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Which of the following is the best method for tipping maxillary and mandibular anterior teeth?

- Finger springs
- Z-springs
- Both are equally efficient
• Finger springs

These finger springs are attached to a removable appliance. The most common problems associated with these simple removable appliances are lack of patient cooperation, poor design leading to lack of retention, and improper activation. An undesirable common side effect of a finger spring is the tendency for the root apex to move in the direction opposite from the crown.

Z-springs can also be used but they deliver excessively heavy forces and lack range of motion.

Maxillary incisor rotation is not commonly treated during the stage of mixed dentition. It is best treated after all permanent teeth have erupted (early permanent dentition). This is usually accomplished with a simple removable appliance. However, if the incisor is in crossbite, it should be corrected as soon as possible (while it is erupting).

Note: When using buccal coil springs to try and regain space by pushing a tooth mesially or distally, be careful because rotation of that tooth instead of actual movement commonly occurs.
Which of the following types of headgear produces a *distal and upward force* on the maxillary teeth and maxilla?

- Straight-pull headgear
- Reverse-pull headgear
- Cervical-pull headgear
- High-pull headgear
• High-pull headgear

High-pull headgear consists of a head cap connected to a face-bow. This appliance places a distal and upward force on the maxillary teeth and maxilla. These types of headgear have a more direct effect on the anterior segment of the arch. **Indications:** Class II, Division I malocclusion that have an open bite.

Cervical-Pull headgear is made up of a neck strap connected to a face bow. This appliance produces a distal and downward force against the maxillary teeth and the maxilla. A major disadvantage of treatment using cervical headgear is possible extrusion of the maxillary molars. Likely results include: opening the bite, first molars will move distally and forward growth of the maxilla will decrease. **Indications:** Class II, Division I malocclusions.

Straight-pull headgear is similar to the cervical-pull headgear. However, this appliance places a force in a straight distal direction from the maxillary molar. Like cervical-pull headgear, the indications are Class II, Division I malocclusion (when bite opening is undesirable).

Reverse-pull headgear unlike all the other headgears above, the extraoral component is supported by the chin, cheeks, forehead or a combination of these structures. **Indications:** Class III malocclusions (where protraction of the maxilla is desirable).
Which of the following is usually used as an **etching agent** before direct bonding of orthodontic bracket?

- 10-15 % unbuffered phosphoric acid
- 35-50 % unbuffered phosphoric acid
- 75-85 % unbuffered phosphoric acid
- 100 % unbuffered phosphoric acid
• 35-50 % unbuffered phosphoric acid

***For 1 minute

Remember: After etching, the tooth surface should have a frosted appearance.

The tooth surface must not be contaminated with saliva, which promotes immediate remineralization, until bonding is completed; otherwise re-etching is required. Topical fluoride should not be used before etching because fluoride decreases the solubility of enamel.

Indications for using bands instead of bonded brackets:
• To provide better anchorage for greater tooth movement
• For teeth that will need both lingual and labial attachment
• Teeth with short clinical crowns
• Tooth surfaces that are incompatible with successful bonding

Cementation of bands: Generally, a heavier mix is required with a longer setting time to permit seating and adaptation of the band. Zinc phosphate cements are routinely mixed over a large area on a cold mixing slab to extend the working and setting time.
Orthodontic appliances can:

- Cause irritation to the gingiva
- Act as plaque harbors
- Make proper oral hygiene difficult to perform
- All of the above
• All of the above

Orthodontic appliances may be irritating or interfere with the performance of good oral hygiene. Prolonged orthodontic treatment has long been associated with the causation of inflammatory periodontal diseases. **However**, if meticulous oral hygiene is maintained at all times during orthodontic treatment, the periodontal health can be maintained.

**Note: When a patient** *(young or old)* **is in active orthodontic treatment and the gingiva is inflamed, the dentist should encourage better oral hygiene. It may be useful to recommend the use of water irrigation devices to help flush food debris away from the brackets.*
Which of the following determines the **effect of a face-bow headgear on the molars to which it is attached**?

- The relation of the outer bow to the center of resistance of the tooth
- The direction of pull of the headgear strap
- The length and position of the outer bow in relation to the inner bow
- All of the above
• All of the above

Remember:
1. There are four basic types of headgear (cervical-pull, straight-pull, high-pull and reverse-pull). Each type has two major components: intraoral (face-bow) and extraoral (neck strap, head cap, chin cup, etc.). The extraoral component is what generally categorizes the type of headgear.
2. One of the greatest advantages of using extraoral anchorage (i.e., headgear) is that it permits posterior movement of teeth in one arch without adversely disturbing the opposite arch.
3. Headgear is often employed for the maintenance of anchorage. Anchorage is the resistance to unwanted tooth movement.
Which of the following is the **most common removable retainer** used in orthodontics?

- Tooth positioner
- Hawley retainer
- Functional retainer
- Anterior spring retainer
• **Hawley retainer**

It incorporates clasps on molar teeth and a characteristic outer bow with adjustment loops, spanning from canine to canine.

The **palatal coverage of a removable plate** like a Hawley retainer makes it possible to incorporate a bite plane lingual to the upper incisors to control the bite depth. This design consideration is important for any patient who once had an excessive overbite. **This palatal coverage (acrylic) is the major source of anchorage in the Hawley appliance.**

A **Hawley retainer can be made** for the upper or lower arch. The lower retainer is somewhat fragile and may be difficult to insert because of undercuts in the premolar region. A patient may have difficulty pronouncing lingualveolar consonants for a few days after receiving a maxillary Hawley appliance until the tongue adapts to the palatal coverage.

**Any removable appliance has three major components:**
1. **Retentive component**: consisting of various clasps to hold it in place
2. **A framework or baseplate**: usually acrylic. This provides anchorage.
3. **Tooth-moving elements**: typically either springs or screws

**Indications for removable appliances:**
- Retention after comprehensive treatment
- Limited tipping movements
- Growth modification during the mixed dentition
Which of the following alloys are used for archwires in orthodontics?

- Stainless steel
- Chromium-cobalt
- Titanium
- All of the above
- All of the above

The properties of stainless steel wires used for archwires can be controlled over a wide range by varying the amount of cold working annealing during manufacturing. Steel is softened by annealing and hardened by cold working (work hardening).

Chromium-cobalt alloys have the advantage that they can be supplied in a softer and therefore more formable state, and that they can be hardened by heat treatment after being shaped. The heat treatment increases strength significantly.

Titanium alloys offer a highly desirable combination of strength and springiness and reasonably good formability.

The properties of an ideal wire material for orthodontic purposes can be described largely in terms of the following criteria. It should possess: 1) high strength, 2) low stiffness, 3) high range and 4) high formability. In addition, the material should be weldable or solderable, so that hooks or stops can be attached to the wire. Loops and helices are incorporated into archwire to increase the activation range.

The stiffness of orthodontic wires is a function of the length of the wire, the diameter of the wire and alloy composition.
All of the following are **fixed orthodontic appliances** *except*:

- Lingual archwire
- Fixed space maintainers
- Palate-separating devices
- Lip bumpers
- Edgewise mechanisms
- Light-wire appliances
• Lip bumpers

Fixed orthodontic appliances offer controlled tooth movement in all planes of space. Examples include: lingual archwire, fixed space maintainers, palate-separating devices, the edgewise mechanism, light-wire appliances as well as other fixed appliances (i.e. twin-wire appliance, universal appliance).

Removable orthodontic appliances are generally restricted to tipping teeth. Examples include:
• Attached removable appliances
  1. Active appliances
     a. Extra-oral traction devices (head gears, face masks, chin cups)
     b. Lip bumpers
     c. Active plates (Schwartz appliance, anterior spring aligners)
     d. Vacuum formed appliances
  2. Passive appliances
     a. Bite planes, occlusal splints, retainers
• Loose removable appliances: (functional appliances, functional jaw orthopedic appliances, etc.).

Note: For an orthodontic appliance to be effective in translating the roots of teeth, it must be capable of exerting a torque.
A seven-year-old child with an otherwise good occlusion has a lingually locked maxillary permanent central incisor. There is sufficient room for the tooth. In order to treat this condition properly, the dentist should do what?

- Wait until all permanent teeth have erupted
- Surgically reposition the central incisor
- Correct the condition immediately with a simple appliance
- None of the above
Correct the condition immediately with a simple appliance

Ideally, this anterior crossbite should have been corrected before it reached the occlusal plane (while it was erupting). The most probable etiologic factor for this happening is prolonged retention of the primary maxillary incisors.

Cross-elastics from the maxillary lingual to the mandibular labial can be used to correct a single-tooth crossbite. A maxillary removable appliance can also be used. When elastics are used to move teeth they should be attached directly to the appliance components.

Anterior crossbite, particularly crossbite of the incisors, is rarely found in children who do not have a skeletal Class III jaw relationship. A crossbite relationship of one or two anterior teeth, however, may develop in a child who has good facial proportions. The maxillary lateral incisors tend to erupt to the lingual and may become trapped in that location, especially in the presence of severe crowding. In this situation, extracting the adjacent primary canines usually leads to spontaneous correction of the crossbite. It is important to evaluate the space situation before attempting to correct any anterior crossbite. If enough space is available to accomplish the movement, a maxillary removable appliance is usually the best mechanism to correct a simple anterior crossbite that requires a tipping movement.
Which appliance listed below is probably the most widely used today by orthodontists?

- The universal appliance
- The edgewise appliance
- Neither of the above
• The edgewise appliance

In its **essential form**, mechanism consists of bands on all of the teeth, tubes on the last molar and brackets on all other teeth. One labial arch is used at a time. The ultimate labial arch wire is .0125 x .028 in diameter and the narrow dimension or edge fits precisely into the bracket slot, which is .022 inches wide from top to bottom. It finds its greatest application in the treatment of comprehensive malocclusions of the adolescent permanent dentitions.

Variations of the basic edgewise appliance include the use of double or tandem brackets (*Siamese twin brackets*) and narrow slotted brackets, .018 from top to bottom. A straight wire appliance is a version of the edgewise appliance with several features that allow placement of an ideal rectangular archwire without bends.

**Components of an edgewise appliance:**
- **Siamese twin bracket**: for use on maxillary anterior teeth
- **Broussard buccal tube**: to allow the use of the segmented arch technique, which is necessary to intrude teeth
- **Straight wire bracket**
- **A bracket with a .022 x .028 rectangular slot**

**Note**: A first order bend in an orthodontic wire is in the horizontal plane.
A steep mandibular plane angle correlates with a:

- **Short** anterior facial vertical dimensions and **anterior open bite** malocclusion
- **Long** anterior facial vertical dimensions and **anterior open bite** malocclusion
- **Short** anterior facial vertical dimensions and **anterior deep bite** malocclusion
- **Long** anterior facial vertical dimensions and **anterior deep bite** malocclusion
• Long anterior facial vertical dimensions and anterior open bite malocclusion

Important: A flat mandibular plane angle correlates with short anterior facial vertical dimensions (height) and anterior deep bite malocclusion.

The mandibular plane angle can be visualized clinically by placing a mirror handle or other instrument along the border of the mandible.

There is also an interaction between face height and the anteroposterior position of the mandible; all other things being equal, a long face predisposes the patient to Class II malocclusion, a short face to Class III.
Which of the following would be indicative of maxillary retrognathism?

- An SNA angle of approximately 82°
- An SNA angle greater than 82°
- An SNA angle less than 82°
- An SNA angle less than 82°

The relative position of the maxilla to the cranial base is obtained by drawing two lines; one from the sella turcica (S) to nasion (N) and one from nasion to Point A. The angle made at the intersection of these two lines is the so-called SNA angle. Steiner indicates that in a good skeletal pattern this SNA angle should approximate 82°. An SNA angle greater than 82° would suggest a maxillary prognathism, while an SNA angle of less than 82° would be indicative of maxillary retrognathism.

The SNB angle created by the intersection of line SN and NB defines the sagittal location of the mandibular denture base. Steiner considers an 80° angle compatible with skeletal harmony. An SNB angle of greater than 80° would therefore suggest mandibular prognathism, while less than 80° would suggest mandibular retrognathism.

A third critical angle emphasized by Steiner analysis is the ANB angle. Steiner's norm for this angle is 2° or the difference between the norm for SNA and SNB. A Class I skeletal profile would therefore have an ANB angle of approximately 2°. When the ANB angle exceeds 4°, however, the skeletal profile is considered Class II. When the angle is less than zero or a minus angle, you are dealing with a Class III skeletal profile.

Note: Dental arch form is ultimately determined by the interaction of environmental influences on the genetic pattern.
Identify and define the following cephalometric landmarks labeled 1-15.
1. Bolton (Bo) – highest point in the upward curvature of the retrocondylar fossa of the occipital bone.

2. Basion (Ba) – lowest point on the anterior margin of the foramen magnum, at the base of the clivus.

3. Articulare (Ar) – point of intersection between the shadow of the zygomatic arch and the posterior border of the mandibular ramus.

4. Porion (Po) – midpoint of the upper contour of the metal ear rod of the cephalometer.

5. Sphenooroccipital synchondrosis (SO) – junction between the occipital and basisphenoid bones.

6. Sella (S) – midpoint of the cavity of sella turcica.

7. Pterygomaxillary fissure (Ptm) – point at base of fissure where anterior and posterior walls meet.

8. Orbitale (Or) – lowest point on the inferior margin of the orbit.


10. Point A (Subspinale) – innermost point on contour of premaxilla between anterior nasal spine and incisor tooth.

11. Point B (Supramentale) – innermost point on contour of mandible between incisor tooth and bony chin.

12. Pogonion (Pog) – most anterior point of the contour of the chin.

13. Menton (Me) – most inferior point on the mandibular symphysis, the bottom of the chin.

14. Gonion (Go) – lowest most posterior point on the mandible with the teeth in occlusion.

15. Nasion (Na) – anterior point of the intersection between the nasal and frontal bones.

The Frankfort-Horizontal plane is constructed by drawing a line connecting porion and orbitale. This has been adopted as the best representation of the natural orientation of the skull.
Which of the following are uses for cephalometrics in orthodontics?

- Diagnosis
- Analysis of treatment results
- Longitudinal study of growth
- All of the above
The lateral head radiograph (cephalometric x-ray) must be compared with the "normal" lateral radiographs from an accepted norm. Linear and angular measurements are obtained utilizing known anatomical landmarks in the lateral head radiography of the patient. These measurements are then compared with those considered within normal limits and in that way enable the orthodontist to assess aberration in the dentition and jaw structures, which result in malocclusion.

Analysis of cephalometric radiographs is not limited to the hard structures such as bone and teeth, but also includes measurements of soft tissue structures such as the nose, lips and soft tissue chin.

Superimposition in longitudinal cephalometric studies is generally on a reference plane and a registration point. This will best demonstrate the growth of structures furthest from the plane and the point. The most stable area from which to evaluate craniofacial growth is the anterior cranial base because of its early cessation of growth.

Cephalometrics is useful in assessing tooth-to-tooth, bone-to-bone and tooth-to-bone relationships. Serial cephalometric films can show the amount and direction of growth.
An anterior crossbite in the primary dentition is often indicative of which two of the following?

- Impacted permanent maxillary canines
- A skeletal growth problem
- A developing Class II malocclusion
- A developing Class III malocclusion
• A skeletal growth problem
• A developing Class III malocclusion

It can be the result of:
• A labially situated supernumerary tooth
• Traumatic injury
• Arch length discrepancy

Anterior crossbite of one or more of the permanent incisors, however, may be evidence of a localized discrepancy and a condition that almost always should be treated in the mixed dentition state or as soon as it’s discovered. It is most often associated with prolonged retention of a primary tooth. Delayed treatment can lead to serious complications, such as loss of arch length. The most essential factor related to correction of anterior crossbite is the space available mesiodistally. It is easily retained once it is corrected.

Note: The premature exfoliation of a primary canine may indicate an arch length deficiency. The premature loss of a primary mandibular canine may cause a lingual collapse of the mandibular anterior teeth.
Displaced teeth related to functional shifts are usually seen in which two of the following circumstances?

- Posterior crossbite after prolonged thumb sucking
- Class II, Division I malocclusion
- Anterior crossbite in mildly prognathic children
- An anterior open bite after prolonged thumb sucking
- Posterior crossbite after prolonged thumb sucking
- Anterior crossbite in mildly prognathic children

**Prolonged sucking habits** often produce a mildly narrow maxillary arch and a tendency toward bilateral crossbite. Children with this condition usually shift the mandible to one side on closure to gain better function, which can guide permanent molars, or later, premolars into a crossbite relationship.

A young child who has a tendency toward **Class III malocclusion** will have end-to-end contact of the primary incisors. **A true anterior crossbite in the primary dentition is quite rare** because mandibular growth lags behind maxillary growth. The primary incisors wear down rapidly, and an anterior shift of the mandible to escape occlusal interferences rarely occurs until the permanent incisors begin to erupt. A pattern of anterior displacement of the mandible may develop when the permanent incisors come into contact, **however**, producing an anterior crossbite from the shift.

**Notes:**
1. An anatomic crossbite (*skeletal*), as contrasted with a functional crossbite (*from thumb sucking*), usually demonstrates a smooth closure to centric occlusion.
2. A corrected anterior crossbite is best retained by the normal incisor relationship that is achieved through treatment (*the overbite*), not appliances.
Which of the following are true concerning a posterior crossbite in the mixed dentition?

- It should be corrected as soon as possible
- It should be thoroughly diagnosed as to whether it is of a dental, functional or skeletal origin
- May be corrected with palatal expansion
- May be associated with a mandibular shaft
- All of the above are true
• All of the above are true

It is important to correct posterior crossbites (which are related to the transverse plane of space) and mild anterior crossbites in the first stage of treatment, even if permanent first molars have not yet erupted. Severe anterior crossbites, in contrast, are usually not corrected until the second stage of conventional treatment.

The most common type of active tooth movement in the primary dentition is to correct a posterior crossbite (transverse problem).

Remember: A skeletal crossbite, as contrasted with a functional crossbite, usually demonstrates a smooth closure to centric occlusion.

After palatal expansion, the following are observed:
• Diastema formation between central incisors
• Expansion of the nasal floor

Note: Tooth movement and skeletal expansion are inevitable when the midpalatal suture is widened.
Which of the following can cause an open bite?

- Tongue-thrusting
- Thumb-sucking
- Genetics
- Speech impediments (*i.e. lisp*)
- All of the above
• All of the above

***Thumb-sucking (or any other sucking habit) is the most common cause of anterior or open bites.

The classical symptoms of a sucking habit include:
• Anterior open bite
• Maxillary incisors tipped facially and the mandibular incisors tipped lingually
• Maxillary arch constriction

***A persistent long term sucking habit may also result in rotation of the maxillary lateral incisors and a Class II malocclusion.

Notes:
1. Most of the time the anterior open bite is asymmetrical with normal posterior malocclusion
2. Anterior open bites are much more common in African Americans than Caucasians, whereas deep bites are much more common in Caucasians.

Remember: An open bite is a malocclusion, or an abnormal bite, in which some teeth – usually the front teeth – cannot be brought into contact with the opposing teeth.
There are many reasons why **crossbites** occur. Which one of the following is **not** one of them?

- Jaw size
- Heredity
- Faulty restorations
- Mouth breathing
- Prolonged retention of primary teeth
• Faulty restorations

A crossbite occurs when some of the teeth wind up on the "wrong side of the track". A crossbite can be unilateral (on one side) or bilateral (on both sides). It also can occur anteriorly or posteriorly.

Orthodontic treatment to correct a crossbite in children should begin as early as possible. The first step, "maxillary expansion", broadens the maxilla with an appliance called an "expander". Fixed to the roof of the mouth, the expander is widened each night for about 1 to 2 months with the turn of a key. The expander remains in the mouth for about 3 more months to allow the bone to harden in its new position.

Note: Braces may be put on the maxillary teeth while expansion is going on to eventually close the "gap-tooth grin" that will develop as the maxilla is being expanded. Once the expansion is complete, the child may need to wear a full set of braces for 1 to 2 years to achieve an ideal occlusion.

Important: The main reason to correct a crossbite in children is to prevent TMJ disorders.
Which type of malocclusion listed below is most often associated with mouth breathing?

- Dental open bite
- Skeletal open bite
- Dental cross bite
- Skeletal cross bite
• **Skeletal open bite** (*sometimes called the "Long Face Syndrome")*

The following factors are associated with chronic mouth breathing:
• Narrow face
• Narrow oropharyngeal space
• Chronic rhinitis – inflammation of the mucous membranes of the nose
• Chronic tonsillitis
• Allergies
• Deviated nasal septum

**Note:** The **earliest possible diagnosis** of this open bite is essential because the condition is **not self-correcting** and usually worsens with time. **Anterior open bites** can be classified as a form of **apertognathism** (*which means open bite deformity).*
Class III malocclusion is also referred to as:

- Retrognathism or overbite
- Prognathism or underbite
- Neither of the above
• Prognathism or underbite

****It is the least common (compared to Class I and II). It occurs when the mandible protrudes forward and the mandibular teeth extend over the maxillary teeth.

Class III malocclusions are those in which the body of the mandible and its superimposed dental arch are in a mesial relationship to the skull base and maxilla. The maxillary first molar therefore occludes distal to the mandibular first molar, while the maxillary canine is an exaggerated distal relationship to the mandibular canine. The mandibular incisors are forward to the maxillary incisors. Also characteristic of the "true" Class III malocclusion is the prognathic mandible. Class III subdivision is a Class III relationship of the teeth on one side with a Class I relationship on the other side.

A pseudo-class III malocclusion is one in which the mandibular incisors are forward of the maxillary incisors when in centric occlusion, however, the patient has the ability to bring the mandible back without strain so that the mandibular incisors can touch the maxillary incisors (this ability is often considered diagnostic). This type is therefore a milder form of the "true" Class III malocclusion and more amenable to conservative orthodontic movement than the "true" Class III malocclusion which often requires surgical correction.
A severe malocclusion may compromise which of the following aspects of oral function?

- Mastication
- Swallowing
- Speech
- All of the above
• All of the above

Severe malocclusion may compromise all aspects of oral function. There may be difficulty in masticating if only a few teeth meet, and jaw discrepancies may force adaptive alterations in swallowing. It can be difficult or impossible to produce certain sounds in the presence of severe malocclusion, and speech therapy may require some preliminary orthodontic treatment. Referral to a speech therapist is helpful because both patient and parents are likely to benefit from the counseling.

Even less severe malocclusions tend to affect mastication, swallowing and speech; not so much by making the function impossible as by requiring physiologic compensation for the anatomic deformity.

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<td>s, z</td>
<td>Lisp</td>
<td>Anterior open bite, large gap between incisors</td>
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<tr>
<td>t, d</td>
<td>Difficulty in production</td>
<td>Irregular incisors (especially lingual position of maxillary incisors)</td>
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<tr>
<td>f, v</td>
<td>Distortion</td>
<td>Skeletal Class III</td>
</tr>
<tr>
<td>th, sh, ch</td>
<td>Distortion</td>
<td>Anterior open bite</td>
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Class I malocclusions share what basic characteristic?

- The midface is concave
- A harmonious skeletal profile
- The midface is convex
- None of the above
• A harmonious skeletal profile

The cephalometric analysis of the Class I occlusion would indicate an ANB angle of less than 4° signifying sagittal harmony between the maxillary and mandibular dental arches. The most common cause of Class I malocclusion is a discrepancy between tooth structure and the amount of supporting bone (length). Perhaps the most prevalent characteristic of Class I malocclusion is crowding (i.e., insufficient alveolar arch length to accommodate all teeth in ideal alignment and in a good sagittal position).

When a diagnosis is made that crowding does exist and this crowding exceeds 4 mm in the mandibular arch, extractions are often required to attain an excellent, stable result. However, the decision whether to extract teeth depends greatly on a space analysis performed on the mandible. The patient should be referred to the orthodontist for this analysis.

In general:
• When the space lacking is less than 4 mm, in most cases it can be obtained by carefully stripping some interproximal enamel from each of the anterior teeth.
• A space deficiency exceeding 4 mm usually indicates extraction for correction of the malocclusion.
Class II malocclusion is also referred to as:

- Retrognathism or overbite
- Prognathism or underbite
- Neither of the above
• Retrognathism or overbite

Those malocclusions in which there is a "distal" relationship of the mandible to the maxilla make up Class II.

Divisions are as follows:
• Class II, Division I – a distal relationship of the buccal groove of the mandibular first permanent molar to the mesiobuccal cusp of the maxillary first permanent molar along with the maxillary incisors (centrals and laterals) in extreme labioversion (protruded).
• Class II, Division II – a distal relationship of the buccal groove of the mandibular first permanent molar to the mesiobuccal cusp of the maxillary first permanent molar along with the maxillary laterals being tipped labially and mesially (sometimes actually overlapping the centrals). The maxillary centrals are usually retruded somewhat.

***Subdivisions: when the distocclusion occurs on one side of the dental arch only, the unilaterality is referred to as subdivision of its division. For example:
• Class II, Division I Subdivision – one side of the maxillary arch is in a Class II relationship with its occluding mandibular quadrant while the other side is in a Class I relationship. The protruded maxillary incisors (centrals and laterals) are usually confined to one side of the maxillary arch.
Which cusp listed below of the maxillary first permanent molar serves as a reference point in identifying Angle's Class I, II and III occlusions?

- Distobuccal
- Mesiobuccal
- Mesiolingual
- Distolingual
• Mesiobuccal

Classification of human occlusion (Angle’s):
• **Class I** – most common *(about 70% of the population).* The mesiobuccal cusp of the maxillary first molar lines up *approximately with* the buccal groove of the mandibular first molar. The maxillary central incisors overlap the mandibulars. Maxillary canine lies *between* the mandibular canine and first premolar.
• **Class II** – less common *(about 25%).* The mesiobuccal cusp of the maxillary first molar falls approximately *between* the mandibular first molar and the second premolar. The lower jaw and chin may also appear *small* and *withdrawn.* The mandibular incisors occlude even more posterior to the maxillary incisors so they may not touch at all. Maxillary canine is *mesial* to mandibular canine.
• **Class III** – the least common *(less than 5%).* The mesiobuccal cusp of the maxillary first molar falls approximately *between* the mandibular first molar and second molar. The chin may also protrude like a *bulldog’s does.* The mandibular incisors overlap *anterior* to the maxillary incisors. The maxillary canine is *distal* to mandibular canine.

Planes of space used to classify malocclusion:
• Antero-posterior
• Transverse
• Vertical
The existence of a forward shift of the mandible during closure is found in:

- "True" Class III malocclusions
- "Pseudo" Class III malocclusions
• “Pseudo” Class III malocclusions

**Remember**: *Pseudo-Class III malocclusion* is therefore a milder form of the “**true**” Class III malocclusion and more amenable to conservative orthodontic movement than the “true” Class III malocclusion which often requires surgical correction.

Notes:
• **Hypertrophy of the mandibular condyle** can result in a *unilateral Class III malocclusion* as well as an anterior cross bite and an ipsilateral posterior open bite.
• For a patient that is a skeletal Class III, **the SNB angle will increase as the patient gets older.**
Malocclusion is most often:

- Acquired from a friend
- Hereditary
- Caused by antibiotics
- Caused by bad habits
• **Hereditary**

There may be a disproportion between the size of the maxilla and mandible or between the jaws and tooth size resulting in overcrowding of teeth or in abnormal bite patterns. Supernumerary teeth, malformed teeth, impacted or lost teeth and teeth that erupt in an abnormal direction may contribute to malocclusion. Less frequent causes of malocclusion include habits such as thumb sucking or tongue thrusting.

**Signs of incipient malocclusion include:**

- The lack of interdental spacing in the primary dentition
- The crowding of the permanent incisors in the mixed dentition
- The premature loss of the primary canines, particularly in the mandibular arch

**Notes:**

1. The significance of the lack of spacing relates to the increased mesio-distal width of the permanent teeth
2. Since arch perimeter increases after the eruption of the incisors and is small in the maxilla and essentially non-existent in the mandible, arch growth can not usually contribute to further dental alignment
3. The premature loss of the mandibular primary canine reflects insufficient arch size in the anterior region. As such, the crowns of the lateral incisors, during eruption, impinge on the roots of the primary canines causing them to resorb. *When the canine is shed, the midline will shift in the direction of the lost tooth.* You will have lateral and lingual migration of the mandibular incisors.
Which of the following are common characteristics of a Class II, Division II malocclusion?

- The maxillary centrals are near normal anteroposteriorly or slightly in linguoverision
- The maxillary lateral incisors are usually labiomesially flared and overlap the central incisors
- Impinging overbite
- All of the above
• All of the above

Class II, Division II is a malocclusion in which the body of the mandible and its superimposed dental arch are also in distal relationship to the maxilla, and the molar and canine occlusion are the same as Class II, Division I type. The distobuccal cusp of the maxillary first molar occludes in the buccal developmental groove of the mandibular first molar, and the maxillary canines occlude mesial to the mandibular canines. The big difference between Division I and Division II is in Division II the maxillary laterals have tipped labially and mesially.

Remember: Class II, Division I = maxillary incisors (centrals and laterals) are in extreme labioversion.

Notes:
• There is no set rule as to when a malocclusion should be treated. The age at which it is treated depends on the problem involved.
• Malocclusions are more identifiable in children 7 to 9 years old because the eruption of permanent incisors reveals tooth-arch length discrepancies.
In most **Class II, Division I malocclusions**, the body of the mandible and its superimposed dental arch are in a:

- **Mesial relationship** to the maxilla and the maxillary incisors are usually in a **labial** axial inclination
- **Distal relationship** to the maxilla and the maxillary incisors are usually in a **lingual** axial inclination
- **Mesial relationship** to the maxilla and the maxillary incisors are usually in a **lingual** axial inclination
- **Distal relationship** to the maxilla and the maxillary incisors are usually in a **labial** axial inclination
• Distal relationship to the maxilla and the maxillary incisors are usually in a labial axial inclination

In addition, the relationship of the maxillary first molars and canines to the mandibular first molars are such that the distobuccal cusp of the maxillary first molar occludes in the buccal developmental groove of the mandibular first molar and the maxillary canines occlude mesial to the mandibular canines. Besides the labial axial inclination of the maxillary incisors (overjet), various aberrations in the individual alignment of the teeth (for example, crowding) can be superimposed upon this class.

Class II, Division I Subdivision includes malocclusions, which have one side of the maxillary arch in a Class II relationship with its occluding mandibular quadrant, while the other side is in a Class I relationship. The maxillary overjet or other anterior aberrations are usually confined to one side of the maxillary arch.

Note: Relative to a heterogeneous population, the incidence of malocclusion in a homogeneous population generally is lower.
Which of the following **facial profiles** is usually accompanied by a **Class II malocclusion**?

- An *orthognathic* profile
- A *retrognathic* profile
- A *prognathic* profile
- None of the above
• A retrognathic profile

The convexity is due to the relative prominence of the maxilla compared to the mandible. The mandibular incisors will most likely be tipped forward.

An orthognathic profile is one in which the nose, lips and chin are harmoniously related. This relationship is usually accompanied by a Class I dental occlusion.

A prognathic profile is one in which the mandible is markedly forward of the maxilla giving a concave midfacial appearance. This is often indicative of a Class III malocclusion. The maxillary incisors will most likely be tipped lingually.

Important: A bimaxillary dentoalveolar protrusion means that in both jaws the teeth protrude. In this condition, you will see severe dental and lip protrusion accompanied by severe lip strain, which is needed to bring the lips into closure.

Note: As children mature their profiles become less convex
A 13-year-old patient has all teeth present and normal occlusion; molar root apexes are not totally closed. The mandibular left first molar has been extracted. The ideal treatment at this time is what?

- Place a **fixed bridge**
- Place a **space maintainer**
- Place a **removable partial denture**
- Do **nothing and observe**
- Place a space maintainer

Although this can be done with either fixed or removable appliances, fixed appliances are preferred in most situations because they eliminate the factor of patient cooperation. If the space is unilateral, it can be managed by a unilateral fixed appliance ("band and loop" space maintainer). If molars on both sides have been lost and the permanent incisors have erupted, it is usually better to place a "lingual arch" space maintainer.

Notes:

1. **Premature loss of a primary maxillary second molar** usually produces a Class II molar relationship on the affected side. A **distal shoe space maintainer** may help alleviate this potential problem. This appliance extends backwards from a crown on the primary first molar and subgingivally to the mesial line of the unerupted first permanent molar, thus preventing mesial migration.

2. With the "lingual arch" space maintainer, the primary second molars or permanent first molars are banded. Typically, the "lingual arch" space maintainer is comprised of two bands which are cemented to the primary second molars or permanent first molars with a loop of wire that rests on the cingula of the incisors.
Which space maintainer is **most often used** when the **primary first molar** needs to be prematurely extracted?

- "Band and loop" space maintainer
- "Distal shoe" space maintainer
- "Lingual arch" appliance
- "Nance" appliance
- **"Band and loop" space maintainer**

Space maintainers that are used to replace one prematurely missing primary tooth include:
- The "**band and loop**" space maintainer is a fixed unilateral appliance. The band is usually cemented to the second primary molar while a loop extends to the primary canine tooth. **Note:** This type of space maintainer must be restricted to holding the space of one tooth because of it has **limited strength**.
- The "**distal shoe**" space maintainer is also a fixed unilateral appliance that is used when a primary second molar is lost before the eruption of the permanent first molar (typically children under the age of 5 or 6).

Space maintainers that are used to replace multiple prematurely missing primary teeth include:
- The "**lingual arch**" which can be a fixed or removable appliance that is used to maintain space when multiple primary teeth are missing and the permanent incisors have erupted. **Note:** Does not restore function and should be made **completely passive**.
- The "**Nance**" appliance or **transpalatal** appliance is used for bilateral loss of primary maxillary molars. An acrylic button rests on the palate and the appliance prevents the mesial rotation and mesial drifting of the permanent maxillary molars to which it is attached.
- **Partial denture** space maintainers are most useful for bilateral posterior space maintenance when the permanent incisors have not erupted. **Note:** Also used for missing anterior teeth when esthetics is a concern.
A child with a pulpally involved primary tooth comes into your office. Which of the following ideally is the best space maintainer for this child?

- A "band and loop" space maintainer
- A "distal shoe" space maintainer
- The pulpally involved primary tooth
- A "lingual arch" space maintainer
• The pulpally involved primary tooth

The **key point** here is that *no prefabricated space maintainer is as good as the natural tooth*. Obviously in this case proper pulpal therapy followed by a restorative procedure would be needed on this tooth for it to function as a space maintainer.

The **natural tooth** will **preserve arch length and integrity** better than any prefabricated space maintainer.

**If a primary tooth is lost,** an orthodontic evaluation is indicated to determine whether or not space maintenance is necessary. The decision is based on the patient's skeletal and dental development. For example, if a child is **dental age 10** and loses the primary first molar, no treatment is **usually** needed. **Remember:** The permanent first premolar **usually** erupts between 10-12 years old.
The **most rapid losses** in the perimeter of the arch usually are due to a:

- Distal tipping and rotation of the permanent second molar after removal of the permanent third molar
- Mesial tipping and rotation of the permanent first molar after removal of the primary second molar
- Mesial tipping and rotation of the permanent canine after removal of the primary lateral incisor
- Distal tipping and rotation of the permanent second premolar after removal of the permanent first molar
• Mesial tipping and rotation of the permanent first molar after removal of the primary second molar

**Very Important:** When the primary second molar is lost, **always maintain space** until the arrival of the second premolar.

**Notes:**
1. If a permanent first molar is extracted on a child **before** the eruption of the permanent second molar, the **best approach** is to allow the eruption of the second molar and the mesial drifting to occur naturally. **This will fill in the space most of the time.**
2. A space maintainer can be removed as soon as the permanent tooth begins to erupt through the gingiva.
An appropriate candidate for post-orthodontic *circumferential supracrestal fibrotomy* is:

- An intruded mandibular second molar
- A rotated maxillary lateral incisor
- An extruded maxillary second premolar
- A mandibular first molar that is in crossbite
• A rotated maxillary lateral incisor

One of the most important aspects of orthodontic therapy is retention. After malposed teeth have been moved into the desired position, they must be mechanically supported until the hard and soft tissues have been thoroughly modified – both in structure and in function – to meet the demands of the new position. Once the desired occlusal results are achieved and the hard tissues are in normal function, the next step is to maintain or to modify the soft tissues in the retention phase. Important: Most clinicians believe that the collagen fibers in the supra-alveolar tissue are significantly responsible for the relapse of orthodontically rotated teeth as well as the redevelopment of spaces between orthodontically moved teeth.

Remember: Collagen fibers are the primary components of the attached gingiva. When teeth are orthodontically moved, the fibers stretch like rubber bands to adjust to the new position. However, like rubber bands, they have a strong tendency to return to their former position, pulling teeth with them as they go.

The circumferential supracrestal fibrotomy is a minor surgical procedure. A simple incision in the sulcus is made to the crest of the bone. This incises all of the collagen fibers that are insert-ed into the root of the tooth. By cutting the collagen fibers, two things are accomplished:
1. Eliminate the potential for relapse due to collagen fiber retraction.
2. Allow new fibers to form that will help retain the tooth in its new position.
The flat bones of the skull and part of the clavicle are formed by:

- Intramembranous ossification
- Endochondral ossification
- Erythropoiesis
- Epiphyseal formation
• Intramembranous ossification

Bone formation begins in the embryo where mesenchymal cells differentiate into either fibrous membrane or cartilage. This leads to two paths of bone development:

1. **Intramembranous ossification** is so called because it takes place within membranes of connective tissue. Osteoprogenitor cells in the membrane differentiate into osteoblasts; a collagen matrix is formed which undergoes ossification. **Note:** The maxilla and mandible are formed this way.

2. **Endochondral ossification** is how the remainder of the skeleton forms and takes place within a hyaline cartilage model. Cartilage cells are replaced by bone cells (*osteocytes replace chondrocytes*), organic matrix is laid down and calcium and phosphate are deposited. This type of ossification is principally responsible for the formation of short and long bones. **Note:** The ethmoid, sphenoid and temporal bones form this way.

**Remember:** Once bone is formed, it grows by appositional growth (*which is growth by the addition of new layers on those previously formed*).
Bone deposition in which region listed below is responsible for the *lengthening* of the maxillary arch?

- Palate
- Tuberosity
- Incisor
- Zygomatic
• Tuberosity

The maxillary arch elongates, moves in a posterior direction, and increases in height. Bone deposition in the tuberosity region is responsible for the lengthening of the arch (elongation). The movement in a posterior direction is a result of resorption of the labio-alveolar surface and apposition of the lingual surface. Alveolar growth is responsible for an increase in height of maxillary bones.

Posterior movement predominates in the area of the tuberosity. The principal movement of the alveolar region and palate is downward, the nasal region moves forward and the zygomatic process moves posteriorly and laterally.

Growth of the maxilla and its associated structures occurs from a combination of growth at sutures and direct remodeling of the surface of the bone.
In which direction do the **permanent teeth move during eruption**?

- Mesially and occlusally
- Occlusally and buccally
- Buccally and mesially
- Occlusally and lingually
• Occlusally and buccally

**Permanent teeth move occlusally and buccally** while erupting. Also, during active tooth eruption there is apposition of bone on all surfaces of the alveolar crest and on the walls of the bony socket.

Remember: The **maxillary arch is slightly longer** in length compared to the mandibular arch. The reason is the sum of the M-D diameter of **maxillary permanent teeth** is approximately 128 mm, whereas the sum of the M-D diameter of the mandibular permanent teeth is approximately 126 mm.
Displacement of a tooth from the socket in the \textit{direction of eruption} is referred to as:

- Tipping
- Translation
- Extrusion
- Intrusion
- Torque
- Rotation
• Extrusion

Six types of tooth movement that can be accomplished with orthodontics:
1. **Tipping** – The crown moves in one direction while the root tip is displaced in the opposite direction due to rotation or pivoting of the tooth around the axis of resistance or axis of rotation (*located somewhere in the apical one-third of the root*). Most readily accomplished with a removable appliance. **Accomplished most easily with anterior incisor teeth.**
2. **Translation (bodily movement)** – Coupled force is applied to the crown to control root movement in the same direction as crown movement (*force is applied through the tooth’s center of resistance*). **Very difficult to accomplish.**
3. **Extrusion** – Displacement of the tooth from the socket in the direction of the eruption.
4. **Intrusion** – Movement into the socket along the long axis of the tooth. **Very difficult to accomplish.**
5. **Torque** – Controlled root movement labiolingually or mesiodistally while the crown is held relatively stable (*mesial-distal root movement is also termed "uprighting").
6. **Rotation** – Revolving the tooth around its long axis. Recurring tooth rotations after orthodontic correction occur because of the persistence of the elastic supracrestal gingival fibers (*mainly free gingival and transseptal fibers*). **Need adequate retention to prevent relapse.**

**Note:** On the side **toward which** the tooth is being moved, you will find "osteoclasts" (*break down bone*) and on the side of the root **from which** the tooth moves, you will find "osteoblasts" (*bone-forming cells*).
A major site of growth of the mandible is the:

- Angle
- Condyle
- Ramus
- Chin
• Condyle

Growth of the mandible occurs by both proliferation of cartilage at the condyles and apposition and resorption of bone at the surfaces of the mandible itself. Resorption occurs along the anterior surface of the ramus and apposition of bone occurs along the posterior surface of the ramus. The main growth site, however, is in the condylar cartilage. Note: The "V" principle of growth is best illustrated by the growth of the mandibular ramus.

Mandibular growth involves a synchronous and selective deposition and resorption of bone from membrane surfaces as well as interstitial and appositional growth changes in the condyle. The main growth thrust appears to be in an upward and backward direction causing the body of the mandible to move downward and forward. In this process, bone is deposited along the posterior aspects of the ramus and in the condylar area.

Important: Growth at the mandibular condyle during puberty usually results in an increase in posterior facial height.
In a young child, which structure listed below grows in height and length to accommodate the developing dentition?

- The tuberosity
- The ramus
- The condyles
- The alveolar process
• The alveolar process

The bone of the alveolar process exists only to support the teeth. If a tooth fails to erupt, alveolar bone never forms in that area; and if a tooth is extracted, the alveolus resorbs after the extraction until finally the alveolar ridge completely atrophies.

The space between the jaws into which the teeth erupt is generally considered to be provided by growth at the mandibular condyles (especially the molars). The condyle is a major site of vertical growth in the mandible. Many arguments have been made about the condyle’s function in mandibular growth. Most authorities agree that soft-tissue development carries the mandible forward and downward, while condylar growth fills in the resultant space to maintain contact with the base of the skull.

In infancy, the ramus is located at about the spot where the primary first molar will erupt. Progressive posterior remodeling creates space for the second primary molar and then for the sequential eruption of the permanent molar teeth. More often than not, however, this growth ceases before enough space has been created for eruption of the third permanent molar, which becomes impacted in the ramus. Note: After age 6, the greatest increase in size of the mandible occurs distal to the first molars.

Remember: Resorption occurs along the anterior surface of the ramus (creates space for mandibular molars). Apposition occurs along the posterior surface of the ramus.
A diastema between erupting permanent maxillary incisors may indicate which of the following?

- A normal stage of development before eruption of canines
- It may be related to a tooth size discrepancy or a mesiodens
- It may indicate an abnormal frenum attachment
- All of the above
• All of the above

The spaces tend to close as the permanent canines erupt. The greater the amount of spacing, the less the likelihood that a maxillary central diastema will totally close on its own. **As a general guideline**, a maxillary central diastema of 2 mm or less will probably close spontaneously, while total closure of a diastema initially greater than 2 mm is unlikely. If the space is 2 mm or less and the maxillary laterals are in good position, it is most likely the result of a normal developmental process.

If it is caused by an abnormal frenum, it is best to align the teeth orthodontically and then do a frenectomy. Usually this is not done until the permanent canines erupt.

**Accepted methods of closing a diastema:**
• Using a lingual arch with finger springs
• Using a Hawley appliance with finger springs
• Using cemented orthodontic bands with intertooth traction
Serial extraction procedures involve:

- The orderly removal of selected **permanent teeth only** in a predetermined sequence
- The orderly removal of selected **primary teeth only** in a predetermined sequence
- The orderly removal of selected **primary and permanent teeth** in a predetermined sequence
- The orderly removal of selected **wisdom teeth only**
• The orderly removal of selected **primary and permanent** teeth in a predetermined sequence

Serial extraction is indicated primarily in **severe Class I malocclusion** in the mixed dentition that has **insufficient arch length**. This procedure primarily benefits children who demonstrate an arch-length discrepancy.

**Stages in serial extraction:** The **primary canines** are the first to be removed, followed by the **primary first molars**, and then the **permanent first premolars** (usually). Six to fifteen months is the interval between extractions. To aid in support and retention during this time, a lingual arch should be used in the mandible and a Hawley appliance in the maxilla. This is usually followed by full orthodontic treatment. **Note:** The key to success is **extraction of the first premolars before the permanent canines erupt**.

In serial extraction procedures, concerns about **eruption sequence** are usually related to the **eruption pattern of the permanent mandibular canines and first premolars**. **Note:** After extraction of the maxillary first premolar in a serial extraction procedure, the maxillary canines path of eruption will usually be downward and backward.

**Remember:** Severe arch space deficiency in the permanent dentition (**over 10 mm**) will almost always require extractions to properly align teeth.
The most commonly impacted teeth are:

- Maxillary canines
- Maxillary central incisors
- Mandibular first premolars
- Mandibular lateral incisors
Maxillary canines

Failure of a permanent tooth to erupt may cause damage to roots of other teeth and also create a severe orthodontic problem. Orthodontic consultation is indicated when first observed on x-ray. An impacted canine or other tooth in a teenage patient can usually be brought into the arch by orthodontic traction after being surgically exposed. In older patients, there is an increasing risk that the impacted tooth has become ankylosed. Even adolescents have a risk that surgical exposure of a tooth will lead to ankylosis.

In treatment planning for an impacted tooth, three principles should be followed:
1. The prognosis should be based on the extent of displacement and the surgical trauma required for exposure.
2. During surgical exposure, flaps should be reflected so that the tooth is ultimately pulled into the arch through keratinized tissue, not through alveolar mucosa.
3. Adequate space should be provided in the arch before attempting to pull the impacted tooth into position.
ORTHODONTICS

Which of the following is **most important** to the orthodontist with regard to the time treatment should begin?

- The **chronologic age** of the patient
- The **physiologic age** of the patient
- Both are the same
• The physiologic age of the patient

**Also called developmental age.** This indicates the degree of physical maturation. Persons with the same chronologic age can vary greatly in their physical maturity. Therefore, a child of 12 years chronologically may be commencing his adolescent growth spurt while another child of the same chronologic age could be months or even years away from the same physical development. **Note:** An early prepubertal growth spurt indicates a fast maturing child.

**Indicators of physiologic age include** assessments of bone age and height-weight data. **Dental age** is another **indicator of physiologic age** and can be assessed by radiographs of the jaws to determine the degree of crown and root formation of each tooth.

**Since treatment of orthodontic problems,** particularly those related to jaw malrelationships, often requires concomitant favorable growth of the jaw and dentition, **indicators of developmental age** are valuable to the orthodontist in his timing and approach to treatment. **Chronologic age** is a poor substitute for physiologic age when growth of the individual is related to one's objectives. Therefore, the orthodontist relies greatly on parameters of physiologic age in his efforts to attain treatment goals.
Ectopic eruption of a **permanent maxillary first molar** is frequently treated by:

- Disking the distal of the primary first molar
- An appliance incorporating a finger spring to move the primary second molar mesially
- A brass wire placed between the primary second molar and permanent first molar
- Extraction of the primary second molar
A brass wire placed between the primary second molar and permanent first molar

**This separating device (brass wire)** will cause the permanent first molar to be tipped distally.

**Ectopic eruption occurs when a tooth erupts** in the wrong place. **It is most likely to occur in the eruption of maxillary first molars and mandibular incisors.** Its occurrence is much more common in the maxilla and is often associated with a developing skeletal Class II pattern. It is seen in about 2-6% of the population and spontaneously corrects itself in about 60% of cases.

**If the eruption path of the maxillary first molar** carries far too mesially at an early stage, the permanent molar is unable to erupt and the root of the primary molar may be damaged. The mesial position of the permanent molar means that the arch will be crowded unless the child receives treatment.

**Ectopic eruption of mandibular lateral incisors,** which occurs more frequently than mandibular first molars, may lead to transposition of the lateral incisor and canine. A poor eruption direction of the canine, sometimes leading to impaction, is observed often but usually is due to the eruption path being altered by a lack of space.
Continuous heavy orthodontic forces may cause:

- The PDL to become crushed
- Resorption of cementum
- Resorption of the alveolar bone
- All of the above
• All of the above

Root resorption of permanent teeth often occurs after orthodontic tooth movements. However, if forces are light, serious root resorption is only rarely seen in orthodontic therapy.

Notes:
1. Resorption of the alveolar bone is termed "undermining resorption" since the attack is from the underside of the lamina dura.
2. The greater resistance to resorption of the teeth (specifically cementum) as compared to that of the alveolar bone is explained by the fact that the teeth are permanent depositories of mineral salt, with a continuous apposition, while the bony system (of which the alveolar bone is part) is a mineral reservoir for the whole organism, with the physiologic resorption and apposition going on all the time.
The most common site for a supernumerary tooth is:

- Distal to the mandibular third molar
- Between the maxillary premolars
- Between the mandibular central incisors
- Between the maxillary central incisors
- Between the maxillary central incisors

***Supernumerary teeth have a 2:1 predilection for males

Extra teeth or those that develop in excess of normal complement are called supernumerary teeth. They can occur in either jaw, but are seen most frequently in the maxilla in the midline of the anterior teeth and sometimes distal to the molar teeth. When an extra tooth occurs between the maxillary central incisors, it is called a mesiodens. These teeth usually are small teeth (microdontia), are peg-shaped and do not resemble the teeth normal to the site. A mesiodens that is impacted can cause a diastema or spacing between the maxillary central incisors. Supernumerary teeth may cause crowding of the normal teeth and may delay the eruption of permanent teeth. Treatment involves removing surgically and observing the progress of the permanent teeth.

An inverted mesiodens may cause delayed eruption of the maxillary central incisors.

To localize a supernumerary tooth or impacted tooth and its relationship to other teeth, you should take two or more periapical x-rays at different angles and an occlusal view film.

Conditions associated with multiple supernumerary teeth:
- Gardener's syndrome
- Cleidocranial dysplasia
- Down syndrome
- Sturge-Weber syndrome
Conditions that may complicate **molar uprighting** include:

- A high mandibular plane and open bite
- The presence of periodontal disease
- Poor crown-to-root ratio and/or short roots
- The presence of root resorption
- A significant centric relation-to-maximum intercuspation discrepancy
- A severe lingual inclination of the tooth in addition to the mesial tipping
- Occlusal plane disharmony (*i.e.*, extruded maxillary and mandibular molars)
- Severe skeletal discrepancies
- All of the above
A common dental condition that can benefit from orthodontic treatment prior to prosthetic treatment is the long-term loss of a mandibular permanent first molar. The loss of the first molar results in tipping, migration and rotation of the adjacent teeth into the edentulous space. Note: The best way to upright a second molar that had drifted mesially is by tipping its crown distally and opening up space for a pontic to replace the missing first molar, rather than attempting to move the second molar mesially to close the space.

A normal angulation of a molar is desirable since it:
- Improves the direction and distribution of occlusal forces
- Decreases the amount of tooth reduction required for parallelism of the abutments
- Decreases the possibility of endodontic, periodontic or more complex prosthodontic procedures
- Increases the durability of the restorations, due to better force distribution
- Improves the periodontal environment by eliminating plaque-retentive areas
- Improves the alveolar contour
- Improves crown-to-root ratio
The time required to upright a molar can vary from:

- 2-3 weeks
- 1-2 months
- 6-12 months
- 2-3 years
6-12 months

*** A severely tipped molar or one that requires mesial movement to shorten the pontic space requires a longer treatment time.

A fixed edgewise orthodontic appliance is usually used for molar uprighting. The bracket slot size of 0.022 inch allows a wide range of wire sizes to be used. The alternate slot size is 0.018 inch, which can also upright the molar, but limits the wire sizes available. The tipped second molar should be banded because of the considerable posterior masticatory forces produced can easily shear off bonded brackets.

Facts about molar uprighting:
• A severely lingually tipped mandibular molar is more difficult to control and upright properly.
• Molar uprighting treatment in high angle cases will tend to result in excessive bite opening (increased anteroposterior maxillary arch size).
Hyaline cartilage differs from bone in that hyaline cartilage may grow:

- By appositional growth
- By interstitial growth
- Neither of the above
• By interstitial growth

Growth of cartilage occurs in two ways:
1. **Appositional** by the recruitment of fresh cells, chondroblasts, from perichondral stem cells and the addition of new matrix to the surface. **Note**: The perichondrium consists of a fibrous outer layer and a chondroblastic inner layer.
2. **Interstitial** by the mitotic division of, and deposition of more matrix around, chondrocytes already established in the cartilage. Examples of sites that grow by interstitial growth include the **mandibular condyle**, nasal septum and spheno-occipital synchondrosis.

Growth of bone:
**Appositional**: below the covering periosteal layer of bone. Periosteum consists of a fibrous outer layer and a cellular inner layer of osteoblasts, which lay down bone. **Because of its rigid structure, interstitial growth is not possible.**

*** (Do not confuse bone growth with bone formation. Bone forms by either endochondral ossification or intramembranous ossification).
Which of the following theories most likely explains why there is a strong tendency for mandibular anterior crowding in the late teens and early twenties?

- Lack of leeway space
- Pressure from third molars
- Late mandibular growth
- Late maxillary growth
• Late mandibular growth

The current concept is that late incisor crowding develops as the mandibular incisors, and perhaps the entire mandibular dentition, move distally relative to the body of the mandible late in mandibular growth.

Late incisor crowding does occur in individuals with no third molars at all, and so the presence of these teeth is not a critical variable. Important: The extent of late mandibular growth is. The mandible can and does undergo more growth in the late teens than does the maxilla.
The rationale for retention in orthodontics is to:

- Allow for reorganization of the gingival and periodontal tissues
- Minimize changes due to growth
- Permit neuromuscular adaptation to the corrected tooth position
- Maintain teeth in unstable conditions
- All of the above
• All of the above

Maintaining the treatment result following orthodontic treatment is one of the most difficult aspects of the entire treatment process. Retention is necessary in orthodontics for the following reasons:

1. The gingival and periodontal tissues are affected by orthodontic tooth movement and require time for reorganization when the appliances are removed.
2. Changes produced by growth may alter the orthodontic treatment result.
3. The teeth may be in an inherently unstable position after the treatment, so that the soft tissue pressures constantly produce a tendency for relapse.

In the last situation, gradual withdrawal of an orthodontic appliance is of no value. The only possibilities are accepting relapse or using permanent retention. Fortunately, only the first two reasons apply to most orthodontic patients, and maintaining the position of the teeth until remodeling of the supporting tissues is completed and growth has essentially ceased allows a stable orthodontic result without further retention. Note: Retention is accomplished with either fixed or removable retainers.

Remember:
• Anterior crossbite is easily retained after orthodontic correction by the overbite achieved during treatment.
• Supracrestal fibers are commonly associated with relapse following orthodontic rotation of teeth.
Which of the following statements are true concerning a mixed dentition analysis?

- It is used to predict the amount of crowding after the permanent teeth come in
- It is performed during the mixed dentition
- It is performed with a boley gauge, study models and a prediction table
- All of the above statements are true concerning a mixed dentition analysis
procedure for mixed dentition analysis:
1. measure the mesial-distal diameter of the mandibular incisors and add them together
2. measure the space available for the mandibular incisors
3. subtract #1 from #2
   ***a negative number indicates crowding in the incisor region***
4. measure the space available for the canine and premolars on each side of the arch
5. calculate from the prediction table the size of the canine and premolars
6. subtract #6 from #5 on each side
   ***once again, a negative number indicates crowding***

****at this point, there will be 3 numbers
• the number for incisor crowding or excess space
• the number for the right canine and premolar crowding or excess space
• the number for the left canine and premolar crowding or excess space

***add the three numbers: a negative number = crowding
    a positive number = space

note: for the maxillary arch, use the mandibular incisors to predict the size of the maxillary canines and premolars. follow the same steps as described for mandibular teeth.
Relative to the primary mandibular canines, the permanent mandibular canines erupt:

- Lingually
-Facially
- Distally
- Mesially
• **Facially (labially)**

However, often they are right in line with the primary canines. If there are problems in eruption, these teeth can be displaced either lingually or labially, but usually they are displaced labially if there is not enough room to accommodate them within the arch.

**Note:** The mesial inclined plane of the *primary* maxillary canine articulates with the distal inclined plane of the *primary* mandibular canine. **This is the normal relationship.**

In both the maxillary and mandibular arches, the permanent incisor tooth buds lie lingual as well as apical (*inferior*) to the primary incisors. The result is a tendency for the mandibular permanent incisors to erupt somewhat lingually and in a slightly irregular position. This occurs even in children who have normal dental arches and normal spacing within the arches.
Which of the following is the normal relationship of the primary molars in the deciduous dentition?

- Distal step
- Flush terminal plane
- Mesial step
- None of the above
The normal relationship of the primary molar teeth is the flush terminal plane.

The primary dentition equivalent of Angle’s Class II is the distal step.

The primary dentition equivalent of Angle’s Class I is the mesial step.

An equivalent of Class III is almost never seen in the primary dentition because of the normal pattern of craniofacial growth in which the mandible lags behind the maxilla.

The edge-to-edge position of the cusps of permanent maxillary and mandibular first molars is the most frequent initial relationship (when primary molars are in a flush terminal plane). This will most likely become a Class I molar relationship by both molars drifting forward (called “early mesial shift”), with the mandibular molar drifting about twice as far as the maxillary molar.

Note: The terminal plane relationship of primary second molars determines the future antero-posterior position of the permanent first molars.
A phase of dentition during which some of the teeth present in the oral cavity are permanent and some are primary is referred to as what?

- Intermediate dentition
- Succedaneous dentition
- Mixed dentition
- Non-succedaneous dentition
• Mixed dentition

The earliest indication of a mixed dentition consists of the primary dentition and the permanent mandibular first molars.

A mixed dentition analysis (transitional dentition analysis) determines space available versus space required. The analysis is based on a correlation of tooth size; one may measure a tooth or a group of teeth and predict accurately the size of the other teeth in the same mouth.

In the Moyers' mixed dentition analyses, the size of the unerupted canines and premolars is predicted from knowledge of the size (mesiodistal width) of the mandibular incisors that have already erupted into the mouth early in the mixed dentition. The maxillary incisors are not used in any of the predictive procedures, since they show too much variability in size. Note: The mandibular incisors are measured to predict the size of maxillary as well as mandibular posterior teeth.

If mandibular anterior crowding is noted during the mixed dentition phase, the most appropriate approach to management is to take study models and perform an arch length analysis. This mandibular incisor crowding usually results from a tooth size-arch length discrepancy.

Remember: Supervision of a child's development of occlusion is most critical at ages 7-10 years (mixed dentition).
"Primate spaces" in the primary dentition are found in which two locations?

- In the maxillary arch, the primate space is located between the central incisors and lateral incisors
- In the maxillary arch, the primate space is located between the lateral incisors and canines
- In the mandibular arch, the primate space is located between the canines and first molars
- In the mandibular arch, the primate space is located between the lateral incisors and canines
• In the maxillary arch, the primate space is located between the lateral incisors and canines
• In the mandibular arch, the primate space is located between the canines and first molars

Spacing is normal throughout the anterior part of the primary dentition, but is most noticeable in these two locations.

These primate spaces are normally present from the time the teeth erupt. Developmental spaces between the incisors are often present from the beginning, but become somewhat larger as the child grows and the alveolar processes expand. Generalized spacing of the primary teeth is a requirement for proper alignment of the permanent incisors. This spacing is most frequently caused by the growth of the dental arches.

If spacing is present, there is a possibility that drifting of the adjacent teeth will occur if there is a loss of primary incisor. However, if there is no spacing present and primary anterior teeth were in contact before the loss, a collapse in the arch after the loss of one of the primary incisors is almost certain.

This is not true in the case of a lost permanent incisor. Space closure occurs rapidly whether spacing is present or not prior to the loss. Space maintenance would be indicated.

Remember: One of the most common causes of malocclusion is inadequate space management following the early loss of primary teeth.
Which of the following is the **difference** in the total of the **mesiodistal widths** between the **primary** canine, **first molar** and **second molar**, and the **permanent** canine, **first premolar** and **second premolar**?

- Primate space
- Leeway space
- Moyer’s space
- Anatomic space
Note: The permanent successors are most often smaller than their primary predecessors.

The mandibular leeway space averages 3-4 mm while the maxillary leeway space averages 2-2.5 mm. The important factor is that some space will be available in the posterior part of the mouth. This leeway space serves to at least accommodate the permanent canines, which are generally larger than the primary canines.

During the canine-premolar transition period, the permanent first molars generally move mesially into the leeway space after the primary second molars are shed, thus causing a loss in arch length. (This is referred to as "the late mesial shift of a permanent first molar").
Orthodontics

Overbite is:

- The horizontal projection of the maxillary anterior teeth beyond the mandibular anterior teeth
- The vertical overlapping of the maxillary anterior teeth over the mandibular anterior teeth
- A malocclusion in which the anterior teeth do not close or come together
- A malocclusion where some of the maxillary teeth are inside of the mandibular teeth when they occlude
• The vertical overlapping of the maxillary anterior teeth over the mandibular anterior teeth

***Overjet is the horizontal projection of the maxillary anterior teeth beyond the mandibular anterior teeth

Other terms to know include:

• **Physiologic occlusion** – although not necessarily an ideal or Class I occlusion, it is one that **adapts to the stress of function and can be maintained indefinitely**.

• **Pathologic occlusion** – cannot function without contributing to its own destruction. It may manifest itself by any combination of:
  - excessive wear of the teeth without sufficient compensatory mechanisms
  - TMJ problems
  - pulpal changes ranging from pulpitis to necrosis
  - periodontal damage

**Note:** Tooth movement caused by pathologic conditions is termed **pathologic tooth movement**.

**An example of physiologic tooth movement** would be the mesial drifting of a permanent molar into a space created by the premature loss of a primary molar. *(Remember: Permanent molars have a natural tendency to drift mesially).*
• **A = Class I:**
  
  **Molar relation** – The mesiobuccal cusp of the maxillary first permanent molar occludes with the buccal groove of the mandibular first permanent molar.
  
  **Canine relation** – The maxillary permanent canine occludes with the distal half of the mandibular canine and the mesial half of the mandibular first premolar.

• **B = Class II:**
  
  **Molar relation** – The buccal groove of the mandibular first permanent molar is dis-