

# CRASH COURSE IN ORTHODONTICS



DENTISCOPE

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DONE BY : SIMA HABRAWI

EDIT BY : HAIF ALQAHTANI

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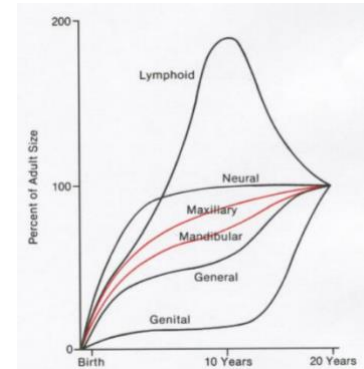
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## Growth and development

### Scammon's curve of growth

- Lymphoid tissue grows by 200% in late childhood then decreases
- Neural tissue grows rapidly until the age of 6-7 then stops
- Genitals negligible growth until puberty
- Somatic tissue [ 2-3 years and 18-20 years = rapid growth]



In jaw bones: Deposition occurs on the side of growth + Resorption occurs on the opposite side of growth → cortical drift

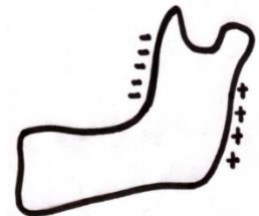
### Bone displacement

- Primary bone displacement** : bone is displaced because of it's own growth / enlargement – displacement occurs in the opposite side but parallel to the direction of growth and amount of displacement depends on amount of bone deposited
- Secondary bone displacement** : the displacement is not related to the growth of the bone itself.

### Mandibular cartilage

- Primary cartilage : Meckel's cartilage → forms the body of the mandible
  - Secondary cartilage : condylar and coronoid cartilage [ coronoid cartilage completely ossifies after birth]
- Condylar cartilage is the major site of mandible growth after birth

During mandible growth the posterior border of the ramus undergoes deposition and the anterior border undergoes resorption + mental protuberance is accentuated by bone resorption above it



### Growth spurt

Boys	Girls
12.5 – 15 years old [ avg 14 year] Max velocity is 10 cm / year Results in height increase of 20 cm and weight increase of 20 kg principal hormone is <u>testosterone</u> but some <u>estradiol</u> may be converted from <u>testosterone</u> .	10.5 -13 years old [ avg 12 years] Max velocity 8 cm / year Results in height increase of 20 cm and weight increase of 16 kg The principal hormone is <u>estradiol</u> but some <u>testosterone</u> may be converted from <u>androstenedione</u>

**\*\*Nutrition is the most important environmental determinant of growth. – mostly affected by malnutrition is muscles and fat then bones then teeth**



**Q: how can you determine the child's age?**

- **Skeletal age** = based on ossification of bones [ mostly assessed by radiographs of the hands and wrists compared to an atlas of radiographs that covers the entire developmental period ]
- **Dental age** = based on tooth formation + eruption [ degree of cusp/ root calcification , development of the roots, closure of the apical foramen, emergence ( penetration of the gingiva) , eruption ( contacting the opposing tooth ) is assessed]  
Simplest way to determine age is look for number of teeth erupted and the sequence of eruption
- **Morphological age** = based on height
- **Sexual** = based on development of sexual features



## Face development

*With growth the profile will straighten*

**Nose growth** length and depth changes continue after skeletal growth stops

- A. At puberty** : frontal bone to nasal bone angulation changes and the **genetically determined dorsal hump is expressed**
- female growth changes are greatest between **10 to 13 years**
  - male growth changes are greatest between **13 to 16 years**
- B. between 13 and 18 years:**
- nasal bone angulation can change by **30%**
  - the dorsum **can lengthen by 1mm/year**
  - the columella depth may change by **0.5mm/year**
  - nose and chin size can be inversely correlated
  - a well balanced profile before puberty may deteriorate

## lip growth

- the **lower lip grows faster than the upper lip**
- the **combined growth of the lips exceeds the growth of the lower anterior face height**
- lip incompetency decreases with age**
- with age lips lose their tone and the lip line drops
- Growth of the **lips trail behind the growth of the facial skeleton until puberty** , then catches up and **exceeds the skeletal growth thereafter**
- Lips grow **earlier in girls than in boys**

Girls	Boys
<b>Most of the vertical growth of the upper lip is achieved by the age of 14</b> <b>Most of the vertical growth of the lower lip is achieved by the age of 16</b>	<b>Both the upper and lower lip continues to grow till 19 with more growth of the lower lip</b>

- Lip thickness increases during childhood and adolescence and reaches maximum at the end of puberty (14 in girls and 16 in boys) and then decreases in late teens
- Girls have more lip thickness than boys at all ages**

## Chin growth

- the symphysis shape is **genetically determined**
- males usually have greater chin change than females**
- changes are accentuated at puberty
- most change in the chin form and position is due to growth rotations
  - chin prominence increases with upward and forward growth rotation patterns** [short face]
  - chin prominence decreases with downward and backward growth rotation patterns** [ long face]





**rotations can occur at either:** the condyles, incisors , premolars , molars , periosteal capsule

Upward and forward growth	Downward and backward growth
<ul style="list-style-type: none"><li>- the chin becomes more prominent</li><li>- the lower incisors upright</li><li>- the molars erupt and move mesially</li><li>- the condyle grows with a forward vector and adds more ramal height</li></ul>	<ul style="list-style-type: none"><li>- the chin becomes less prominent</li><li>- the lower incisors move forward</li><li>- the molars erupt vertically</li><li>- the condyle grows with a backward vector and adds less ramal height</li></ul>

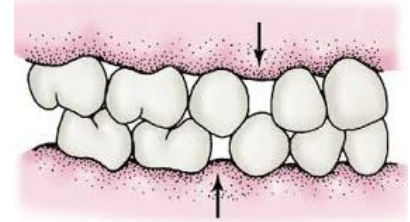




## Development of the dentition

### Primary dentition: [ 2.5 – 6 years]

Primate space / anthropoid space : space **mesial to the upper primary canine** and **distal to the lower primary canine**



- Arches are spaced – **space excess of 6 mm in each arch in the primary dentition** indicate that the perm dentition will be well aligned [ absence of space in the primary dentition is strongly associated with crowding in the perm dentition ]
- Primary teeth are in up right position – if **the overjet / reverse overjet is severe** in primary dentition it might indicate a future problem in the permanent dentition [ minimal variations in overjet have little predictive value ]  
Normal overjet = 0-4 mm
- **Over bite increases as the primary dentition erupts** and then gradually reduces before exofliation
- **Oral habits are prominent in this stage**
- Buccal occlusion : **MB cusp of the upper second primary molar occludes in the buccal groove of the lower second primary molar** – distal surfaces of the upper and lower second primary molars are in the same vertical plane [ this is because the lower second primary molar is significantly larger than the upper – **does not indicate future development of class II** ]
- Functional occlusion is difficult to asses [ crossbite can exist because of habits and can cause functional displacement of the mandible]

### Mixed dentition [ 6 -12 years ]

- Lingually positioned , mildly crowded lower permanent incisors at the age of 8-9 will align spontaneously by :
  - 1- Small increase [ 2mm] of the transverse dimension between the canines as the perm teeth erupt in a more lateral position within the arch
  - 2- Permanent incisors erupt in a more labial position giving 1-2 mm of space to relieve crowding
  - 3- Primate space [ distal to the lower canine ] is used as the erupting incisors cause the canines to migrate distally → inter canine width increases by 1mm

**Q: How is the space for upper perm incisors provided ?** the primary incisors are spaced + there is primate spacing mesial to the upper primary canine

- **Diastema between the upper perm centrals is normal** – it will partially close as the upper laterals erupt and closes completely as the upper canines erupt [ **at the age of 8-9 you should be able to palpate the perm canines buccally** – other indications of the canine position is the distal flaring of the lateral incisors and the mobility of the primary canines]

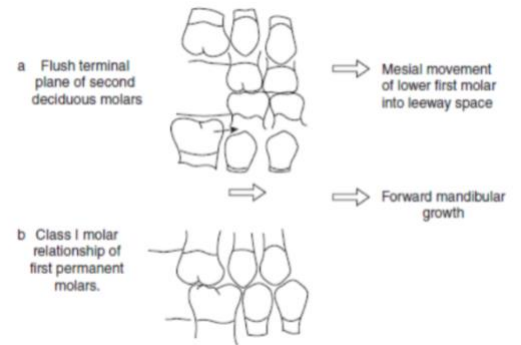
**UGLY DUCKLING STAGE** : the upper lateral incisors appear flared distally as the permanent canine erupt down and press on the distal aspect of roots of the lateral incisors – as the canines continue to erupt this will self correct and the centrals and laterals will align properly.



- **Transitory open bite is common in mixed dentition** [ caused by the incomplete eruption of the incisors , normal eruption will cause the open bite to resolve ]
- Digit sucking that persists in the mixed dentition will act as mechanical interference to the eruption of the upper incisors and leads to increase in overjet and asymmetrical open bite
- **Mild infra occlusion of the primary molars is common and normal** – but if the primary molars slip below the contact point of the permanent adjacent teeth → perm tooth will tip → intervention is needed
- Upper incisors can erupt in a crossbite or there might be buccal crossbites → can be corrected using removable appliances

**Q: how does the flush terminal plane molar relationship in primary dentition change into class 1 molar relationship?**

Forward growth of the mandible and the mesial shifting of the permanent first molars into the leeway space



**Permanent dentition [ 12 – 25 years ]** starts with the exfoliation of the last primary tooth and the eruption of all permanent teeth except the 3<sup>rd</sup> molars

- Ideally upper and lower arches are well aligned with no rotations + tight interproximal contacts
- Crowns of molars / premolars are inclined lingually / palatally
- Canines are tipped mesially
- Incisors are slightly proclined labially + the upper incisors are angulated towards the midline
- Overjet = 1-3 mm
- overbite = lower incisors contacting the cingulum plateau of the upper incisors at intercuspatal position [ upper incisors cover 10-50% of the crowns of the lower incisors ]
- Angle class 1 molar and canine relationship
- **Curve of spee:** the antero- posterior curve of the vertical height of crowns in the lower arch [ this is called the compensatory curve in the upper arch ]
- **Curve of Wilson:** the bucco lingual curve of the occlusal surface of post teeth
- **In ICP :** even contacts on all posterior teeth with light contacts on incisors
- **Protrusion:** causes dislocation of all posterior teeth
- **In lateral excrusion :** no contacts on the non working side

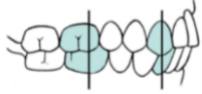

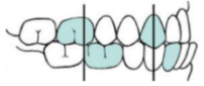
### Occlusion changes throughout adulthood

- 1- Crowding in the lower incisors in the late teens and early 20s [ due to late mandibular growth and mesial migration of the dentition ]
- 2- Spacing might occur as a result of periodontal disease
- 3- Attrition will cause a shift from canine guidance to group function
- 4- Growth rotations of the maxilla and mandible continue throughout adulthood – but occurs at a rate that allows the occlusal relationships to be maintained



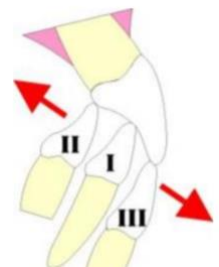
## Classification of occlusion

**Angle's molar classification** Based on the relative anteroposterior (AP) position of the first permanent molar.

Class I	Class II	Class III
<p>The buccal groove of the mandibular first permanent molar should occlude with the mesio-buccal cusp of the maxillary first molar. This is considered to be the normal relationship.</p>	<p>The buccal groove of the mandibular first permanent molar <b>occludes posterior to</b> the mesio-buccal cusp of the maxillary first molar. The degree of discrepancy is described as a fraction of the MD width of a premolar unit.</p> <p><b>DIVISION I:</b> The maxillary central incisors are proclined or normally inclined and the overjet is increased.</p> <p><b>DIVISION II:</b> The maxillary central incisors are retroclined.</p>	<p>The buccal groove of the mandibular first permanent molar <b>occludes anterior to</b> the mesio-buccal cusp of the maxillary first molar.</p>
		

## British institute classification of incisor relationships

Class I	Class II	Class III
<p>The lower incisor edges occlude <b>on or lie below the cingulum plateau</b> of the upper incisors.</p>	<p><b>Division I :</b> The lower incisor edges <b>occlude behind the cingulum plateau</b> of the upper incisors and the upper incisors are <b>normally inclined or proclined</b>.</p> <p><b>Division II:</b> The lower incisor edges <b>occlude behind the cingulum plateau</b> of the upper incisors and <b>the upper incisors are retroclined</b>.</p>	<p>The lower incisor edges occlude <b>anterior to the cingulum plateau</b> of the upper incisors.</p>





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## Canine relationship

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### **Class I**

the maxillary permanent canine occludes **in the embrasure** between the lower canine and first premolar



### **Class II**

The maxillary canine occludes **anterior to the embrasure** between the lower canine and first premolar



### **Class III**

The maxillary canine occludes **posterior to the embrasure** between the lower canine and first premolar





## Clinical examination in orthodontics

Orthodontic examination begins as soon as the pt walks in [ determine general stage of development , height , presence of secondary sexual characteristics → this will allow you to know the amount of growth remaining]

### Extra oral assessment

- 1- assessment of skeletal pattern
  - AP
  - Vertical
  - Transverse
- 2- Assessment of soft tissues
  - Lips
  - Nasio labial angle
- 3- TMJ

### Intraoral assessment

- OH
- Dental development
- Dental / mucosal pathology
- Tongue
- Tooth position withing and in between the arches

#### Habits :

Lower lip biting → retroclined lower incisors [ class II div 1]

Nail biting → tooth wear + root resorption

### 1- Assessment of skeletal pattern :

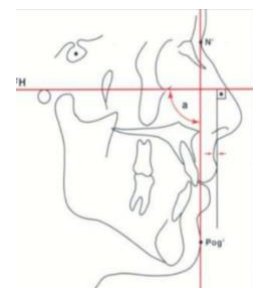
#### A. Antero posterior dimension

- Assessed in the natural head position [ standerized and reproducible] – the pt should be sitting upright , relaxed, looking straight ahead at a distant point at eye level , teeth should be lightly in occlusion
- The **most anterior part of the maxilla and the mandible** can be palpated in the **midline** through the **base of the upper and the lower lips**



<b>Class I</b>	The mandible lies 2-3 mm posterior to the maxilla [ straight profile ]
<b>Class II</b>	The mandible lies retrusive to the maxilla [ convex profile]
<b>Class III</b>	The maxilla lies protrusive tot the mandible [ concave profile]

- **Zero meridian line represents the anterior limit of the cranial base soft tissue** A point should lie 2-3 mm ahead of this line soft tissue B point should like 0-2 mm behind this line



### B. Vertical dimension



Vertical skeletal dimension can influence :

- 1- The degree of vertical incisor overlap
- 2- Over all facial esthetics
- 3- Lip competency

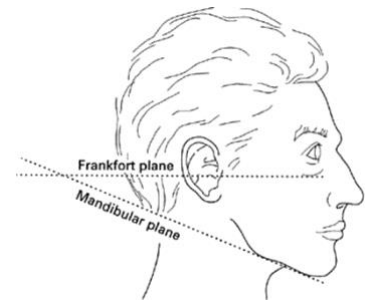
**Vertical dimension can be assessed through :**

- A. **Lower anterior facial height proportion [ LAFH]** – the upper and lower facial heights should be approximately equal
- B. **Frankfort mandibular plane angle [ FMPPA]**



Assessed in profile view – gives an indication of the relationship between the LAFH and posterior facial height [ ramus height]

<b>Normal</b>	<b>When the lines intersect in the occiput region</b>
<b>Increased</b>	When the lines intersect anterior to the occiput
<b>Decreased</b>	When the lines intersect posterior to the occiput



**C. Transverse dimension**

**Assessed through :**

**1- Facial symmetry :**

Assessed by constructing the facial midline from the soft tissue nasion to the middle part of the upper lip at the vermilion border , the chin point must coincide with this line.

If the chin point does not coincide → check for compensatory cant in the maxillary occlusal plane

Asymmetries in the chin point can be produced by lateral displacement of the mandible on closing if there is occlusal interference

**2- Arch width :** on intraoral palpation the maxilla should be slightly wider than the mandible

**NOTE:** the absolute transverse dimensions of the maxilla and the mandible can be normal but there might be a posterior cross bite [ relative transverse maxillary discrepancy] due to incorrect antero posterior positioning of the jaws [ because the jaws get wider as you move posteriorly]



**2- Assessment of soft tissues :**

**1- Lips :**

**Lower Lip line** = the vertical relationship between the lower lip and the maxillary incisors at rest

Normally the lower lip should lie against middle 3<sup>rd</sup> of the crown of the upper central incisor

- if it lies above this level → max incisor retroclination [ class II div 2]
  - if it lies below this level → maxillary incisors proclination [ class II div 1]
- CAUTION: in class II div 1 , the stability of the overjet correction is questionable if the lower lip does not cover at least the incisal 3<sup>rd</sup> of the max central incisor at rest

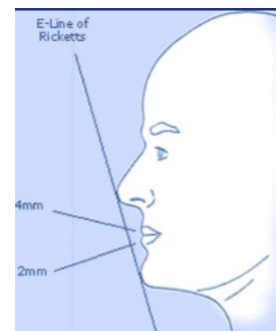
Lip length : females = 20 – 22mm                      males = 22-24 mm

You need to also check :

**1- Lip fullness and tone**

**2- Lip competency**

- A. **Competent lips** : a lip seal is produced with minimal muscular effort when the mandible is at rest position
- B. **Potentially competent** : positioning of the upper incisors prevents a comfortable lip seal
- C. **Incompetent** : excessive muscular activity is required to achieve lip seal [ **the interlabial distance at rest is > 4 mm** ]



**Signs of excessive muscular activity :**

- Flattening of the labio mental fold when the lips are held together
- Puckering of the skin overlying the chin [ due to the mentalis muscle contraction]

**3- Method of achieving anterior oral seal at rest and at swallowing**

**Rickett’s esthetic line [ E- line]:**

- upper lip should lie 4 mm behind this line
- lower lip should lie 0-2 mm behind this line

2- **Nasio labial angle:** gives an indication of the position of the upper lip – in Caucasians the upper lip should slope slightly anteriorly [ 8-14° to the vertical]

<b>Normal</b>	<b>102 ± 8</b>
<b>Acute</b>	<b>&lt; 90</b>
<b>Obtuse</b>	<b>&gt;90</b>

**Habits:**

- A. Digit sucking will produce callus on the digit sucked
- B. Nail biting can be examined by looking at the nails



**3-Assesment of the TMJ:** Look for any tenderness in the muscles of mastication + clicking or crepitus in the TMJ

**INTRAORAL EXMAINATION:**

- 1- **Determine OH**
- 2- **Determine if dental development is normal or not**  
[abnormalities in the sequence of eruption are more important in detecting developmental disturbances – asymmetries in dental development of more than 6 months indicates the need for radiographic examination]
- 3- **Asses dental / mucosal pathology** [ caries , gingivitis, toothwear, hypoplasia ]
- 4- **Examine the tongue :**  
It is difficult to asses the size of the tongue unless it is greatly abnormal
- 5- **Asses tooth position within and in between the arches**

**Tooth position :**

3 segments should be assessed :

- A. Labial segment
- B. Canines
- C. Buccal segment  
\*\* asses and quantify crowding, spacing and teeth inclination [ canines and molars] in each segment + presence of abnormal frenal attachment in cases of diastema

**Static occlusion :** check :

- 1- Overjet : normal = 2-4 mm
- 2- Overbite : normal the upper incisors should cover the incisal 3<sup>rd</sup> of the lower incisors
- 3- Centerlines
- 4- Incisor relationship / canine relationship / molar relationship
- 5- Crossbites

**Dynamic occlusion :** check for interferences in lateral excursions

Poor OH during Ortho Tx consequences:

- 1- Decalcifications
- 2- Gingival hyperplasia
- 3- Periodontal breakdown
- 4- Removable appliance related stomatitis

signs of tongue thrusting and macroglossia :

- 1- Crenulations on the lateral border of the tongue
- 2- Presence of the tongue interposed between the incisors at rest
- 3- Presence of lisp
- 4- Anterior open bite
- 5- Reverse curve of spee in the lower arch
- 6- Proclination of the upper and lower incisors





## Cephalometric analysis

**Lateral cephalometric radiograph [LCR]** is mostly used in ortho diagnosis and treatment planning because it is **standardized and reproducible** by the use of a cephalostat .

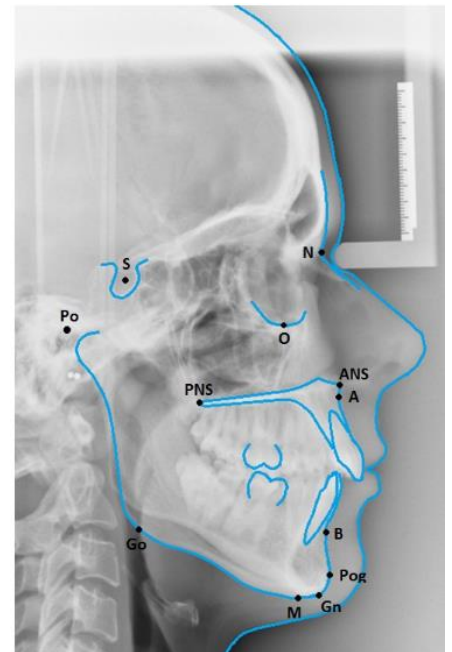
**The cephalostat** = a head positioning device that has 2 posts that engage the external auditory meatus and ensures that the pt's sagittal plane is parallel to the film during lateral ceph radiographs.

**Pt's teeth should be in centric occlusion and the Frankfort plane should be aligned horizontally**



**Q: mention the uses of LCR in ortho?**

- 1- Ortho diagnosis and treatment planning [ specially in cases of orthognathic surgeries]
- 2- To identify the etiology of malocclusion [ to know whether it is dental or skeletal or both ]
- 3- Monitor treatment progress
- 4- In research

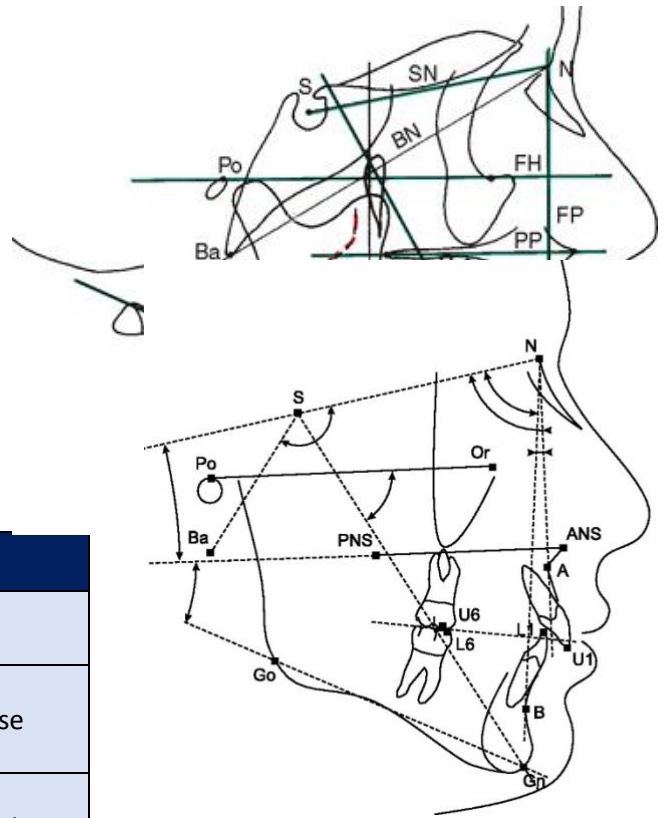


Cephalometric point	Description
<b>A point [A]</b>	The point of deepest concavity anteriorly on the maxillary alveolus
<b>B point [B]</b>	The point of deepest concavity anteriorly on mandibular symphysis



<b>Sella [S]</b>	The mid point of the sella turisica [ pituitary fossa]
<b>Nasion [N]</b>	Most anterior point on the fronto nasal suture
<b>Orbitale [ Or]</b>	Most anterior inferior point on the infra orbital rim
<b>Porion [ Po]</b>	The upper midpoint on the external auditory meatus
<b>Anterior nasal spine [ ANS]</b>	The tip of the anterior nasal spine
<b>Posterior nasal spine [ PNS]</b>	The tip of the posterior nasal spine
<b>Gonion [Go]</b>	The most posterior, inferior point on the mandibular angle
<b>Gnathion [Gn]</b>	The most anterior, inferior point on the mandibular symphysis
<b>Menton [Me]</b>	The most inferior point on the mandibular symphysis
<b>Pogonion [Pog]</b>	The most anterior point on the mandibular symphysis

Line / plane	Description
<b>SN line</b>	plane demonstrated by a line <b>through the nasion and sella</b>
<b>Frankfort Plane</b>	plane demonstrated by a line <b>through the orbitale and porion</b>
<b>Mandibular Plane (MnPI)</b>	plane demonstrated by a line <b>through the gonion and menton</b> [the plane of the lower border of the mandible]
<b>Maxillary Plane (MxPI)</b>	plane demonstrated by a line <b>through the anterior and posterior nasal spines</b>



Angle	Description
SNA	Represents the relative anterioposterior position of the maxilla to the cranial base
SNB	represents the relative anterioposterior position of the mandible to the cranial base
ANB	represents the relative anterioposterior position of the maxilla to the mandible and <b>can be used to determine skeletal class</b>
Inter-Incisal Angle	Angle between the long axis of the maxillary incisors and the long axis of the mandibular incisors
Maxillary-mandibular plane angle (MMPA)	angle formed between the Maxillary Plane and Mandibular Plane
Maxillary Incisal Inclination (UInc to MxPI)	angle between the maxillary plane and the axis of the maxillary incisors (UInc)
Mandibular Incisal Inclination (LInc to MnPI)	angle between the mandibular plane and the axis of the mandibular incisors (LInc)

The anterior cranial base is generally constant after the age of seven, → it is used as a stable point to compare the facial structure against

The sella turcica is used as this reference for the anterior cranial base

**Q: why do we measure facial structures against the cranial base?** Because it is stable after the age of 7



**Q: what is the reference point for the cranial base ?** sella point

**Q: what does SNA and SNB indicate?** The anterior posterior position of the maxilla and the mandible relative to the cranial base – if their values are increased or decreased it means that the jaws are positioned anteriorly or posteriorly

**Q: The skeletal pattern can be assessed by looking at which angle?** ANB [compares the difference between SNA and SNB so it determines the relationship of the maxilla relative to the mandible ]

- ANB = 2-4° → class 1
- ANB < 2° → class 3
- ANB > 4° → class 2

**Q: which angle would you use to determine the incisal positions?** the angles UInc to MxPI and LInc to MnPI and the Inter-incisal angle – those angles show if the incisors are average or retroclined or proclined

**The inter-incisal angle shows how deep the overbite is** - if the angle is increased, the patient has a deeper overbite

**Q: which angle should you use to determine overbite?** The interincisal angle

**Q: which angles should you use if you want to assess vertical relationship?** MMPA – will indicate the facial height proportions

Increased MMPA → backward pattern of mandibular growth and a decreased overbite

Decreased MMPA → forward pattern of growth and increased overbite



## Soft tissue analysis

The face is divided into 3<sup>rd</sup> s [ frontal , nasal and gnathic 3<sup>rd</sup>]

### Rickett's lip analysis

The reference line used by Ricketts (esthetic line): tip of nose to skin pogonion

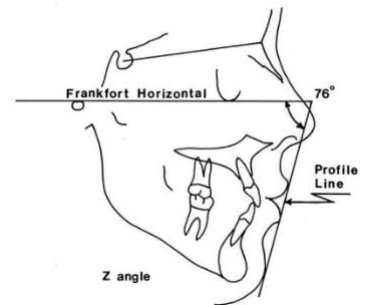
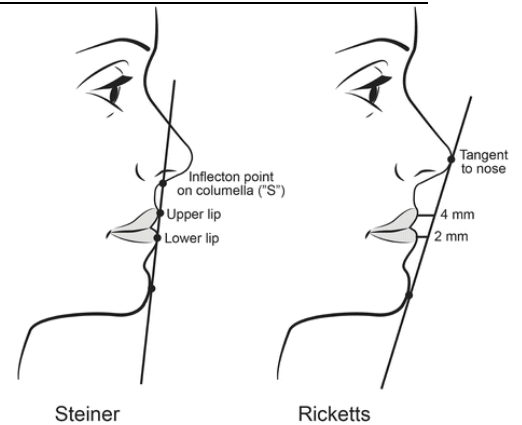
- Upper lip 2-3 mm behind this line
- lower lip 1-2 mm behind this line

### Steiners lip analysis

Reference line is center of (S) shape between tip of nose and upper lip and soft tissue pog.

If lips behind this line → lips are too flat. If lips anterior to it → lip are too prominent

**Merriβield 'Z' angle** is taken between a line from soft tissue pogonion to the most procumbent lip, and the Frankfort horizontal plane [ normal = 70-80 degrees ]





## Etiology of malocclusion

Malocclusion is caused by genetic and environmental factors [ multifactorial anomaly ]

- Craniofacial dimensions + size and number of teeth are **determined genetically**
- Dental arch dimensions are affected by **environmental factors**

**Skeletal problems - antero – posterior → mostly genetic**

- **Class II is caused by mandibular deficiency**  
Mild to moderate class II → mostly inherited  
Severe class II → inherited + environmental factors
- **Class III is caused by maxillary deficiency or mandibular prognathism** [ mostly genetic ]  
**Mandibular prognathism has racial and familial tendencies**

**Skeletal problems – vertical / transverse → Mostly inherited** [ but environmental factors can contribute]

- **Crowding genetic factors:** the child inherits the jaw size from one parent and tooth size from another parent → small jaw and big teeth
- **Crowding environmental factors:**
  - 1- Early loss of primary teeth
  - 2- Digit sucking
  - 3- Softer less abrasive diet [ less interproximal tooth wear , less demands on the jaw function and general tendency for smaller jaws ]

**Facial typing :**

- Brachycephalic [ short + broad ] = mostly associated with class II div 2
- Dolicocephalic [ narrow,tapered long face]
- Meso cephalic [ round + oval ]

**Facial profile:** Convex → class II                      concave → class III                      flat → class I

**Hypodontia :** [ mostly genetic – related genes are PAX 9 and MSX1 ]

- Mild hypodontia → 1 or 2 teeth missing
  - Moderate hypodontia → up to 6 teeth missing
  - Severe hypodontia → more than 6 teeth missing [ oligodontia]
- > **Peg shaped laterals are common in Asia , Macrodonia is common in Africa**
  - > Generalized spacing with large tongue and large jaws is common in africa
  - > Ectodermal dysplasia is associated with hypodontia + [ no hair and no sweat glands ]
  - > Most common tooth anomaly = hypodontia
  - > Most common area for supernumerary teeth = in the premaxilla [ mesiodense – between the 2 centrals]
  - > Paramolar = supernumerary tooth between the 1<sup>st</sup> and 2<sup>nd</sup> molar buccaly
  - > Distomolar = a supernumerary tooth behind the last molar [ also called 4<sup>th</sup> molar]



- > Supernumerary teeth are either conical or tubercular, tubercular is mostly associated with impaction of upper centrals
- > **Most common congenital defect in the orofacial region = cleft lip and palate**

**Q: what are the most common congenital missing teeth after the 3<sup>rd</sup> molars ?** upper laterals and lower premolars

**Overjet could be due to :** Jaw position [ genetic ]                      upper incisor proclination [ enviromental]

**Q: mention prenatal and post natal environmental causes of malocclusion in general ?**

Prenatal	Post natal
Trauma during birth [ using forceps during delivery] Maternal diet [ ex: deficiency in folic acid or vit D ] Maternal consumption of alcohol and drugs	TMJ injuries Accidents Fractures

- Intrusion of a primary tooth can cause dilaceration of the perm tooth [ extreme curvature in the root ] → tooth becomes impacted and there will be drifting and loss of space
- The curvature location will correspond to when the trauma happened [ if the curvature is in the apical 3<sup>rd</sup> → trauma happened when most of the root was already formed]

**Q: how can febrile diseases cause malocclusion?** Fever can affect growth and dental development leading to malocclusion

- **Muscular dystrophy :** disturbed muscular balance → such cases are very hard to treat because they the teeth will relapse again because of the severe anterior open bite [ no contact between the teeth and no zone of balance]
- **Typical appearance of diabetic pts =** Proclined and rotated upper incisors causing diastema
- **Thumb sucking leads to:**
  - 1- Anterior open bite
  - 2- Proclined upper incisors and retroclined lower incisors
  - 3- Unilateral posterior crossbite
  - 4- If 2 digits are being sucked → asymmetrical anterior open bite
- Posture is not an important factor in malocclusion, maybe a contributing factor

**Q: what are the complications of having supernumerary teeth ?**

- 1- Impaction /root resorption / malpositioning of adjacent teeth
- 2- Severe crowding
- 3- Cyst formation
  - Macrodontia is mostly seen in the upper centrals or lower 2<sup>nd</sup> premolars [ molarization of the premolars]
  - Lower second primary molar is the most common tooth to be lost prematurely



Retained primary teeth without a successor should be retained as much as possible to maintain bone thickness [ if more than 2/3 of the root is lost or the tooth is not intact → extraction ]

**Q: how can you confirm if the diastema is caused by the labial frenum?** Pull the lip upward and outward and check for blanching of the incisive papilla + presence of thick tissue and if you take an upper occlusal radiograph you'll see a V shaped notch between the upper centrals

**Q: how can atypical root resorption cause retention of the tooth?** Abnormal resorption will cause one root to be resorbed while the other root will remain intact → tooth is not mobile and will be retained for a long time.





## Biomechanics of tooth movement

Tooth movement has tension and pressure sides – the direction where the tooth is moving [ pressure] will have bone resorption and osteoclasts and the opposite side [ tension] will have bone deposition and osteoblast.

Heavy forces	Light forces
Delayed movement after <b>7- 14 days</b> Blood vessels of the PDL in the pressure side occlude and cells die Movement will be <b>intermittent every 10- 14 days</b> and by <b>undermining resorption</b>	Movement occurs after <b>2-3 days</b> Blood vessels in the PDL are slightly compressed allowing metabolic changes Movement will be smooth and <b>continuous</b> by <b>bone remodeling</b>

Heavy forces are associated with :

- pain
- delayed movement
- anchorage loss
- mobility
- root resorption

Bodily movement requires most force  
 Intrusion requires least force

- ortho movement usually causes transient inflammation in the pulp but it can cause loss of pulp vitality if the tooth is previously traumatized or you are using heavy forces
- ortho treatment will always cause **root resorption of 1-2 mm** [ root resorption increased if the roots are thin, with heavy force, asthma, compromised teeth , history of root resorption]
- ortho treatment causes **alveolar crest bone loss of 0.5 -1 mm**



## orthodontic movements

All ortho movements follow Newton's 3<sup>rd</sup> law [ for every action there is an opposite and equal reaction]

The sum of forces [ or moments] in any ortho appliance should equal to ZERO

**Centre of resistance [ COR ]** = center of mass

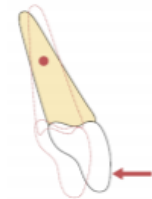
- center of resistance is **located 1/3 away from the root tip in single rooted teeth** [ moves more apically if bone support is lost due to perio disease]
- center of resistance in multirooted teeth is located **between the roots 1-2 mm apical to the furcation**
- **COR is affected by : bone height – PDL status – root length**
- if force passes through the center of resistance → bodily movement
- if force passes at a distance from the center of resistance → tipping / rotation [ the greater the distance from the COR the greater the rotation]

**Couple** = two equal and opposite forces

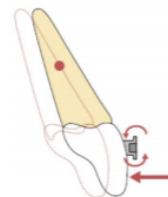
- couple acting alone → rotational movement
- couple combined with another force → bodily movement
- a couple exerts no net force [ because the forces cancel each other out ] → causes bodily movement
- a couple is generated when the ortho wire is engaged in a bracket

### Tooth movement in ortho brackets

In order to move the tooth bodily the force must pass through the COR , but you can't apply the force through the center of resistance [ because it is located in the root ], the force is always applied at some distance from the COR [when you apply a force onto the crown of a tooth → rotational force will be generated ]



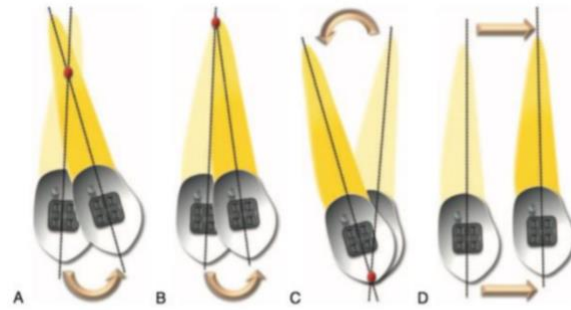
bodily movement requires a combination of a **force + couple to control rotation** , when a **rectangular wire is engaged in an edge wise bracket** a **couple** is generated [ this will stabilize the root position] → bodily movement can be carried out in the direction of the applied force





## Movements

Movement	Location of center of ROTATION
Uncontrolled tipping	Apical to the center of resistance
Controlled tipping	At the apex of the tooth
Torque / root movement	At the incisal edge
Bodily movement	Infinity [ does not exist ]



A, Uncontrolled tipping. B, Controlled tipping. C, Root movement (torque). D, bodily movement. Centre of rotation in every case is depicted by a red dot. Note that during translation (D) the CoR is at infinity or, in other words, does not exist

**Torque or root movement is used to correct class II div 2**

**Friction** = a force that resists the motion of 2 objects in contact with each other [ two types : static ( at rest) , kinetic ( at motion) ]

- friction affects tooth movement in all **fixed appliances** but particularly in **edge wise brackets**
- **consequences of friction :**
  - A. reduced or no tooth movement
  - B. distortion of the wires
  - C. loss of anchorage

**factors affecting friction:**

- stainless steel wires have the least friction → Niti wires → beta titanium wires [ greatest friction]
- friction increases as the archwire thickness increases
- ceramic brackets cause more friction than st steel brackets [ this is corrected by incorporating a metal archwire slot in the ceramic bracket]
- narrower brackets have greater friction
- elastomeric ligation results in greater friction , but **self ligating brackets [ retain the wire with a clip ] have less friction**



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## Orthodontic records

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**Q: what orthodontic records should you take for any ortho pt?**

- 1- photo graphs
  - A. extra oral [ front, three quarters and profile view each with lips closed and in full smiling]  
when taking all extra oral photographs the focus must be on the lower eyelid on the eye closest to the photographer [ to ensure that the rest of the area of interest is in sharp focus]
  - B. intraoral [ front , right and left buccal , upper and lower occlusal ]
- 2- models [ to evaluate occlusion + dental anatomy + arch form, detect abnormalities in the arch form, space analysis, kesling set up ]  
digital models are as accurate as plaster models
- 3- clinical measurements – on visit to visit basis to monitor tx progress [ overjet, overbite, centerlines, canine and molar relationships]

**Q: what is the best camera to use ?** Canon 60 D with 100 mm Macro lense and ring flash

Photographs are indicated at the beginning and end of treatment and at any tx milestone [ like the end of functional appliance therapy ]

**The photographer should** be holding the mirror [ for occlusal photographs ] and the cheek retractors [ on the side being photographed ]



## Anchorage in orthodontics

**Anchorage** = resistance to **unwanted tooth movement** of the reactive unit [ the anchorage unit can move , but it's role is to provide resistance]

- **Most unwanted side effects in ortho tx result from insufficient anchorage**
- Anchorage is **harder in adults** because there is no longer growth
- In adults there is no growth to interfere with the forces generated by the ortho appliance → **tooth movement is a result of the applied force**, but muscles function and soft tissue balance will modify the effect of the ortho tx

### Classification of anchorage

#### 1- According to the site of anchorage

- A. **Intra oral** : using the teeth , mucosa and other oral structures
- B. **Extra oral** : anchorage established outside the oral cavity [cervical, occipital, cranial , facial ]

#### 2- According to the jaws involved

- A. **Intra maxillary**: anchorage is established in the same jaw as the active element
- B. **Inter maxillary**: anchorage is established in the opposite jaw of the active element

**Active unit** = teeth to be moved

**Reactive unit** = teeth that will be considered as anchorage

#### 3- According to burstone : in relation to space closure

- Type A = space is closed primarily by the RETRACTION of the anterior teeth
- Type B = EQUAL CONTRIBUTION by the anterior and posterior teeth to close the space
- Type C= space is closed primarily by the PROTRACTION of the posterior teeth

#### 4- According to space availability : [ most practical]

- ✓ **Minimum** = 2/3 of space utilized by the movement of the anchor unit  
[ Ex: if the space is 7 mm → 2/3 [ 4 mm ] will be closed by moving the posterior teeth forward ]
- ✓ **Moderate** = ½ of the space utilized by the movement of the anchor unit and the other ½ by the movement of the moving unit  
[ Ex: if the space is 7 mm → 3.5 mm will be closed by the posterior teeth moving forward and 3.5 mm will be closed by the anterior teeth moving backwards]
- ✓ **Maximum** = not more than ¼ of the space is utilized by the movement of the anchor unit  
[Ex: if the space is 7 mm → 1.5 mm will be closed by the movement of the post teeth forward]
- ✓ **Absolute** = **no movement of the anchor unit**  
[ex: the posterior teeth will not move at all – provided by head gear and by minim implants ]  
**In absolute anchorage the entire space is closed by the movement of the ACTIVE UNIT**



**5- According to the manner of force application :**

- A. Simple = the anchorage unit is **allowed to tip** during movement
- B. Stationery = the anchorage unit is allowed to **bodily move** only [ translate] – [ Ex: adding certain components to the appliance or bending the wires in a specific way to prevent tipping of the anchor unit]
- C. Reciprocal = **each unit is both active and anchorage unit** , they move in equal amount but in apposite direction [ Ex: closing a diastema , both teeth will move in the same amount but in opposite directions ]

**Methods of reinforcing anchorage**

- 1- Using many teeth against fewer teeth [ frequently leads to anchorage loss]
- 2- Use rigid wires [ transpalatal arch , lower lingual arch, cast structures , stiff st. st. wires]
- 3- Use of metallic implants [ palatal implants and temporary anchorage devices [TADs], miniscrews]
- 4- Distal tipping of the molars
- 5- Push the anchorage teeth to be in cortical bone [ more dense and will provide better resistance]
- 6- Allow the anchorage teeth to only move bodily [ tipping is an easier movement, when you allow anchorage teeth to only move bodily → better resistance]  
Differential anchorage = allowing one unit to tip and one unit to bodily move [ major problem = it might split the arch into two occlusal planes , but this can be prevented by keeping the moment to the anchorage unit below the level that causes tipping]
- 7- Free anchorage [ rarely used]: using teeth that will be extracted as anchorage or **ankylosed teeth and 3<sup>rd</sup> molars**
- 8- Reinforce intra oral with extra oral anchorage or inter with intra maxillary anchorage

**Most commonly used anchorage auxiliaries** = transpalatal arch and lower lingual arch

Palatal implants are no longer used, but sometimes they are used for cases of severe hypodontia

Miniscrews provide **ABSOLUTE ANCHORAGE**

If the moment to force ratio increases → the tooth will only move bodily

Ankylosed teeth = **ABSOLUTE ANCHORAGE**

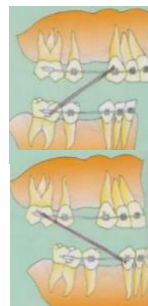
Splitting of the arch into 2 occlusal planes due to the use of differential anchorage



**Intermaxillary anchorage** : by using elastics , bite jumping appliances like herbst appliance, **occlusion itself** is a type of intermaxillary anchorage]

✓ Class II elastics : from upper canine to lower 1<sup>st</sup>

✓ Class III elastics : from lower canine to upper 1<sup>st</sup> molars



molars

The goal after ortho TX is to provide proper occlusion so that the teeth will interlock and prevent relapse



Herbst appliance = an appliance that is fixed on the upper posterior teeth and the lower canines → forces the pt to bite forward [ used to correct class II malocclusion]

**Side effects of intermaxillary anchorage :**

- 1- Extrusion
  - 2- changes to the inclination of the occlusal plane
  - 3- provides only Intermittent force
  - 4- Depends on pt's compliance
- Class II elastics will cause → extrusion + retroclination of upper incisors
  - Class III elastics will cause → extrusion + retroclination of lower incisors

**Extra oral anchorage :** by head gears , cervical gears etc attached to the intraoral appliance by a facebow

**FACTORS AFFECTING ANCHORAGE:**

- 1- Teeth [ root form , size, number, length , angulation ]
- 2- Alveolar bone [ will resist movement up to a certain limit , then it will allow movement by remodeling] – in case of periodontitis → more anchorage is needed
- 3- Basal bone [ certain areas will act as resistance areas like the palate and the lingual surface of the mandible ]

Cases where you need more anchorage :

- 1- Alveolar bone loss
- 2- Bodily movement
- 3- Moving teeth over long duration



## Dental crowding

**Crowding** = the malignment of teeth caused by inadequate space

- Crowded tooth is either displaced lingually or labially A/O rotated

The last tooth to erupt in the arch is most likely to become crowded :

- In the maxilla → the canines [ laterals are more affected than centrals because they erupt after them ]
- In the mandible → the 2<sup>nd</sup> premolars

Problems associated with crowding:

- 1- Difficult cleaning the teeth which might lead to caries and periodontal disease
- 2- Prevent ideal occlusion
- 3- Un attractive smile may lead to Low self esteem for the child

## Classification of crowding

### 1- According to the source

A. **Hereditary:** tooth size – jaw size discrepancy [ genetically the pt inherits small jaw from one parent and large teeth from another parent]

### B. Environmental :

- Premature loss of primary teeth / trauma
- Un restored proximal caries → deficiency in the arch length → teeth will tip → no space for perm teeth to erupt
- Prolonged retention of the primary teeth / ankylosed primary teeth
- Altered eruption sequence / abnormal eruption path
- Transposition of teeth [ teeth exchange position – mostly in the upper between lateral incisors and canines , in the lower between canines and 1<sup>st</sup> premolars]
- Discrepancy of tooth size [ ex: Macrodonia of the lower 2<sup>nd</sup> premolars leads to localized crowding ]
- abnormal tooth shape

### 2- According to the time of appearance:

A. **Primary crowding:** determined genetically and caused by disproportion between the jaw size and the teeth size

B. **Secondary crowding:** acquired and caused by the loss of arch length due to environmental factors like premature loss of primary teeth

C. **Tertiary crowding:** late lower incisor crowding during and after adolescence [ from 18 – 30 years]

#### Caused by :

- 1- Forward mand growth
- 2- Mesial migration of posterior teeth





- 3- +/- eruption of 3<sup>rd</sup> molars
- 4- Soft tissue pressure
- 3- According to severity [ most important ] :**
  - Mild = up to 4mm crowding
  - Moderate = 4 – 8 mm crowding
  - Severe = more than 8 mm crowding

True transposition → teeth exchange position

False transposition → caused by crowding

## Management of crowding

### 1- Mixed dentition

Type	Timing	Tx
<b>Mild</b>	Wait and watch [ it may self correct]	No tx
<b>Moderate</b>	Can wait until the premolar eruption or immediate tx	Expansion [ only if the pt has crossbite] or eruption guidance
<b>Severe</b>	Immediate tx	Expansion Eruption guidance Serial extractions Extraction + ortho tx

Q: why don't we start ortho tx in the mixed dentition? Because you don't know how the teeth will erupt + if you use an appliance at this stage → it will make the tx very long

Most ortho tx is carried out between 11-15 YO

### 2- Permanent dentition:

Do kesling set up and carey's space analysis

Degree of crowding = space required – space available

Type	Tx
<b>Mild – moderate</b>	<ul style="list-style-type: none"> <li>• Expansion [ only if the pt has crossbite ]</li> <li>• Distalization [ moving the buccal segments ( premolars and molars) distally ]</li> <li>• Stripping/ proximal reduction [ you must remain in the enamel , you remove ¼ mm from each proximal surface]</li> </ul>
<b>Moderate - Severe</b>	Expansion Extraction

### Q: what happens if you do expansion and the pt does not have a crossbite ?

It will relapse because of the zone of balance between the lips, cheeks and tongue

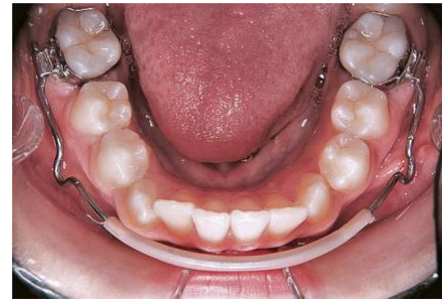
In the upper arch it can cause scissor bite - In the lower arch it can cause a crossbite



**Distalization can be done with :**

**1- Lower arch → lip bumper**

Keeps the permanent molars at their correct position and prevents possible crowding in the premolar region by a wire going from 36 to 46 buccally with an **acrylic shield that pushes the lip buccally** [ lips are pushed away from the teeth → the tongue will cause proclination of lower anteriors ]  
**Result :** The lower incisors are proclined [ the molars are not moved ]



**2- Upper arch → head gear**

If the force is above the center of resistance [COR] → roots are tipped distally  
 If the force is below the COR → crowns are tipped distally  
 If the force is at the COR → bodily movement  
**The alternative to head gear now is mini screws**  
**Result :** distalization of the molars, or tipping or bodily movement buccally

Lower lip bumper will cause proclination of the lower incisors  
  
 Head gear will cause distalization of the molars, or tipping or bodily movement

**3- Upper arch → frog appliance**

**4- Upper arch → URA with screw**

**5- Upper arch → micro implants**



**Arch expansion [ mild to moderate crowding ]:**

- Rapid maxillary expansion separates the mid palatal suture – turn the screw ¼ a turn per day
- Slow expander moves the teeth buccally – turn the screw ¼ a turn a week

**Extraction [ moderate to severe crowding ]:**

- Extract either 1<sup>st</sup> or 2<sup>nd</sup> PM if all the other teeth have good prognosis
- You can extract a tooth with poor prognosis

- If you are fixing anterior crowding → extract 1<sup>st</sup> PM
- If you need only a small space → extract 2<sup>nd</sup> PM
- Unwanted tooth movement is more when you extract 2<sup>nd</sup> PM
- If you want more space → extract 1<sup>st</sup> PM

**Q: why do we prefer extraction of premolars?**

- 1- They are in the middle of the arch [ esthetic reason]
- 2- Since there are 2 premolars, even if you extract one you will still be able to achieve ideal occlusion
- 3- They provide enough space when extracted



## Maxillary midline diastema

common causes of diastema	Less common causes
1- Physiological [ normal stage of development]- most common 2- Discrepancy in tooth size or shape 3- Discrepancy in tooth size / arch size ratio 4- Mesio distal angulation of incisors 5- Missing lateral incisors [ causes drifting of the centrals and a diastema forms] 6- Ectopic maxillary canines [ there is no pressure on the laterals → the centrals will drift causing a diastema ] 7- Proclination of anterior teeth 8- Abnormal labial frenum 9- Pathology [ midline cyst]	1- Hypotonic lips [ allow the teeth to procline causing a diastema] 2- Thumb sucking [ will cause proclination of the incisors → teeth are arranged in a larger arch → diastema ] 3- Supernumerary mesiodense 4- The use of RME

- The most common supernumerary tooth causing a diastema = mesiodense [ supernumerary tooth between the upper 2 centrals]
- Diastema is more in boys and it is more in blacks
- **Q: when would a physiological diastema self-correct ?** at the age of 16

## Causes of diastema

### 1- Physiological:

Most maxillary midline diastemas in the mixed dentition occur since the jaws increase in width in preparation for the eruption of the larger permanent teeth.

The un erupted maxillary canines lie superior and distal to the root apices of the maxillary lateral incisors, as the canines erupt they tend to force the lateral and central incisors towards the midline closing the gap.

**A diastema of less than 2 mm will close spontaneously unless the pt has generalized spacing of the dentition**

### 2- Discrepancy of tooth shape or size:

- A. Size = The most common cause is **small lateral incisors**

**Bolton analysis can be used to compare tooth size discrepancies**

Such cases will benefit from restorations that rebuild the tooth to the proper form and size → this will close the diastema

- B. Shape = the most common cause is central incisors that are excessively triangular OR have **mesial surfaces** that are convex or concave

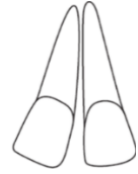
### 3- Discrepancy in tooth size / arch size ratio:

size discrepancy between the tooth and the arch size will result in **generalized spacing** in pts with good occlusion



**4- Mesiodistal angulations of the incisors:**

A. **Root convergence:** distally inclined crowns can produce a diastema with a space positioned more incisally



B. **Root divergence:** mesially inclined crowns can produce a diastema with a space located gingivally and **closed off incisally by the contact point between the teeth** [ black triangle] – this is also associated with decreased papilla fill.



- Almost half of the cases of crowded maxillary incisors will end up with black triangles at the midline after fixed appliances , unless sth is done to close this space before the appliances are removed.
- There is high incidence of CONCAVE mesial surfaces in crowded maxillary incisors and this will become more apparent after de crowding by ortho tx  
The Papilla fill is related to the distance between the contact point and the bone crest [ as the distance increases the possibility of papilla fill decreases]

5- **Missing maxillary lateral incisors:** This will allow the maxillary central incisors to drift distally

6- **Ectopic maxillary canines :** will allow the maxillary centrals to drift distally

7- **Proclination of the anterior teeth :** this leads to greater arch circumference [ width] → anterior spacing

**8- Abnormal frenal attachment :**

**Abnormal frenal attachment:** excessively thick with an alveolar attachment that is in between maxillary centrals and apparent continuity with a large incisive papilla.

**Frenectomy is indicated when:**

- ✓ Occlusal radiograph shows V shaped radiolucency [ notch] in the crestal bone
- ✓ diastema of more than 2 mm
- ✓ thick frenum [ can be tested by pulling the lips upward and outward if the papilla blanches → thick frenum , if no blanching → frenum is not attached deep into the tissue ]



**9- pathology:**

- in children it might be due to a midline cyst
- in adults it is mostly due to periodontal disease and bone loss

10- **hypotonic lips :** reduced lip pressure on the labial aspect of the teeth – the incisors will procline and drift distally

11- **habits [ digit sucking] :** will procline the upper anterior teeth → spacing and diastema

12- **supernumerary tooth [ mesiodense]:** rare cause of diastema in children

13- **iatrogenic [ rapid maxillary expansion]:** those spaces will close spontaneously within 1-2 weeks





## Treatment of diastema

- treatment depends on the etiological factor [ ex: if it is caused by habits → stop the habit]

Cause	Management
<b>Physiological diastema</b>	<p>Diastemas less than 2 mm in 9 YO will close spontaneously [ by the age of 16 ] – if the diastema is causing speech problems or low self esteem → interfere immediately</p> <p>If small diastemas don't close spontaneously → use finger springs on removable appliances</p> <p>In adults with larger diastemas → fixed appliances are used to correct teeth angulations</p> <p>** if the diastema is due to tilted centrals → use removable appliances</p> <p>If it is due to bodily moved centrals → use fixed appliances</p>
<b>Tooth size / shape discrepancy</b>	<p>Small maxillary centrals / laterals → move them mesially so that most of the restoration will be distally to build the tooth to the correct size</p> <p>Tooth shape discrepancy → dinking of the mesial surface or restorations</p> <p>** dinking might make the proximal surface flat and change the contact point to a contact surface</p>
<b>Tooth size/ arch size discrepancy</b>	<p>In pts with generalized spacing → collaboration between the orthodontist and the general dentist to position the teeth in a way that provides maximal restorative effect [ might include closing some spaces and opening others] – requires prolonged retention</p>
<b>MD angulation of incisors</b>	<p>Root convergence → angulate the crowns and the roots to eliminate the diastema</p> <p>Root divergence → upright the roots of the centrals + move the crown contact point gingivally to stimulate papilla refill</p>
<b>Abnormal frenum attachment</b>	<p>frenectomy [ if indicated ] should be done towards the end of the treatment or after closure of the diastema by ortho tx [ so that the scar tissue will <b>aid in the retention</b>] – if the frenectomy is done at the beginning of the treatment → the scar tissue will prevent the closure of the diastema</p> <p><b>Exceptions</b> : when the frenum is very thick and will not allow the closure of the diastema or becomes inflamed + swollen during the treatment as the teeth approximate → you can do frenectomy at the beginning after frenectomy you need retention because the frenum is attached deep into the tissues and will prevent the interdental fibers from attaching the centrals together [ the key to successful frenectomy is the removal of interdental fibrous tissue]</p> <p><b>retention is provided by :</b></p> <p><b>bonded palatal fixed retainer</b> [ in cases of large diastemas – this retention is permanent] + <b>removable hawley's retainer to be worn at night for the first few years</b></p> <ul style="list-style-type: none"> <li>➤ advise the pt to maintain <b>excellent OH and use floss threaders</b>, the problem with this retention is that mostly it will debond from one side causing severe caries without the pt noticing]</li> </ul>



- most cases of diastema require lifelong retention
- anterior crossbite does not require retention because the correction itself is retention
- some cases of midline maxillary diastema can be closed by resin composite
- resin composite [ without bonding agent] can be used to close the diastema temporarily and will be removed as the teeth approximate together



## Crossbite

**Crossbite** = a bucco lingual mal relationship between upper and lower teeth , can be anterior or posterior , uni or bi lateral

- cross bites may be associated with **mandibular displacement on closing** [the occlusal contact will deflect the mandible **anteriorly or laterally** to allow maximum interdigitation]
- with mandibular lateral displacement there will be **centerline shift**
- the direction of the crossbite is based on the location of the lower teeth → if the lower teeth are buccal to the upper teeth then it is **buccal crossbite** , if the lower teeth are lingually to the palatal cusps of the upper teeth then it is **lingual crossbite [ scissors crossbite]**
- the most common crossbite is **buccal crossbite**

**Cross bites are always accompanied by crowding unless there is a skeletal cause for the crossbite.**

If the upper lateral is in crossbite it will always be in palatal crossbite

### Causes of crossbite

#### 1- Skeletal factors:

- mismatch between the widths of the dental arches
- Antero posterior skeletal discrepancy
- Lingual crossbite is seen in class II , buccal A/O anterior crossbite is seen in class III
- Growth restriction of the maxilla following cleft lip and palate repair / growth restriction of the mandible following condylar fractures / trauma

#### 2- Soft tissue factors:

With digit sucking the **tongue position is lowered** → the contraction of the cheeks during sucking is un apposed → displaces the upper posterior teeth **palatally** → **unilateral buccal crossbite**

#### 3- Crowding:

in areas where the arch is inherently crowded the **upper lateral incisor might be pushed palately** and the **upper 2<sup>nd</sup> / 3<sup>rd</sup> molars might be pushed in a scissors bite [ lingual crossbite]**

#### 4- Premature loss / retention of a primary tooth :

can cause the permanent tooth to erupt in a crossbite relationship



### Treatment :

When the crossbite is associated with mandibular displacement → functional indication for it's correction because:

- A. Displacing occlusal contacts might cause TMJ problems
- B. Traumatic anterior occlusion will deflect the lower incisor labially → compromised periodontal support and recession + tooth wear

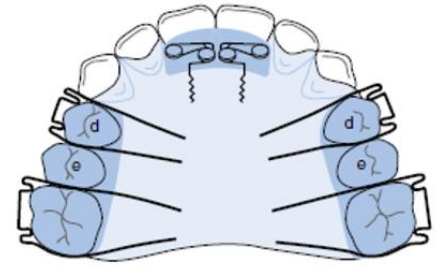




## Treatment of anterior crossbite

When one or two incisors are in crossbite **there's usually mandibular displacement and treatment early in the mixed dentition** is advisable [ if there is enough overbite to maintain the correction]

If the tooth inclination can be corrected by tipping then an upper removable appliance with **buccal capping [to free the occlusion] + z spring [ for proclination]**



- **Retentive components = Adam's clasps on the 1<sup>st</sup> PM and 1<sup>st</sup> molars**
- **Active components = z springs, double cantilever spring , screw section]**

If there will be insufficient over bite after tx or the tooth needs to be moved bodily to correct the crossbite → **use fixed appliances in the permanent dentition**

**If there is insufficient anterior retention** → appliance with screw section + clasping on the teeth to be moved.

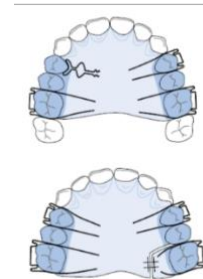
## Treatment of unilateral buccal crossbite

Upper removable appliance with T spring [ to correct crossbite on a premolar ]

OR

Upper removable appliance with a screw section [ to correct a crossbite on a molar]

It is not recommended to make more than one active components in the same removable appliance because then you need more retention



- If the space needed to correct the crossbite is up to 2mm → you can use the expansion alone
- If space needed to correct the crossbite is more than 2 mm → you need to either move the teeth distally or extract teeth or do proximal stripping to provide enough space for the correction
- If you need reciprocal movement of opposing teeth in order to correct the crossbite then → used fixed appliances with cross elastics
- If the cross bite is unilateral → you place the screw closer to the side that is going to move
- If the cross bite is bilateral → you place the screw in the midline

Unilateral buccal crossbite with mandibular displacement can be caused by :

- A. Mild discrepancy of the dental bases widths
- B. Narrowing of the upper arch caused by digit sucking

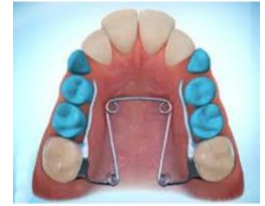
If the primary teeth have premature contacts causing the mandibular displacement → you need to grind this premature contact to prevent the posterior cross bite from continuing into the perm dentition OR you can use upper arch expansion with midline screw / quadhelix appliance





Quadhelix appliance is more effective than midline screw [ because it allows you to expand as much as you want, but the midline screw has limitations ]

Quad helix can be used for uni lateral / bi lateral crossbites and can tip teeth or move them bodily.



### Treatment of bilateral buccal crossbite

- Rarely associated with functional problems
- It indicates symmetrical transverse skeletal discrepancy
- Should be accepted unless it's correction is part of the over all tx plan → in this case it is corrected by RME [ by turning a midline screw twice daily for 2 weeks] – RME should be carried out **before early teenage years [ before 15 yo]** and **only 25% of the expansion will be retained on the long term [ you lose 75% of the expansion done]**
- In adults → SARPE [ surgical assisted rapid maxillary expansion ]

**Q: when can you accept a crossbite and not fix it?** If it's posterior + bilateral + not causing any mandibular displacement + the pt is not bothered about it

Bilateral crossbites are usually caused by skeletal problems → corrected by RME

- If the posterior crossbite is causing anterior crowding → you need to correct it

### Treatment of single tooth in lingual crossbite

- Mostly due to crowding
- Once crowding is relieved the tooth can be pushed palatally by a buccally approaching spring on a removable appliance [ occlusion must be disengaged]

### Treatment of unilateral lingual crossbite

- A. Associated with mand displacement → lower arch expansion and upper arch contraction can be done using fixed appliances / removable appliances
- B. Not associated with displacement → surgery

**Treatment of bilateral lingual crossbite:** surgical correction only

- The most important thing to check in crossbites is if there is mandibular displacement on closure or not
- Lingual crossbite is mostly seen in **class II div 2**
- **Pseudo class III** is caused by premature occlusal interferences causing mandibular shifting



## Cleft lip and palate

- **Cleft lip + palate** is more common in **boys**
- **Cleft palate alone** is more common in **girls**
- Most to least common : cleft lip and palate → cleft palate → cleft lip → cleft lip and alveolus



Unilateral Cleft lip and palate



cleft palate



cleft lip



Bilateral cleft lip

- In unilateral cleft lip and palate there will be a large segment and a small segment , the small segment will collapse due to cheek pressure

### Problems related to CL/P

- 1- **Feeding problems** : because there is no separate between the nasal and the oral cavity + those babies cannot form an anterior oral seal
- 2- **Hearing problems**: CL/P infants are more prone to otitis media [ ear infections] + build up of fluids in their ears [ glued ear] which will affect their hearing
- 3- **Dental problems**: higher risk of tooth decay and anomalies
- 4- **Speech problems** : if CL/p is not repaired → unclear , nasal sounding speech
- 5- **Facial growth** : maxillary hypoplasia [ due to scar formation after the surgical repair of the maxilla] + mand prognathism [ leads to class III malocclusion]
- 6- **Emotional / psychological problems**

#### Associated dental problems with CL/P: [ from most to least common]

- 1- Malocclusion [ every CL/P pt will develop malocclusion]\*\*
- 2- Missing teeth [ mostly the upper lateral incisors]
- 3- Dystrophic teeth [ odd shape or form]
- 4- Supernumerary teeth – mostly supplemental type [ most common is the upper lateral incisors]

**\*\* the canine tooth can be successfully erupted after bone grafting done at the age of 9-10**

**Q: what is the most common malocclusion seen in CL/P pts?** Class III, the surgical repair of the palate will result in scar formation which will result in maxillary hypoplasia



**CL/P is multifactorial and it is caused by :**

- A. Environmental factors [ mostly] – Ex:** maternal smoking, alcohol drinking, obesity and folic acid deficiency , anti seizure or anti epileptic drugs use during pregnancy
- B. Genetic factors [ autosomal recessive]- Ex:** mostly associated with syndromes like [ di-George syndrome , velocardiofacial syndrome , pierre robin sequence]

Primary palate forms during 4-7<sup>th</sup> week of IUL .

Secondary palate forms during the 6-9<sup>th</sup> week of IUL.

## Classification

- Unilateral / bilateral
- Complete / incomplete
- Cleft palate / cleft lip and palate  
Ex: Bilateral complete cleft lip and palate

Diagnosis of CL/P :

Usually picked up during the mid pregnancy anomaly scan at 18-21 weeks

If it is not detected by the scan , it is detected immediately after birth or within the first 72 hours

Management of CL/P: [ requires a team ]

- 1- Orthodontist
- 2- OMFS
- 3- Pediatric dentist
- 4- Speech therapist
- 5- ENT specialist
- 6- Psychologist

<b>Birth to 6 months</b>	Feeding assistance + parents support + hearing tests + pediatric assessments
<b>3-6 months</b>	Lip repair [ weight > 10 lbs , 10 weeks old , HB > 10 g/dl]
<b>6-12 months</b>	Palate repair
<b>18 months , 3 years, 5 years</b>	Speech assessment
<b>8-12 years</b>	Bone grafting in the cleft area to allow the eruption of the canine
<b>12-15 years</b>	Ortho tx

Feeding problems management :

- If breast feeding is not possible then breast milk should be expressed into a bottle that is specially designed for cleft lip/ palate infants
- Some cases might require a feeding tube until the surgery can be done
- Swallowing is not impaired and oral feeding is still possible , **if a bottle is used it is advised to make a cross cut in the nipple to aid in feeding**
- **Feeding can be done with a spoon, bulb syringe with a nipple**
- **The child must be held in a head up position at 45° during and after feeding + must be placed in a lateral psosion during sleep**



### Hearing problems management :

- Regular hearing tests
- Small plastic tubes [ grommets ] might need to be inserted into the ear drum to drain the fluids from the ears

### Dental care:

- Regular visits to monitor and prevent dental caries
- Sometimes ortho tx might be needed before bone grafting that will allow canine eruption

### Submucous cleft palate:

- Difficult to diagnose [ mostly appears only as a small notch on the uvula]
- Mostly asymptomatic
- **Nasal sounding due to velopharyngeal insufficiency**
- It only requires surgery if it is causing problems for the pt [ the most common reason for surgical repair of submucous cleft palate is **nasal – sounding speech**]

### Pierre robin sequence:

- Micrognathia
- Glossoptosis
- Airway obstruction [ because of the severe retrognathic mandible ]
- Cleft palate
- Velopharyngeal insufficiency



**Velopharyngeal insufficiency:** inability of the velopharyngeal sphincter to separate the oral cavity from the nasal cavity during speech → hypernasality + decrease in voice strength + short phrases + swallowing problems]

NOTE: in cases of bilateral cleft lip / palate you cannot do surgery immediately because there will be a lot of tissue tension during suturing → an appliance is used to push the lips [ prolabium ] + anterior part of the nose and premaxilla backwards so they can be easily aligned during surgery and sutured

Devices used :

A. Grayson molding plate



B. naso alveolar molding



Naso alveolar molding is fitted 1-2 week and is kept until primary lip repair, it has to be reviewed weekly , and the nasal stent is added once the size of the cleft is 5 mm



NOTES:

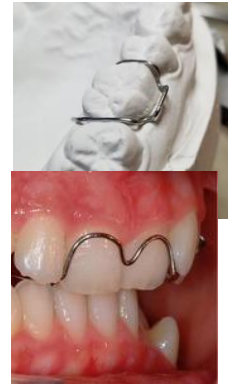
- If the parents had a child with cleft lip and palate it is UNLIKELY that they will have another child with the condition
- The chance of getting a child with CL/P if the one of the parents had CL/P = 2-8 % [ most CL/P parents will have a normal child]
- The chance of getting a child with CL/P if they already have a child with CL/P = 2-8%
- If the parent has a genetic disease like DiGeorge syndrome → there is a 50% chance of them passing it to their children



## Removable appliances

### Design of a removable appliance

- 1- Base plate / bite planes [ mostly heat cured acrylic because it is strong, less porous and less color change]
  - 2- Active components [ parts that will move the teeth – springs, screws etc.]
  - 3- Retentive components [ clasps]
  - 4- Anchorage [ prevention of unwanted tooth movement]
- Most common clasp used in ortho = Adam's clasp , can be used on any tooth but used mostly on the **premolars and molars**
  - Adam's clasp is made using 0.7 mm rigid St.St wire/ springs are made from flexible St St wires
  - Southend clasps is a clasp used on anterior teeth [centrals]



Removable appliances mode of action = simple tipping movements

#### Advantages

- 1- Can be removed for cleaning [ biggest advantage]
- 2- Cheap
- 3- Less chair side time
- 4- Palatal coverage [ good anchorage]
- 5- Other txs in the mouth can be done [ as long as they don't affect the fitting of the appliance ]

#### Disadvantages

- 1- Appliance is removable [ needs pt's cooperation]
- 2- Limited tooth movements possible
- 3- Lower appliance is poorly tolerated [ you need to increase retentive components]

Removable appliances are reviewed every 4-6 weeks .

You need to show the pt how to wear the appliance and how to activate it – wrong insertion can lead to deformed springs or components

In the first return appointment you need to check for:

- 1- Progress
- 2- Appliance fit
- 3- Wear signs on the mucosa
- 4- Speech should be normal

The appliance must be worn for at least 12 hours to deliver light continuous force. [ the pt is instructed to wear it at all times and only remove it for eating]

***If the child still has problems with speech and there are no signs on the mucosa → the child was not wearing the appliance***



**Indications for removable appliances:**

- 1- Alignment of **mesially inclined canines**
- 2- Correction of crossbites [ faster for cases of 1 or 2 teeth in crossbite]  
 Ex: a lateral incisor in crossbite – if you use fixed appliances you need to intrude the tooth then push it buccally , but with removable appliances you can use a posterior bite plane to open the bite then the tooth can be tipped easily]
- 3- Overjet reduction [ only when the upper incisors are proclined]
- 4- Overbite reduction  
 Ex: **deep anterior bite** → you place **anterior bite plane** [ to intrude the incisors and extrude the molars ]  
 In **anterior open bite** → you place **posterior bite plane**
- 5- Eliminate occlusal interferences [ ex: unilateral crossbite will be corrected by a removable appliance with midline screw that will cause maxillary expansion]
- 6- As an adjunct to fixed appliances [ ex: in class II div 2 , the upper incisors are inclined palatally preventing the ability to place brackets on the lower incisors → a removable appliance is used to tip the teeth buccally before placing brackets]
- 7- Space maintenance [ex: missing laterals , a removable appliance is used to maintain the space until the pt can get prostho or implants]
- 8- Retention

**Contraindications:**

Complex tooth movements are needed [ bodily movements, intrusion , rotation etc]

**Case selection:**

Patient	Malocclusion
Well motivated and cooperative [ must wear the appliance at all times] Good OH and no caries	Class I or mild class II / III skeletal pattern Favorable ST Tooth movement can be achieved by tipping Spontaneous alignment is possible in the lower arch

Causes of overjet:

- A. Teeth are normal but there is an overjet in the jaws
- B. Upper teeth are proclined
- C. Upper teeth are bodily more forward

**Q: why do you need to expand the maxilla symmetrically in cases of unilateral crossbites?** To eliminate occlusal interferences - The crossbite mostly occurred because the maxilla is narrower than the mandible causing the jaws to meet cusp to cusp







- 3- **Modification of soft tissue activity : lip competency is achieved by using screens and shields** [ pts with extreme overjet will not have proper lip seal , by biting edge to edge they will have proper lip seal]

**Q: how is eruption guidance achieved in functional appliances ?** by using acrylic bite planes / capping

**Q: how is mandibular repositioning achieved in functional appliances?** By using “ working bites”

**Q: how is altering the soft tissue balance / lip competency achieved in functional appliances ?** by using screens and shields

**Growth spurts :**

- Not related to chronological age – has some correlation with dental development
- There is a strong correlation between maxillary & mandibular growth and standing height / shoes size [ they both grow in the same pattern]

**NOTE: the long term effect of functional appliances is very minimal [ after tx people who did not use a functional appliance will have the same growth as people who used it]**

**NOTE: functional appliances cause 90% dental changes and only 10% skeletal changes**

**Q: what are the main changes produced by functional appliances?**

- A. Dental changes [ upper incisors are retroclined , lower incisors are proclined, differential eruption of molars]
- B. Skeletal changes [ very minimal , maxillary growth restriction and enhances mandibular growth ]
- C. Favourable soft tissue and lip competency

**Q: why should you use functional appliances to correct over jet ?**

- 1- To reduce risk of trauma
- 2- Improve profile and smile esthetics
- 3- Allow the lips to become more competent
- 4- Make subsequent ortho tx much easier [ this might be the only tx that the pt needs]

### Classification of functional appliances

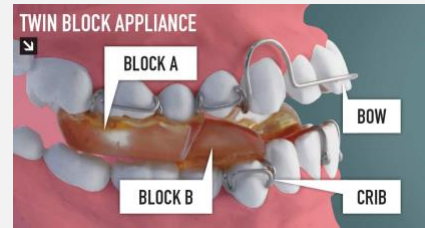
Tooth borne	Soft tissue borne	Combined tooth / soft tissue borne
<ul style="list-style-type: none"> <li>• Mostly cause dental tipping</li> <li>• Good retention</li> <li>• Well tolerated</li> </ul>	<ul style="list-style-type: none"> <li>• Less tipping movement</li> <li>• Less retention</li> <li>• Less tolerated [ difficult to achieve 24 hours wear time]</li> </ul>	



**FUNCTIONAL APPLIANCES**

**TWIN BLOCK APPLIANCE**

- **Tooth borne [ by the use of cribs ]**
- Most commonly used appliance
- Well tolerated
- Has 2 bite blocks [ upper and lower ] that will posture the mandible forward
- Mostly used to correct class II
- Head gear can be added



**FRANKEL**

- Soft tissue borne → good in mixed dentition [ tooth loss will not affect retention]
- Good to use when soft tissues contribute greatly to the malocclusion
- **Used in class II malocclusion or class III malocclusion**
- The acrylic shields are used to push the lower lip outward and increase bone deposition in the mandible



Used to control the tongue that could be causing the over jet + it contacts teeth to resist maxillary growth [ but still soft tissue borne]



Trick to know if frankel is used to correct class II or class III → look at where the lip shields are :  
 Lip shields on the maxilla → this is to correct class III  
 Lip shields on the mandible → this is to correct class II



Class III Frankel



class II Frankel

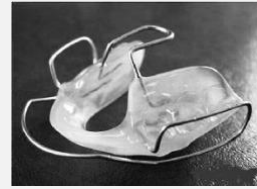


**BIONATER**

- Combined soft tissue and tooth borne
- Mono block

3 types :

- A. Standard appliance
- B. Class III appliance
- C. Open bite appliance



For class II malocclusion

**HERBST**

- Fixed functional appliance
- The upper and lower teeth are connected to each other → so the mandible will always bite forward - lateral movements are allowed
- Not commonly used because of the high % of breaking
- Advantage : it is fixed and you don't need pt compliance to wear it , but the pt has to look after it to prevent it from breaking
- Used for class II malocclusion



NOTE: only twin block is 2 pieces . Bionator and Frankel are one piece , Herbst is fixed and not removable .



## Twin block functional appliance

Twin block functional appliances produce dramatic positive change in malocclusion in a short period of time [ if they are designed properly ] – usually you will see change within 6 weeks [ if you don't see change it means the design is wrong]

- Mostly used to correct class II malocclusion [ might have some modifications to be used in other cases ]

Advantages of twin block [ compared to other functional appliances]:

- 1- It's mechanism of action is very similar to natural dentition
- 2- Allows free mandibular movement [ pt can eat and speak]
- 3- Less bulky
- 4- Better pt compliance
- 5- Excellent retention and easily tolerated
- 6- Appearance is noticeably improved after insertion

Description:

It is a functional appliance that has 2 components [ upper and lower plates] that interlock together at **70° angle** and work as one unit to posture the lower jaw forward into ideal class I occlusion + this will allow the lower jaw to reach it's full growth potential

- The inclined blocks should start at the **middle of the lower 2<sup>nd</sup> primary molar or lower 2<sup>nd</sup> permanent premolar**
- **The upper and the lower plates may also have expansion screws to widen the jaws**
- **Tx with twin block functional appliance takes 12-18 months**

**Q: why do we incorporate expansion screws in twin block appliances in some cases ?** the arch is wider posteriorly , if you move the mandible forward without expanding the jaws → you 'll end up with crossbite

Functional appliances are inserted earlier in females compared to males because female growth spurt occurs earlier

**Indications for using twin block functional appliances:**

- 1- Class II div 1 or 2 [ can be used in other cases , but the appliance has to be modified ]
- 2- Growing pt
- 3- Pt is in late mixed dentition [ the perm 1<sup>st</sup> molar and 1<sup>st</sup> premolars in both arches need to be erupted , because those teeth will be used for clasping]
- 4- IDEALLY [ but not necessary] – well aligned arches
- 5- Mild to moderate class II skeletal pattern
- 6- Retrognathic mandible
- 7- Overjet of 10 mm or less
- 8- Normal to deep overbite [ Average or reduced OVD - because all functional appliances increase OVD]
- 9- Improved facial esthetics once the mandible is brought forward



## Phases of treatment

### Active phase – phase 1 :

- 80% of the overjet is corrected at this stage
- Reposition the mandible forward until overjet and over bite are corrected [ first molars and canines will be in class I relation]
- Vertical interarch space in the premolar region should be **7- 8 mm** [ this is important because this way the pt has to bite forward to be comfortable → stretching the muscles , but if the interarch space is less than 7 mm → the pt will bite down on the blocks , the muscles are not stretched and the mandible is not moved forward]
- Worn for a **period of 7-9 months** [ full time] to prevent dual bite

Q: why do you need a period of retention? Because there might be relapse but the pt is still growing

### Retention phase – phase 2 : [ there are 2 options]

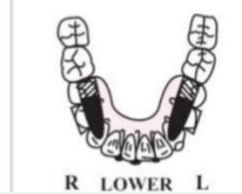
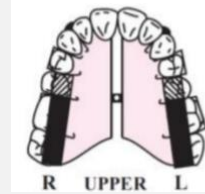
- A. **Upper removable appliance with anterior bite plane** to maintain OB and OJ correction
  - The anterior bite plane is located just behind the maxillary incisors and canines and tilts lingually at an angel of 70-80°
  - Molars must be in contact to begin stage II
  - **Allows you to start fixed appliance tx at the same time**
- B. **Wear the twin block appliance on night time basis for 3-6 months**
  - **You cannot use it with fixed appliance → there will be a 3-6 months delay in tx progress**

### COMPONENTS AND DESIGN

#### TYPE 1

**STANDARD TWIN BLOCK** [ CLASS II DIV I – WITH GOOD ARCH FORM]

- > Adams or delta clasps on the upper 1<sup>st</sup> premolar and 1<sup>st</sup> molar and lower 1<sup>st</sup> premolar
- > Ball clasps are used anteriorly
- > Twin blocks at 70° angle to advance the mandible

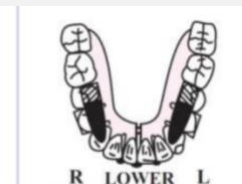
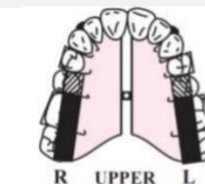


#### Upper midline screw for expansion

#### TYPE 2

**STANDARD TWIN BLOCK** [ CLASS II DIV I – WITH CROWDED LOWER ARCH]

- > Adams or delta clasps on the upper 1<sup>st</sup> premolar and 1<sup>st</sup> molar and lower 1<sup>st</sup> premolar
- > Ball clasps are used anteriorly
- > Twin blocks at 70° angle to advance the mandible
- > **upper and lower midline screw**

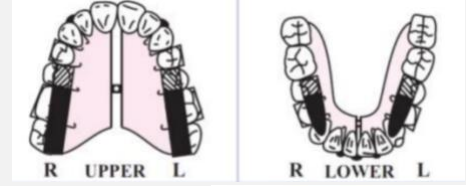


[ same as type 1 – but upper and lower midline screws]

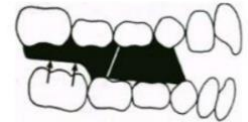


**TYPE 3**  
CLASS II DIV II [ DEEP BITE  
TWIN BLOCK]

- > Adams or delta clasps on the upper 1<sup>st</sup> premolar and 1<sup>st</sup> molar and lower 1<sup>st</sup> premolar
- > Ball clasps are used anteriorly
- > Twin blocks at 70° angle to advance the mandible
- > upper and lower midline screw
- > palatal springs to move the upper anteriors forward
- > to open the deep bite the upper bit block needs to be reduced to allow the eruption of the lower molars to adjust the overbite



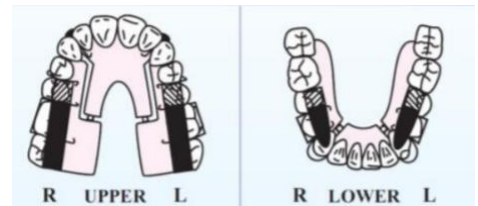
[same as type 2 but with palatal springs and trimming of the upper block]



**TYPE 4**  
CLASS II DIV II [ DEEP BITE  
TWIN BLOCK – SAGITTAL ]

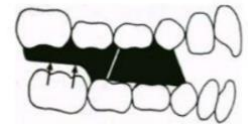
USED IN CASE ALL OF THE  
UPPER ANTERIORS ARE  
RETROCLINED NOT JUST  
THE INCISORS

- > Adams or delta clasps on the upper 1<sup>st</sup> premolar and 1<sup>st</sup> molar and lower 1<sup>st</sup> premolar
- > Ball clasps are used anteriorly
- > Twin blocks at 70° angle to advance the mandible



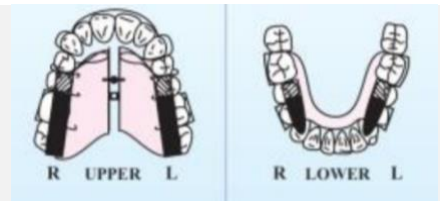
A-P screws turned ¼ a turn per week to advance the anterior teeth

- > to open the deep bite the upper bit block needs to be reduced to allow the eruption of the lower molars to adjust the overbite



**TYPE 5**  
TWIN BLOCK USED TO  
CLOSE AND OPEN BITE

- > Adams or delta clasps on the upper 1<sup>st</sup> premolar and 1<sup>st</sup> molar and lower 1<sup>st</sup> premolar
- > Twin blocks at 70° angle to advance the mandible



- > Tongue guard to prevent tongue thrusting and act as an inclined plane to support the corrected incisor relationship
- > Lower acrylic is extended to the lower first molars
- > Acrylic is relieved lingual to the anterior to correct the open bite

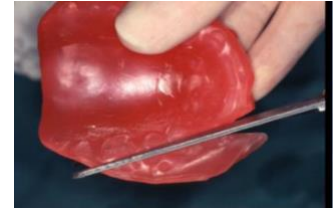
To reduce the open bite – the molars need to be intruded so they must be contacting the acrylic at all times

**Impressions:** need to record all teeth + full depth of the sulcus + **the last standing tooth with 2 mm distal to it**

**Bite registration:** is done using a thick block of softened wax , make the pt practice posturing the mandible forward multiple times before you take the registration. [ **when the pt moves the mandible forward they should achieve about 80% correction of the over jet**]



After taking the bite registration you need to trim ½ of the occlusal surface to make sure the pt is biting correctly without shifting the mandible when they posture it forward + to make sure you have 7-8 mm space in the premolar region.



**Q: what happens if the mandible was shifting and you did not detect it at this stage?** The jaws will have abnormal growth

**Fitting the appliance and pt instructions:**

- 1- The appliance should be fitted within **maximum of 2 weeks after taking the impression** [ to avoid any changes in the dentition like teeth exfoliating or new teeth erupting ]
- 2- You need to tell the pt that there will be **immediate drastic improvement in their appearance** and those changes will only occur if they follow the instructions and wear the appliance
- 3- They should **wear the appliance full time and only remove it for cleaning or eating**
- 4- Appliance should be **cleaned properly for at least 3 minutes twice daily with a soft tooth brush and liquid soap**
- 5- **Reinforce OH and give dietary advice to maintain proper gingival health throughout the tx**
- 6- Show the child how to place and remove the appliance then make them explain all of the instructions and remove and place the appliance in front of their parents
- 7- **Follow up after 4-6 weeks** [ try not see the pt in the first 4 weeks because their complaints will drastically decrease after the 3<sup>rd</sup> week]

\*\* if there is any problem tell them to keep wearing the appliance and come to the clinic to fix it

**Follow up:**

**Q: how do you know that the pt was not wearing the appliance?**

- 1- Check speech [ if child still has problems in speech like lisping or abnormal speech → they were not wearing the appliance]
- 2- Check for intraoral signs / demarcations of the device on the mucosa
- 3- Check if there is any progress in tx [ reduction in overjet , overbite centerlines etc]

At each follow up session – check :

- 1- If they are wearing the appliance properly
- 2- Marks on the mucosa
- 3- Progress in tx [ changes in OJ , OB , spacing , molar relationship etc ]
- 4- Speech
- 5- Adjust retention of the appliance or head gear if needed

NOTE: after a couple of months the pt will be used to the appliance and if they had increased overbite you can now remove the lower cribs and trim the upper block to allow eruption of the lower molars to correct the overbite

**In case you are using the appliance to correct class II div II with over bite → trimming the upper bite block is done in the follow up session not immediately.**



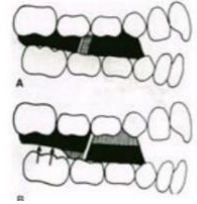


After **4 months if the pt was cooperative then the reduction in the over jet should be 4-6 mm.** at this stage if further reduction is needed you can reactivate the appliance.

- Ask the pt to position their mandible forward an air gap should open up between the upper and lower planes [ if the pt can comfortably hold this position → they are ready for reactivation ]

**Re activation is done antero posteriorly and vertically :**

- A. Ask the pt to posture the mandible more forward then add acrylic to the **distal inclines of the lower bite plane** → to make the mandible move more forward
- B. Ask the pt to open slightly then add acrylic to increase **the height of the upper and lower bite planes** → to allow vertical eruption of lower molars in pts with **increased overbite**



- If the OJ is 7-8 mm → you can do it all in one stage
- OJ = 10 mm → you can do it in one stage or 2 stage activation
- OJ > 10 mm → 2 stage activation

**Q: what records do you need after the pt finishes treatment with twin block appliance?**

- 1- Lateral cephalogram
- 2- Photographs
- 3- Impressions + bite registration

Because the pt will change from class II skeletal and dental to class I skeletal and dental relation





## Fixed appliances in ortho

- Removable appliance need pt compliance to wear them and they can only do **tipping movements**.
- Fixed appliances need pt compliance in maintaining OH and looking after the appliance and **can do all types of movements**.

### Indications of fixed appliances : [ complex movements needed]

- 1- Intrusion / extrusion
- 2- Rotations
- 3- Bodily movements
- 4- Multiple teeth movements
- 5- Overbite reduction needed by intrusion of incisors
- 6- Overjet reduction by bodily movement of incisors
- 7- Closure of hypodontia or extraction spaces

#### Advantages

- 1- Allows treating complex cases
- 2- High standards of finishing
- 3- Do not affect speech
- 4- Less bulky compared to removable appliance + better tolerated by the pt
- 5- Do not need pt compliance in wearing the appliance

#### Disadvantages

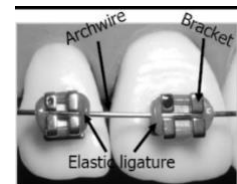
- 1- Diet restrictions and need to maintain excellent OH
- 2- **iatrogenic damage [ decalcifications] – biggest disadvantage**
- 3- Causes **root shortening [ 1-2 mm is normal ]**
- 4- Requires special skills and training + close monitoring

### Pt Instructions for fixed appliances:

- 1- Must maintain excellent OH
- 2- If they eat anything hard like apples, nuts or hard bread → cut it into small pieces and chew it on your posterior teeth
- 3- If the appliance breaks contact the clinic immediately  
Follow up should be in 4-6 weeks

## Components on fixed appliances

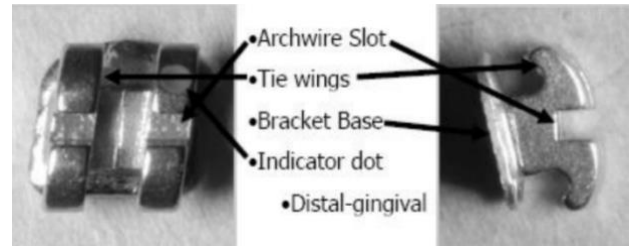
- 1- Brackets – have 2 slot sizes 0.018 “ inch or 0.022 “ inch  
Most used is 0.022 “ because **it allows the use of more versatile wires**
- 2- Archwire – **held in the bracket by elastic ligature [elastomeric module]**
- 3- Elastic ligature





**Brackets :**

- Tie wings = to hold the elastic ligature [ elastomeric module]
- Indicator dot = aids in localizing the bracket [it should always be disto gingival]



**Placing brackets:** clean the teeth with pumice → acid etch with phosphoric acid → bonding agent → apply composite and place the brackets → remove excess → light cure

**Self ligating brackets :**

- The arch wire is retained by a **clip gate** not by elastomeric module or elastic ligature
- **can reduce friction a little bit and shorten tx time by 1-2 months**
- 2 systems are available :
  - A. Active [ smart clip & innovation] – the clip presses on the wire
  - B. Passive [ Damon ] – does not encroach on the archwire - **most commonly used**



**Esthetic brackets:**

**Plastic brackets**

No longer used because they

- A. Stain
- B. Don't have dimensional stability
- C. Have larger friction

**Ceramic brackets**

**Compared to plastic :** ceramic brackets are more durable and have less staining and better dimensional stability

**Compared to metal:** ceramic brackets are bulkier , have more friction and higher risk of fracture

- **cause wear of teeth contacting the bracket**
- **cause enamel damage on debonding [ because the bond is very strong they can cause enamel cracks on debonding]**

new advancement is having the base as metal and the rest as ceramic [ but still has high friction]

Highest to lowest friction brackets : plastic → ceramic → metal

**Bands:**

- brackets welded on pre formed metal bands
- used mainly on molars – **or on the premolars when you need to place expanders**
- cemented with GIC



**Buccal tubes:**

- used for head gear and auxillary wires
- Can be single , double , triple



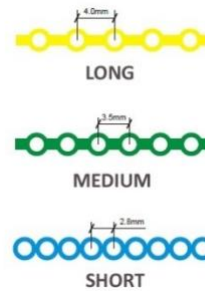


## Ligatures – Elastics

- Used to **retain the arch wire** – available in diff colors

## Elastic chains

- used for **space closure** [ when they are stretched they apply force to close the space , have different sizes depending on the space closure needed]



## Archwires:

- stainless steel = stiff and rigid
- TMA [ titanium molybdenum alloy] = some flexibility [ 50% the rigidity of the st st wire]
- nickel titanium = flexible + shape memory

**Most to least stiff = st st → TMA → nickel titanium**

**Q: how are different wires used in fixed appliances?** Nickel titanium is used in the early stages of the tx [ aligning and leveling] then st st wires are used for space closure followed by TMA wires for finishing

## Fixed appliances – auxiliaries:

### 1- Transpalatal arch: [TPA]

Bands are placed on the upper first molars and a wire crosses the palate between the molar bands

Can be used to expand or derotate the upper molars

### 2- Nance appliance :

Similar to TPA but has additional acrylic button to gain more anchorage from the palate

### 3- Lower lingual arch [ LLA]:

bands on the lower 6s and a wire that crosses the arch and passes behind the lower incisors

### All have similar functions:

- Increase posterior anchorage
- Maintain molar width [ intermolar distance]
- space maintainer





**4- coil springs**

open coil springs → used for OPENING A SPACE  
 closed coil spaces → used for CLOSING A SPACE



**5- power thread [ zing string] :** used to apply traction forces to teeth



**6- expanders – rapid maxillary expander**

- bands **cemented** on the first perm molars and first perm premolars + a midline screw  
**the screw is turned twice daily to achieve 0.5 mm daily expansion of the upper arch**
- expansion is done by separation of the mid palatal suture**



Another design has palatal arms extending onto the anterior teeth or acrylic splints on posterior teeth



Expanders are used to correct skeletal crossbites

Normal expander = ¼ mm per week

RME = ½ mm per day

**7- expanders – Quad helix**

- fixed expansion appliance** – bands on the perm 1<sup>st</sup> molars
- has 4 loops [ helices to give flexibility and good range of action]
- TYPES :

A. the wire is soldered to the bands → if you need to expand you need to remove the whole appliance and re cement it again

B. Wire is inserted into a sheath and can be removed [ called Nitum ]

advantage of using Nitum → **the wire is inserted through a sheath so you don't need to remove the entire appliance to expand it you just remove the wire**





**8- Elastics:**

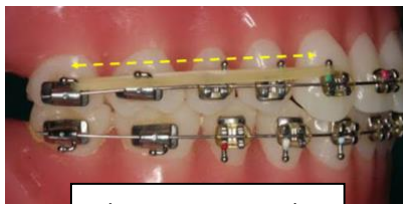
<b>Class I</b>	<b>Intra arch elastics to close spacing</b>
<b>Class II</b>	To correct class II malocclusion
<b>Class III</b>	To correct class III malocclusion
<b>Vertical</b>	To correct open bite
<b>Anterior cross elastics</b>	To correct center line discrepancy
<b>Posterior cross elastics</b>	

**9- Separators:**

- Placed interproximally between teeth **for 2-3 days and a maximum of one week**
- Also used in proximal caries detection



Kesling separator



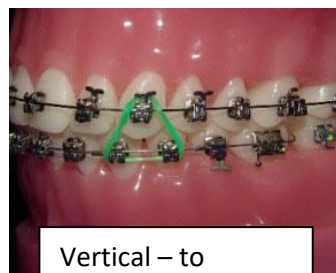
Class I – intra arch elastics for space closure



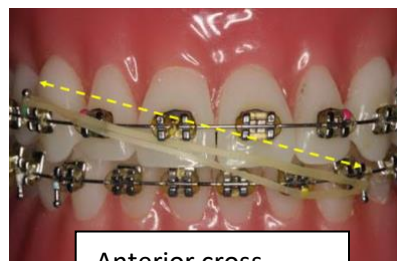
Class II – from upper anterior to lower posterior teeth to correct class II malocclusion



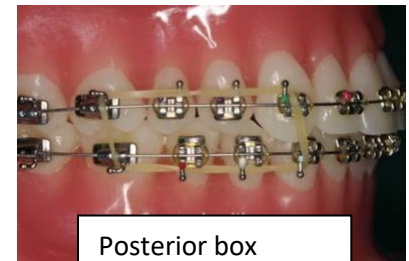
Class III– from upper posterior to lower anterior to correct class III malocclusion



Vertical – to correct open bites



Anterior cross elastics to correct center line discrepancy



Posterior box elastics



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## Timing of orthodontic treatment

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**Q: when should you refer a pt to an orthodontist ?** there is no fixed time it depends on the type of problem that has been diagnosed and the dental development

**Q: why do we prefer to start treatment early?** To be able to utilize the child's growth and minimize the time needed for further treatment later on.

**Q: why is it important to minimize the duration of treatment as much as possible?** To achieve good cooperation of the pt + the longer the tx the more risky it will become

- Most ortho treatment take 18- 24 months [ treatment should not take more than 3 years]

**Interceptive treatment:** intervening in developing dentition to achieve best occlusion possible or to make further tx much easier

- You start looking for problems in the dentition as the first perm teeth start to erupt not before! [ not before the age of 6]

**Q: what are the most common problems to look for In the early mixed dentition? [ when the incisors and the 6s erupt]**

- 1- Delayed eruption of the perm incisors [ specially central incisors or if the eruption pattern is not symmetrical]
- 2- Early loss of deciduous teeth [ specially lower E ]
- 3- One or more incisors in crossbite
- 4- Impaction of first perm molars [ specially the upper 6]

**Q: what are the most common problems to look for In the late mixed dentition? [ when the lower canine and first premolars erupt]**

- 1- Severe skeletal problems
- 2- Poor quality first perm molars
- 3- Congenitally missing perm teeth

**Q: what are the most common problems to look for In the early permanent dentition? [ all the perm teeth have erupted except for the second perm molar]**

- 1- Severe skeletal problems
- 2- Impacted teeth [ specially upper canine]
- 3- Hypodontia





## Early management of tooth size / arch size discrepancy

- 1- Extractions of primary teeth to:  
Maintain center lines [ mostly the contralateral lower C or D is extracted]  
Maintain the buccal relationships [ by extracting the opposing tooth ]
- 2- Early extraction of C to correct the palatal displacement of 3 and allow it's spontaneous eruption
- 3- Early extraction to relief crowding [ removing the upper C to create space for the upper lateral incisors and prevent them from erupting in a crossbite]
- 4- Using leeway space to relief crowding
- 5- Using primate spaces to relief crowding
- 6- Active expansion of the arches in the mixed dentition [ only expand **the upper arch** – this method has high degree of relapse and needs long retention time]

Primate spaces = spaces mesial to the upper C and distal to the lower C

Leeway space = the difference in the MD width between CDE and 345 [ CDE are wider than 345 → space is provided for the eruption of 345]

Leeway space = 1.8 in the maxilla [ 0.9 mm in each side ]

3.4 mm in the mandible [ 1.7 mm in each side]

## Early management of posterior crossbite

You need to intervene early **if the cross bite is associated with mandibular displacement** to prevent it from progressing into the perm dentition + prevent TMJ problems / anterior tooth wear and gingival recession - **For other cases of crossbites you don't need to intervene early**

Correction is done with **selective grinding and active expansion with removable or fixed appliances**

### Appliances for expansion :

- A. Removable : [ removable appliances with midline screw can cause buccal tipping of the posterior teeth , rapid maxillary expansion will produce more bodily movement]
- B. Fixed [ quadhelix]

**Early management of anterior cross bite** : Done with removable or fixed appliances

- Success of correction of an anterior crossbite depends on the ability to produce a positive overbite at the end of treatment that will prevent relapse [ the upper incisors should cover at least the incisal 3<sup>rd</sup> of the lower incisors]

## Early management of severe class III: can be done using :

- A. Functional appliances [ ex: reverse twin block or frankel class III ]
- B. Protraction head gear [ will cause slight anterior movement of the maxilla]
- C. Chin caps  
**All should be worn from preadolescent stage** until the pt is fully grown and all will result in the same changes → retroclination of lower incisors + proclination of upper incisors + rotation of the mandible downward and backward

**NOTE: early management of class III malocclusion is generally not successful in cases of increased lower facial height and decreased overbite**



**Q: why are protraction head gears and chin caps not commonly used for the early correction of class III?** Because in order to have maximum effect of those appliances the pt must wear them from pre adolescent stage until they are fully grown [ which is a long time]

## Early management of class II

By using functional appliances followed by a period of retention [ those appliances will only have temporary effect and no significant long term effect]

**Q: why do you need to manage class 2 early ?** to modify the growth of the jaws + improve self esteem and reduce risk of trauma

**Q: what is the disadvantage of early management of class II with functional appliances?** It has to be done in a certain stage when the pt is still growing + those appliances don't have significant long term benefits

**Compliance of young [ pre adolescent pts] is better** because they understand the reason of the treatment and instructions and don't care about peer pressure . older pts [ adolescents ] are less compliant and more affected by peer pressure

**IMP NOTE: most ortho tx starts in the late mixed dentition just before the loss of lower E- this will allow you to :**

- A. Maximize growth potential and compliance
- B. utilize lee way space
- C. Keep the overall tx time as short as possible

Early intervention is indicated for cases like impacted centrals and canines, mandibular displacement due to crossbites





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## References

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- Laura Mitchell, . An Introduction to Orthodontics, 4th ed.



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