonding of resin to the enamel - Prime -> Conditions enamel and chemically bonds to resin on the bracket - Bracket positioning -> Center of the tooth crown, cure the adhesive 

Exo Vs Non-Exo

Non-Exo Indications	Exo Indications
- Minimal crowding or spacing - Deep Bite (Non-exo, opens bite) - Flat retrusive lips - Obtuse nasolabial angle	- Severe Crowding - Minimal OB or Open bite - Full protrusive lips - Acute nasolabial angle - Anterior recession or thin tissue - Camouflage

Stages of Comprehensive Treatment

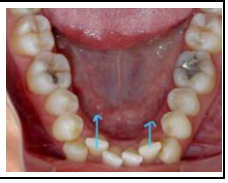
1. Alignment and Leveling
2. AP Correction and Space Closure
3. Finishing and Detailing

Adult Treatment

- More likely to opt for ceramic, lingual or invisible braces
- Periodontal conditions should be stable before ortho Tx
- Steel ligatures retain less plaque than elastics
- No growth modification possible

Retention

2 Types of relapse

Elastic Recoil - Short Term - Dental change	Need to allow time for the reorganization of soft tissue fibers - PDL: Takes 3-4 months -> Full Time Retention - Gingival Fibers: 4-6 months -> Part time retention wear (night time) - Supracrestal fibers: 1+ years **Supracrestal fiberotomy (SCF) -> Recommended for teeth with severe rotation** - This isn't really done anymore though, pretty aggressive
Differential Jaw Growth - Long Term - Skeletal	= Late Mandibular AP and vertical growth can continue (in small amounts late into adult life) -> Leads to relapse - Pushing teeth into an unstable position can expose them to cheek, lip, or tongue pressure -> Causes malalignment over time - This is why we use a bonded lingual wire on the mandible 

Retainers

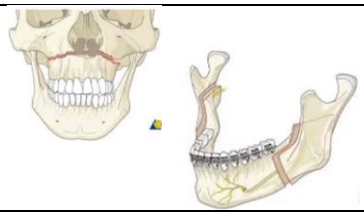
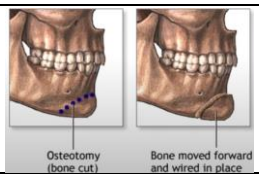
Hawley Retainer (Maxillary)	Acrylic on Palate -> Connects all the wires together, controls overbite Labial Bow -> Controls Incisor-Canine retention Adams Clasps -> Controls Premolar – Molar retention **Customizable to add finger springs or to use as space maintainer if needed** 
Hawley Retainer (Mandibular)	Acrylic on Lingual (or labial) Clip on bar from 3-3 -> Usually where most retention is needed 
Vacuum-Formed Retainer	Clear Plastic - More esthetic if wearing full time **Separation of posterior teeth in occlusion may develop** - Molars are never truly touching in ICP with the plastic in the ay
Lingual bonded retained	**Indicated if ≥2mm of forward repositioning of lower incisors was done, or if large diastema closure of upper incisors** - There will be ↑ lip pressure that you need permanent retention to counteract - Flexible wire attached to the lingual surface of each tooth OR rigid wire bonded to the 2 outside teeth  

Types of Relapse

Class II Relapse	Plan for Relapse: - Overcorrect by 1-2mm during the finishing stage *More severe the initial class II and the younger the patient is at debonding = ↑ chance you will need headgear or bionator w/ full time retainer wear*
Class III Relapse	Plan for Relapse - Overcorrect by 1-2mm during the finishing stage **Continued mandibular growth is very likely and hard to predict/control** - Surgical correction after growth may be the only answer
Deep Bite Relapse	Prevent overeruption of incisors - Use Upper Hawley retainer with anterior bite plate
Open Bite Relapse	Prevent intrusion of incisors and over-eruption of upper molars - Avoid oral habits (thumb sucking, tongue thrusting) - Upper modified Hawley retainer w/ Posterior bite blocks - Vacuum-formed retainer w/ thickened plastic over posterior occlusal surfaces to invade the freeway space

Orthognathic Surgery

- Indicated for the most severe skeletal discrepancies (unsuccessfully treated with growth modification or not possible with growth modification
- Ex: Class III, Open Bites, Asymmetry

A-P Corrections	**LeFort I** - Maxillary advancement -> Class III Correction - Maxillary setback -> Class II correction **BSSO (Bisaggital Split Osteotomy)** - Mandibular advancement -> Class II Correction - Mandibular setback -> Class III Correction 
Vertical Corrections	**LeFort I** - Maxillary superior repositioning -> Correct open bite and shorten face - Maxillary inferior repositioning -> Correct deep bite to lengthen face
Transverse	**Maxillary Expansion (SARPE)** - Expansion after the maxillary suture has closed **Maxillary Constriction** - Limited **Mandibular Expansion (MSDO)** - Limited because there are no sutures to distract **Mandibular construction** 
Facial Esthetics	**Genioplasty** - *Sliding genioplasty* moves chin in all 3 directions - Submental cut allows you to move the chin wherever you need 

Relapse Stability

Soft tissue is to blame for applying relapse pressure

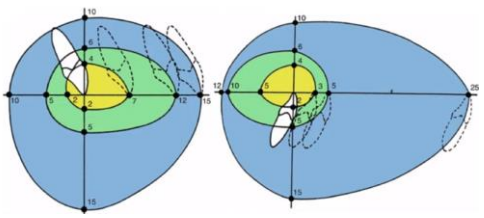
1. Maxilla Up
2. Mandible forward
3. Chin in any direction
4. Maxilla Forward
5. Maxilla up + Mandible forward
6. Maxilla forward + Mandible back
7. Mandible back
8. Maxilla down
9. Maxilla wide

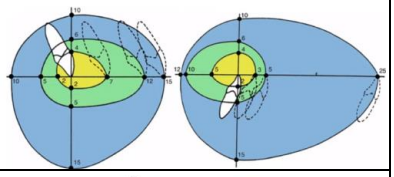
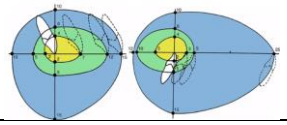
Envelopes of Discrepancy

= Describes the amount of change in tooth position that can be achieved by:

- Orthodontic movement of teeth
- Growth modification of the Jaws
- Surgical reposition of the jaws

Each envelope is additive

Envelope of Tooth Movement	(Dashed line is where the tooth starts, solid line is where the tooth ends up) - Inner circle (yellow) shows the possibility of ortho alone **U1:** - Retraction: 7mm - Protraction: 2mm - Extrusion: 4mm - Intrusion: 2mm **L1:** - Retraction: 3mm - Protraction: 5mm - Extrusion: 2mm - Intrusion: 4mm 

Envelope of Growth Modification	- Middle circle (green) shows the possibility if we take advantage of growth modifications Restricting Class II Growth: 5mm - When combined with ortho = 12mm Restricting Class III growth: 3mm - When combined with ortho = 5mm 
Envelope of Surgical Change	- Setting the mandible back is the most significant change that can be made 

Post- Op Complications

BSSO	- ***Damage to the IAN/Paresthesia*** - Condylar Sag -> relapse - Swelling - Infection - Bleeding
General Anesthesia	Alectasis -> Lung collapse + Fever Pneumatosis intestinalis -> Air in the intestines + Fever