Orthodontics

Dr. Lama Hammoud

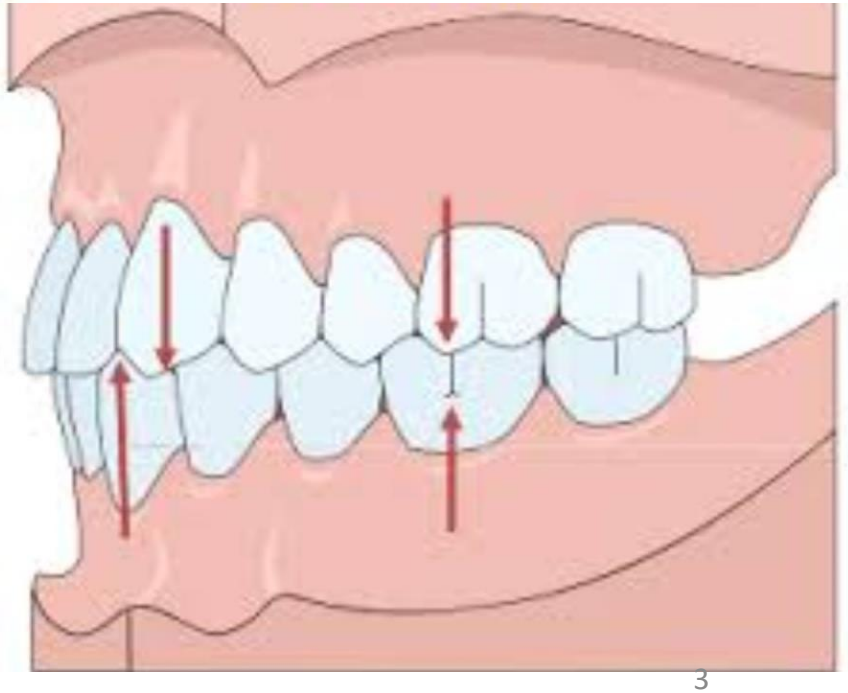
Purpose of Orthodontic Practice and Malocclusion Classifications

Orthodontia (ortho = *straight*, dont = *tooth*) is the study dealing with the prevention and correction of abnormally positioned or misaligned teeth. The dentist specializing in this practice, the orthodontist, is a graduate dental student who has completed an additional two to three years of study in orthodontics. This specialist is concerned with the causes and treatment of malocclusion. With additional specialized training in the control and modification facial growth, the orthodontist can practice dentofacial orthopedics, usually in conjunction with a team of other specialists. Some of these procedures can be TMJ dysfunction, cleft palate, and facial and tooth reconstruction.

Classification of Malocclusion:

Dr. Edward Angle divided malocclusion into three classifications while the teeth are set in centric relationship, the most retruded position of the mandibular condyle into the glenoid fossa (biting on the back teeth). The three classifications are described here:

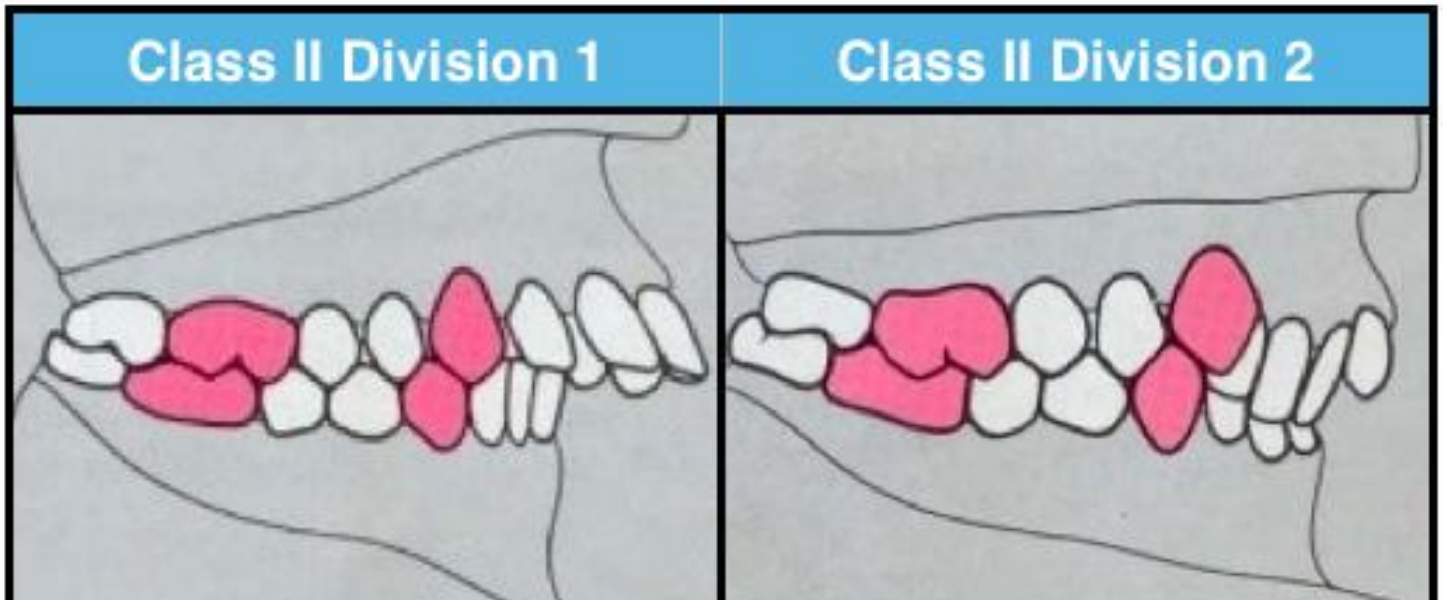
neutrocclusion :Class I condition in which the anteroposterior occlusal positions of the teeth or the mesiodistal positions are normal, where the mesiobuccal cusp of the maxillary first permanent molars occludes into buccal groove of the mandibular first permanent molar ,but other malocclusion or positioning of the individual teeth occurs, such as crowding, misalignment, and crossbites



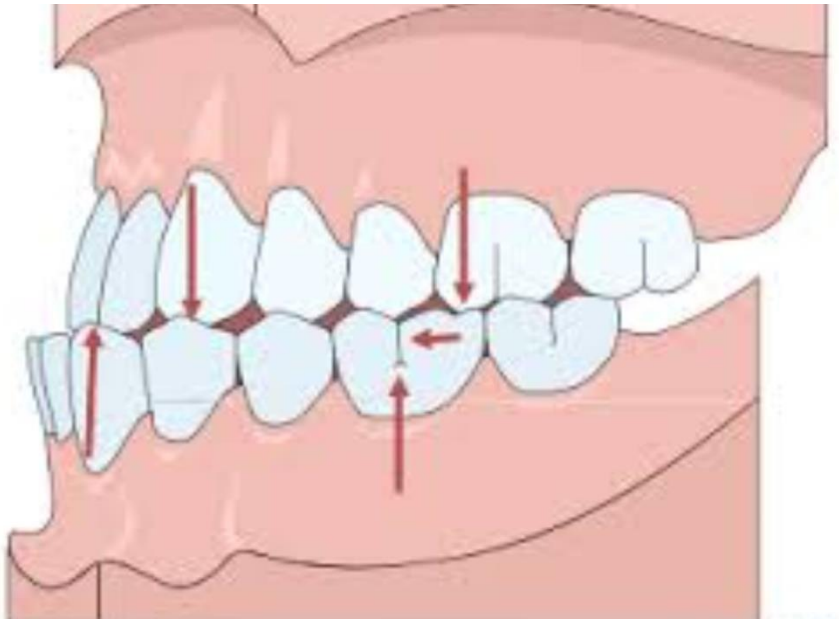
distocclusion: Class II condition in which the mesiobuccal cusp of the maxillary first molar is anterior to the buccal groove of the mandibular first molar, resulting in an appearance of a retruded mandible. Class II is further separated into two divisions, according to the individual placement of the anterior teeth:

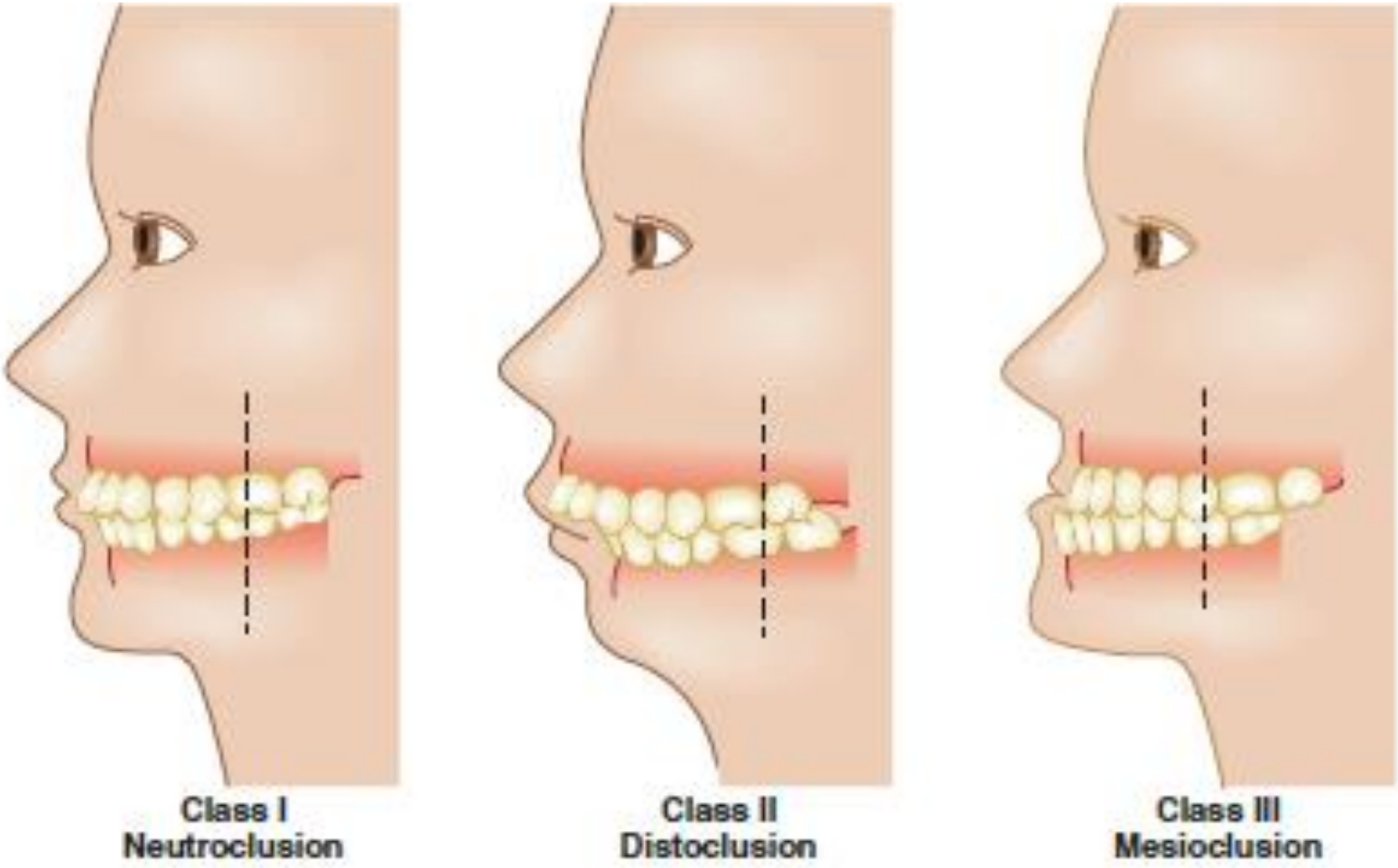
Division 1: maxillary incisors protruding with a V-shaped arch instead of a U-shaped arch; overjet present.

Division 2: maxillary incisors having a lingual incline with an excessive overbite and a wider than normal arch.



mesiocclusion: Class III condition, in which the mesiobuccal cusp of the maxillary first molar occludes in the interdental space of the mandibular permanent first molar's distal cusp and the mesial cusp of the mandibular permanent second molar, resulting in an appearance of a protruded mandible.




Class I
Neutroclusion
Class II
Distoclusion
Class III
Mesioclusion

An individual tooth position can also be classified as:

mesioversion: tooth is positioned more mesial than normal.

distoversion: tooth is positioned more distal than normal.

labioversion: anterior tooth positioned outside the arch toward the lips.

buccoversion: posterior tooth positioned toward the cheek.

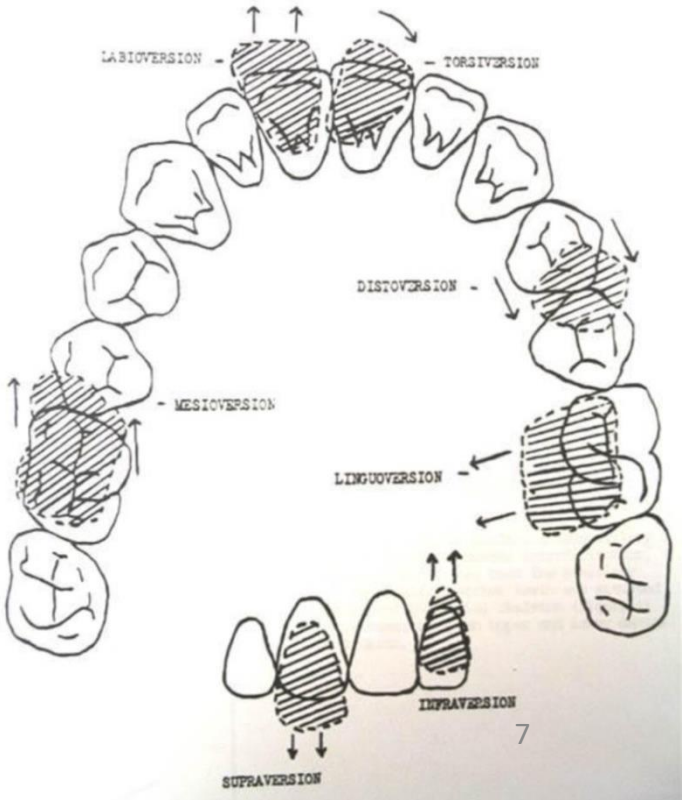
linguoversion: tooth positioned inside the arch toward the tongue.

infraversion: tooth not fully erupted or into space.

supraversion: tooth over erupted.

torsoversion: tooth rotated on its axis.

transversion: tooth in wrong order.



Causes of Malocclusion:

Malocclusion occurs from diverse causes and in various forms. Causes include trauma, habits, poor mouth conditions, or congenital *(present at birth)* factors, such as supernumerary teeth or ectopic (*out of place*) eruption of teeth.

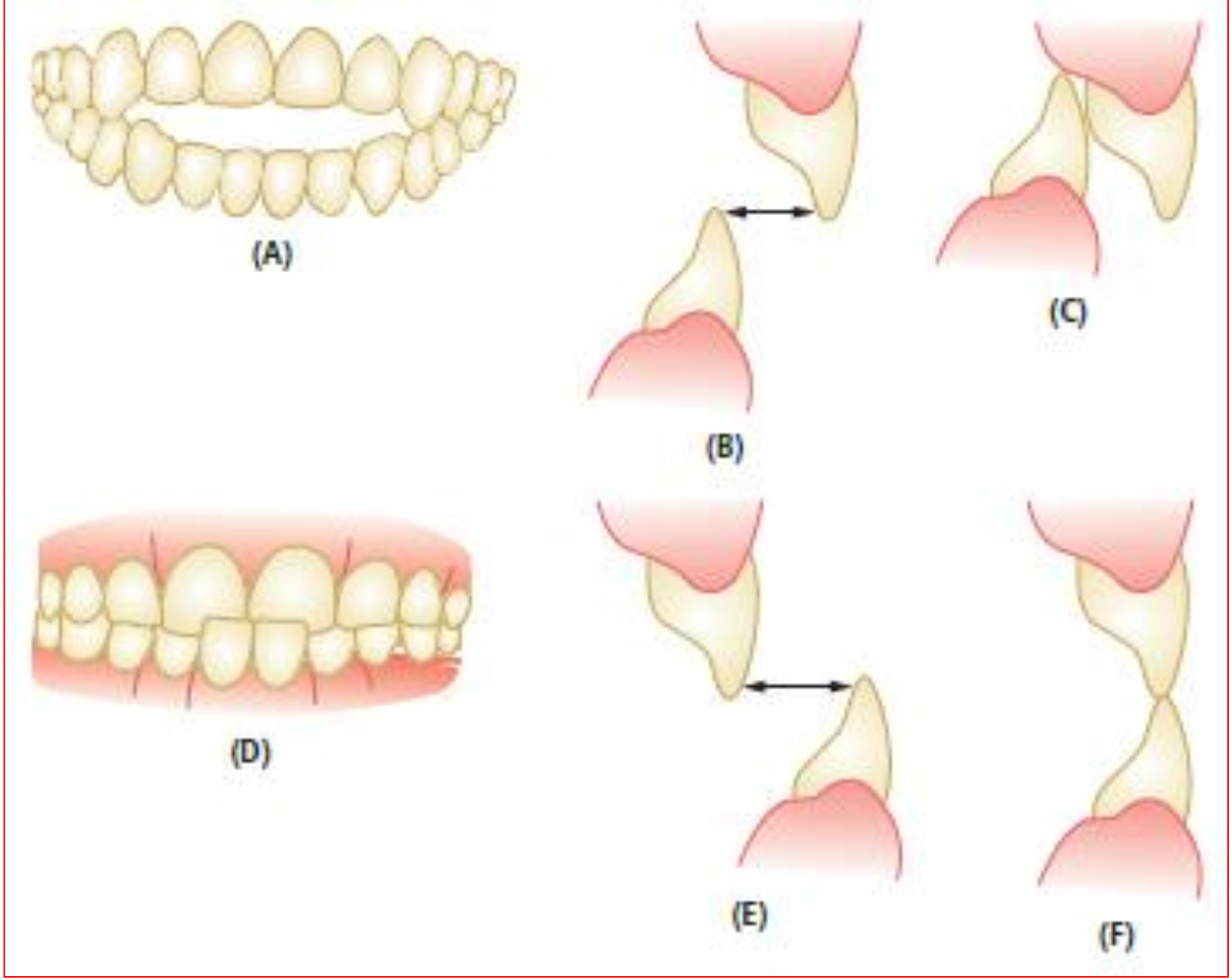
open bite: anterior teeth do not contact with each other, or no contact exists between the maxillary and mandibular posterior teeth.

- **vertical overbite**: excessive amount of overlap of the maxillary and mandibular central incisors when they are in occlusion.
- **overjet**: also known as horizontal overbite, increased horizontal distance between the incisal edges of maxillary and the labial surfaces of the mandibular central incisors.

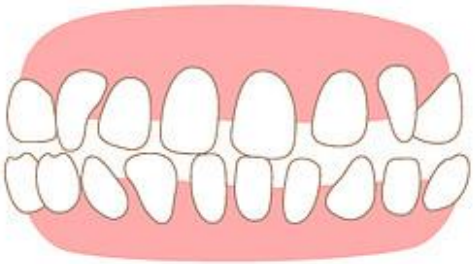
- **crossbite**: midsagittal alignment between central incisors not in agreement; posterior tooth crossbite can also occur when teeth do not meet correctly in the centric bite.

underjet: maxillary incisors lingual to mandibular incisors.

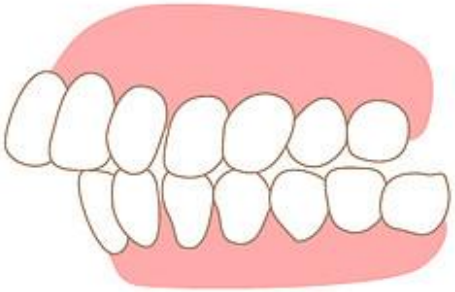
end to end: edges of maxillary and mandibular incisors meeting each other.



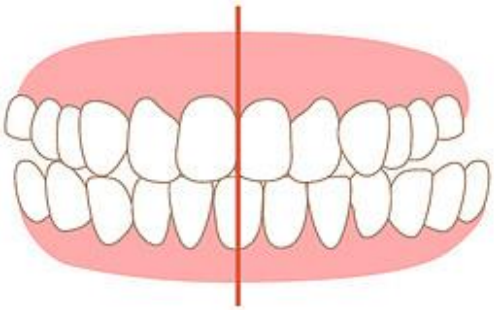
Assorted malocclusion conditions: (A) open bite; (B) overjet; (C) vertical overbite; (D) crossbite; (E) underjet; (F) end-to-end.



SPACING



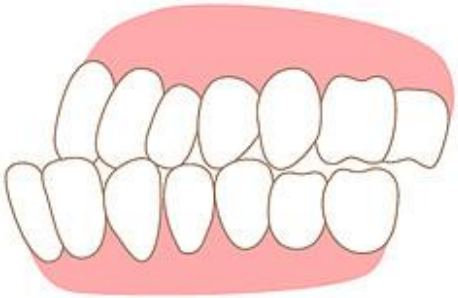
OVERJET



CROSSBITE

OPEN BITE

CROWDING



UNDERBITE

Types and Methods of Orthodontic Treatment:

Malocclusion is treated with a variety of methods or treatment plans:

preventive orthodontics: procedures taken to preserve the integrity of a normal developing occlusion by protecting current conditions or preventing situations that would interfere with growth, such as correction of caries, poor nutrition, elimination of habits through myotherapeutic (*muscle healing treatment*) exercises, or by the placing of space maintainers in areas of missing teeth.

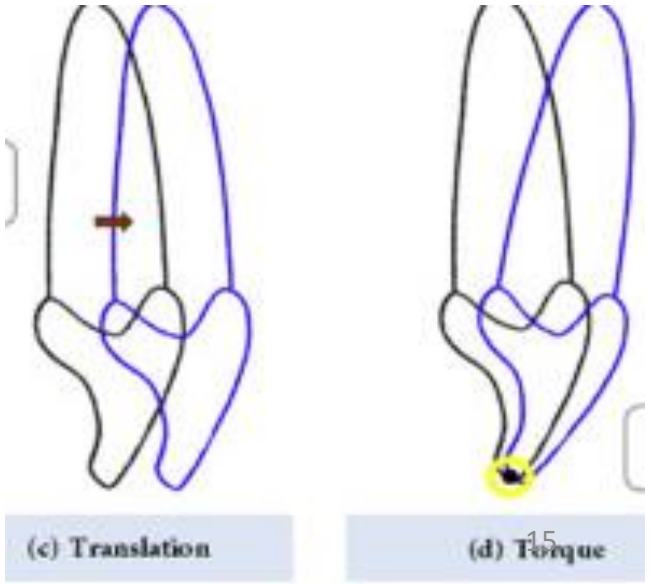
interceptive orthodontics: procedures taken to lessen the severity of any existing malfunctions or problems from genetic or environmental factors, such as placement or use of appliances to correct improper growth patterns. Examples of these appliances are a tongue retrainer or incline bite plane to move a crossbite.

corrective orthodontics: procedures taken to reduce or eliminate malocclusion; treatment plans include the application of intraoral and extraoral appliances and auxiliary forces for tooth direction. Some movement forces are:

rotation (*turn around on an axis*): altering the position of a tooth around its long axis.

translation: bodily tooth movement; a change of teeth to alternate positions.

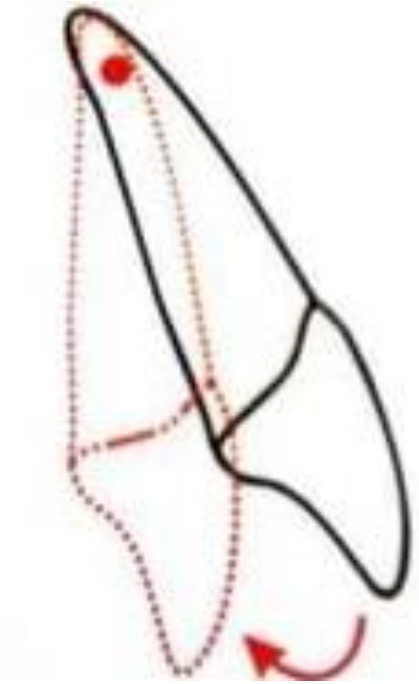
torque : movement of the root without the movement of the crown.

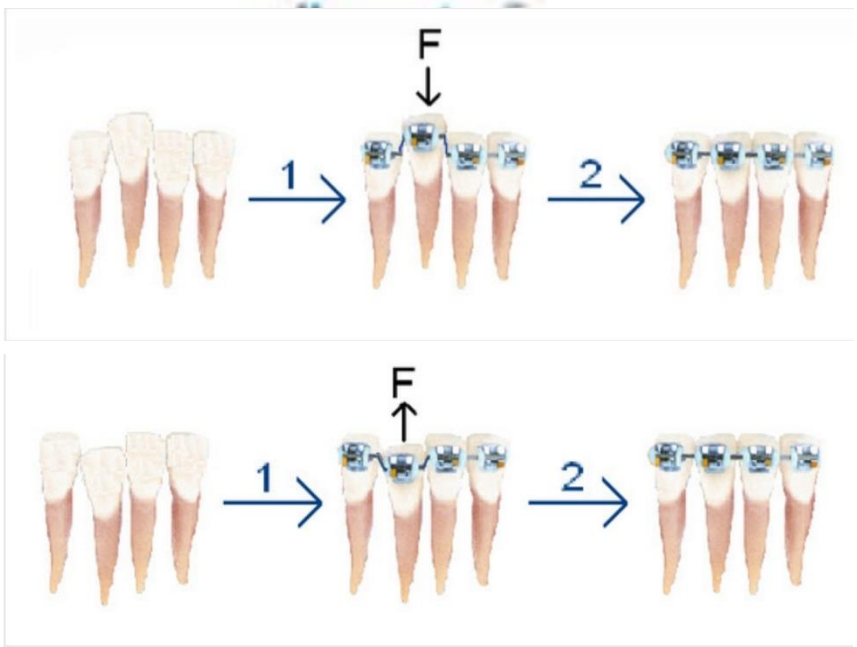


tipping: change of a tooth position to a more upright direction.

intrusion : movement of the tooth into the alveolus.

extrusion : movement of the tooth out of the alveolus.





Corrective orthodontic treatment is determined by many factors, including age, degree of malocclusion, cause of malocclusion, the patient's general health and attitude, and economics, as well as the orthodontist's expertise and training. Today's patient has many choices or methods of correction, including the following:

banding: placing a metal band around the entire selective tooth or teeth. Brackets, tubes, hooks, springs, and other devices are placed on these bands and are used to attach push/pull pressure to the teeth movements and arch wire shaping.

- **direct bonding:** cementing brackets of stainless steel or gold-plated metal composite, ceramic with metal centers, or (monocrystalline sapphire) clear brackets on the surface of the tooth to attach needed pressures and arch wire forms. Brackets may be plain hook style for attachments or a self-ligating system clip style that does away with elastics, requires fewer appointments, and is quicker in adjusting appointments. After the tooth is cleaned and etched, the bracket's back side is coated with cement and then attached to the prepared tooth, where it auto (self) sets or is light cured. Some brackets now are precoated with adhesive and are placed directly on the prepared surface and cured.

indirect bonding: placing and cementing brackets to tooth surfaces by means of tray delivery. This method requires two visits. One visit is for impression taking for model construction, which is sent to the lab, where bracket placement is fitted and cemented into the model's selected tooth surface. A tray material is then expressed over the model and brackets. Upon set and removal, the bracket tabs and tray unit is cleaned and returned to the dentist for patient insertion within 14 days. On the second visit, the teeth are cleaned, isolated, etched, and then receive the tray with cement on the brackets. Cement may be light cured or self-curing, and when set the tray is removed, the brackets remain on the tooth to have appropriate wires attached for continuing treatment.

Invisalign braces: strong plastic (polyurethane) custom trays used in mild malocclusion cases. The specially trained orthodontist takes impressions, X-rays, and photos that are sent to the Align lab, which prepares a CT scan and a 3D model for the fabrication of trays. These trays are returned to the dentist who inserts and instructs the patient. Trays are changed every few weeks, for approximately 12 to 18 months, making adjustment in the bite until the desired occlusion is obtained, and then maintained until stabilized. The patient may remove them for eating, drinking, and tooth brushing but must wear them for 20 to 22 hours per day.

lingual braces:

braces that are placed on the tongue side of the teeth Some orthodontists take required radiographs, impressions, and measurements that are sent to a laboratory to use 3D CAM/CAD technology to prepare custom braces that fit the lingual tooth surfaces, and precision bent wires that are delivered in a tray for indirect bonding to the tooth lingual surfaces. Lingual brackets are always applied using an indirect bonding tray procedure.

accelerated osteogenic orthodontic treatment: surgical orthodontic "team" approach that involves placement of a regular orthodontic apparatus on the teeth and a periodontist or oral surgeon to incise the gingiva and expose the alveolar bone. Then, a surgical drill is used to remove some alveolar plate and score the mandible bone surrounding the teeth, which causes **osteopenia** (*osteo* = bone, *penia* = lack of). While the bone is in a weakened condition, the teeth move quickly into position (three to eight months) and are retained there while the bone remineralizes and strengthens. This procedure is also termed *Wilckodontics.*

adjunctive orthodontics: Along with selective biomechanical movement, other procedures are taken to facilitate a proper outcome. Selective **enameloplasty** (removal of enamel surface) of adjacent teeth to allow increased space for movement is one. Occasionally, an existing tooth (a premolar on each side) is removed to provide ample space for movement of other teeth.

Other orthodontic procedures that are necessary to correct or restore function include cleft palate surgery, TMJ dysfunction, periodontal damage, pulp changes, closing of diastemas, jaw reduction, or other cranio-maxillofacial problems. This type of treatment called orthognathic surgery combines the skills of several specialists. Usually the orthodontist's alignment of the teeth is completed along with services of an oral maxillofacial surgeon to reposition jawbones, the prosthodontist to provide prosthetic devices, and the family dentist for dental care of the patient. Other dental and medical specialists may also be involved in this type of surgery

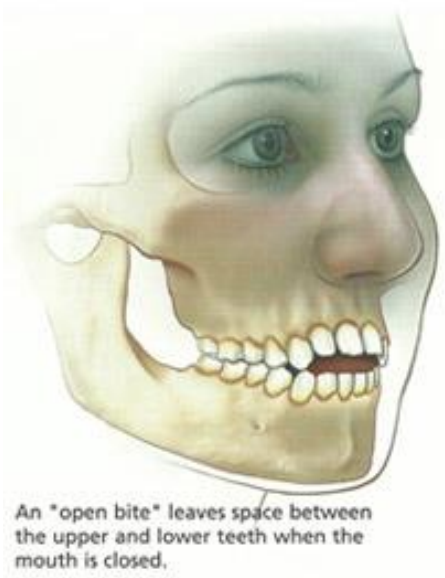
The most common orthognathic surgical procedures involving tooth and jaw irregularities are:

open bite: space between the upper and lower teeth when the mouth is closed.

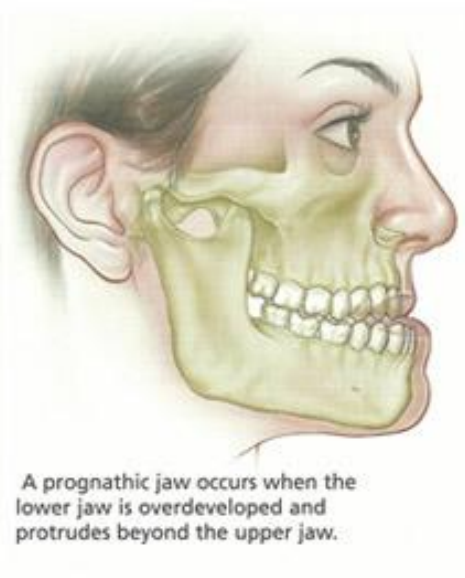
retrognathia: receding lower jaw or "weak chin."

prognathia: protruding lower jaw, extending jaw.

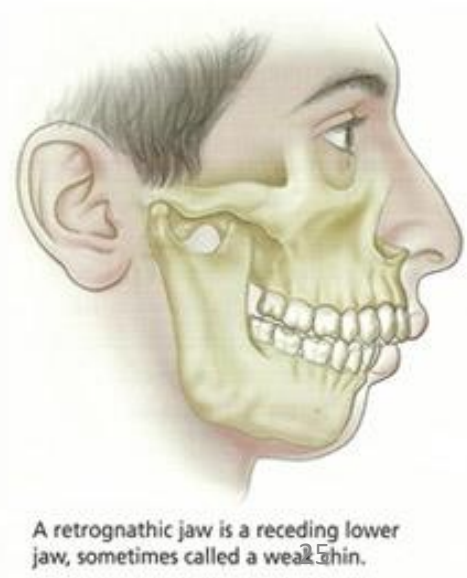
temporomandibular joint dysfunction (TMD): improper TMJ movement.



An "open bite" leaves space between the upper and lower teeth when the mouth is closed.



A prognathic jaw occurs when the lower jaw is overdeveloped and protrudes beyond the upper jaw.



A retrognathic jaw is a receding lower jaw, sometimes called a weak chin.

After extensive testing, examination (medical, clinical, CT, and 3D i-CAT radiology) photos, and planning, the teeth are orthodontically prepared and stabilized. Oral surgery for bone movement and jaw alignment will follow. The mouth may be temporarily "fixed" or held in place for a short time. Healing and after care will require appointments with all specialists and readjustment of stabilizers as progression occurs. Time involvement is from several months to two or more years.

Requirements for Diagnosis and Treatment Planning for Malocclusion:

Diagnosing the type of malocclusion to enable the identification of subsequent treatment depends on a thorough workup exam that includes the following:

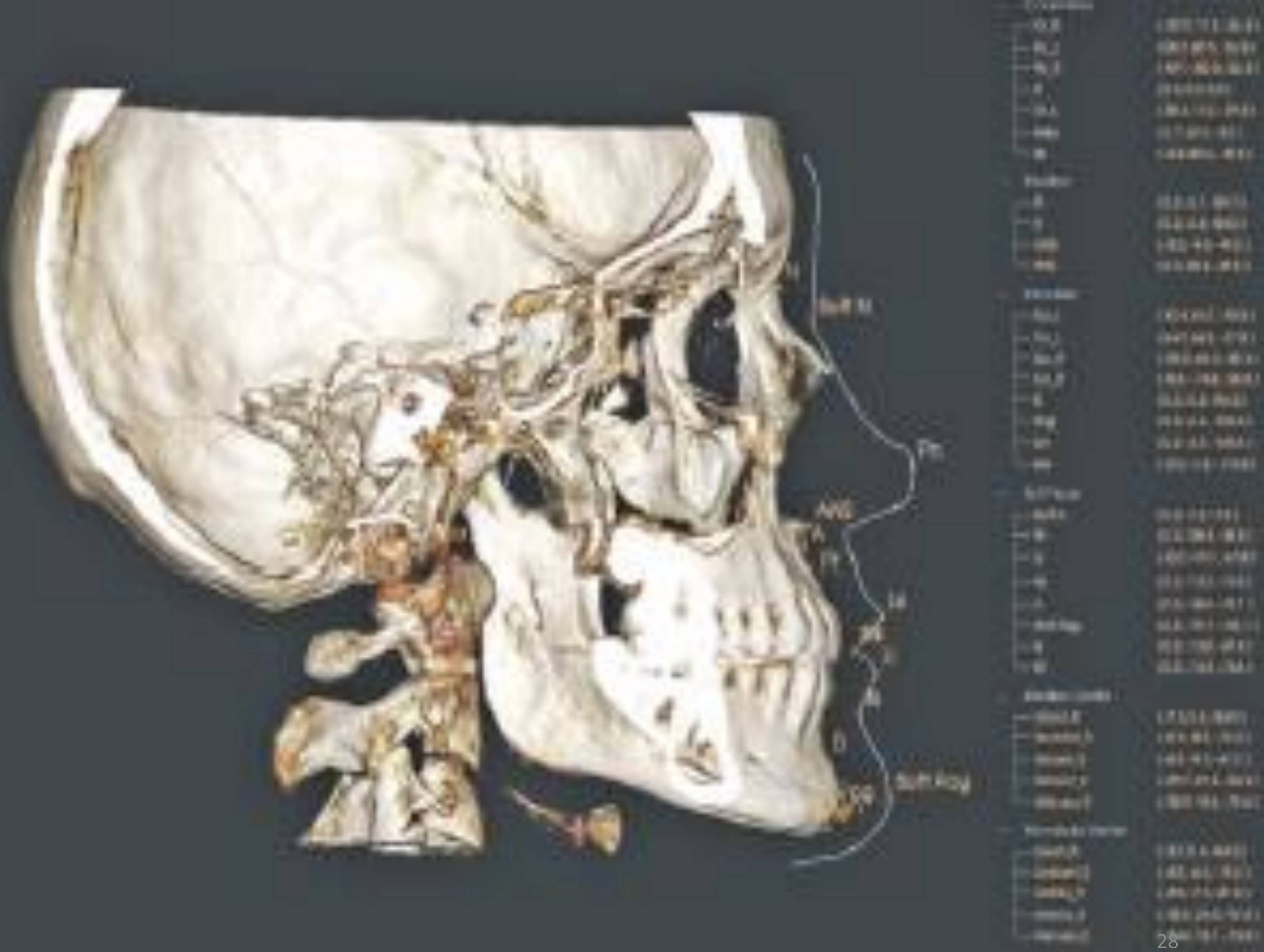
patient medical and dental history: summary of health problems, dental hygiene habits, patient's desire to follow treatment instructions, and care plan for a long time period.

clinical examination: inspection and charting of teeth, soft-tissue condition, and biting ability.

photographs (extraoral and intraoral): photographic record of current condition; used to plan treatment and effective for before and after treatment status. Intraoral views are used for teeth and soft tissue while extraoral views are used to determine skeletal and tissue profile.

impression taking: impressions of both arches and a bite registration are taken for the construction of a study model to be placed on an articulator and used for study and measurements.

radiographs: full mouth series to view tooth conditions, panoramic X-ray Exposure for growth projection, **cephalometric** (*measurement of the head*) films for skeletal pattern, and possibly 3D i-CAT cone beam computerized tomography for bone depth and condition.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After the workup appointment, the patient returns for a discussion about possible solutions, therapy, time, financial cost/payment, and participation matters. Both parents (if possible) are usually present for a child patient at this time. If any preliminary work such as dental restorations, removal of impacted third molars, or gingival therapy is needed, appointments are made with the appropriate dental provider before beginning orthodontic treatment.

Intraoral Appliances and Auxiliaries Used in Orthodontics:

Treatment of malocclusion is accomplished by applying forces through an intraoral or an extraoral source, or a combination of both. They may be fixed or removable. Retainers, positioners, and habit avoidance devices are examples of removable items. The most common fixed orthodontic appliances, known as "braces," are fixed bands or brackets to which auxiliary devices are applied. Some intraoral items used are:

bands: stainless steel circles or rings that are sized and cemented around a tooth. Bands are supplied as maxillary or mandibular in varying sizes, and they may be supplied with or without brackets or tubes attached.

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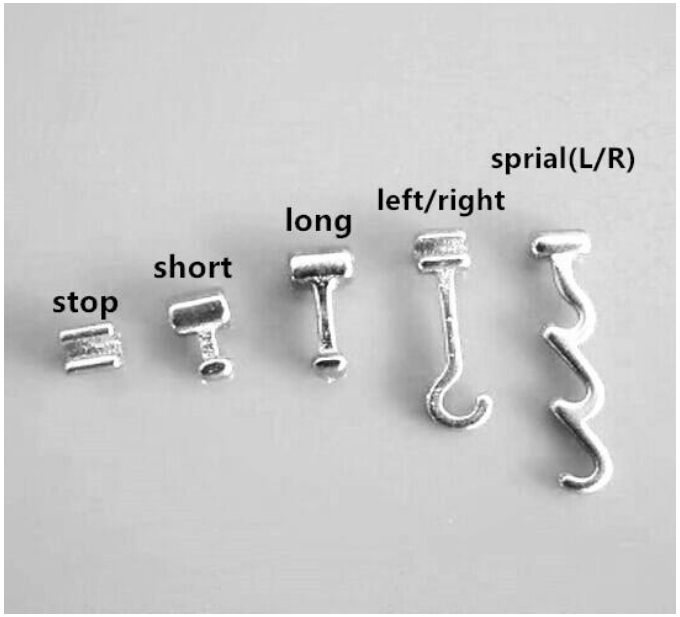
bracket: a metal, ceramic, composite, or clear resin holding device used to support and stabilize the arch wire in the mouth. To hold the arch wire to the teeth, some brackets require ligatures (thin wires) to be tied around the bracket and the thicker arch wire. The newer brackets are self-ligating and require no ligatures.

arch wire: horseshoe-shaped stainless steel or nickel titanium wire that may be round, rectangular, or square and removable or fixed. For the first year, round wires normally are used to move the tooth crown; during the second year, square or rectangular wires are used to move the root of the tooth. The arch wire is attached and held by ligatures to the brackets and tubes.

buccal tubes: support devices soldered on bands into which headgear and arch wires are inserted. They also may serve as stabilization for elastics or power devices. Buccal tubes may also be used on molar brackets (precemented or plain). Molar brackets can serve as retainers for arch wires or as stabilizers for spring and rod attachments.

button, cleats hooks, eyelets: devices used for support and holding power devices, elastics, and wires.



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ligature (***binder or tie off***): thin, stainless steel wires used to tie on or attach arch wires and any necessary attachments. Ligatures are not needed for self-ligating brackets.

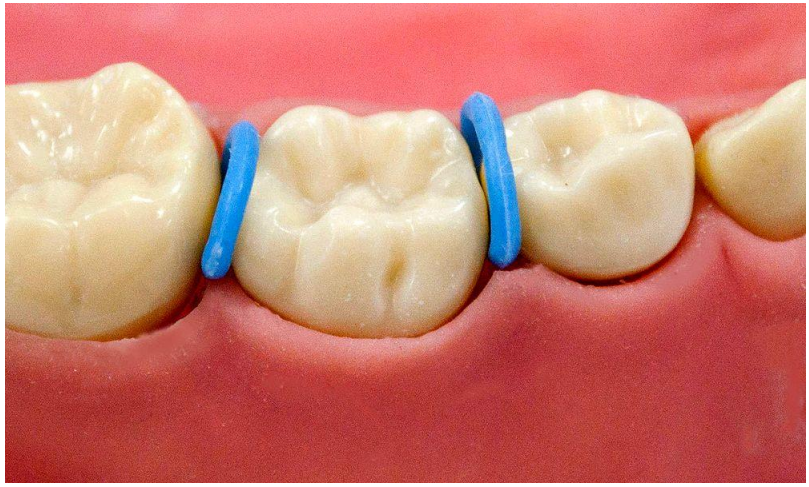
elastics: sized latex circles providing various pull forces or elastomeric ties for holding.

Ligature wire

Ligature wires are more efficient than rubber ligs. Rubber ligatures looses it elasticity over time, once it does, the movement stops. Whereas for ligature wires it remains constant.

auxiliary springs: noble metal or stainless steel attachment to apply directional force.

separators (*device to set aside*): brass wire, steel springs, or elastomeric materials that are placed between the teeth to obtain space before placing the bands.



Types and Purposes of Headgear and Traction Devices:

Many cases of corrective orthodontics require the application of external forces to obtain proper movement and alignment. The application of force stimulates the osteoclast cells to resorb the alveolar bone. After the misaligned tooth has moved into the proper place and is retained in that position, the osteoblast cells deposit mineral salts necessary to strengthen the alveolar bone, making the movement permanent. A combination of fixed intraoral appliances and removable extraoral devices are used to apply the proper amount of force

headgear: device composed of facebow and traction. It is used to apply external force.

facebow: stainless steel external archbow device that is inserted into the fixed molar tubes on the maxillary first molars; the open wing ends extending from the oral cavity are connected with the prepared elastic traction strap devices. The facebow is used to move the molars distal for more anterior space.

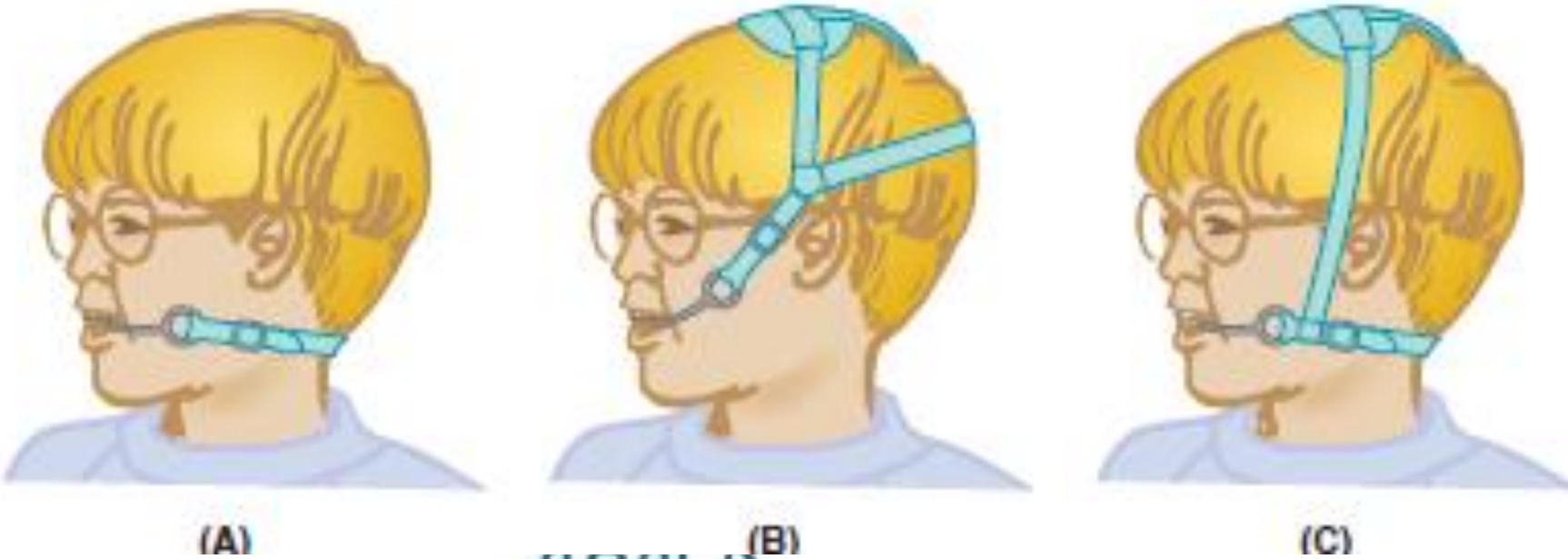
traction device: fitted, expandable device to be hooked onto a facebow after placement on the head. The traction device is custom made and placed to achieve desired movement of teeth.

cervical device: circles the patient's neck and attaches to the facebow to pull in a parallel position to retract teeth .

high-pull device: fits on top of the patient's head and hooks in downward position, perpendicular to occlusion, to retract anterior teeth and control maxillary growth .

combination high-pull and cervical device: traction combining both forces

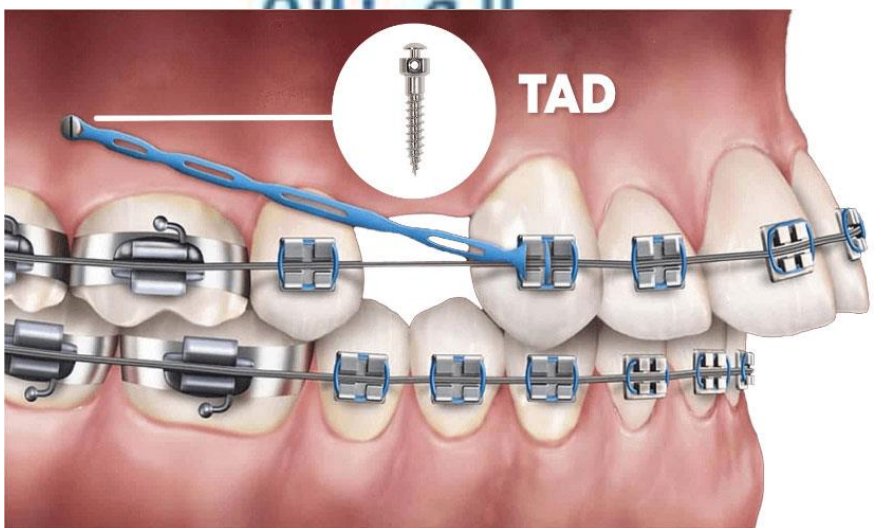
chin device: placed on the chin; incorporates high-pull and cervical forces and is used to control mandible growth.



example of orthodontic traction devices: (A) cervical traction device; (B) high-pull traction device; (C) combination high-pull and cervical traction device

In recent years, the popularity of the headgear apparatus has declined partly because of the patient reluctance for wearing but mostly of the use of temporary fixed anchoring and *Forsus* Class II correction devices, as described here:

temporary anchoring device (TAD): titanium alloy miniscrew microplant device inserted into the interproximal bone to supply anchorage and a traction hold point; used to upright tilted teeth, open bites, and jaw movements.



Class II correction devices: spring bar that clasps onto the buccal bracket on one end and arch wire placement on the other. The pressure generated on the mandible is constant and provides movement faster than with headgear/traction that is worn 20 or so hours a day and removed at times.

Assorted and Specialized Appliances and Retainers:

Each orthodontic treatment case is individualized for the patient. Devices and appliances are developed to accomplish a specific goal. Related terms are:

aligner: an invisalign system of computer-imaged and computer-generated clear plastic overlay trays used with milder cases of misaligned teeth. The patient wears this removable, personal aligner tray for a designated period of weeks and then progresses to the next tray until movement has been completed, and the teeth are in position.

activator: appliance designed to guide, change, or alter facial and jaw functions for a more favorable occlusion position. Some popular activators such as Anderson and Quad Helix are constructed to conform to an acrylic plate to the inside of the mouth's palate area with bands and springs attached to the teeth.

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Activator

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Hawley appliance: removable, customized, acrylic and wire appliance designed to maintain newly acquired tooth position that is worn at night and sometimes during the day. Newer retainers surround the teeth with clear wire (ASTICS), which are adjusted as need be.

Crozat appliance: removable appliance made of precious alloy with body wires, lingual arms, and a high labial arch wire (maxillary); molar clasps hold the appliance in place.

lingual retainer: mandibular lingual bar with cuspid-to-cuspid cemented unions to maintain lower incisors in position. When extended and attached to the mandibular molar-to-molar areas, it is known as a **lingual arch retainer**; also termed a fixed retainer.

orthodontic tooth positioner: customized mouth tray device constructed of soft acrylic or rubberized material surrounding the crowns of all the teeth in both jaws; worn by the patient to maintain the newly acquired tooth placement until calcification and positioning are assured. They are not adjustable and differ from invisalign trays that cause movement.

palatal expanders: known as RPE (rapid palatal expanders), a fixed appliance cemented to the maxillary molar teeth with a spring insert in the palate area. The spring is activated by a key rotation to expand the appliance. his expansion applies force that rapidly expands the midpalatal suture and increases the size of the maxilla.

fixed space maintainer: custom-constructed appliance attached to the remaining teeth to hold a tooth pattern or to maintain space from the premature loss of a tooth.

Nightguard: removable plastic splint worn at night to lessen the harmful effects of patient's grinding of teeth (bruxism).

mouth guard: removable custom-made plastic tooth covering piece worn as protection from trauma while engaged in sport activities.

Instrumentation for the Orthodontic Practice

Each practice requires specialized tools and instruments to complete assigned tasks. Some of the most popular orthodontic instruments are listed here:

band remover pliers: used to remove bands from teeth.

bird-beak pliers: used to bend and shape appliance wires.

loop forming pliers: used to form and shape loops in wires.

Howe pliers: used to make arch wire adjustment; sometimes called How pliers.

three prong pliers: used to close or adjust clasps.

contouring pliers: used to contour bands for concave or convex tilt.

ligature tying pliers: used to tie or bind off ligature wires and to place elastics.

arch forming pliers: used for bending or holding dimensional wires.

stress and tension gauge: narrow, handheld instrument with interior 1 oz. and 4 oz. marked sliding scale; used to measure intraoral forces.

band seater: rounded, serrated end is used to "seat" band onto a tooth. ligature tucker: straight-handled instrument with claw-like end that is used to guide ligatures and assist with the bending of cut wire edges.

bracket tweezers: reverse-action, small-ended tweezers used to place direct bond brackets.

ligature cutter: used to cut ligature wire, intraorally or extraorally.

pin and fine wire cutter: used to cut or snip off ends of tied ligature wires.

Weingart utility pliers: used for placing arch wires.

anterior band slitter: used to shear upper and lower bands.

distal end cutter: used to cut, hold arch wire that was inserted into the buccal tube.

band pusher: used to push and seat bands onto the teeth.

ligature director: used to direct and place ligature wires.

scaler: hand instrument used to remove excess cement from bands, and to direct wires, bands, and elastics into placement.

direct bonding bracket holder: used to hold DBs in position during placement.

edgewise pliers: used to hold or adjust arch wires.

Boone gauge: measuring device used to establish the height of the orthodontic bands.

hemostat: scissor-like clamps, straight and curved, which are used to carry or hold small objects.

bite stick: plastic or metal handled instrument with projecting serrated steel area that is used to help "seat" posterior bands.

protractor (orthodontic): triangular pre-marked form used to make cephalometric tracing.