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FIXED APPLIANCES

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Fixed Appliance

Development of fixed appliance:

Dr. Edward Hartley Angle (Father of modern orthodontics) contributed not only to classification & diagnosis but also to develop new orthodontic appliances. In 1927, he created the Angle system which ultimately would result in the introduction of the edgewise multibanded appliance in 1928. With few exceptions the contemporary edgewise appliances based on Angles design from early twentieth century.

He developed four major fixed appliances were –

- a. The E – arch appliances
- b. Pin & tube appliances
- c. Ribbon arch appliances
- d. Edgewise appliances

The E – arch appliances:

Angle's First fixed appliances:

- a. Bands were placed only molar & a heavy labial arch wire extended around the teeth.
- b. The end of the wire was threaded & a small nut placed on the threaded portion of the arch allowed the arch wire to be advanced so

that the arch perimeter increased.

- c. The appliance was often used in early 1900s. Because of its simplicity & it was successful in the stability of polished teeth.
- d. It was capable only of tipping teeth to a new position but it was not able to precisely position any individual tooth.

Edward Angle's E-arch, from the early 1900s.

Ligatures from a heavy labial arch were used to bring malposed teeth to the line of occlusion.

Pin & tube appliances:

- a. To overcome this problem, Angle began to place bands on other teeth & used a vertical tube on each tooth into which a soldered pin from a smaller arch wire was placed.
- b. Tooth movement was accomplished by repositioning the individual pin at each time.
- c. A very skillful craftsman was indispensable to construct & adjust these appliances.
- d. Although theoretically it was capable of great precision in tooth movement but in the clinical usage it proved impractical.

Ribbon arch appliances:

- a. It was modified from the pin & tube appliances. A vertical positioned rectangular slot was provided behind the tube. A ribbon arch of 10 × 20 was placed into slot & held with pin.

It was immediate successful because of arch wire & quite efficient in aligning malposed teeth. The major weakness of the appliances was that relatively poor root control. The disadvantage is that the root control is not good.

Dr. Begg modified the ribbon arch brackets that have been used in the Begg technique & it was also called light wire system.

Angle's ribbon arch appliance, introduced about 1910, was well-adapted to bring teeth into alignment but was too flexible to allow precise positioning of roots.

Edgewise appliances:

- a. Reoriented the slot from vertical to horizontal & inserted a rectangular wire.
- b. The dimension of the slot was changed to 0.22 × 0.28 inches a 0.22 × 0.28 precious metal was used.
- c. Marking rectangular wire was tied into rectangular slot with ligature wire.

- d. Function is to make excellent control of both crown & root portion in all three plane.

Contemporary edgewise appliances:

- a. It has designed beyond the original design.
- b. Gold arch wire was replaced by steel wires because same size of steel wire was so much stiffer than gold wire.
- c. For that slot size also reduced from 0.22 to 0.018 inch.

Angle's edgewise appliance received its name because the arch wire was inserted at a 90-degree angle to the plane of insertion of the ribbon arch. The rectangular wire was tied into a rectangular slot with wire ligatures, making excellent control of root position possible. Eyelets in the corners of the bands were tied to the arch wire as needed for rotational control, as on the distal of the upper left central incisor.

Modern Edgewise Appliance:

- a. Recently modern edgewise appliances refer to as straight wire appliance.
- b. The appliances are able to go without a bend in the wire because of the angulation (tip), torque & in-out already built into the bracket (Pre – adjusted bracket). Compensating bend such as 1st, 2nd & 3rd order

bend will always be necessary because of individual variation in tooth thickness, angulation & torque straight wire.

First order bends:

- a. These are made in the horizontal direction.
- b. They are required to make the wire to conform anatomically to the labial & buccal contours of teeth.

Second order bends:

- a. These bends are made in the vertical plane.
- b. They are used for anchorage preparation or up righting teeth.
- c. They are also used for paralleling of the roots & elevation or depressing certain teeth. Tip – back is the 2nd order bend.

Third order bends:

- a. These are made for torque.
- b. They are used to tip the crown or roots labially or lingually or buccally.

A, First-order bends in a maxillary (*left*) and mandibular (*right*) arch wire. Note the lateral inset required in the maxillary arch wire, and the canine and molar offset bends that are required in both. B, Second-order bends in the maxillary incisor segment to compensate for the inclination of the incisal edge of these teeth relative to the long axis of the tooth. C, Third-order bends for

the maxillary central incisors and maxillary first molars showing the twist in the arch wire to provide a passive fit in a bracket or tube on these teeth. Twist in an arch wire provides torque in a bracket; the torque is positive for the incisor, negative for the molar.

Fixed orthodontic appliances:

The appliances that are fixed or fitted into the teeth by the operator & cannot be removed by the patient will be called fixed appliances.

Patient cooperation is dispensed to a large extent in the use of fixed appliances.

Advantages of fixed appliances:

- a. Fixed appliances can bring about various types of tooth movements including bodily movement, rotation, tipping, intrusion, extrusion & root movement.
- b. Fixed appliances are therefore very versatile & can be used to most malocclusions.
- c. Multiple tooth movements are possible simultaneously.
- d. More precise tooth movements & detailing of occlusion is possible using fixed appliances.
- e. Fixed appliances offer better control over anchorage.

Disadvantages of fixed appliances:

- a. The most important disadvantage is oral hygiene maintenance which becomes more difficult. Plaque & food debris tend to accumulate around the attachments & cleaning of the teeth becomes more difficult for the patient.
- b. Fixed orthodontic appliances require special training of the operator & invariably handle by specialized orthodontist. Otherwise there is greater possibility of producing adverse tooth movements.
- c. Damaged appliances that apply miss – directed forces cannot be removed by patient.
- d. Fixed appliances are by far more expensive than removable appliances.

Component of fixed appliances:

A. Passive components:

Band

Bracket

Buccal tube

Lingual attachments

Lock pin

Ligature wire

Etc.

B. Active components:

Arch wire

Spring

Elastic

Separator

Active components: Parts which give force.

Passive component: Parts do not give force but remain.

Functions of every component are described below:

Band:

- a. Bands are passive components that help in fixing the various attachments into the teeth. (by welding)
- b. They are available in various sizes to suit different teeth & made of soft stainless steel.
- c. The outer surface of band material is smooth & glossy. The inner surface is comparatively rough & dull which helps to aid in retentions of the cement.
- d. The attachments like molar tubes, brackets are welded & soldered over the bands.

- e. The use of performed band or seamless band becoming popular now a days. It has become popular because it reduces chair side time, eliminates the tedious task of placement of band & ultimately comfortable to patient.

Forming a custom band from a strip of band material. Three types of band-forming pliers to stretch band material for a tight fit around the teeth; B, close-up view of band material in the pliers; C, band being formed on a lower premolar.

Separators:

While attempting to pass a band through tight inter dental contact, it results in:

- a. Difficulties during banding.
- b. The band tends to be distorted.
- c. In addition, patient may experience some discomfort.

So, tooth should be separated to break the tight inter dental socket.

Brass wire separators:

Soft brass wire of 0.5 or 0.6 mm diameter is passed around the contact and the ends are tightly twisted together. The end is cut short & tucked between the teeth.

Ring separators:

They are small elastic rings that are passed through the contact using special pliers. The stretched elastic ring exercise the inter dental contact & as it contacts, the teeth are separated.

Dumbbell separators:

It is dumbbell shaped piece of elastic that is stretched and passed through the interdental contact. The stretch tries to regain its original length & doing so brings about separation of teeth.

Banding:

Although the direct bonding of bracket is common, there are a number of situations where the use of bands is advantageous.

Banding is preferred over bonding in case of posterior teeth. The banded attachments are capable of resisting occlusal force bonded attachments. In addition, bonding needs through moisture contact which is difficult in posterior teeth.

It is preferable to band a tooth that requires buccal as well as lingual attachments.

Indication of banding:

- a. Bands are better likely to resist force as in case of extra oral devices such as headgear.

- b. Although it is possible to bond attachments on teeth that have porcelain or gold restorations or crown, banding is preferred in these cases.
- c. It is preferable to band that show recurrent breakage of the bonded attachments due to failure.

Steps in banding:

- a. Separation of teeth
- b. Selection of band material
- c. Fixing the attachments
- d. Cementation of the band

- a. Separation of teeth:

Most separations have to be left in the mouth for 24 hours or more to bring about sufficient separation of the inter dental contact.

- b. Selection of band material:

Band on which tooth is being banded, the band materials of appropriate thickness and width is selected.

- c. Fixing the attachments:

Appropriate attachments are fixed into the band. The attachments include bracket for the anterior teeth and buccal or molar tube for posterior teeth. The attachments are fixed to the band by spot welding or soldering.

d. Cementation of the band:

- I. The final step involves cementation of the band around the tooth.
- II. The inner surface of the band is rough in order to aid in retentions.
- III. The careful cementation of bonds is vital to ensure successful results with the fixed appliances & minimizes the risk of decalcification.
- IV. Cementation is required to eliminate the space between the band & teeth.

Steps of banding procedure:

- a. Prior to cementation, teeth must be cleaned with prophylactic paste to remove plaque.
- b. It is necessary to adequate moisture control by means of saliva ejections and cotton rolls are used to subsequently keep dry during cementation.
- c. Cotton rolls are also used for isolation of teeth.

- d. Sufficient amount of cement on the bands to fill the space completely between the band & the tooth.
- e. It is important to keep the attached brackets and tubes free from the cement. Some brackets are available fitted with preformed bracket protectors or alternatively covering with soft wax prior to cementation.
- f. Excess cement may be wiped off the tooth using a dry cotton roll or can be removed using a hand instrument. Excavator or hand scalar may be used.
- g. Generally Zinc phosphate cement is used. The main advantage of this cement is to act as reservoir for fluoride ions which are released throughout the treatment period so reducing the possibility of decalcification. In addition, chemically adhere to enamel & stainless steel & less liable to dissolution in the mouth.

Brackets:

Brackets act as handle to transmit the force from the active components to the teeth. Brackets have one or more slots that accept the arch wire.

Function: To transmit the force arch wire to teeth.

There are a number of bracket designs available. Brackets are:

- a. Edgewise type of brackets

- b. Ribbon arch brackets
- c. Weld able & bondable brackets
- d. Metallic brackets
- e. Ceramic brackets
- f. Plastic brackets

a. Edgewise type of brackets:

Edgewise brackets are used in edgewise & straight technique & have an arch wire channel which is rectangular in cross section, with the largest dimension horizontal. The term “Edgewise” refers to the ability of the brackets to accept a rectangular cross section arch wire with its largest dimension horizontal.

These brackets can also be used with round cross section arch wire. Edgewise brackets provide great control over tooth movement & do not permit tipping of teeth.

b. Ribbon arch technique:

- I. They are brackets which possess a vertical slot facing the occlusal or gingival direction.
- II. The slot is also narrow mesio distally.

III. These kinds of brackets are used with round wires to bring about tipping of teeth in labio – lingually as well as buccally. Round or rectangular wire used for bodily movement.

c. Bondable & weld able brackets:

I. Brackets that are bonded directly over the enamel of teeth using of bonding adhesive are called bondable brackets. The under surface of these brackets have a meshwork or grooves to help in interlocking with the adhesives.

II. Brackets that are welded or soldered over bands which are in turn are cemented around the teeth are called welded brackets. Weld able brackets have a metal frange that can be welded to the band.

d. Metallic brackets:

Most of the brackets of current use are metallic variety. Among them, steel brackets are commonly used.

Elastics:

- a. Resemble a rubber band & made of latex elastics.
- b. Available in various diameters & the force applied by the elastics depends upon their diameter.

- c. These are color coated for easy identification.
- d. Normal force is 150 gm, 300 gm. Highest of orthopedic force is 350 – 900 gm.

Use of Elastics:

- a. Closure of space.
- b. To correct open bite.
- c. Treatment of cross bite.
- d. Correction of inter arch relationship.

Class – I elastics:

Intra arch elastics, stretched between the molars & anteriors. Generally used for closure of space & retraction of teeth.

Inter maxillary traction:

The term is used to describe the use of elastic stretched between the upper & lower arches. Tooth movement to be achieved in one arch with anchorage derived from the other arch.

Class II elastics:

Inter maxillary elastics stretched anteriorly in the upper arch & posteriorly in the lower. In general it is used in the treatment of class II malocclusion. Depending upon the upper archwire configuration class II traction provides a distal force to the whole upper arch preventing forward movement of the

upper buccal teeth or it may be used to reduce the overjet by moving the incisor in a palatal direction. In the lower is to move the buccal teeth forwards possibly closing extraction space.

Class III elastics:

Inter maxillary elastics stretched between molars & mandibular anteriors.

These are generally used in the treatment of class III malocclusion. In the upper arch it moves the molar forwards & this can be used to procline the upper incisors or to close extraction space. In the lower arch it provides a distal force either to lower incisors to the lower incisors or to the whole arch.

Diagonal elastics / Oblique elastics:

The elastic is worn across the anterior teeth diagonally. They are used generally for the correction of midline deviation.

Cross bite elastics:

They are generally extended between the palatal surface of maxillary molars or pre molars to the buccal surface of mandibular molars or pre molars or vice versa. They are used mainly to correct cross bite in buccal segment.

Box elastics:

These types of elastic are stretched between the maxillary & the mandibular anteriors like a box.

They are used to correct the anterior open bite. The open bite is corrected by the force eruption of upper & lower anteriors. But, particularly in lab, we use up & down elastics.

Extra oral elastics:

These elastics are used in conjunction with extra oral appliances like face mask, face bow. It generally exerts high forces. When elastic length increases, force is decreased.

Elastic chain:

Commonly referred to as a E – chain & usually made of synthetic polyurethane materials. These are available in three different strengths based on the distance between the rings as continuous or closed, short or long. Mainly used in the closure of space between the teeth by stretching the rings between them but there is always a risk of applying exercise.

Commercial name of elastic chain is power chain.

Elastic thread:

- a. Made of a core of latex rubber surrounded by a sleeve of woven silk.
- b. Available in a spool.

- c. It is used to exert force which is used to correct derotated tooth, consolidation of anterior spacing.

Elastic modules:

- a. Made of two elastic rings separated by a variable distance.
- b. Available in various sizes based on inter ring distance.
- c. Generally used to close space or for derotation of teeth.

Spring:

Various types of spring are used as auxiliaries to generate tooth moving force. Mainly used for tooth uprighting or torquing the Begg appliances therapy or the tip edge appliances. Spring may also be used to open or to close space.

Classification of spring:

- a. Uprighting spring: Which move the root of tooth in mesial or distal direction.
- b. Whips (Rotation spring): These are used to produce rotation of an individual tooth around its long axis.
- c. Torquing spring: They are moving the root of the tooth in a labial/lingual or palatal direction.

Coil spring:

Coil springs are made of hard stainless steel round band & firm Nickel Titanium alloy.

- a. **Open coil spring:** The spring of appropriate length compressed between two or more teeth to open up space between its points of attachment.
- b. **Close coil spring:** Stretched between teeth to close space.

Disadvantages: Food particles may be collected in spring.

Stages of fixed appliance treatment:

- a. **Leveling of teeth**
- b. **Canine retraction**
- c. **Anterior retraction**
- d. **Finishing stages**

a. Leveling of teeth:

In this step, labio lingual & vertical malposition of individual tooth & rotated tooth almost corrected. 0.012, 0.014, 0.016 inches wires are used for leveling of teeth.

Steps to follow for leveling of tooth:

- a. Rotation correction
- b. Crowding correction

- c. Suitable arch form
- d. Decreasing curve of spee
- e. Uprighting position of teeth
- f. Overbite correction
- g. Approach to class I

b. Canine retraction:

Canine retraction is performed by using 0.016 inch round arch wire with a compressed coil spring or power chain with leveling upper lateral incisors. At the beginning of step, the extra oral anchorage is indicated so as to show remarkable anchorage loss.

Steps to follow for canine retraction:

- a. Canine retraction
- b. Rotation correction
- c. Crowding correction
- d. Maintenance of suitable arch form
- e. Decreasing curve of spee
- f. Open bite correction
- g. Approach to class I

c. Anterior retraction:

It is performed by using the upper 0.018 × 0.025 & lower 0.017 × 0.025 inches rectangular arch wire with loops called “V” loop. Adequate torque is given in each arch depending on each region that is anterior, lateral & molar region. At the end of this step, all spaces are completely closed & class I molar relationship must be maintained.

Steps to follow for anterior retraction

- a. Anterior retraction
- b. Torque control
- c. Acquirement of suitable arch form
- d. Overbite control
- e. Approach to class I

d. Finishing stages:

The ideal arch wires are consisted of 0.018 × 0.025 & .017 × 0.025 inches rectangular wires, are set into the upper & lower arches respectively. The ideal arch wires play very important role in obtaining adequate torque & interdigitation. During this step, the intermaxillary elastics, mainly up & close elastics in combination with class II or class III elastics are used.

Function:

- a. Control of tooth axis
- b. Acquirement of suitable interdigitation

- c. Co ordination of upper & lower arch form

Instructions for patients wearing a fixed appliance:

- a. Clean the teeth with a brush immediate after every meal & before go to bed. If teeth are not kept clean, damage will occur.
- b. Avoid eating hard & sticky food.
- c. Since it will be necessary to use a tooth brush after eating, most patients find it best to avoid snacks between main meals.
- d. Contact the orthodontist if the appliance hurts, become loose or any part however small is broken.
- e. Continue the routine dental visits.

Advantages of fixed Appliance over RA

- 1. Both simple & difficult type of malocclusion can be corrected.
- 2. Multiple tooth movement can be possible at a time.
- 3. Bodily tooth movement can be done.
- 4. Multiple rotations can be corrected.
- 5. Root movement can be carried out.
- 6. Cases other than 1st PM Ex. can be treated.
- 7. Posterior segment can be brought forward.

8. Controlled tipping & bodily movement possible.
9. Final alignment of teeth is possible.
10. Pt cannot remove the appliance by himself.
11. Appliance cannot be easily damage or distorted.
12. Appliance can be given in sever class II & class III cases.

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Dedicated To

My Mom, Zubaida Shaheen

My Dad, Md. Islam

&

My Only Son

Mohammad Sharjil

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