

Etiology and development of malocclusions

- Malocclusion

- Poor relationship of upper teeth to lower teeth. Can be measured by the following parameters

Parameter	What's measured	Units
Overjet	-Horizontal protuberance of maxillary incisors compared to mandibular incisors -Negative if mand incisors are more protuberant	mm
Overbite	-Vertical overlap of maxillary incisors over the mandibular	% of mandibular incisor covered
Molar relationship	-Class I: MB cusp of max 6 in buccal groove of mand 6 -Class II: MB cusp is more anterior -Class III: MB cusp is more posterior	-Class I/II/III
Canine relationship	-Class I: max canine tip lines up to mand canine/premolar embrasure -½ class II: max canine tip lines up to mand canine tip -Class II: max canine tip anterior to mand canine tip -Class III: max canine tip posterior to class I position	-Class I/II/III
Crowding		
Spacing		
Midline asymmetry		

- Factors determining malocclusion

- Genetics of tooth development

- Tooth size or number or eruption/position
- Tooth size/jaw size discrepancy (mostly teeth too big for jaw, rarely vice versa)
- Upper tooth size to lower tooth size discrepancy
- Congenitally missing teeth (commonly max laterals and mand 2nd premolars)
- Supernumerary teeth, ectopic erupting teeth, failure to erupt teeth

- Genetics of jaw development

- Jaw size or position
 - Upper jaw too large or too small relative to lower jaw
 - Lower jaw too large or too small relative to upper jaw
- Incomplete jaw development
 - Cleft palate and/or lip
 - Occurs at 7~8 weeks gestation
 - Affects 1:2000 blacks, 1:700 caucasians, 1:500 orientals
 - Multifactorial genetic cause
 - Can be unilateral or bilateral (unilateral on left side more common)
 - More common in boys
 - Can be treated here, but not in less developed countries
 - Usually associated with a retrognathic mandible
 - Hemimicrosomia
 - Half of the face is less developed than the other side →
 - Frequent complaint is ear problems
 - Other craniofacial anomalies
 - Mandibular ramal/condylar underdevelopment (unilaterally or symmetrically)

- Functional

- Dental interferences causing shift away from centric relation
- **Lateral mandibular shift:** usually due to a small maxilla → teeth can't get into intercuspatation → mandible moves to one side to allow unilateral intercuspatation. Leads to unilateral crossbite on posterior teeth. Bilateral crossbite is rare
- **Anterior mandibular shift:** anterior interference causes teeth to go in anterior crossbite
- **Anterior and lateral mandibular shift:** anterior interference causes teeth to go in anterior + unilateral posterior crossbite
- When the mandible has to deviate while closing due to interferences, this is called a functional crossbite



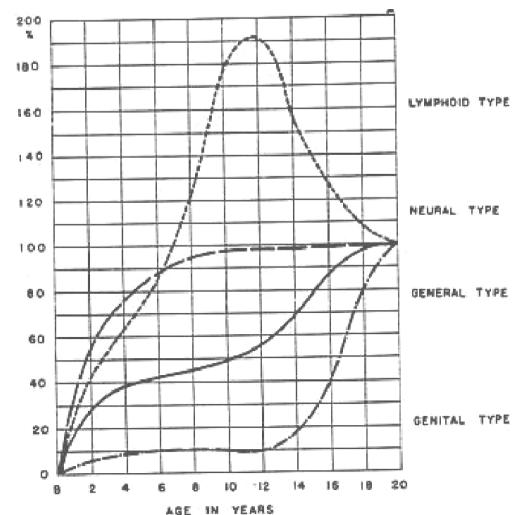
- Parafunctional habits
 - Mouth breathing - due to allergies or adenoids obstructing nose
 - **Presentation:** long narrow face, protruding teeth, lips apart at rest, steep mandibular plane, retruded mandible, overerupted molars, anterior open bite, maxillary constriction excessive overjet
 - **Treatment:** refer to ENT to fix airway and orthodontics +/- surgery to fix malpositions
 - Thumb sucking habit – normal for infants, but should be stopped when permanent incisors erupt
 - **Presentation:** labial flaring of maxillary incisors, lingual tipping of mandibular incisors, high and narrow palatal vault, V shaped constriction, and tongue thrust swallow, severe class II div 1
 - **Treatment:**
 - Encourage patient to stop, and schedule a 6 month recall
 - If they are still doing it at 6 months, place a fixed palatal crib for 12 months
 - Cribs should be V or U shaped loops, never sharp spikes
 - Prevents patient from thrusting tongue forwards
 - Clenching and bruxing – can move teeth
- Ideal occlusion
 - Molar class 1: mesiobuccal cusp of first molar lines up with buccal groove of mandibular first molar
 - Minimal overjet and overbite
- Lower jaw growth and its effect on occlusion
 - Maxillary incisors will tilt distally if the lower jaw is too small
 - Jaw will need to grow – growth can be forced using appliances if the patient is still of growing age
 - <13~16 in females
 - <20 in males
- Equilibrium theory
 - Object is subject to a set of balanced forces and remains in the same position
 - If the forces are imbalanced, it will move to a different space
 - Forces that act on teeth
 - Internal: lips, cheeks, tongue, PDL, gingival fibers
 - External: finger habits, orthodontics
 - Requirements to move teeth
 - Forces must be mild~moderate and occur daily for 4~6 hours for the teeth to move
 - Heavy brief forces will not move teeth (mastication, swallowing)



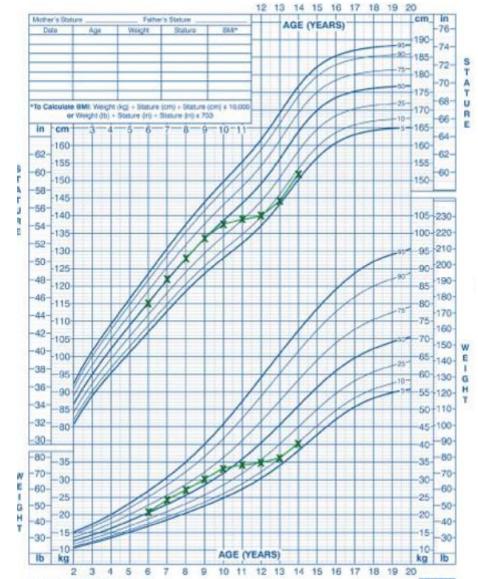
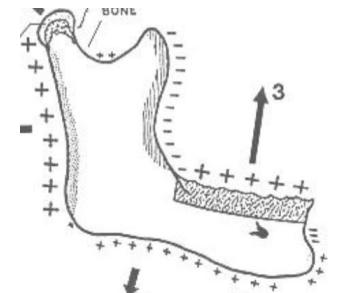
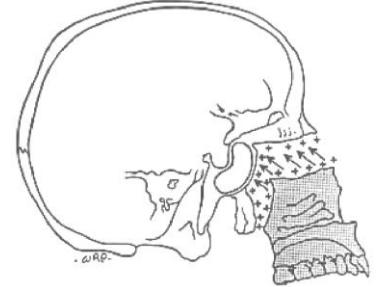
	Forces:	Duration:	Magnitude:
1.	Mastication	very short	very heavy
2.	Swallowing	short	moderate
3.	Speaking	very short	light
4.	Resting	long	very light
5.	Habits	variable	moderate
6.	Orthodontics	variable	moderate
7.	Perio. ligament	long	light
8.	Gingival fibers	long	light

Craniofacial growth and development

- Growth vs development
 - Growth = size
 - Development = complexity and maturation
- On the right represents growth of different tissues
 - Neural tissues reach 100% quicker than other tissues
 - The cranium follows this curve
 - Lymphoid tissues peak at age 12, but decrease in adulthood
 - "General type" represents body growth and peaks at infancy and at age 12~14
 - The jaw follows this curve
 - Growth rates for cranium, upper face, and lower face are all different
 - Growth also happens in spurts, not a steady progression



- Growth mechanism – cortical drift
 - There are “growth fields” on bone surfaces. These growth fields can be resorbing bone or depositing bone
 - Generally, the external surface of a bone will have a depositing growth field and the internal surface will have a resorbing growth field
 - This is how bones can change in dimension and proportion
- Movement of bones due to growth
 - Primary displacement: when a bone enlarges, it physically moves away from whatever it is connected to. As the bone grows in a given direction, it displaces the opposite direction
 - The jaw does not grow “downwards and forwards.” More accurately, the jaw grows upwards and backwards, which displaces the mandible downwards and forwards
 - Secondary displacement: when other bones enlarge, it displaces a bone that is not participating. For example, growth of the middle cranial fossa can move the maxillary bone away from the cranium
- Proportions
 - From fetal stage to adulthood, the head becomes smaller in proportion to the body
 - This is referred to as cephalocaudal gradient of growth
 - Also, the jaw becomes bigger in relation to the face
- Growth curves
 - Plots age and size/weight and also the resulting growth curve of a sample size
 - Shows the growth curves representative of certain percentiles
 - Can plot individual’s growth curve to see where they fall
 - Poor predicting ability - poor nutrition or a change in lifestyle can suddenly stop growth, or someone who was small can suddenly enter normal height/weight percentile
- Why is it significant to track craniofacial growth?
 - Being able to make predictions
 - Dentition: estimate eruption time/sequence, crowding/spacing, and interarch relationships
 - Jaw growth: estimate distance, growth speed, and rotation
 - However, how good were the predictions in clinical practice?
 - Predicting dentitions are fairly simple
 - Predicting jaw/body growth is poor. Growth varies all over the place, and mean $=/\approx$ median
 - Decide if orthodontic/orthopedic manipulation is necessary
 - Mandible growth can be restricted (chin cup), stimulated, or rotated
 - Maxilla growth can be restricted (headgear), stimulated, or rotated
 - Teeth can be guided into correct position
- Measuring growth and development
 - Direct: measure teeth directly
 - Indirect: take cephalometrics (2D) or cone beams (3D)
 - Superimpositions: allows monitoring of growth over time by overlaying multiple ceph or cone beams
 - Cranial base (occipital, sphenoid, ethmoid, and frontal bones) don’t grow very much, so they can be used as a landmark for superimpositions
 - General finding is that the face grows downwards and forwards
- Clinical significance of measurements
 - Concept of normal
 - Social and cultural influences
 - Access to care providers
 - Treatment techniques (knowledge and technology)
 - Socioeconomic factors (esthetic values)



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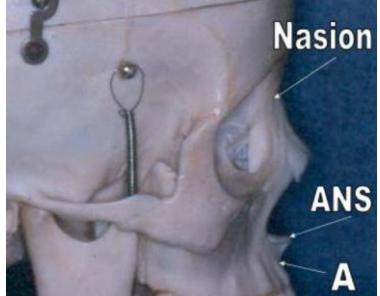
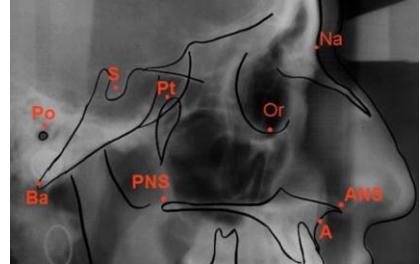
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- Summary

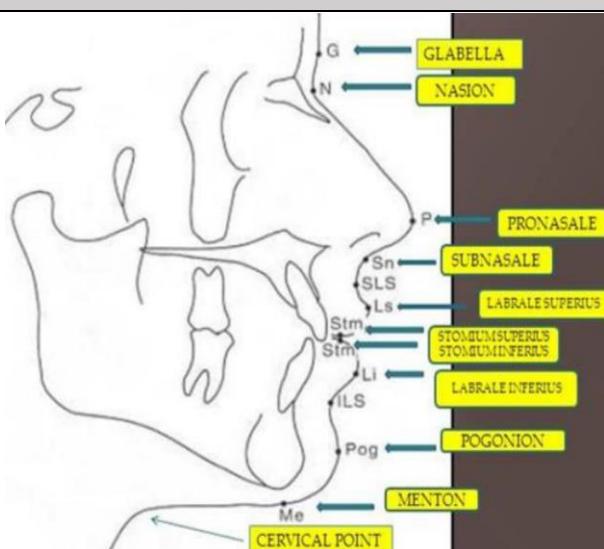
- It's hard to predict growth, and the fact that the dentition, midface, and mandible grow at different rates complicates things even more
- Stimulating and constricting growth is difficult
- Mechanism of growth (growth plates)

Cephalometric analysis

- Bony landmarks

Landmark	Description	Image
Nasion	-Most anterior point on frontonasal suture	
Anterior nasal spine	-Anterior point on maxillary bone -May not be visible sometimes, so estimate where it is	
A point	-Most concave point of the anterior maxilla	
B point	-Most concave point on mandibular symphysis	
Pogonion	-Most anterior point on mandibular symphysis	
Menton	-Lowest point on mandibular symphysis	
Gonion	-Most posterior inferior point of angle of mandible -Can be the point of bisection when extending mandibular plane and ramus of mandible lines	
Gnathion	-Point located perpendicular on mandibular symphysis midway between pogonion and menton	
Sella	-Center of the sella turcica is used as a landmark	
Porion	-Most superior point on the external acoustic meatus	
Basion	-Anterior margin of the foramen magnum, often used as a cephalometric landmark	
Orbitale	-Most inferior point on the lower left orbit -Craniometric and cephalometric landmark	
Pterygomaxillary fissure	-Most superior point of the pterygomaxillary fissure	
Posterior nasal spine	-Posterior extension of the nasal floor	

- Soft tissue landmarks

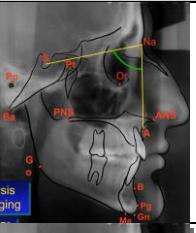
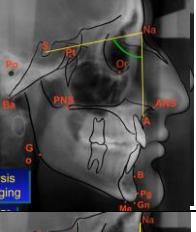
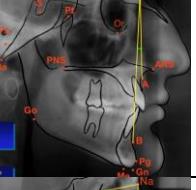
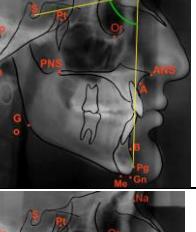
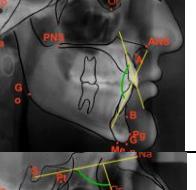
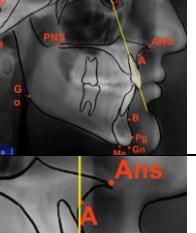
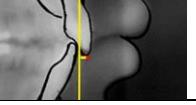
Landmark	Description	
Glabella	-Most anterior point of forehead	
Nasion	-Area of greatest concavity between nose and forehead	
Pronasale	-Most anterior point of nose	
Subnasale	-Area of greatest concavity between nose and philtrum	
Labrale superius	-Most anterior point of upper lip	
Stomium	-Superius: Most inferior point of upper lip -Inferius: Most superior point of lower lip	
Labrale inferius	-Most anterior point of lower lip	
Soft tissue Pogonion	-Most anterior soft tissue point on mandibular symphysis	
Soft tissue Menton	-Lowest soft tissue point on mandibular symphysis	
Cervical point	-Inflection point	

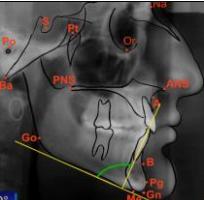
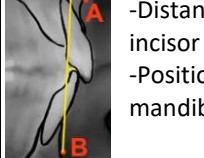
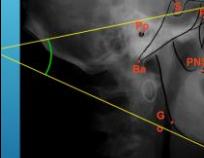
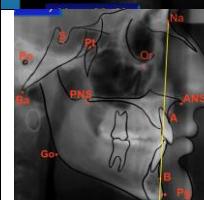
- Cephalometric analysis

- Goal: to evaluate horizontal + vertical relationships of the 5 major components of the face:

- Cranium and cranial base
- Skeletal maxillae
- Skeletal mandible
- Maxillary dentition and alveolar process
- Mandibular dentition and alveolar process

- Measurements

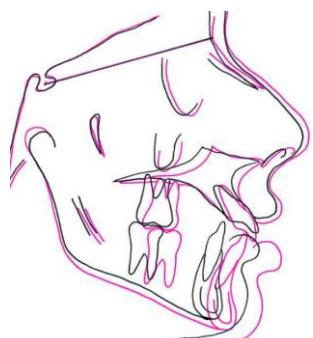
Measurement	How to measure	Mean	Significance
SNA	 <ul style="list-style-type: none"> -Angle formed when S-N-A are joined -Position of the maxilla relative to the cranium base 	82 +/- 2 deg	Greater than: maxilla is protruded Less than: maxilla is retruded
SNB	 <ul style="list-style-type: none"> -Angle formed when S-N-B are joined -Position of the mandible relative to the cranium base 	80.9 +/- 2 deg	Greater than: mandible is protruded Less than: mandible is retruded
ANB	 <ul style="list-style-type: none"> -Angle formed when A-N-B are joined -Magnitude of skeletal jaw discrepancy, but not which jaw is at fault 	1.6 +/- 2 deg	Greater than: skeletal class 2 Less than: skeletal class 3
SN-Pg	 <ul style="list-style-type: none"> -Angle formed when S-N-Pg are joined -Anteroposterior position of mandible -Basically SNB 	80 +/- 2 deg	Greater than: mandible is protruded Less than: mandible is retruded
Interincisal angle (U1-L1)	 <ul style="list-style-type: none"> -Angle between the long axis of upper and lower incisors -Relationship of incisors 	130 +/- 2 deg	Greater than: retroinclination Less than: proinclination
U1-SN	 <ul style="list-style-type: none"> -Angle formed by intersection of the long axis of the maxillary incisor with the SN plane -Relationship between maxillary dentition to maxilla 	102.1 +/- 1 deg	Greater than: Proinclination Less than: Retroinclination
U1-NA	 <ul style="list-style-type: none"> -Distance from the maxillary incisal tip to the NA line 	3mm	Greater than: Protrusion Less than: Retrusion

L1-MP		-Angle formed by long axis of lower incisor to the mandible	95 +/- 2 deg	Greater than: Proinclination Less than: Retroinclination
L1-NB		-Distance from incisal tip of lower central incisor to NB line -Position of lower incisor relative to the mandible	4mm	Greater than: incisal protrusion Less than: incisal retrusion
MP-SN		-Intersection of mandibular plane and S-Na plane	33 +/- 2 deg	Greater than: Vertical growth Less than: Horizontal growth
Pg-NB		-Linear measurement from NB line perpendicular from it to Pg -Prominence of chin button	1mm	Greater than: Prominent chin button Less than: Deficient chin button
Holdaway angle	-[(ST Pg)-UL] - [(ST Pg)-Na]	10 +/- 2 deg	Greater than: convex Less than: concave profiles	
Skeletal convexity	-Nasion-pogonion plane's distance to A point	-1 to +1 mm	Greater than: skeletal convexity Less than: skeletal concavity	

- Cephalometric analysis
 - Many types: Steiner's, WITS, Down's, Bjork's, Tweed's, McKee, ABO
 - We will use McKee and ABO methods of cephalometric analysis

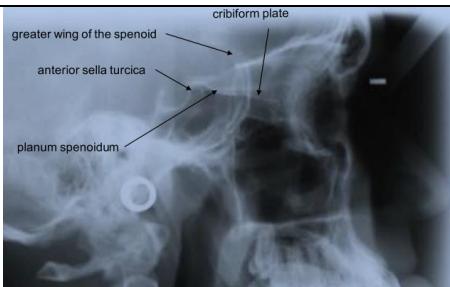
McKee	ABO
<p>Mandible Dentoalveolar</p> <p>IMPA (L1-MP) (°)</p> <p>L1 - NB (°)</p> <p>L1 - NB (mm)</p> <p>L1 Protrusion (L1-APo) (mm)</p> <p>Vertical Dimension</p> <p>FMA (MP-FH) (°)</p> <p>SN - GoGn (°)</p> <p>UFH/TFH (N-ANS:N-Me) (%)</p> <p>LFH/TFH (ANS-Me:N-Me) (%)</p> <p>P-A Face Height (S-Go/N-Me) (%)</p> <p>U6 - PP (UPDH) (mm)</p> <p>L1 - MP (LADH) (mm)</p> <p>L6 - MP (LPDH) (mm)</p> <p>Soft Tissue</p> <p>Upper Lip to E-Plane (mm)</p> <p>Lower Lip to E-Plane (mm)</p> <p>Nasolabial Angle (Col-Sn-UL) (°)</p> <p>Facial Convexity (G'-Sn-Po') (°)</p>	<p>Maxilla to Cranial Base</p> <p>SNA (°)</p> <p>Mandible to Cranial Base</p> <p>SNB (°)</p> <p>SN - MP (°)</p> <p>FMA (MP-FH) (°)</p> <p>Maxillo-Mandibular</p> <p>ANB (°)</p> <p>Maxillary Dentition</p> <p>U1 - NA (mm)</p> <p>U1 - SN (°)</p> <p>Mandibular Dentition</p> <p>L1 - NB (mm)</p> <p>L1 - MP (°)</p> <p>Soft Tissue</p> <p>Lower Lip to E-Plane (mm)</p> <p>Upper Lip to E-Plane (mm)</p>

- Cephalometric superimposition
 - Patient's growth pattern can be tracked at different ages
 - SN plane is reported to be relatively stable over the years → can be used as a reference point
 - S and N are in the mid sagittal plane and are displaced by a minimal degree by movement of the head



Cephalometric superimpositions

- Goal of cephalometrics
 - Evaluate the relationships, both horizontally and vertically, of the five major functional components of the face
 - Relate to population norms or itself over time
- Why is cephalometrics important?
 - Underlying etiology of the malocclusion
 - Limitations of dental casts
 - Finding true midline may not be possible with just a cast
 - Difficult to mount incisors in the correct inclination
 - Differential diagnosis of Cl II and Cl III malocclusions
 - For example, is the class II malocclusion due to a prognathic maxilla or retrognathic mandible?
 - Depending on the offending arch, the treatment plan can vary
 - Provides an indication of future pattern of craniofacial growth
 - Cervical maturation index looks at cervical vertebrae and estimates when growth spurts will happen
 - Prediction on timing of maximal growth
- Cephalometric superimposition
 - Analysis of cephalograms taken at 2 different times on the same patient
 - Purpose
 - Assess changes due to treatment
 - Assess changes due to growth
 - Determining timing of treatment
 - Determining cessation of growth
- Reference points
 - There needs to be a stable reference point when cephalometrics are compared
 - Need to find a structure that remains the same shape and goes not grow over time

Area of interest	Total changes of head	Maxillary teeth	Mandibular teeth
Stable reference point for this area of interest	-Cranial base (anterior sella, greater wing of sphenoid, cribriform plate, and ethmoid crest) -Does not grow after age 7	-Anterior surface of zygomatic process -Secondary landmarks are orbital and nasal floors	-Anterior-inferior contour below pogonion -Inner contour of the cortical plate at the lower border of the symphysis -Contours of the alveolar canal -Secondary: inferior outline of 3 rd molar before root formation
Image			

- Example of using ceph's to see effect on treatment
 - This patient with a severe overjet was given a palatal appliance to try to "distalize" the upper molars
 - Later on, it seemed like the palatal appliance was very effective – but what happened?
 - This is where we use the cephalometric superimpositions to help us understand
 - Looking at the maxillary superimposition (bottom left), it appears that there was hardly any change and molar was not distalized
 - The mandibular superimposition shows significant growth
 - Conclusion: the improvement in occlusion was likely due to the appliance inhibiting maxilla growth, not due to distalizing the molars



- Using superimpositions for determining timing of treatment
 - When a patient presents with orthodontic problems, a cephs is taken and clinical exam is done
 - All the findings and measurements are used to formulate a treatment plan
 - The treatment plan must be tailored to the patient's age and likely growth based on ceps
 - Patient that is 15 should not get "dental camouflaging" (extracting teeth then using the space to pull the anterior teeth back) until they are 19 years old
 - Patient that is 15 cannot have growth modifications as a valid Tx plan
 - Helps determine if surgery is a good treatment choice or not
 - In summary: superimpositions are used to see when patients are at the right time of growth to receive certain treatments
- Using superimpositions for determining cessation of growth
 - Patients with missing teeth may want implants, but implants are not recommended when bone is growing
 - Implants need to be placed when growth has stopped, and bone structure is stable
 - Superimposing ceps is a good way of monitoring when growth has stopped
 - Example on the right → implant placed too early (18) on a male
 - **Gold standard for measuring completion of growth**
 - Nation-menton distance
 - 2 ceps taken 6 months apart → should show no change in distance
 - Other methods for measuring completion of growth
 - Age estimates
 - Hand-wrist radiographs
 - Cervical vertebral maturation



Orthodontic therapy of the mixed dentition patient

- Mixed dentition stage is between 6~12 years of age. During this stage, important developmental steps are happening:
 - Guidance of eruption of permanent teeth
 - Functional occlusion development
 - Skeletal development
 - Arch perimeter development
- Goal of early treatment
 - Alleviate the problems that may interfere with growth and development of an ideal occlusion, ideal facial esthetics, and a stable dentition in an individual
- Diagnostic considerations
 - Present occlusion
 - Possible future development
 - Timing of treatment (early active, early passive, supervision)
- Steps in diagnosis
 - **Cursory examination**
 - Static exam
 - Skeletal problems: A/P disharmony, transverse disharmony, vertical disharmony, asymmetry
 - Non skeletal problems: alignment problems, occlusal problems, diseases
 - Functional exam
 - Visual: functional shift of mandible, dual bites, centric slides, premature contacts
 - Palpation: clicking, crepitus, tender/sore muscles, asymmetry in muscle size, hyperactive muscles
 - From all these exams, a tentative diagnosis is made
 - **Obtaining full diagnostic records**
 - Intraoral radiographs, panoramic radiographs, cephalographs, dental casts, photos
 - **Analysis of diagnostic records**
 - Clinical exam analysis, radiographic analysis, dental cast analysis (arch length + width)
 - **Formation of a problem list**
 - **Comprehensive diagnosis**

- Problems found in the mixed dentition patient

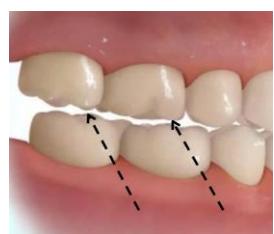
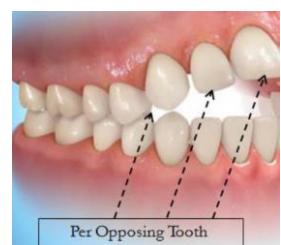
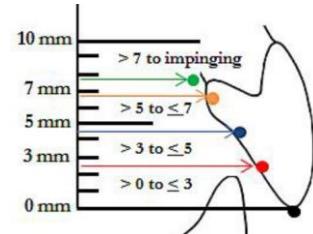
Problem	Case study
Number of teeth -Missing teeth -Supernumerary teeth -Loss of teeth due to trauma, caries, etc	1 = tooth 21 grew in fine 2 = tooth 11 should grow in symmetrically (or within 6 months), but it has not 3 = seems like the lateral incisor is blocking the 11 from growing in 4 = this patient has another lateral incisor -Tx: surgeon decides which lateral is in worse shape/anatomy, and extracts it -Orthodontics association recommends a pan at age 7 to start counting teeth, as this is the age that all the teeth are changing over and you can count all the teeth and see abnormalities
Variation in shape and size of teeth -Spacing or crowding -Fused teeth -Peg laterals	  -Clinical exam shows strange looking incisors -DDx: gemination (twinning) or fusion - Gemination: 2 teeth/crowns from 1 follicle. Most frequent presentation is a big crown connecting to one root/root canal - Fusion: 2 follicles fuse to form 1 tooth -Take a radiograph to get proper diagnosis -Radiograph shows one root and 2 crowns -Final diagnosis is likely gemination
Space management -Space maintenance -Space regaining -Space supervision -Gross discrepancy *Key to successful space management is a proper mixed dentition analysis	Space maintenance -When 1+ primary teeth are lost, arch is susceptible to space loss -Space maintenance treatment aims at maintaining arch length and creating a favorable mixed dentition prediction -Lack of space management or poor management can cause teeth to drift or tip into the edentulous space -Leaves no room for a tooth to erupt into Space regaining -1+ primary teeth have been lost and space lost due to drifting -Mixed dentition analysis must show that there is sufficient room for all permanent teeth if the space from drift is recaptured Space supervision -When it is doubtful if there will be room for all the teeth -Will utilize the leeway space in the lower arch to maximize arch length -Late mesial shift of the mand first molar must not occur -Requires full cooperation of parents and patients Gross space discrepancy -Tooth size and arch size calculations show that there is >5mm space shortage -Class 1 molar relationship -Lack of skeletal discrepancy -Treatment of choice: extract 1 bicuspid in each quadrant to create space
Difficulties in eruption -Alteration in sequence of eruption -Ectopic eruption of teeth -Impaction of teeth	-Here are some pictures to enhance learning
Lateral relationships of dental arches -Dental crossbite -Dental alveolar contraction -Gross disharmony between osseous bases	-Devices can be fabricated to widen the palatal arch and correct a posterior crossbite
Anteroposterior relationships of teeth and arches -Class II -Labioversion of maxillary incisors with class I molar relationship	

Vertical relationships of teeth and dental arches	
-Open bite	
-Excessive overbite	
Gross facial deformities	
-Mandibular prognathism	
-Cleft lip and palate	

- Narrow maxillary arch and lower arch crowding require complex multiple treatment modalities

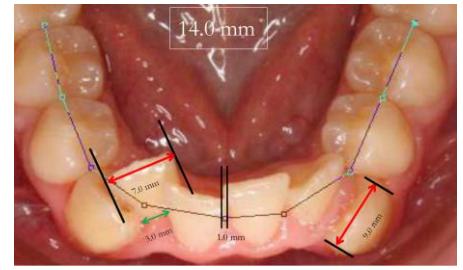
American Board of Orthodontics Discrepancy index

- Scoring system quantifying the degree of orthodontic correction that is needed
 - Aims to make all dentists refer their patients to an orthodontist provide patient centered care
 - All ortho patients must be scored, and those with score >5 must be referred
 - Isolates location of the problems and forces a complete assessment
 - Some cases score high and treatment is easy, other cases score low and treatment is hard
- Occlusion for plaster models is determined by placing the separated, properly trimmed study casts (Mx/Mn) on a flat surface and then bringing them together into maximum intercuspsation. All measurements must be made from this position. For digital models, measurements will be made from a standard 3D orientation that is described in ABO Digital Model Requirements.
- **OVERJET:** Overjet is a measurement between two antagonistic anterior teeth (lateral or central incisors) comprising the greatest overjet and is measured from the facial surface of the most lingual mandibular tooth to the middle of the incisal edge of the more facially positioned maxillary tooth.
 - For ≥ 0 to <1 mm, score 1 pt (edge-to-edge)
 - For ≥ 1 to ≤ 3 mm, score 0 pts
 - For >3 to ≤ 5 mm, score 2 pts
 - For >5 to ≤ 7 mm, score 3 pts
 - For >7 to ≤ 9 mm, score 4 pts
 - For >9 mm, score 5 pts.
 - In addition, if there are anterior teeth with negative overjet (canine to canine in anterior crossbite >0 mm), measure from the facial surface of the maxillary tooth to the middle of the incisal edge of the mandibular tooth.
 - Round any fractional remainder to the next full mm
 - Then score 1 pt per mm per anterior tooth in crossbite.
- **OVERBITE:** Overbite is a measurement between two antagonistic anterior teeth (lateral or central incisors) comprising the greatest overbite.
 - For >0 to ≤ 3 mm, score 0 pts
 - For >3 to ≤ 5 mm, score 2 pts
 - For >5 to ≤ 7 mm, score 3 pts
 - If any of the lower incisors are impinging on the palatal tissues (≤ 0.5 mm) or there is 100% overbite (a complete vertical overlap of antagonistic incisors), score 5 pts.
- **ANTERIOR OPEN BITE:** For each anterior tooth (canine to canine) in an open bite relationship with an opposing tooth, measure from the incisal edge of the Mx tooth to the incisal edge of the Mn tooth.
 - For each anterior tooth in edge-to-edge relationship (0 mm), score 1 pt per tooth.
 - For each anterior tooth in open bite (> 0 mm), round any fractional remainder to the next full mm,
 - Then add 1 pt per mm per tooth in open bite.
 - No points are scored for any anterior tooth that is blocked-out of the arch due to space deficiency or not fully erupted.
- **LATERAL OPEN BITE:** For each maxillary posterior tooth (from the 1st premolar to 2nd molar) in an open bite relationship ≥ 0.5 mm from its opposing tooth, measure cusp to cusp.
 - Round any fractional remainder to next full mm
 - Then score 2 pts per mm of open bite for each tooth.
 - No points are scored for any tooth that is blocked-out of the arch due to space deficiency or not fully erupted.



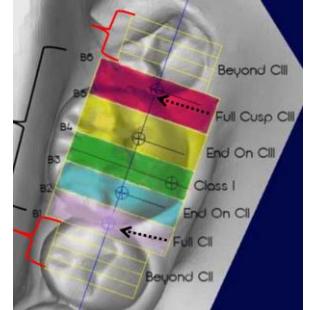
- **CROWDING:** Measure the most crowded arch (only one arch) from the mesial contact point of the right first molar to the mesial contact point of the left first molar. If there are conditions such as missing, fractured or decayed teeth, then measure crowding consistent with your treatment objectives and be prepared to defend the score at your oral examination.

- For ≥ 0 to ≤ 1 mm, score 0 pts
- For >1 to ≤ 3 mm, score 1 pt
- For >3 to ≤ 5 mm, score 2 pts
- For >5 to ≤ 7 mm, score 4 pts
- For >7 mm, score 7 pts.

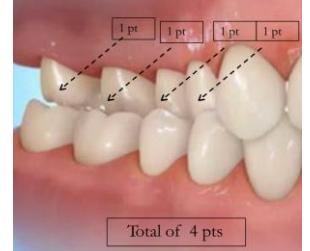


- **OCCLUSAL RELATIONSHIP:** Models must exhibit the patient's maximum intercuspatation. The Angle molar classification is used.

- If the mesiobuccal cusp of the maxillary first molar occludes with the buccal groove of the mandibular first molar or anywhere between the buccal groove and the mesiobuccal or distobuccal cusps (Class I to End On) - Score 0 pts.
- If the mesiobuccal cusp of the maxillary first molar occludes with the mesiobuccal (Class II end-to-end) or distobuccal (Class III end-to-end) cusps of the mandibular first molar – Score 2 pts per side.
- If the relationship is a full Class II or III - Score 4 pts per side.
- If the relationship is beyond Class II or III, measure the additional distance, round any fractional remainder to next full mm – Score 4 pts plus 1 addl. pt per mm per side.



- **LINGUAL POSTERIOR CROSSBITE:** For each maxillary posterior tooth (from the 1st premolar to the 2nd molar) where the maxillary buccal cusp is > 0 mm lingual to the buccal cusp tip of the opposing tooth - Score 1 pt per tooth.



- **BUCCAL POSTERIOR CROSSBITE:** For each maxillary posterior tooth (from the 1st premolar to the 2nd molar) where the maxillary palatal cusp is > 0 mm buccal to the buccal cusp of the opposing tooth - Score 2 pts per tooth.

- **CEPHALOMETRICS:** (See Construction of Mandibular Plane)

- If the ANB angle is $\geq 6^\circ$ OR $\leq -2^\circ$, score 4 pts; then, add 1 pt for each full degree $> 6^\circ$ OR $< -2^\circ$
- If the SN-MP angle is between 27° and 37° score 0 pts.
- If the SN-MP angle is $\geq 38^\circ$, score 2 pts; then, add 2 pts for each full degree $> 38^\circ$.
- If the SN-MP angle is $\leq 26^\circ$, score 1 pt; then, add 1 pt for each full degree $< 26^\circ$.
- If the Lower Incisor to MP angle is $\geq 99^\circ$, score 1 pt; then, add 1 pt for each full degree greater than 99° .

- **OTHER:** (List number of occurrences and total points.)

- Supernumerary teeth – Score 1 pt for each extra tooth.
- Ankylosis of permanent teeth – Score 2 pts per tooth.
- Anomalous morphology of tooth size & shape (e.g. natural and/or iatrogenic) - Score 2 pts per tooth.
- Impaction of teeth (except 3rd molars) – Score 2 pts per tooth.
- Midline discrepancy – The midline for each arch equals the mid-point between the Mx central incisors and the Mn central incisors demonstrated by two vertical reference lines. The discrepancy is the difference between the two vertical reference lines measured in the horizontal plane – Score 2 pts for ≥ 3 mm.
A diagram shows a dental arch with two vertical dashed lines representing the midlines of the upper and lower central incisors. A red arrow points to the horizontal distance between these lines, labeled '4.0 mm midline discrepancy = 2 pts.'
- Missing teeth (except 3rd molars) - o Non-congenital – Score 1 pt per tooth. o Congenital – Score 2 pts per tooth.
- Spacing – o For generalized spacing per arch in which there is ≥ 0.5 mm of space on both sides of any 4 teeth or more - Score 2 pts per arch. o For Mx central diastema of ≥ 2 mm - Score 2 pts.
- Tooth transposition – Score 2 pts for each event.
- Skeletal asymmetry (treated nonsurgically) – Score 3 pts (appropriate diagnostic information recommended)
- Additional treatment complexities - Score 2 pts each and identify.

TOTAL D.I. SCORE

OVERJET

≥ 0 to < 1 mm (edge-to-edge)	= 1 pt
≥ 1 to ≤ 3 mm	= 0 pts
> 3 to ≤ 5 mm	= 2 pts
> 5 to ≤ 7 mm	= 3 pts
> 7 to ≤ 9 mm	= 4 pts
> 9 mm	= 5 pts

Negative Overjet (x-bite):

1 pt per mm per tooth

Total = pts
OVERBITE

> 1 to ≤ 3 mm	= 0 pts
> 3 to ≤ 5 mm	= 2 pts
> 5 to ≤ 7 mm	= 3 pts
Impinging (100%)	= 5 pts

Total = pts
ANTERIOR OPEN BITE

0 mm (edge-to-edge), 1 pt per tooth	= <u> </u> pts
then 1 pt per mm per tooth	= <u> </u> pts

Total = pts
LATERAL OPEN BITE

≥ 0.5 mm, 2 pts per mm per tooth	Total = <u> </u> pts <input type="text"/>
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CROWDING (only one arch)

≥ 0 to ≤ 1 mm	= 0 pts
> 1 to ≤ 3 mm	= 1 pts
> 3 to ≤ 5 mm	= 2 pts
> 5 to ≤ 7 mm	= 4 pts
> 7 mm	= 7 pts

Total = pts
OCCLUSAL RELATIONSHIP

Class I to End On	= 0 pts
End-to-End Class II or III	= 2 pts per side
Full Class II or III	= 4 pts per side
Beyond Class II or III	= 1 pt per mm additional

Total = pts

For mm measures, round up to the next full mm.
Examiners will verify measurements in each category.

LINGUAL POSTERIOR X-BITE> 0 mm, 1 pt per tooth Total = pts
BUCCAL POSTERIOR X-BITE> 0 mm, 2 pts per tooth Total = pts
CEPHALOMETRICS (See Instructions)

ANB $\geq 6^\circ$ or $\leq -2^\circ$	@4pts = <u> </u>
Each full degree $> 6^\circ$	<u> </u> x 1 pt = <u> </u>
Each full degree $< -2^\circ$	<u> </u> x 1 pt = <u> </u>

SN-MP

$\geq 38^\circ$	@2pts = <u> </u>
Each full degree $> 38^\circ$	<u> </u> x 2 pts = <u> </u>

 $\leq 26^\circ$

Each full degree $< 26^\circ$	@1pt = <u> </u>
<u> </u> x 1 pt = <u> </u>	

 $\bar{1}$ to MP $\geq 99^\circ$

Each full degree $> 99^\circ$	@1pt = <u> </u>
<u> </u> x 1 pt = <u> </u>	

Total = pts
OTHER (See Instructions)Supernumerary teeth x 1 pt = Ankylosis of permanent teeth x 2 pts = Anomalous morphology x 2 pts = Impaction (except 3rd molars) x 2 pts = Midline discrepancy (≥ 3 mm) @ 2 pts = Missing teeth (except 3rd molars) x 1 pt = Missing teeth, congenital x 2 pts = Spacing (4 or more, per arch) x 2 pts = Spacing (mx cent diastema ≥ 2 mm) @ 2 pts = Tooth transposition x 2 pts = Skeletal asymmetry(nonsurgical tx) @ 3 pts = Addl. treatment complexities x 2 pts =

Identify:

Total Other = pts

Congenitally missing teeth

- Types of missing teeth disorders
 - **Anodontia:** total absence of all teeth (rare)
 - **Oligodontia:** partial anodontia, absence of many but not all teeth
 - **Hypodontia:** absence of only a few teeth
- Epidemiology
 - Incidence is 1.5~9.6%
 - Racial tendencies
 - 7.7% of African Americans are missing lower second premolars
 - 9.2% of Japanese are missing lower lateral incisors
 - More common in women, and has a genetic link
 - Having no primary teeth means the following permanent tooth will also be missing
 - Primary teeth are missing in 0.5~0.9% of the population
- Partial anodontia
 - Relatively rare
 - Usually associated with a systemic abnormality
 - For example, ectodermal dysplasia presents with thin, sparse hair, absence of sweat glands and congenitally missing numerous teeth
 - Individuals with a family history are at greater risk
- Hypodontia
 - Individuals with a family history are at greater risk
 - Maxillary lateral incisors have the highest genetic component of variability
 - Canines have the smallest genetic influence on its size
 - Relatively common finding
 - Most commonly missing tooth are third molars (20%)
 - Second most common missing tooth are lower 2nd premolars (3.4%) and upper laterals (2.2%)
 - Upper laterals most frequently missing when only 1~2 teeth absent
 - Second premolars most frequently missing when >2 teeth absent
 - Rule of thumb: if 1~3 teeth are missing, the absent tooth will be the distal tooth of any given type (3rd molars, 2nd premolars, 2nd incisors)
 - Association of hypodontia to craniofacial development
 - Hypodontia in the general population is 1.5~9.6%. Most common in 8 >> lower 5 > upper 2 > upper 5
 - Hypodontia in the cleft population is >25.5%. Most common in 8 >> upper 2 (cleft side) >> upper 5 (on normal side) >> lower 5

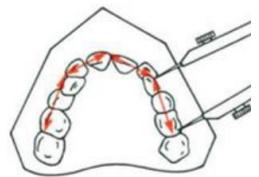
- Treatment of missing permanent teeth
 - 2 treatment options: open the edentulous space, or close the edentulous space

	Open the space	Close the space
Things to consider	<ul style="list-style-type: none"> -Manage and maintain space -Leave ridge in ideal condition for future restoration -Create correct amount of space 	<ul style="list-style-type: none"> -Avoid detrimental alterations to the occlusion and facial profile if decision is to close the space
In missing anteriors	<p>Objectives</p> <ul style="list-style-type: none"> -Distalize canines into a class I occlusion with canine rise in laterotrusus -Obtain a proper midline -Achieve golden proportions of tooth size and gingival architecture -Improve/maintain facial profile -Restore missing space with a prosthesis <p>Implants</p> <ul style="list-style-type: none"> -Today, the restoration of choice is an implant -Should not be placed if patient is still growing -Waiting too long before placing implants → ridge can resorb 	<p>Considerations</p> <ul style="list-style-type: none"> -Golden proportions in dental esthetics -Tooth size discrepancies -Gingival architecture with the mesial movement of cuspids to replace lateral incisors -Need RCT + crown to eliminate lingual cusp interference of upper first premolar -Overjet -Will create a flatter facial profile – keep in mind <p>Objectives</p> <ul style="list-style-type: none"> -Obtain a proper midline -Canine guidance in laterotrusus
In missing posteriors	<p>For mildly infraoccluded E's (E grew in, but no premolar replaced it)</p> <ul style="list-style-type: none"> -Keep the primary molar if possible -Prognosis of keeping primary molar is good in lower arch, but poor in upper arch -Reduce width of the retained primary molar to optimize occlusion (shave mesial + distal surfaces) -If there is a disparity in alveolar bone levels, just extract the infraoccluded (low) primary molar -If the lower primary molar is only slightly infraoccluded, it can be built up with restorative material -Take a disc and trim the mesial and distal surfaces -Can be matched to upper arch with a restoration as well 	<p>Considerations</p> <ul style="list-style-type: none"> -Evidence of dental crowding -Premolar extraction -Orthodontic anchorage with mini screws for molar protraction -Long term retention of space closure -Eliminate need for prosthetic replacement
Indications	<ul style="list-style-type: none"> -Minimal growth remaining (growth can be assessed with lateral cephs or hand-wrist radiographs) -Space adequate for restoration -Ideal occlusion already exists -No further orthodontic intervention -Assessment of ridge augmentation -Dental esthetics 	<ul style="list-style-type: none"> -Opposite of ← I guess?

- Studies regarding opening/closing spaces
 - Upper anteriors
 - Space can be closed/left open without much difference in occlusal function/cupid rise
 - No relationship between periodontal status between 2 groups
 - Lower anteriors
 - Closure: facial profile flatter, midline discrepancy, lateral/cupid function, overjet
 - Open: facial profile maintained, midlines on center, cupid rise function, need for prosthesis
- Using orthodontics to maintain ridge space
 - When a tooth is extracted, allow the adjacent to drive into the extracted site
 - Later on, use orthodontics to move the drifted teeth back and open up the edentulous site
 - This will deposit a robust alveolar ridge while the tooth is moved back
 - An implant can now be placed on the robust ridge

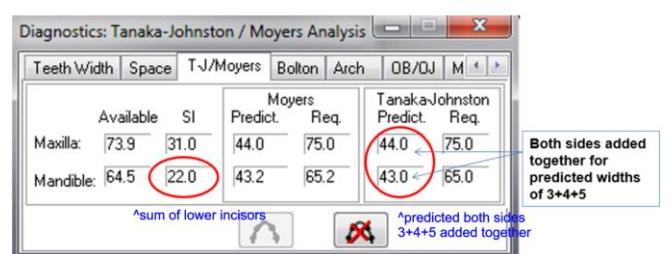
Mixed dentition and Bolton analysis

- Arch analysis
 - Can be done digitally or manually on a cast. Today, the manual method is still more popular
 - The manual method involves using a Boley gauge
- Arch measurements
 - **Maxillary depth:** height from occlusal table to height of palate
 - **Symmetry:** individual teeth compared on both sides, using the midpalatal suture as the midline
 - **Required arch length:** sum of mesio-distal widths of each tooth mesial to the first molar
 - **Available arch length:**
 - Segment technique
 - Divide the arch into 4 segments ($15/14/13 + 12/11 + 21/22 + 23/24/25$)
 - Add them up
 - Brass wire technique
 - 0.5mm thick malleable wire is placed from the mesial of the 6 to other 6
 - If teeth are well aligned, wire is placed on incisal edges
 - If teeth are proclined, wire is placed on cingulums
 - If teeth are retroclined, wire is placed on buccal surfaces
 - **Discrepancy in required/available arch lengths**
 - Arch length available – arch length required = ideally 0
 - If there is excess arch length = arch has spacing
 - If there is deficient arch length = arch is crowded
 - However, this only works when all the permanent teeth have grown in. What if the patient is presenting with a mixed dentition?
- Arch analysis for mixed dentitions
 - You can measure the arch length available, because that's always measurable
 - For arch length required, you can't measure it because not all the permanent teeth are erupted
 - There are models to predict what the width of 3/4/5 will be based on widths of 1/2
 - Moyer's prediction chart
 - Uses the sum of **lower** incisors to predict the width of all **upper and lower** 3/4/5's
 - The chart on the right is using lower incisors to predict upper 3/4/5
 - We use 75% probability, meaning 75/100 patients will be smaller or equal to this value (tends to overestimate, which is good)
 - This prediction method has a standard deviation of 1.0mm
 - Calculating mandibular required arch length: $(4 \text{ mand incisors}) + 2 * (3/4/5 \text{ predicted})$
 - Calculating maxillary required arch length: $(4 \text{ max incisors}) + 2 * (3/4/5 \text{ predicted})$
 - Tanaka and Johnston
 - Instead of using a chart, it uses a simple formula
 - Quick and easy
 - No tables needed
 - Tends to over estimate, which is better than underestimating required arch length
 - Greatest amount of error
- UBC TJ/Moyers analysis in OrthoCAD
 - 22.0 mm is used to make all predictions
 - 44.0 and 43.0 are the predicted values of bilateral 3/4/5 in each arch
 - Limitation: Leeway space is included in available space, which is not good because it could be lost

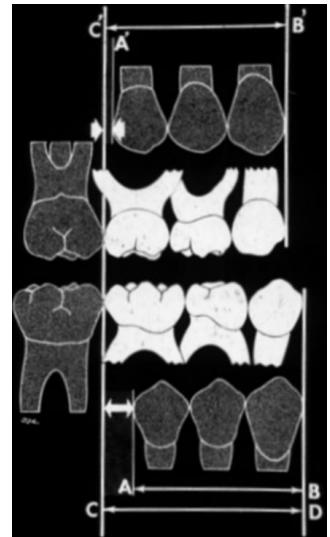


Probability chart for predicting the sum of the widths of upper 3,4, & 5 on one side.												
Σ lower incisors	19.5	20.0	20.5	21.0	21.5	22.0	22.5	23.0	23.5	24.0	24.5	25.0
95%	21.6	21.8	22.1	22.4	22.7	22.9	23.2	23.5	23.8	24.0	24.3	24.6
85%	21.0	21.3	21.5	21.8	22.1	22.4	22.6	22.9	23.2	23.5	23.7	24.0
75%	20.6	20.9	21.2	21.5	21.8	22.0	22.3	22.6	22.9	23.1	23.4	23.7
65%	20.4	20.6	20.9	21.2	21.5	21.8	22.0	22.3	22.6	22.8	23.1	23.4
50%	20.0	20.3	20.6	20.8	21.1	21.4	21.7	21.9	22.2	22.5	22.8	23.0

$\frac{\text{M/D Width of 4 MN Incisors}}{2} + 10.5 = \text{Mandibular C + PM1 + PM2}$
$\frac{\text{M/D Width of 4 MN Incisors}}{2} + 11.0 = \text{Maxillary C + PM1 + PM2}$



- Leeway space
 - Permanent premolars are always smaller than the primary molars that precede it
 - Leeway space is how much space is left when primary molars come out and premolars come in
 - Mandibular leeway space = 1.7mm on each side
 - Maxillary leeway space = 0.9mm on each side
 - Leeway space includes the canines
 - Normally, leeway space will be lost as teeth will drift forward
 - If there is a flush terminal plane (max 6 and mand 6 are completely in line end-to-end), the leeway space will establish a molar class 1 relationship
 - The maxillary molar moves ~0.9mm, the mandibular molar moves ~1.7mm
 - Since the mandibular molar moves more, the class 1 relationship is obtained
 - In mixed dentition analyses, if the leeway space is already lost, don't subtract it from space available
 - An appliance can be used to maintain leeway space if it is absolutely needed
- Bolton analysis
 - Analysis of permanent dentition only – not used in mixed dentition
 - Measures the ratio between maxillary teeth to mandibular teeth
 - 5% of the population will have tooth size discrepancies between arches, mostly due to maxillary laterals
 - Ideal ratios
 - $[\text{Mandibular 3-3}] / [\text{Maxillary 3-3}] = 77.2\%$
 - $[\text{Mandibular 6-6}] / [\text{Maxillary 6-6}] = 91.3\%$
 - When it says 6-6, it includes up to the distal of the 6
 - Analysis
 - If anterior ratio $>77.2\%$ = mand teeth too big and is excessive and overjet may be reduced
 - Look at the Bolton chart, and see what the correct mand 6 size should be
 - $(\text{Actual mand 6}) - (\text{Correct mand 6})$ = excess mand 6 in mm
 - A value $>1.5\text{mm}$ is significant
 - Ways to fix: mand interproximal reduction, extraction of mand incisors, expand max incisors
 - If anterior ratio $<77.2\%$ = max teeth too big and is excessive and overjet may be increased
 - Look at the Bolton chart, and see what the correct max 6 size should be
 - $(\text{Actual max 6}) - (\text{Correct max 6})$ = excess max 6 in mm
 - A value $>1.5\text{mm}$ is significant
 - Ways to fix: max interproximal reduction or leave extra overjet
 - Same method for 6-6 ratio



Consequences of delaying orthodontic treatment

- Consequences associated with malocclusions
 - Facial esthetics due to digital habits or maxillary constrictions w. a functional mandibular shift
 - Root resorption due to crowding and arch length discrepancies
 - Periodontal disease (bone loss + recession) due to traumatic anterior crossbite with AP shifts
- Treating too early
 - Lateral incisor's root can resorb with early FEA treatment
 - Long period of retention
 - Poor patient cooperation
- Treating too late
 - Where the lack of treatment has a consequence, it is not apparent until the passage of time - when your patient approaches adulthood
 - May be too late to address sequelae of problems that could've been addressed at a younger age
 - Teeth are subject to random drifting and malocclusion due to growth
- Types of random drifting of teeth
 - Passive eruption without opposing contacts

Findings	How it can be addressed
Overeruption of mandibular anteriors in class III relationships	-Increase vertical height of teeth -Can prevent jaw surgery
Overeruption of maxillary anteriors leading to a deep bite with big overjet	-Deep bite could cause trauma, no anterior guidance -Give braces to reduce overbite
Premature loss of teeth causing overeruption of opposing teeth	-Need for an implant or a prosthesis to prevent overeruption of opposing tooth

- Ectopic eruption of teeth
 - Teeth can be impacted, ankylosed, or resorbed (upper E's)
 - **Impaction** – frequent with the canines, and can be due to supernumerary teeth
 - **Ankylotic teeth** – ankylosed teeth can cause vertical bone defects, so it's better to take them out early and bone graft the site
 - **Resorption** – sometimes when the 6 erupts ectopically, it can start resorbing the E's roots
 - When the E's are prematurely lost due to ectopic 6's or due to decay, the space loss has to be fixed via space regaining
- Supernumerary teeth
 - Mesiodens can affect the eruption pattern of adjacent teeth
 - Mesiodens: supernumerary tooth in the midline between central incisors
- Congenitally missing teeth and retained primary teeth
 - Will need to decide if the space should be left open or closed (see previous lecture)
 - Extracting + closing the space should be done in patients with facial fullness and significant crowding
 - Allow for natural space closure
 - Prosthetic preparations may be needed
 - Associated with alveolar clefting
 - Second premolars and upper lateral incisors are commonly missing
- Occlusal wear
 - Overeruption of teeth with incisal wear
 - TMJ symptoms

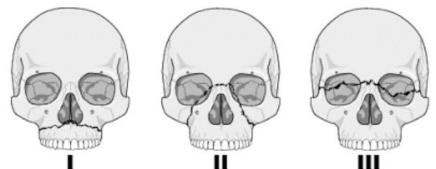
- Consequences of adverse growth on malocclusions
 - Growth patterns/directions
 - Transverse growth (Growth in the medio-lateral direction)
 - Easily manipulated (maxillary constrictors, palatal expanders, etc)
 - Anteroposterior growth
 - Class II malocclusion can result due to max prognathism or mand retrognathia
 - Class III malocclusion can result due to max retrognathia or mand prognathism
 - Easily manipulated with arch expansion and constriction
 - Exception: a prognathic mandible cannot be constricted due to TMJ problems, so surgical intervention is the only option
 - Vertical growth
 - Gets worse with time, and is hard to control
 - May lead to an open bite
 - Functional concerns and influence on growth
 - Maxillary constriction
 - Results in mandibular asymmetry → CR and CO discrepancies
 - Can affect normal growth
 - Seen in hemifacial mandibular microsomia
 - Is a consequence of delayed expansion
 - Digital habits
 - Tongue thrust habit, thumbsucking habit, narrow maxilla
 - Needs treatment if there is an open bite
 - Eruption pattern and crowding
 - Expansion or extraction
 - Effect on facial esthetics, root resorption, and periodontal health
 - Prosthetic preparation
- Consequences of delayed expansion
 - Expansion is difficult or unstable
 - Adverse growth patterns may result
 - Mandibular skeletal asymmetry may result
- Mandibular skeletal asymmetry
 - Can be corrected only if it's due to a functional shift
 - In other words, the shape of the mandible is fine, but there is asymmetrical TMJ orientations
 - If the asymmetry is due to the actual mandibular shape, it cannot be fixed
 - Example: Goldenhar syndrome
 - Presentation: short ramus, no condyle, no ear, asymmetrical mandible
 - Etiology: lack of brachial arch 2
- Ideal treatment time
 - Treatment is most effective when the malocclusion can be influenced or altered, reducing future treatment (surgical or otherwise), trauma, and compromise to dental health
 - “Altering” malocclusion: keeping the malocclusion but due to an altruistic cause (reducing trauma, preventing root resorption, or recession)
 - This is commonly during the patient's growing years, where poor timing contributes to an iatrogenic or aberrant growth pattern

Crossbite

- Background
 - Crossbite: abnormal relationship between teeth of the opposing arch. Reversal of B-L relationships
 - Fixing crossbites due to an underlying skeletal issue will need surgery
 - If a patient refuses surgery, then just fixing the crossbite by dental means will cause perio issues
 - Generally will not self correct
 - Affects 8~16% of deciduous teeth and 8~16% of mixed dentitions
- Reasons to fix crossbite
 - Periodontal concerns (recession)
 - Chipping and wearing of teeth and esthetics
 - Functional shift
- Etiology (don't need to know)
 - Environmental (thumb sucking habit), congenital (cleft palate), developmental, traumatic, iatrogenic
- Diagnosis
 - Seeing crowded, rotated, displaced teeth occluding in crossbite
 - Existence of a narrow tapering maxillary arch or high palatal vault
- Hidden crossbites
 - **Dental compensation:** When a crossbite is revealed after fixing a dental issue (flared max. incisors, upright lower incisors, accentuated mand CoW)
 - **Class II occlusion:** when the skeletal A-P discrepancy is fixed, turns out the mandible is actually too wide for the maxilla, causing the crossbite
- Types

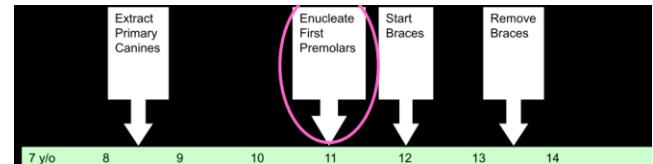
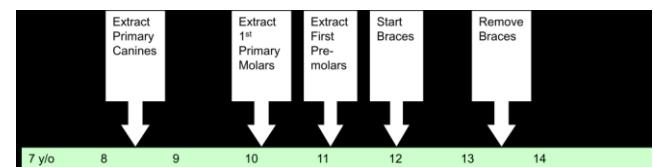
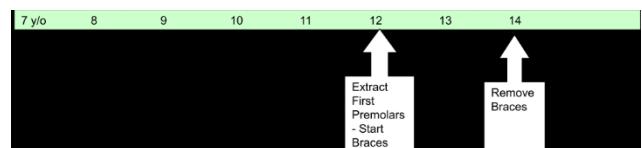
	Anterior	Posterior
Dental crossbite	<ul style="list-style-type: none"> -Insufficient arch length, crowding -Over-retention of primary teeth -Ectopic development of the tooth bud (secondary to trauma or idiopathic) -Typically involves 1~2 teeth <p>Treatment</p> <ul style="list-style-type: none"> -Space must be available, or space must be created -Bite plane or composite buildup may be needed to "jump" the bite <u>Tipping only:</u> -Removable appliance with springs -Fixed (LHA) with springs <u>Torquing, uprighting, or translation:</u> 	<ul style="list-style-type: none"> -Unilateral or bilateral -Teeth are tipped buccal/lingual -Malpositions in one or both arches -Single or group of teeth -May occur if there is skeletal transverse discrepancy <p>Treatment</p> <ul style="list-style-type: none"> -Removable appliances with fingersprings (for tipping) -Removable appliances with a midline jackscrew -Fixed appliances (torqueing, derotating) -Cross arch elastics -Occlusal adjustment or extractions of primary canines (functional shift)
Functional crossbite	<ul style="list-style-type: none"> -Pseudo class III -Patient has to push the mandible forward (+/- laterally) so that they have molar contact -Could involve entire anterior segments -May have dental or skeletal component 	<ul style="list-style-type: none"> -Fixed edgewise appliance <ul style="list-style-type: none"> -Mandible could deflect to one side as the patient closes in CO -Manipulation will bring mandible to edge-to-edge or OJ -Sunday bite: some kids try to hide their class I/II by forcing the mandible forward, making it look like a class III. Creates significant TMJ problems
Skeletal crossbite	<ul style="list-style-type: none"> -Associated with skeletal class III -Typically involves entire anterior segment -No amount of manipulation can bring teeth into positive overjet or edge-to-edge contacts <p>Treatment</p> <ul style="list-style-type: none"> -Face mask (in a young growing patient) for maxillary deficiency -Posterior bite plane to jump the bite when required -Fixed edgewise appliance -Surgery in non growing patients 	<ul style="list-style-type: none"> -Bilateral: usually due to small maxilla, normal mand -Unilateral: usually due to small maxilla (symmetrical) corrected with a functional shift. Sometimes due to asymmetric mandible growth with no functional shift -Unilateral maxillary abnormalities are rare -Asymmetric mandibles can be idiopathic, due to condylar damage, or due to disease/pathology <p>Treatment</p> <ul style="list-style-type: none"> -Rapid maxillary expander (once 6's have erupted) -Superscrew (wrench) -W-arch -Quad helix -Removable split acrylic plates (young patients only)

- Pseudo class III
 - Proper diagnosis is critical
 - Dental: linguoversion of upper anterior or labioversion of lower anteriors
 - Skeletal: slight maxillary retrognathism, slight mandibular prognathism
 - Combination of the above
 - Class III malocclusions that are primarily skeletal will not be pseudo class III
- Which appliance to use?
 - Removable appliances
 - Advantages: easy to clean, and only does tipping (won't move roots where you don't want)
 - Disadvantages: compliance, and only does tipping (you may want to move the roots in 3 dimensions)
 - Fixed appliances
 - Advantages: compliance not an issue, allows torque control (move tooth in 3 dimensions)
 - Disadvantages: difficult hygiene, possibility of root resorption/damage due to torque
 - W arch/quad helix
 - Practitioner is able to control amount of expansion, and it is slow
 - Allows for individual dental movement, whereas RPE cannot
 - Smaller than an RPE, so easier for patient to adjust to
 - However, it requires more office time, may need re-cementation, increased tipping compared to RPE, and arms can be broken or distorted by the patient
 - Rapid palatal expander
 - Allows the maximum skeletal change
 - Success is determined by the skeletal age (not chronological age). Ideally 8~10 years old
 - Activation is done at home by the patient or parent → 1 turn = 0.125mm
 - Cannot be bent or broken by patient
 - However, they are harder to adjust to and individual teeth movements are not possible
 - Face masks
 - Apart from temporary anchorage devices and bone plates, this is the only device that can cause skeletal changes in class III's
 - Changes the skeletal frame and pulls the mandible down
 - Can also pair with an expander to open up the suture
 - Needs a posterior mandibular bite block
 - Need to do it in patients <10 years
 - Temporary anchorage device
 - Mini implant
 - Ultimate anchorage when you can't use other teeth as anchors (like pulling an intruded tooth)
 - Bone plates
 - Ultimate anchorage from a titanium plate screwed into bones
- Decompensation
 - In skeletal class III's, the mandibular anteriors are linguoclined
 - The lower anteriors are decompensated by orthodontically moving them buccally → worsens crossbite
 - When surgery is done to correct the class 3 occlusion, the lower anteriors will now be in proper occlusion
 - Types of surgeries
 - LeFort 1: surgerize the maxilla, usually for orthodontics
 - LeFort 2: right below the orbit
 - LeFort 3: for car accidents

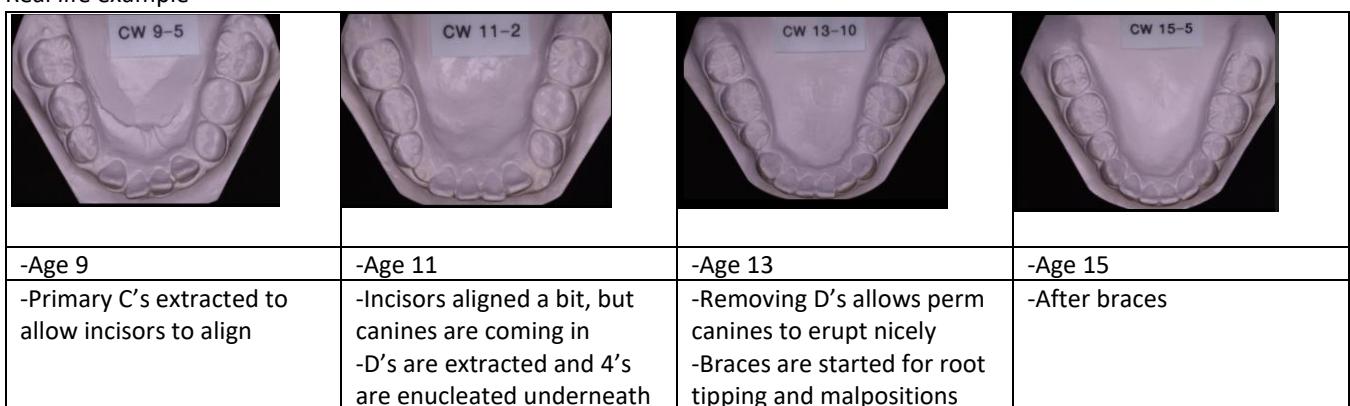


Serial extraction

- What it is
 - Removal of primary teeth then permanent teeth then fixed appliances
 - 15% of the population has 7mm or more of crowding, with it being more common on the mandible
 -
- Indications
 - Requirements: class I, no missing teeth, no ectopic teeth, minimal overbite, protrusive dentition
 - Serial extraction will deepen overbite, so you want it to be minimal initially
 - Serial extraction will bring anterior teeth back, so you want it to be protrusive initially
 - Significant crowding of 8mm or more
- Timeline
 - Late premolar extraction
 - Did this back in the day
 - Waited for all permanent teeth to come in at 12 years old, and immediately place braces
 - Keep braces for 2 years
 - Serial extraction
 - Remove primary canines → allows 4 incisors to spread out
 - Wait until age 10, then remove D's → speeds up eruption of permanent 4's
 - 4's erupt earlier → extract the 4's right away
 - Allows permanent canines to align properly
 - At age 12, adult teeth should erupt. This is when you start braces
 - Due to the serial extractions done before, braces should only be needed for 1.5 years
 - Serial extraction via enucleation
 - At age 10, D's are extracted and permanent 4's are enucleated all in one appointment
 - Patient doesn't need to come back later to take out 4's

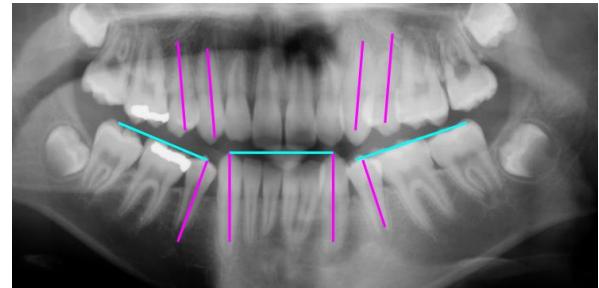


- Real life example



- Is serial extraction of C's effective in aligning the 4 incisors?
 - Not guaranteed that the incisors will line up once primary canines are extracted
 - Study of 31 serial extraction cases (Yoshihara et al, 2000) showed that:
 - There is significant improvement in irregularity after extracting C's (relieves 6mm of crowding)
 - Extracting 4's has a small effect on incisor alignment
 - Most change happened after extracting C's (age 8.9 to age 11.9)

- Disadvantages to serial extraction
 - The creation of space causes teeth to fill in, which is good
 - However, the lower teeth will tip
 - Curve of Spee will deepen
 - Incisors will tend to extrude to a higher occlusal level than the posteriors (see blue line)
 - This is what deepens the overbite
 - Curve of Wilson will deepen
- Advantages to serial extraction
 - Canine erupts into attached gingiva, rather than having them erupt buccally, which is usually the case when there is crowding
 - Buccally erupted canines are initially supported by non-attached gingiva
 - When the canines are then put into the correct place, they have very bad recession
 - SE saves treatment time
 - Study showed that it saved, on average, 11 months of treatment compared to late premolar extraction
 - You have to do more appointments, but the total treatment duration is shorter
 - Teeth mostly self-align, allowing easier treatment (driftodontics)
- Serial extraction and its effect on the face
 - Smile width: study in 2003 showed that smile width was not negatively impacted
 - Facial profile: extractions don't change or negatively affect the profile. Facial flattening happens from nose and chin growth



Benefits of early management of orthodontic problems

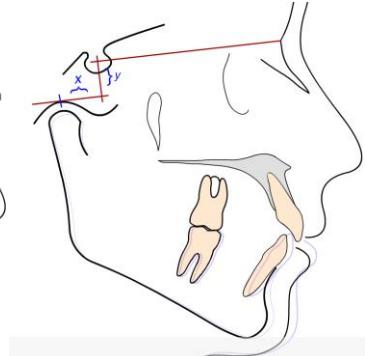
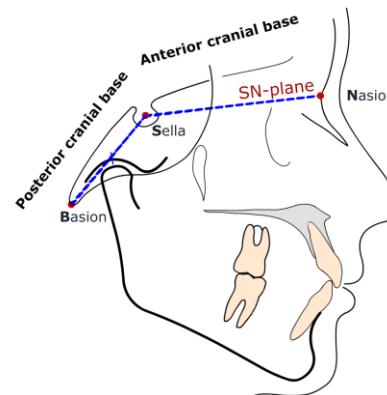
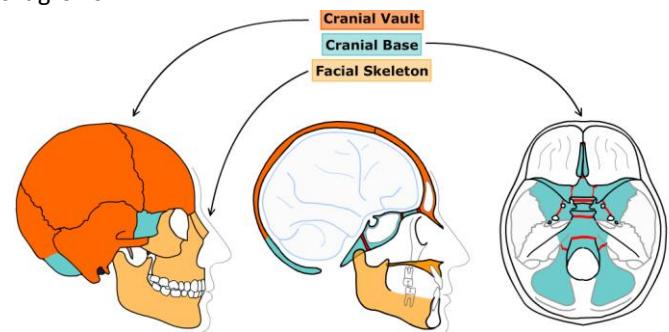
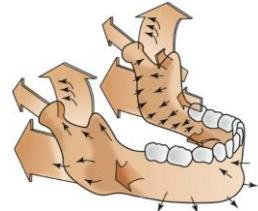
Indications for early intervention	Benefits of early treatment
<ul style="list-style-type: none"> • Anterior crowding and midline shifts • Anterior crossbite (crossbites should be fixed early, and alignment can be fixed later on) • Posterior crossbite (usually due to a small maxilla, which needs expansion) • Early or late loss of deciduous teeth • Deep overbite, large overjet • Open bites (due to habits only. Open bite due to a retrognathic mandible cannot be treated early) • Ectopic eruption (can impact teeth, cause root resorption) • Missing teeth (can cause asymmetry) • Impacted teeth • Habits (thumb, finger, tongue, lip) • Skeletal class II and III (headgears used early could prevent need for surgery) • Ankylosed teeth • Congenitally missing teeth or extra teeth • Excess space, midline diastema (although diastemas sometimes close when laterals erupt, patient may want immediate Tx) 	<ul style="list-style-type: none"> • Influence jaw growth in a positive manner • Harmonize width of dental arches • Improve eruption patterns • Lower risk of trauma to protruded upper incisors • Correct harmful oral habits • Improve esthetics and self esteem • Simplify and shorten treatment time for ortho later on • Reduce likelihood of permanent impacted teeth • Improve speech problems • Preserve or gain space for erupting permanent teeth

- Recommendation is to screen children for ortho at age 7
 - Posterior occlusion is established around this age, when the first molars erupt
 - You can assess the antero-posterior and transverse relationships of the occlusion
 - You can check for functional shifts
 - Incisors have begun to erupt, so early problems like crowding, habits, deep bites, open bites, asymmetries visible
 - Parent's peace of mind
 - Dentist appears informed, caring, and concerned for the well being of the patient

Growth indices

- Development of the head relative to the body
 - The limbs show drastic increases in size
 - Comparatively, the increase in size of the head is minimal
 - However, the growth in the head is more complicated than simple elongation
 - There is an increase in size (apposition), displacement, and remodelling (resorption)
 - The picture shows remodelling of the jaw as it grows
- Growth and development of the head
 - Cranial vault and facial skeleton grows via intramembranous ossification. It contacts other bones via sutures
 - Cranial base grows via endochondral ossification. It contacts other bones via synchondroses
 - Modularity: each module of region of the skull grows independently of each other
 - Integration: regions of the skull are influenced by others during growth
 - Sequence of growth
 - Transverse and antero-posterior growth of the head finishes first
 - Then, the head grows vertically
 - As the vertical dimension increases, the teeth erupt to maintain occlusal contacts resulting in increased alveolar bone height
 - This is why you should wait for full growth before placing implants
 - Growth rates are not constant with age
- Cranial base size and its effect on occlusion
 - Class III occlusion → smallest cranial bases
 - Class II occlusion → largest cranial bases
- Sella-condyle distance and its effect on occlusion
 - Small A-P distance → class III
 - Large A-P distance → class II
 - Small vertical distance → open bite
 - Large vertical distance → deep bite
- Why do we care about growth?
 - Class II malocclusion
 - Corrected by holding back the mandible to grow
 - Best to fix class II's during peak growth
 - Class III malocclusion
 - Corrected by advancing the midface to catch it up with the mandible
 - Best to fix class III's before peak growth
 - You need to know when to time these treatments, because you can extract teeth and treat a patient for many years and have it all relapse
 - Example in the online lecture: class III occlusion was fixed with extractions and headgear
 - In the end, the patient ended up having the class III relapse at age 18
 - We need to know not to execute treatment prematurely
 - **Any surgeries must be done after growth has finished**
- Methods to assess growth

Chronological	-Number of years the person has been alive -Does not reliably identify onset of pubertal growth
Biological	-For orthodontics: hand+wrist maturation, 3 rd finger middle phalanx maturation, cervical vertebral maturation, dental maturation -Others: standing height, menarche and voice change, biomarkers
Others	-Psychological, functional, social



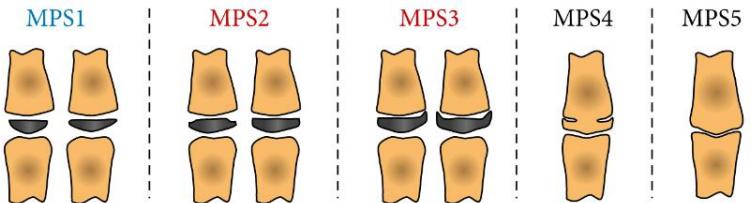
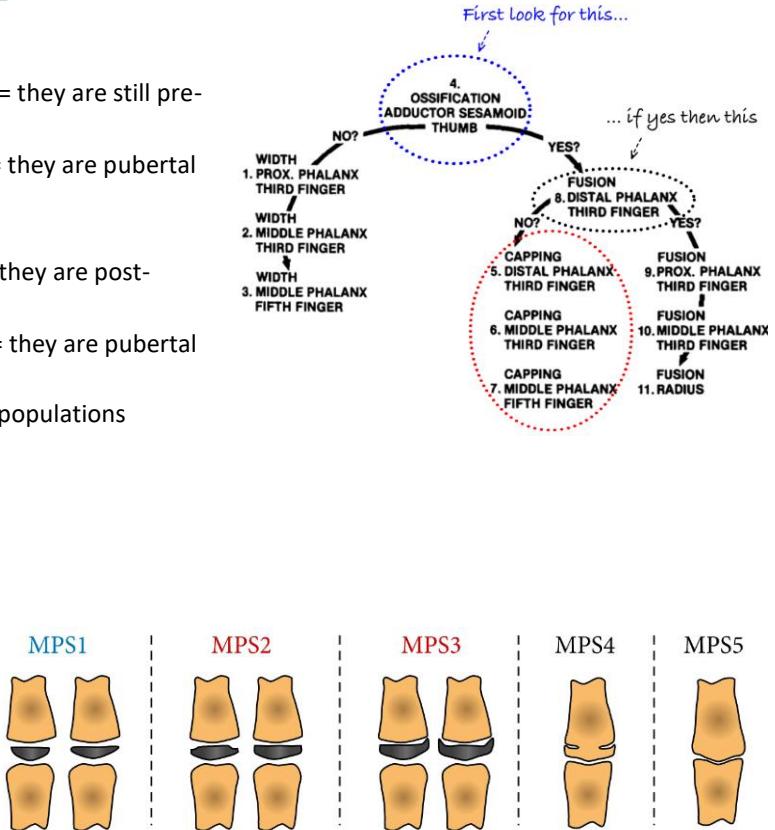
maxilla and allowing the

- Hand and wrist maturation method
 - Also known as SMA (skeletal maturation assessment)
 - By looking at the ossification in the hand, you give the patient an SMI value
 - The SMI value corresponds to what stage of development they're in (blue, red, black)

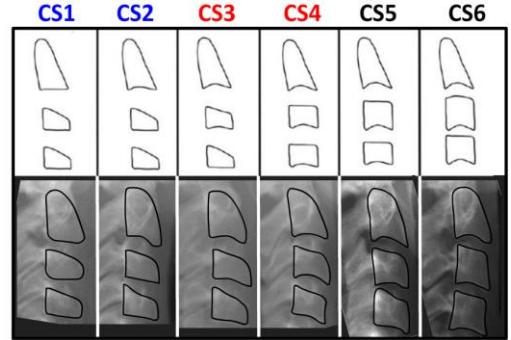


Stage description
SMI 1: third finger proximal phalanx, epiphysis as wide as metaphysis
SMI 2: third finger middle phalanx, epiphysis as wide as metaphysis
SMI 3: fifth finger middle phalanx, epiphysis as wide as metaphysis
SMI 4: thumb, appearance of adductor sesamoid
SMI 5: third finger distal phalanx, epiphysis showing capping towards the metaphysis
SMI 6: third finger middle phalanx, epiphysis showing capping towards the metaphysis
SMI 7: fifth finger middle phalanx, epiphysis showing capping towards the metaphysis
SMI 8: third finger distal phalanx, fusion of epiphysis and diaphysis
SMI 9: third finger proximal phalanx, fusion of epiphysis and diaphysis
SMI 10: third finger middle phalanx, fusion of epiphysis and diaphysis
SMI 11: radius, fusion of epiphysis and diaphysis

- Simplified method
 - Look at #4 first
 - Small round bone present = they are still pre-pubertal
 - Small round bone absent = they are pubertal OR post-pubertal
 - Then look at #8
 - Distal phalanx in 1 piece = they are post-pubertal
 - Distal phalanx in 2 pieces = they are pubertal
- Advantages to HWM
 - Independent of differences among populations
 - Independent of secular trends
- Disadvantages to HWM
 - Increased X ray exposure
 - Prevents serial recording
 - Limited to single stages
- Third middle finger phalanx maturation
 - Pre pubertal
 - Epiphysis is narrower than metaphysis, or they are same width but both with tapered and rounded lateral borders
 - Pubertal
 - Epiphysis at least as wide (or wider) than metaphysis
 - May have signs of capping (MPS3)
 - Post pubertal
 - Epiphysis begins to, or has finished fusing to metaphysis



- Cervical vertebral maturation method
 - Each stage from 2~5 lasts about 1 year
 - Trace the cervical vertebrae C2, C3, and C4
 - CS1 → CS2: C2 shows a concavity
 - CS2 → CS3: C2 and C3 show a concavity
 - CS3 → CS4: C3 and/or C4 appear rectangular, all with concavities
 - CS4 → CS5: C3 and/or C4 appear square
 - CS5 → CS6: C3 and/or C4 appear tall rectangular
 - Stage 1+2 are prepubertal
 - Stage 3+4 are pubertal
 - Stage 5+6 are postpubertal
- Dental maturation
 - Exfoliation of deciduous teeth → not a good indicator
 - Phase of dentition → not a good indicator
 - Dental emergence → not a good indicator
 - Calcification stage → works, but has limited usefulness
- Biomarkers
 - Markers like IGF-1 and alkaline phosphatase may be useful in the future
- Serial cephalograms
 - Superimpose ceph tracings from 6 months ~ 1 year apart
 - Use the cranial base as a reference point when superimposing ceps
 - Growth occurs throughout life, but becomes very slow after mid-20's
 - Good indicator for class III treatments (extraction or surgery)
 - Good for timing implants

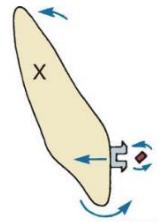


Removable appliances

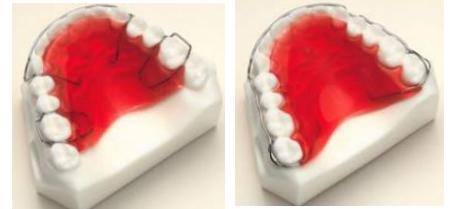
- Purposes
 - Growth modification
 - Big ramps can be placed on the appliance
 - When the patient bites down, it forces them to function the jaw in a forward position
 - Teeth are held into class 1 for long enough that it accommodates that position
 - Picture on the right: twin block appliance used to force class II growth into class I
 - For esthetics and fine-tuning occlusion, braces go on afterwards
 - Minor tooth movement
 - If you want pure translation, you have to apply forces on a tooth's center of resistance
 - If you apply forces on a tooth anywhere outside of the center of resistance, then the tooth will tip
 - Removable appliances can only tip the tooth, as it contacts the tooth at one point
 - Typical uses: transverse and labial expansion (via tipping), aligning individual teeth
 - Limited ability: bodily movement, torqueing, major rotation, intrusion, active extrusion
 - Passive extrusion is possible, if the appliance tips teeth and opens space for an impacted tooth to extrude
 - Traditional: has a retentive component, an acrylic framework, and tooth moving elements
 - Aligners: can be made of acrylic or clear plastic
 - Acrylic aligners have metal wires to help align the teeth
 - Impression → pour into cast → section misaligned teeth (like pindexing) → align teeth on cast → make appliance → give to patient
 - Clear plastic aligners: Invisalign, ClearCorrect, ClearLine (Protec), Simpli5



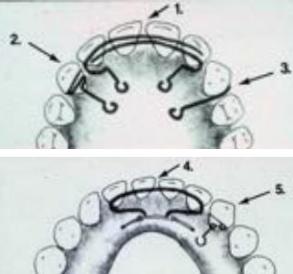
- Fixed appliances allow tipping and translation of the tooth, because the square wire can exert translational forces and rotational forces
- Example with a golf ball
 - Moving a golf ball with a removable appliance would be like tapping it gently at one point
 - Moving a golf ball with a fixed appliance would be like picking it up (2 points of pressure) and moving it to its destination



- Retention (most common)
 - Meant to retain teeth position after orthodontic therapy
 - Hawley: acrylic base with metal wires that form a labial bow
 - Wrap-around: like a Hawley, except the wire wraps the labial surfaces of all teeth
 - Essex: vacuform retainer



- Advantages
 - Fabricated in lab (reduced chair time)
 - Removed by patient (social situations, hygiene)
 - Growth guidance potential
- Disadvantages
 - Patient compliance required
 - Tooth movement primarily limited to tipping teeth
- 3 major components of a traditional removable appliance
 - Retentive components: ball, Adams clasp, occlusal rest, arrow, circumferential, molar tube
 - Framework and baseplate in acrylic
 - Tooth moving elements (springs or screws)

Springs	Screws
<p>1. Overlapping lap springs 2. Z spring (multiple coils that push buccally) 3. Finger spring 4. Mousetrap spring (placed on buccal, pushes teeth lingually) 5. Z spring with helixes</p> 	<p>-Transverse expansion (Schwartz and palatal expander) -A-P expansion</p> 

- When there is only one tooth in crossbite, it is cheaper and simpler to use a removable appliance with a finger spring (or Z spring) to push it buccally

Orthodontic emergencies

- Background
 - Very few genuine emergencies in orthodontic therapy
 - Most can be handled by proper initial education over the phone
 - Wax and TLC will typically get them through until the following day
- Normal sequelae
 - Tooth soreness for 2~7 days (pain peaking at day 3) after adjustments is normal
 - Soft tissue irritation for 1~2 weeks after initial placement
- Problems with removable appliances
 - Lost removable appliance
 - Schedule appointment for a new impression
 - If they lost a retainer, time is critical if they got their braces off recently
 - Irritation
 - Schedule in few days~weeks and make adjustments



- Problems with fixed appliances

Problem	Treatment	Urgency
Poking ligature tie	-Push wire down with fingernail or eraser end of a pencil -Apply wax	
Archwire poke	-Push wire away from tissues -Trim with fingernail cutter -Apply wax	
Loose bracket	-Can be left alone, if it's not bothering the patient -Bracket can be removed from the arch wire	-Can wait for a few days to a week -Multiple units = schedule ASAP
Loose band	-If not bothering patient, can be left for a week -Push back down around tooth if needed	-Can wait for a few days to a week -If painful = schedule ASAP
Lost ligature tie or broken chain	-Usually can wait a few days until appointment -Could risk tooth movement or rotation, fix sooner than later	-Can wait for a few days to a week
Archwire out of molar tube	-Be sure to cinch back arch wire to avoid this from happening -Avoid long spans if possible -Have patient trim wire and apply wax until you can clip it	
Loose RME, TPA, LLHA	-Re-bond	-Schedule ASAP

- In summary: when to schedule in ASAP

- Loose RME, TPA, LLHA, several brackets with a bent archwire, or band with pain
- Severe discomfort or pain

Functional appliances

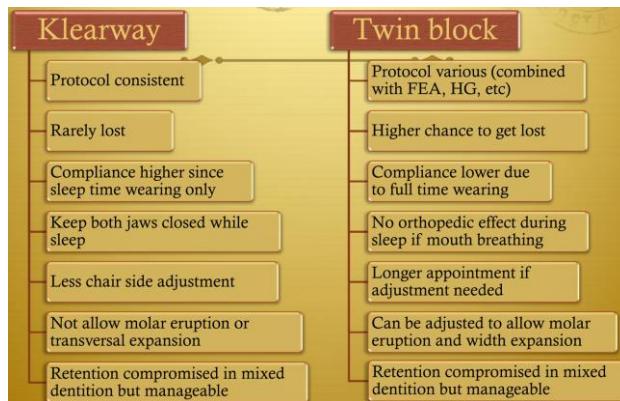
- Background
 - **Functional appliance:** a device that alters a patient's functional environment to influence and permanently change the surrounding hard tissue
 - Influences the environment, rather than the teeth (like a fixed appliance does)
- How they work
 - Designed to work with natural forces (muscles, tooth eruption, growth of max and mand)
 - Mode of force application: transmits, eliminates, and guides
 - **Strong evidence:** glenoid fossa remodelling, dento-alveolar changes
 - **Moderate evidence:** increased condylar growth, increased mandibular length
 - **Weak evidence:** maxillary growth restriction (headgear-like effect), maxillary molar distalization
- Patient selection
 - **Children:** must start early, but mature enough follow instructions. Best time to fix a class II is age 9~11
 - **Adults:** sequence, treatment, and type of FA may be different. Always respect the health of the TMJ
- Indications
 - **Patient:** active grower, cooperative, minimal crowding of teeth
 - **Mandible:** short lower face height, retruded mandible, flat mandibular plane, or retroclined incisors
 - **Maxilla:** proclined incisors
- Contraindications
 - **Patient:** non cooperative, crowding of teeth, vertically directed grower
 - **Mandible:** labial tipping
 - **Maxilla:** class II skeletal due to maxillary prognathism
- Advantages
 - Enlarges transverse width of arches → relieves crowding
 - No fixed appliance problems like gingival proliferation, decalcification, extractions, etc
 - Reduce or eliminate dysfunctional habits
 - Reduced time with braces (?)
 - Treatment of TMD (?)

- Types
 - Passive tooth borne appliances (Activator, Bionator, Herbst, Twin Block)
 - Tissue borne appliances (Frankel)
 - Active tooth borne appliances
- Functional appliances in detail

Type	Design	Result
Activator	<ul style="list-style-type: none"> -Removable -One large piece of acrylic -Bite shell that holds the upper posterior teeth in place -Designed to wear at night 	<ul style="list-style-type: none"> -Mandibular teeth are guided to erupt higher and tilt forward -Turns a class II occlusion into class I -Advances mandibular jaw -Holds the jaw open, so cannot speak or eat while using
Bionator	<ul style="list-style-type: none"> -Removable -Most popular one piece appliance -Palatal spring to fold the tongue back to the soft palate -Brings incisors edge to edge -Less bulky than an activator -Worn day and night 	<ul style="list-style-type: none"> -Modifies tongue behaviour and brings it into correct position. Tongue position is the main cause of open bites, overjet, CII and CIII occlusions -Allows normal development of the arch rather than stretching facial muscles -Speaking possible, but difficult
Herbst	<ul style="list-style-type: none"> -Fixed (cemented on teeth) -Most popular FA in US -Maxillary molar has a bar connecting it to a mandibular tooth 	<ul style="list-style-type: none"> -Most dento-alveolar changes compared to other FA's, and some glenoid fossa + condylar remodelling -Less airway blockage -Uses maxilla to push on mandible and posture it correctly
Frankel appliance	<ul style="list-style-type: none"> -Only soft tissue FA -Has vestibular shields and anterior labial pads to push against muscles -Best results if placed before 3, 4, and 5's go into position -Compliance quite high 	<ul style="list-style-type: none"> -Removes muscle forces in buccal and labial areas that restrict mandible growth -FR1: for class I, class II div 1 -FR2: for class II div 2 (red appliance) -FR3: for class III (green appliance) -FR4: for open bites and bimaxillary protrusion
Face mask + maxillary expander	<ul style="list-style-type: none"> -Maxillary expanding appliance placed in the mouth -Face mask with vented pads on the forehead and chin 	<ul style="list-style-type: none"> -Treats midface insufficiency, mandibular prognathism, maxillary hypoplasia, clefts, tongue problems
Twin block	<ul style="list-style-type: none"> -Most popular FA -Full time wear possible -Acrylic framework with metal wires -Can be removable or fixed -Composed of 2 pieces: one on the mand and one on the max -The max and mand components have a ramp on the occlusal surface 	<ul style="list-style-type: none"> -Less airway blockage, improved speech -Studies show significant dento-alveolar changes -When patient bites, the collision of the ramps forces the mandible to posture forward -Truax TB: looks like a vacuform with some occlusal padding -Bonded button TB: composite buttons on teeth engage with metal clasps on TB -Evans TB: clasps engage interproximal embrasures between teeth
Klearway appliance	<ul style="list-style-type: none"> -Designed for mild~mod obstructive sleep apnea -Thermo active acrylic framework, with a metal wire connecting arches -Meant for night wear 	<ul style="list-style-type: none"> -Repositions mandible forward -Lateral and vertical movements are sufficient to allow yawning, swallowing, and drinking

Note: all screws for arch transverse expansion allows 0.25mm of expansion per screw turn

- Klearway vs twin block



- How to take bite registrations
 - **Class I and class II (<5mm):** take an edge to edge bite registration AND one with a vertical opening of 2~3mm
 - **Class I or class II open bite:** take a minimum bite opening registration
 - **Severe class II:** take registrations as the overjet is corrected in stages
 - **Class III:** retrude the mandible as far back as possible and open the bite enough to allow anterior crossbite correction
- Relapse from FA
 - Reasons
 - Inadequate time for skeletal adaptation
 - Continued growth in genetically determined pattern
 - Dental relapse of tipping movements
 - Solutions
 - Minimum of 7~9 months to ensure not ending up with a dual bite
 - Overcorrection
 - Wear slowly decreased with regular monitoring overjet
 - One more year half-time wear after overcorrection has been recommended

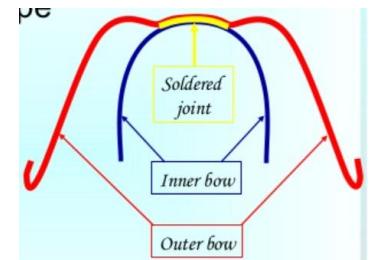
Space maintenance and space regaining

- Crowding
 - In the maxilla, crowding can easily be treated with expanding the arch. However, be careful not to over-expand as it can cause dehiscence of the teeth
 - In the mandible, crowding is much harder to treat. Generally, premolars are pulled early
- Importance of space maintenance
 - Prevents future crowding
 - Mesial migration of teeth if space is not maintained
 - Premature loss of delayed eruption of anteriors can cause midline to shift
- Space regaining
 - If we are not placing braces, it is good to re-establish lost space before eruption of permanent teeth
 - Distalizing the 6's before the 7's erupt makes it much easier to deal with crowding
 - If braces are planned, space regaining through fixed appliances is not difficult, so there is no rush
 - Therefore, treat crowding early if it will affect gingival health. Also, if crowding falls under the "severe" category, then there is no point trying to regain or maintain space. Go straight to extractions
 - However, expansion appliances should be done early
- Appliances

	Maxilla	Mandible
Space maintenance (fixed)	-Nance palatal arch with an acrylic pad on the anterior palate	-Lingual holding arch -Lip bumper that pushes molars back due to pressure from lips
Space maintenance (removable)	-Acrylic plate with clasps	-Acrylic plate with clasps
Space regaining (fixed)	-Brackets with active arch wires and coil springs	-Brackets with active arch wires and coil springs
Space regaining (removable)	-Acrylic plate with expansion screws +/- headgear	-Acrylic plate with expansion screws

Headgears

- 2 types of growth
 - **Craniofacial:** brain grows, and face grows in a downward + forward direction
 - **Dento-alveolar growth:** teeth supraerupt as the ramus grows bigger and increases vertical dimension
 - Growth happens at the sutures. Putting pressure in a suture will decrease its growth, whereas stretching it will increase growth
 - Growth is greatest during ages 0~2 then during pre-puberty (11~13 for girls, 12~13 for boys)
 - Headgears only work if the patient is growing. It works better when the patient is rapidly growing
- Headgear background
 - Should be worn 12~14 hours per day
 - For dental movement, should be always present. Wearing at night only limits tipping
 - Composed of the molar tube, facebow, and head strap
 - The facebow is composed of an inner bow (intraoral) and outer bow (extraoral)
 - Inner bow sits below the center of rotation of the tooth, which will cause the tooth to rotate. To balance this force, the outer bow is always angled above the inner bow to balance the force



- Headgear types

	Design	Skeletal effect	Dental effect	Bow configuration
Occipital		-Slows anterior and posterior vertical growth of maxilla	-Intrusion of due to vertical ramus growth -Minor molar distalization -Closure of open bite	-Outer bow needs to be short and 10 degrees higher than the inner bow
Cervical		-Slows anterior growth of maxilla, but not vertical	-Extrusion, but will be minor due to opposing teeth and not wearing 24/7 -Minor molar distalization -Opens bite, which is helpful in deep bite	-Outer bow needs to be long and 10 degrees higher than the inner bow
Combination		-Slows anterior growth of maxilla, but not vertical	-Mostly a distalization effect -Movement is along the plane of the teeth, so no correction of open bite or deep bite	-Outer bow needs to be short and 10 degrees higher than the inner bow
Asymmetric		-Used in cases with subdivision malocclusion, usually in combination with cervical or combination headgear		-Outer bow is long and further out on the class II side -Less class II side: closer to cheek

- Adjustments

- Pliers are used to modify the wire (pull to the side, pull back)
- Should be made so that the wire sits passively over both molar tubes, making it easy for the patient to attach
- Each side should have 250 grams of force

Management of moderate/severe crowding in the mixed dentition

- Space evaluation
 - Space available
 - Divide the arch into 4 segments (mesial of 6 to distal of 2, distal of 2 to mesial of 1 bilaterally)
 - The sum of these segments is the available space
 - Space needed
 - Measure the M-D width of each tooth and add up the total
 - If tooth is not yet erupted:
 - Can measure using radiographs (prone to distortion)
 - Can estimate from pre-determined values (TJ or Moyers)
 - Assumptions in this method
 - Assuming position of incisors are correct
 - Assuming space available will not change due to growth or drift
 - Assuming all teeth are reasonably normal in size
- Moderate crowding (4~7mm)
 - Usually, you need 21mm of space for the 3, 4, 5 to erupt
 - Treatments for moderate crowding in the mixed dentition

Procline anteriors			-Band the 6's -Bracket the incisors -Use wire to push incisors -For every 1~2mm of proclination, you gain 4mm of space
Distalize posterior			-Band the D's and 6's -TPA or Nance on D's to distalize them -Spring connecting D and 6 will push 6 back -Can combine with a headgear to help distalize as well
Expand arch			-Left picture is an expander with a pendulum attachment used to distalize the 6's -For every 1mm of expansion, we gain 0.7mm of space

- Severe crowding (8mm+)
 - Whenever you see the premolar (4) contacting the lateral incisor, you immediately know there is severe crowding
 - Severe crowding is seen in 15% of the population
 - Needs to be treated with extractions
 - Traditionally, used to extract C's → D's → 4's (late premolar extraction)
 - Now, serial extraction is also an option (already covered in previous lecture)
 - Serial extractions
 - Indications: class I, no missing teeth, ectopic teeth, minimal overbite, protrusive dentition, significant crowding of 8+mm

Non skeletal/skeletal anterior crossbite in the mixed dentition

- Why anterior crossbites need to be treated
 - Cosmetics
 - Incisal wear (weak evidence)
 - Gingival recession (secondary to traumatic occlusion)
 - Others: reduce TMJ pathology, encourage favourable growth (untreated dental crossbite could turn skeletal)
- Considerations before treatment
 - Crossbites in the primary dentition will not self correct, and needs treatment
 - Consider treating crossbite in primary dentition if it is dental
 - If we do treat crossbite in the primary dentition, we need to make sure that the underlying skeletal structure will not cause the crossbite to come back in the permanent dentition
 - Happens when you treat a crossbite thinking it's dental, but is actually skeletal
 - Stability of the correction is generally excellent after reaching positive OJ

- Anterior crossbites can be skeletal or dental

	Skeletal anterior crossbite	Dental anterior crossbite
Etiology	-Maxillary hypoplasia -Mandibular prognathism	-Retained primary teeth (forces permanent teeth to erupt more lingually) -Trauma to primary teeth -Supernumeraries -Crowding
Presentation	-Multiple teeth -Family history -Cephalometric evidence (ANB) -No CR/CO slide -Poor arch coordination (maxilla looks much smaller than mandible)	-Single tooth (and less severe in general) -CR/CO slide (when you move the jaw, the patient goes into edge-to-edge) -Class I dentition -Arch coordination
Treatment	Mandibular excess: chin cup or surgery to retract mandible once growth is finished Maxillary deficiency: protraction with a headgear (<10 yo) or surgery to protract mandible once growth is finished Dental camouflage: extract a few teeth	-Tongue depressor treatment -Fixed incline plane -Removable/partial fixed appliance -Note: avoid removable appliances in mixed dentitions, as it could lose retention when deciduous teeth exfoliate

- Example case – skeletal crossbite

Initial	Treatment	Result
 	 	 

-Clear skeletal crossbite due to multiple teeth being involved and facial profile
-Likely maxillary deficiency

-Palatal expander to open up the sutures and make headgear more effective
-Headgear used to pull maxilla by anchoring on E's and 6's

-No more crossbite
-Midlines are almost coincident
-Facial convexity established
-Monitor until pt finishes growing to see if class III comes back

- Dental anterior crossbite – treatment options in detail

- Tongue depressor
 - Get a child to bite down hard on a tongue depressor for 60 mins/day, for 6~8 weeks
 - Very cheap treatment option
 - Child should feel soreness and correction of crossbite on teeth (tipping only)
 - Results in a shallow overbite
- Fixed incline plane
 - Same idea as the tongue depressor, except it's cemented onto mandibular anterior
 - Device is a ramp cemented on the incisal surface, to guide the maxillary teeth forward when biting
 - Not to be used in primary dentitions, because it may cause teeth to exfoliate
 - Used for 6~8 weeks. Any longer and it risks a posterior open bite
- Removable appliance with springs
 - Used for linguoinclined maxillary incisors (class II div 2)
 - If permanent canines aren't erupted: don't bracket the laterals because the bracket will cause their roots to tip distally, impacting the canines
 - Components
 - **Retention elements**
 - **Labial/facial bow:** prevents teeth from proclining too much. However, must be relieved occasionally to allow linguoinclined incisors to move forward
 - **Posterior bite pad:** acrylic on occlusal surface to open the bite, so that the incisors can jump the crossbite and go in front of the mandibular incisors. Using a bite pad for prolonged periods can cause an open bite, so monitor well
 - Cannot rotate teeth
- Partial fixed appliance
 - Used when there are rotations or a diastema

Orthodontic finishing

- Andrews 6 keys of occlusion (need to know)
 - Andrews evaluated >1000 treated cases and compared them to 120 ideal norms
 - Simplified the ideal occlusion into 6 criteria

Interarch relationship		-Represents the way the upper and lower arches fit together -Class I molar and canine relationships
Crown angulation		-All crowns have a positive angulation with respect to the midline -Gingival portion is distal to the incisal -Numbers are not very important, it's more important to know that roots are spread out so there are equal amounts of bone
Crown inclination		-Crowns should have a consistent inclination pattern -Upper central and lateral teeth: normally + inclination -All other teeth: normally - inclination -Also known as a Curve of Wilson
Rotation/alignment		-All teeth should be free of rotations -See if the central fossa of the teeth line up with the curve of the arch
Spacing		-Contact points between teeth should exist, unless there is a discrepancy in the M-D width of a crown
Curve of Spee		-Depth of the curve should be flat to a slightly concave surface -At most, should be 1.5mm -Having a 2nd molar too high can interfere with movements

- Edgewise appliance
 - Appliance mechanism – an analogy
 - The bracket (attaches to tooth) is like a door handle. The door handle attaches to a door (tooth) and can manipulate its movement in any direction
 - As long as the bracket is correctly positioned on the tooth, many movements can be achieved
 - The action for the brace is at the wire-bracket interface
 - Andrews developed the straight wire system
 - The bracket is pre-adjusted, eliminating the need to bend the wire
 - Focus shifted from wire bending to bracket placement
 - Introduced flexible wires to orthodontics
 - Assumptions: bracket will move tooth to correct position, all teeth are the same, and all brackets are ideally placed

	Traditional wire	Andrews straight wire
First order In-out bracket phase		 -Changed the thickness of the bracket -Brackets that attach on the anteriors are thick B-L, whereas brackets on the molars are thin
Second order -Angulation of slot		 -The angulation is incorporated into the bracket instead of the wire, so a straight wire can be placed
Third order -Torque of the slot of bracket	-Wire was bent to incorporate the curve of Wilson (-10 degree inclination of max molars, +7 degree inclination of max incisors) -In other words, controlled proclination/retroclination	 -Crown inclination was incorporated into the bracket -Image is a cross section of one bracket

- After orthodontic finishing, how do you evaluate it?
 - There is a scoring system called the **ABO Cast-Radiographic Evaluation**
 - Evaluation is done on a tooth by tooth basis

Alignment	-1 point per misaligned tooth on the cast
Marginal ridges	
B-L inclination	
Overjet	-Should be 1~2mm, but give 1~2 points depending on amount of overjet excess
Occlusal contact	
Occlusal relation	-1~2 points if canine guided occlusion is not present on laterotrusions -2 points if the canines or molars are not in proper class I occlusion
Interproximal contact	
Root angulation	-Look at pan to see if there is enough bone between roots

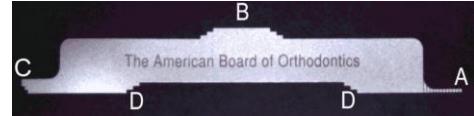
 - **Parameters affected by appliance placement:** alignment, marginal ridges, occlusal contact, and root angulation (need to know)
 - In other words, half the parameters depend on how well you place the brackets on day 1
 - **Parameters affected by orthodontic mechanics:** B-L inclination, overjet, occlusal relation, interproximal contacts
 - Lower the score, the better
 - If the total score is under 20 (or 25~27??) it's a pass. If the total score is >30, it's a fail
- ABO measuring gauge
 - Tool that helps with measuring the cast and looking for discrepancies

A This portion of the gauge is in 1 mm increments and is used to measure discrepancies in alignment, overjet, occlusal contact, interproximal contact, and occlusal relationships. The width of the gauge is 0.5 mm.

B This portion of the gauge has steps measuring 1 mm in height and is used to determine discrepancies in mandibular posterior buccolingual inclination.

C This portion of the gauge has steps measuring 1 mm in height and is used to determine discrepancies in marginal ridges.

D This portion of the gauge has steps measuring 1 mm in height and is used to determine discrepancies in maxillary posterior buccolingual inclination.



Posterior crossbites in the mixed dentition

- About
 - Any abnormal B-L relation between opposing teeth in CO
 - Affects transverse plane of the space
 - More often upper molars are lingually positioned
 - Unilateral (90%) and bilateral (10%) presentation
 - Dental and skeletal causes
 - Frequently associated with a functional shift
 - Affects 8~16% of the population, and 7.1% of US children ages 8~11. Affects more females, and the right side
 - Does not self correct, so it has a similar frequency from primary to mixed dentition
- Arch width and form
 - The inter-maxillary width increases as the dentition progresses from primary to permanent
 - Male arches are wider, but the average width is 50~53mm
 - It is possible to normalize arch width via ortho, but it does not stimulate growth past the normal
- Etiology

Skeletal posterior crossbite	Dental posterior crossbite
<ul style="list-style-type: none"> -Narrow maxilla (narrow + high palate) -Bilateral crossbite -Associated with habits, mouth breathing, and cleft lip/palate -Relatively large mandible 	<ul style="list-style-type: none"> -Normal maxilla -Usually 1~2 teeth involved -Primary canine interference on laterotrusions -Unilateral with mandibular shift (most common) -Ectopic eruption in 8%

- Diagnosis
 - **Clinical evaluation:** angulation of posterior teeth and palatal vault width
 - **Cast evaluation:** relationship between width of palatal vault and skeletal base
- Types
 - Bilateral skeletal (presents with a narrow palatal vault)
 - True unilateral skeletal (infrequent)
 - Unilateral with functional shift (most frequent)
 - Dental (torque, ectopic)
 - AP-discrepancy (class II to class I – bringing mandible forward means wider part of mandible occluding against the narrower part of the maxilla)
 - Mixed dental, skeletal, functional, A-P
- Treatment modalities
 - Equilibration
 - Success rate of 27~64%, and only works on patients <5 years of age
 - Mostly primary canine, less frequently on the primary molars
 - For when functional crossbite is present, and CR =/= CO. Usually the canine has a premature contact
 - Maxillary expansion
 - Maxilla expands in a pyramidal pattern vertically and antero-posteriorly
 - Vertical dimension: maxilla expands more on inferior, less on superior (near the nose)
 - A-P dimension: maxilla expands more on anterior, less on posterior

Slow	<ul style="list-style-type: none"> -Mostly for dental crossbites, little skeletal changes -Delivers a constant physiologic force that results in dental tipping 	<ul style="list-style-type: none"> -Magnets, removable appliances, TPA, quad helix, cross elastics -Removable has issues with compliance, cost, and duration
Rapid	<ul style="list-style-type: none"> -Used in early permanent dentition stage -Opens the mid-palatal suture, allowing skeletal changes -Overexpansion (max. palatal cusps occluding to mand. buccal cusps causing open bite) is done to compensate for relapse -Expand 2~3m → retention 6~9m = total 8~12m -1~2 activations/day. Each turn exerts 2~5 kilos of force -Combined with FEA, provides 6mm of arch perimeter 	<p>Hass</p> <ul style="list-style-type: none"> -Tissue and tooth borne <p>Hyrax</p> <ul style="list-style-type: none"> -Tooth borne

- Force level and rate of expansion
 - Depends on age, gender (maturation), suture status (most important), type of constriction
 - Infants have a Y shaped suture, meaning the sutures can be separated quite easily
 - Adolescents have a Z shaped suture, with lots of inter-digitations. Much harder to expand
 - Sutures close earlier in females
- Advantages of early intervention
 - Effective and stable
 - Resolves shift on closure
 - Prevents crossbite to permanent dentition
 - Prevents permanent growth alteration
 - Prevents signs and symptoms of TMD
 - Improves arch length deficiency secondary to maxillary constriction
 - Challenging in late mixed dentition because of exfoliating deciduous teeth

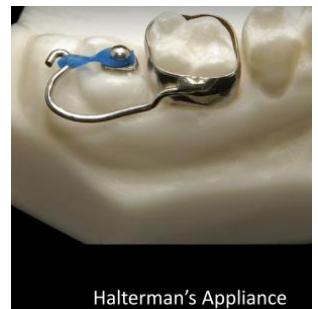
Canine impaction

- About
 - Canine impaction affects 0.25~5%, with maxillary canines being 2nd most likely to be impacted
 - More prevalent in females 2:1
 - Palatal impaction is 4x more likely than labial impaction
 - Maxillary is more likely to impact simply due to the eruption sequence – they are one of the last to come in
- Factors
 - Localized crowding or too much space
 - Trauma (especially if upper incisors are traumatized)
 - Cysts (like dentigerous cysts)
 - Genetics (craniofacial disorders)
 - Local factors (small laterals, missing laterals → no guidance during eruption)
- Etiology
 - Genetic or developmental
 - Labial impaction: due to localized crowding
 - Palatal impaction: due to missing/small laterals or tortuous eruption pathway
- Appliances
 - Cantilever springs attached to a trans-palatal arch
 - Swing loop: auxiliary spring from a buccal arch wire
 - Elastic chain or thread from arch wire
 - Buccal root torque on bracket or arch wire
 - Buccal torqueing loop
 - It is important for buccally erupting canines to receive proper attached gingiva. This is accomplished by apically repositioned flaps or laterally repositioned flaps

Dental anomalies

- Congenitally missing teeth
 - Types
 - Anodontia – no teeth
 - Oligodontia – missing 6 or more teeth
 - Hypodontia – missing less than 6 teeth
 - Epidemiology
 - Overall incidence of 3~7% to have 1+ missing teeth, overall prevalence of 1.5~3%
 - Most commonly missing: lower 5's, upper 2's, upper 5's
 - 1.3x more common in females
 - More commonly unilateral, except U2's which are more bilateral
 - Diagnosis
 - See chronologic age of patient
 - Compare to first premolar or opposing tooth
 - Check family history
 - Check for late eruption (radiograph)
 - Treatment options
 - Leave primary tooth → could build it up or disc it down
 - Extract primary → maintain space → restore
 - Extract primary → close space
 - Extract early or disc it down → allow drift to close space
 - Transplant
 - If there is crowding (or an ectopic tooth) in one area and missing tooth in another
 - Long term success of 80%, comparable to implants
 - The root must be 2/3 to 3/4 formed → timing is critical
 - Possible transplant sites: incisor to incisor, PM to PM, PM to missing upper incisor, 3rd molar to 1st molar

- Supernumerary teeth
 - Almost always grows palatally, and 90% are found in the anterior maxilla
 - Frequency of 0.15~3% with racial variation
 - Easily missed on a pan, so must always count teeth
 - Mesiodens is a conical extra tooth
 - Mesiodens could also be inverted, erupting into the bone rather than into the mouth
 - Teeth are extracted. Earlier the better
- Ectopic teeth – 1st permanent molars
 - Eruption in the wrong place or along the wrong path
 - Overall incidence of 3.5%, 20% in siblings
 - Upper more common than lower
 - Causes increased mesial angulation and crowding
 - Diagnosed from bitewings (general practice)
 - May resorb the root of the E, forming a “ledge”
 - Treatment
 - 2/3 of cases will self-correct if ledge is <2mm → monitor for 6 months
 - Unlikely to self correct → [distalize 6 + retain E] OR [distalize 6 when E is lost + maintain space]
 - Brass wire, active spring, or Halterman's appliance can be placed between the E and 6 → push 6 distally
- Ectopic teeth – canines
 - About
 - Incidence of 1-2% with genetic influence
 - Associated with small max 2's or missing max 2's/max 5's
 - Family history
 - 2/3 are impacted palatally, 1/3 are impacted buccally
 - Causes
 - Early loss of primary tooth
 - Resorption of permanent teeth
 - Malformed laterals → poor guidance for canines
 - Consequences
 - Impaction of canine
 - Resorption on max 2 or max 1
 - Transposition of tooth (worst case) → may need to leave alone
 - Treatment
 - Take routine radiographs and a CBCT
 - Extract primary canines → 65-90% of cases show improvement
 - Early intervention reduces severity/impact on adjacent teeth, but severe cases will require surgical intervention
 - Repositioning is done either by surgery or exposing the tooth and placing traction to put it into place
- Impacted teeth - 2nd molars
 - Treatment
 - Surgical uprighting (patient preferred)
 - Braces: minimum 1yr in braces if the rest of their teeth are straight



Halterman's Appliance

Debonding and retention

- Appointments
 - Private practice
 - First appointment: remove appliances, prophy, take impressions, take photos, take a final pan
 - Second appointment: retainer delivered
 - UBC
 - First appointment: remove band and wires, take impressions (for retainer) with brackets in place
 - Second appointment: remove brackets, prophy, take impressions (for casts)
 - Third appointment: check retainer and adjust if necessary
- Stages of orthodontic treatment
 - Levelling and aligning → Vertical correction → A-P correction → Finishing → Retention
 - Retention (retainer should be included as part of the initial treatment plan)

- Debanding molar tubes
 - Use debanding pliers: rubber side goes on occlusal surface, and the hook side goes under the band
 - For the mandible, approach from the lingual
 - For the maxilla, approach from the buccal
 - Triple check for a sub-gingival Band-lok
- Debonding brackets
 - Leave the arch wire in place, so the brackets can be debonded and all removed as 1 unit
 - Ligature cutter is used on an angle that causes the bracket to rotate and pop off
- Composite/cement removal
 - Debanding pliers (don't use the corner, but use the perpendicular surface)
 - Scaler
 - Slow speed hand piece 12 fluted carbide finishing bur
- Relapse
 - Tendency for teeth to return to their original positions after orthodontic movement, or any deterioration of the occlusion after active treatment
 - Types of relapse
 - Intra-arch alignment
 - Inter-arch occlusion (much harder to correct)
 - Causes of relapse (exam)

Periodontal tissues	-Tooth movement involves PDL remodelling -It is normal to see widened PDL with slight tooth mobility during ortho
Gingival tissues	-Elastic fibers stretched during treatment -Main cause of short term relapse, as it takes 4~12 months for these fibers to remodel -Elastic supracrestal fibers take 12 months
Teeth are inherently in an unstable position	-Forces of tongue, lips, muscles cause teeth to move back to their stable positions. The position left by the braces was inherently unstable -Arch expansion, proclination >2mm, or any expansion across canines are inherently unstable -Lingual bonded retainers are usually worn for life, to keep this position
Latent growth	-Slow growth happens even from ages 30 to 80 -Main cause of long term relapse -Differential growth of maxilla and mandible leads to interarch changes, which could manifest as crowding
3 rd molars??	-No, 3 rd molar eruption has nothing to do with lower incisor crowding -Late lower incisor crowding is attributable to late mandibular growth
- Retention – principles
 - Gingival and periodontal tissues contribute to short term relapse and intra-arch relapse
 - Continued growth contribute to long term relapse and inter-arch relapse
 - Generally, patients will need to wear 12 months full time
 - Afterwards, at least 12 more months of night time wear, unless patient is still growing or significant arch expansion was involved during treatment
- What is a retainer?
 - Appliance that resists the forces that cause relapse
 - Can be passive in design, as they only need to exert a very light and continuous force
 - Can be removable or bonded
 - Bonded retainers have better compliance and effectiveness, but worse hygiene. Vice versa for removable
- Removable retainers



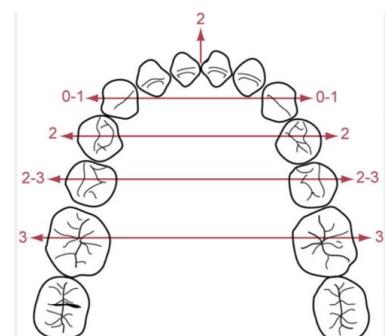
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	Design	About
Hawley	1) wrap around Hawley 2) additional springs and clasps 3) acrylic on labial bow	-Durable (10+ years with proper care) -Great for holding deep bite and transverse corrections (TEST Q)
Vacuform	-Clear and esthetic	-Quick, easy, cheap -Less durable (12 months about) -Holds individual positions well
Positioner	-Large mouthguard with each tooth being adjustable for position	-Can modify positions of each tooth, as the tooth positions can be moved around like denture teeth

- Bonded retainers
 - Great for long term applications
 - Best for holding spaces closed
 - No cooperation required, but makes OH more difficult
- Adjunctive procedures: Circumferential supracrestal fiberotomy
 - Best for rotated teeth
 - At the time of debanding, take a scalpel blade and slice fibers around the tooth to disconnect all the fibers that are trying to rotate the tooth back
- Treatment for relapse
 - Do nothing
 - Adjust/squeeze retainer on and increase frequency of wear
 - Make an active retainer: a spring Hawley can be made by the lab for ~\$150 and can straighten mild crowding. This appliance can then be used as a retainer thereafter
 - Go for treatment again

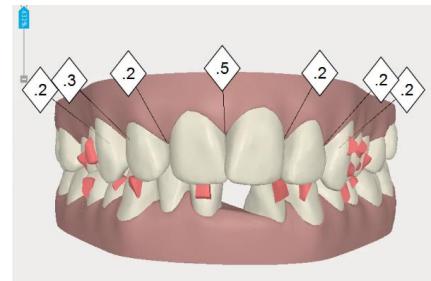
Permanent dentition spacing and crowding

- Etiologies of spacing
 - Congenitally missing teeth
 - Tongue habits/position:
 - Tongue thrust or posture can cause an open bite
 - High tongue posture can cause spacing in maxilla
 - Low tongue posture can cause spacing in the mandible
 - Tooth to jaw size discrepancy
 - Oral habits
 - Reduced periodontal support
- Crowding severity
 - Mild (<4mm)
 - Extraction rarely indicated
 - Disking of select teeth
 - Moderate (5~9mm)
 - Extraction is an option
 - Space regaining or transverse expansion for non extraction
 - Severe (>10mm)
 - Extraction required
 - Class II pattern: extract upper 4's, lower 5's
 - Class III pattern: extract upper 5's, lower 4's
 - Drawbridge effect: anterior extractions → incisors recline → closes anterior open bite
 - Wedge effect: posterior extractions → close anterior open bite
 - Lips: 3mm of incisor retraction will yield 1mm of lip competence. Once lips are closed, 1mm of incisor retraction means 1mm of lip retraction
- Stability of expansion
 - You can push the anteriors up to 2mm while keeping stability
 - Anything more will mean lip and tissues will pull it back. Has instability and possible dehiscence of gingiva
 - Thin biotypes require grafting due to ortho
 - Inter-canine expansion has the poorest stability
 - The corners of the mouth have the highest inward force
 - Only 0~1mm of expansion is stable
- Guidelines
 - No extraction: the more you expand without moving the upper incisors forward, the better
 - Extraction: the most you close without over retracting the incisors, the better
 - Excess expansion → mucogingival problems
 - Expansion or extraction makes no difference to mastication or health



Invisalign

- What is Invisalign?
 - Clear, custom made removable orthodontic appliances called aligners
 - Moves teeth sequentially into their desired position by wearing a series of aligners (series of 3D printed aligners)
- Process
 - Records,
 - Photos
 - Panoramic, cephalometric
 - Models
 - Diagnosis and treatment plan
 - **Transverse** expansion needed like an RME? Any crossbites?
 - **Anteroposterior** relationship? Class I/II/III? Skeletal or dental?
 - **Vertical** deep bite or open bite?
 - **Degree of crowding** – make space with expansion, proclination, interprox reduction, or extractions?
 - **Malpositions** – any ectopic canines, rotated teeth, submerged teeth, etc?
 - Impressions
 - PVS
 - Intraoral scan
 - ClinCheck setup and modification
 - Software that virtually shows you the teeth positions and how you want them to move
 - Number = # of aligner
 - Technician programs the initial treatment movements, but the dentist should review it before the aligners are made
 - Can factor in for attachments (pink blocks on teeth), interproximal reduction, and over-correction
 - Deliver aligners to patient
 - Give instructions
 - Wear for 22 hours per day, remove to eat
 - Each set of aligners is used for 1~2 weeks, then move on to the next set
 - Brush with normal toothbrush and toothpaste after brushing own teeth
 - Don't throw away used aligners
 - What to expect
 - Discomfort, tenderness, changes in speech, increased saliva
 - Show patient ClinCheck tooth movements
 - Apply attachments if needed
 - Attachment template is used with composite resin to bond to teeth
 - Functions
 - Boost aligner retention in patients with short crowns or non retentive teeth
 - Aids in tooth movement (rotation, intrusion, extrusion, space closure)
 - **Myth: Invisalign can only tip teeth. False, attachments can control root movements**
 - Interproximal reduction if needed
 - Can use sandpaper strips, burs, or discs
 - Slenderizes teeth to make space without needing to extract
 - Can shrink the size of black triangles, as the teeth come closer together
 - Monitor the treatment
 - Compliance, fit of aligner, condition of attachments
 - If contacts are tight, hard to move the teeth → IPR as needed
 - Tooth movement concurrent with ClinCheck staging
 - Check bite



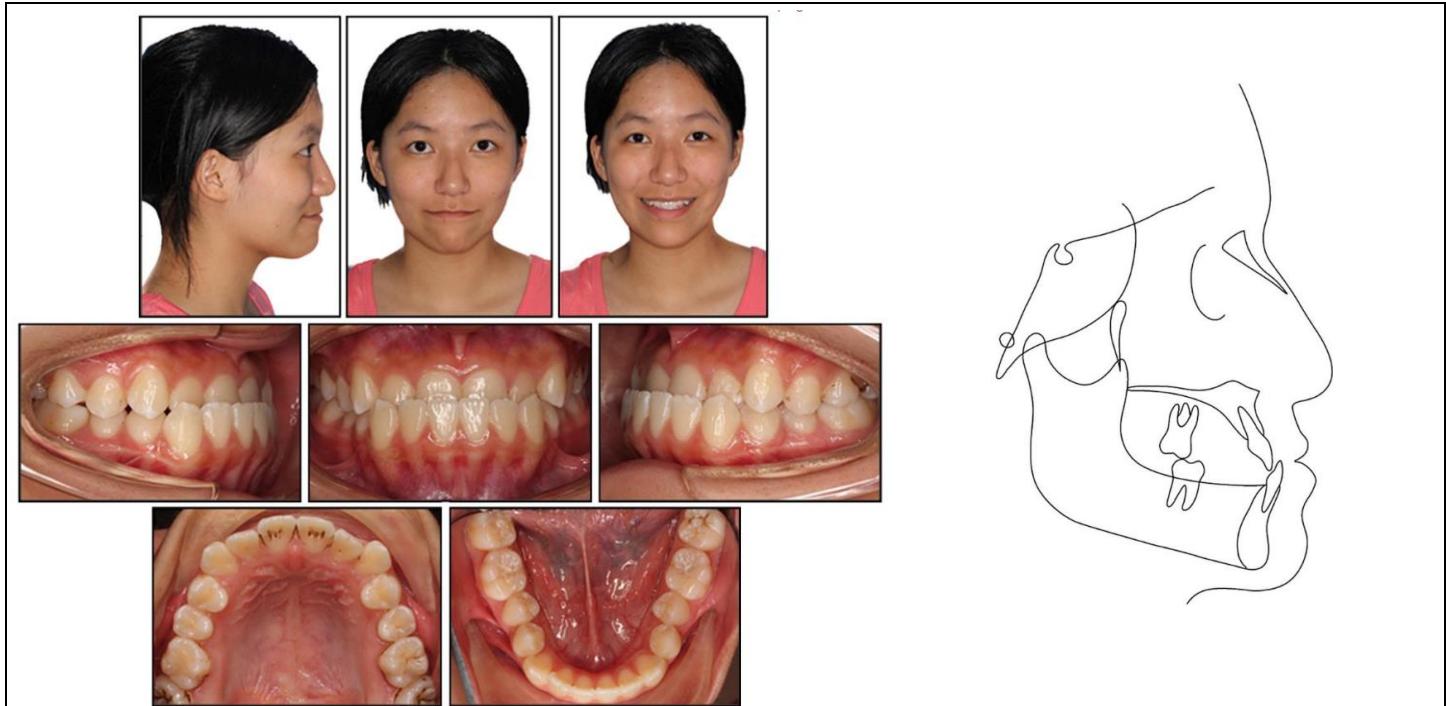
- Finish the case
 - **Myth: invisalign's finished result is never perfect. About 90%. False, it depends on case selection + skill**
 - Detailing pliers
 - Forms pressure points to modify minor discrepancies, nudges the teeth into place
 - Additional aligners
 - Very typical to need some refinement after first series of aligners are finished
 - Reasons: open contacts, improve occlusal contacts, minor movements, requests by patient
 - Ask for over-correction
 - For difficult movements, some teeth lag behind others
 - Over-correction can be incorporated into the first set of aligners
 - Over-correction is over-rotating a tooth by 5 degrees, tipping, torqueing, etc
 - Virtual C chain aligners to close open contacts
 - Special aligners used to close contacts
 - May cause crowding if worn when all contacts are sufficiently closed
 - Frequently used as the last 3 aligners
- Retention
 - Fixed
 - Bonded lingual wire to each anterior tooth, or just on the canines
 - Usually just done on lower arch, but possible to do on maxilla as well
 - Removable
 - Hawley retainers
 - Essix vacuform
 - Vivera retainers (3d printed clear aligners)
- Invisalign vs fixed appliances
 - **Myth: braces are better than Invisalign. False, depends on malocclusion, patient, and doctor**
 - **Myth: Invisalign takes longer than braces. False, depends on experience and skill**
 - **Myth: Invisalign costs more than braces. Lab cost is higher (~\$2000) + clinician's fee**

	Advantages	Disadvantages
For the patient	<ul style="list-style-type: none"> -Esthetics -Removable -Good hygiene -Gentle forces -Comfort 	<ul style="list-style-type: none"> -Lots of cooperation and compliance
For the doctor	<ul style="list-style-type: none"> -Decreased chair time -Fewer appointments -Fewer emergencies -Isolates tooth movements, control reciprocal tooth movements for anchorage -Control incisor inclination, limit proclination, calculate IPR -Distalization -Design finalized at the start 	<ul style="list-style-type: none"> -Not as efficient for very rotated teeth -Frequently needs additional aligners or overcorrections -Auxiliary treatment required for difficult tooth movements (segmental brackets, buttons) <ul style="list-style-type: none"> -Severe rotation -Bilateral crossbite -Single tooth extrusion -Molar uprighting -Root movements
- Case selection
 - Class I or mild class II
 - Mild~moderate spacing or crowding
 - Ideal to moderate overbite, or up to 50% overbite
 - Limited treatment objectives (like a patient with relapse from initial ortho Tx)
 - Diastema closure
 - Generalized spacing
 - Anterior crossbite (by adding bite ramps into aligners)
- Moderate difficulty (experience of 16~50 cases)
 - Difficult rotations, IPR >6mm, cases requiring distalization or elastic wear
- Advanced cases (experience of >50 cases)
 - Lower incisor extraction, premolar extractions, buccal crossbites, orthognathic surgery

Case - lecture

Soft tissue analysis	Prognathism/retrognathism in facial profile	-Normal	
	Convexity or concavity of the facial profile	-Flat	
	Facial shape (dolico, meso, brachycephalic)		
	Asymmetries, soft tissue midline	-Normal	
	Smile line	-Normal, maybe a little high	
	Horizontal fifths, vertical thirds	-Normal	
	Lip competence	-No lip competence	
	Lip fullness (relative to E plane)	-Excessive	
	Nasolabial angle	-Acute	
	Mento-labial strain	-Normal	
Dental analysis	Mixed, primary, or permanent dentition?	-Permanent	
	Missing teeth/ectopic teeth	-Normal	
	Canine/molar relationships	-Class I canine and molar	
	Overbite/overjet	-Shallow overbite, steep overjet	
	Crossbites	-Normal	
	Curve of Spee/Wilson	-Normal	
	Crowding/spacing (in mm)	-2~3mm?	
	Tipping, rotating, malpositioning	-Max incisors severely proclined	
Skeletal (ceph) analysis	-Just from looking at the tracings, it appears that skeletally this patient is normal -However, there is severe malpositioning of the dentition -Maxillary appears more off		
Functional analysis			
Treatment planning	Diagnosis	-Class I malocclusion with bimaxillary proclination of incisors, short upper lip, protrusive lips, and large overjet	
	Prioritized problem list and proposed treatment	<ul style="list-style-type: none"> -Proclined upper incisors → extract 4's, retrocline incisors -Proclined lower incisors → extract 4's, retrocline incisors -Anterior overjet → retrocline upper more than lower -Protrusive lips → retrocline incisors -Short upper lip → do not treat 	
	Mechanotherapy	<ul style="list-style-type: none"> -Full mouth fixed appliance → anterior segmental osteotomies – Patient declined this treatment method -Full mouth fixed appliance → extraction of all 4's → retraction of canines → retroclination of incisors -3 screws were drilled into the palate, to anchor a bar -The bar had elastics attached (red circles) to a wire connecting bilateral 6's -The screwed palatal bar pulls back on the first molars, preventing them from moving mesially while we allow the canines and incisors to move back to fill the space of the extracted 4's -Without the palatal anchor, the incisors would still move back, but not as much because the molars would move forward as well 	

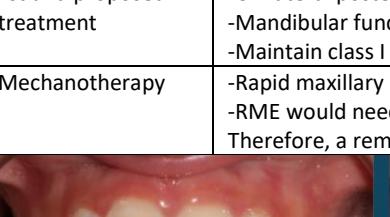
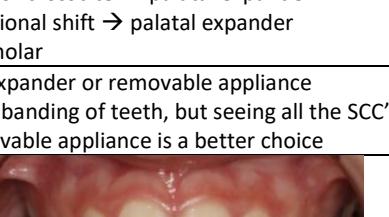
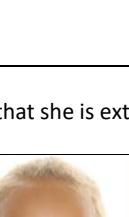
Case - lecture



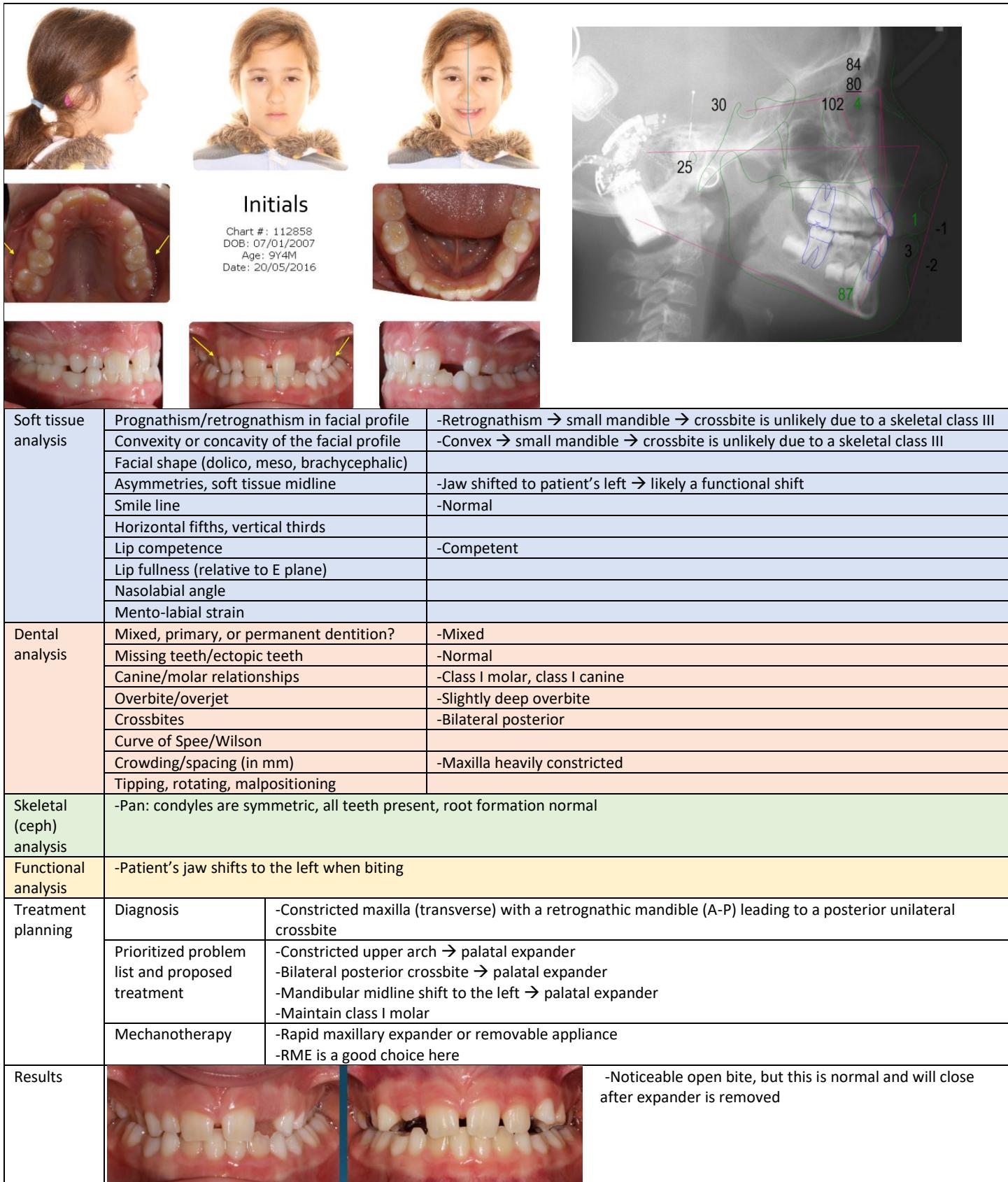
Soft tissue analysis	Prognathism/retrognathism in facial profile	-Mandibular prognathism	
	Convexity or concavity of the facial profile	-Acceptable midface convexity	
	Facial shape (dolico, meso, brachycephalic)		
	Asymmetries, soft tissue midline	-Normal	
	Smile line	-Normal	
	Horizontal fifths, vertical thirds	-Normal	
	Lip competence	-Competent	
	Lip fullness (relative to E plane)	-Normal	
	Nasolabial angle	-Perpendicular	
	Mento-labial strain	-High tension	
Dental analysis	Mixed, primary, or permanent dentition?	-Permanent	
	Missing teeth/ectopic teeth	-Normal	
	Canine/molar relationships	-Class III canine and molar	
	Overbite/overjet	-Underjet	
	Crossbites	-Anterior crossbite in centric occlusion	
	Curve of Spee/Wilson	-Deep curve of Spee in the mandible	
	Crowding/spacing (in mm)	-Present in both arches	
Tipping, rotating, malpositioning			
Skeletal (ceph) analysis	-Prognathic mandible and retroclined lower incisors		
Functional analysis	<ul style="list-style-type: none"> -Mandible was able to move back slightly with the incisors edge to edge at centric relation -Trick question: you cannot determine functional shift on ceph's, unless you take one at CR and ICP (rarely done) 		
Treatment planning	Diagnosis	-Angle class III malocclusion with mild crowding on a class III skeletal base with mandibular prognathism in the anteroposterior dimension	
	Prioritized problem list and proposed treatment	<ul style="list-style-type: none"> -Anterior crossbite -Mandibular functional shift anteriorly 	<ul style="list-style-type: none"> → rotate mandible down and back, upper incisors anteriorly and lower incisors posteriorly → eliminate unstable incisor premature contact, max. incisors anteriorly, mand. incisors posteriorly, extrude posterior teeth and get posterior contacts → max. incisors anteriorly, mand. incisors posteriorly → rotate mandible down and back → rotate mandible down and back → extrude upper posteriors → expand arches
	Note: chief complaint is always the highest priority	<ul style="list-style-type: none"> -Class III canine and molars -Prognathic soft tissue profile -Mentolabial strain -Deep mandibular curve of Spee -Mild crowding 	
	Mechanotherapy	<ul style="list-style-type: none"> -Full mouth fixed appliance → orthognathic surgery (max advance, mand retract) – patient declined -Full mouth fixed appliance → extract lower 6's → distalize lower teeth using mini implants and TAD's 	

Case – palatal expansion lecture



Soft tissue analysis	Prognathism/retrognathism in facial profile	-Retrognathism → small mandible → crossbite is unlikely due to a skeletal class III
	Convexity or concavity of the facial profile	-Convex → small mandible → crossbite is unlikely due to a skeletal class III
	Facial shape (dolico, meso, brachycephalic)	
	Asymmetries, soft tissue midline	-Jaw shifted to patient's right → likely a functional shift
	Smile line	-Normal
	Horizontal fifths, vertical thirds	-Lower 1/3 (bottom of nose to chin) is large
	Lip competence	-Competent
	Lip fullness (relative to E plane)	
	Nasolabial angle	
	Mento-labial strain	
Dental analysis	Mixed, primary, or permanent dentition?	-Mixed
	Missing teeth/ectopic teeth	-Normal
	Canine/molar relationships	-Class I molar, class I canine (?)
	Overbite/overjet	-Shallow overbite
	Crossbites	-83, 53, 12, 83 with 46, 56, 84, 85
	Curve of Spee/Wilson	
	Crowding/spacing (in mm)	-Maxilla looks constricted, mandible is slightly crowded
	Tipping, rotating, malpositioning	
Skeletal (ceph) analysis	-Pan: condyles are symmetric, all teeth present, root formation normal → not condyles causing asymmetric bite/smile -Ceph: ANB is 5 → skeletal class II → retrognathic mandible MP is 35 → steep mandible → patient will grow vertically	
Functional analysis	-Patient's jaw shifts to the right when biting. Likely due to early canine interference	
Treatment planning	Diagnosis	-Constricted maxilla (transverse) with a retrognathic mandible (A-P) leading to a posterior unilateral crossbite
	Prioritized problem list and proposed treatment	-Constricted upper arch → palatal expander -Unilateral posterior crossbite → palatal expander -Mandibular functional shift → palatal expander -Maintain class I molar
	Mechanotherapy	-Rapid maxillary expander or removable appliance -RME would need banding of teeth, but seeing all the SCC's shows that she is extremely high caries risk. Therefore, a removable appliance is a better choice
Results	 	 

Case – palatal expansion lecture



More to be added