Fixed Appliance

Fixed appliances form the second major division of orthodontic appliance system. They include orthodontic devices, which have attachments that are fixed on the teeth surfaces, and the forces are exerted via these attachments using archwires and / or auxiliaries. These appliances cannot and should not be adjusted or removed by the patient.

They have certain important advantages, as well as certain disadvantages, when compared with removable appliances:

Advantages

1. Precise control of tooth movement.
2. Multiple and complex tooth movements can be done.
3. Less dependent on patients cooperation.
4. No retention problems.

Disadvantages

2. Anesthetic and expensive.
3. Need experienced dentist (Specialist).
4. Increased chairside time.
5. High possibility of producing adverse tooth movement.

Indications for the use of FA

- Correction of mild to moderate skeletal discrepancies.
- Intrusion/extrusion of teeth .
- Correction of rotations .
- Overbite reduction .
- Multiple tooth movement .
- Closure of extraction spaces ,or spaces due to hypodontia, to ensure a good contact between teeth.

Components Of Fixed Orthodontic Appliances

The components which form any fixed orthodontic appliance system can be divided into three categories, attachments, archwires and auxiliaries.
A) Attachments

Include whose parts which fixed on teeth surfaces. They may be welded to metal bands which are cemented to the teeth, or may be bonded directly to the teeth through acid-etch retained bonding system.

Bands

These are rings encircling the tooth to which buccal, or lingual attachments are soldered or welded. Prior to introduction of the acid-etch technique, bands were only means of attaching the attachment to teeth. With the development of modern bonding techniques, bonded attachments became popular.

The method of fixing attachments by welding them to a metal band which are then cemented to the teeth with polycarboxylate or similar cement is called banding. This method generally still used till now on:

- Teeth that are likely experience excessive occlusal forces from opposing teeth like lower molars, premolars, or incisors in crossbite.
Teeth that have large metal restorations (structurally weak) or having metal prosthesis.

Teeth particularly upper molars when a headgear or cemented palatal arch needs to be used.

Bands must be placed accurately and the teeth have to be separated from adjacent tooth contacts by using a separator around the contact area.

**Brackets**

The brackets were introduced with advert of acid-etch technique and the modern composite. Adhesion to the base of metal brackets is gained by mechanical interlock. A wide variety of brackets have been introduced over years to get better biomechanical properties, better esthetic appearance and less enamel damage. Brackets can be classified according to materials that they are made from:

- Metal – Gold, Stainless steel, Titanium, Nickel.
- Plastics.
- Ceramics.
- Combination – Metal reinforced plastics, metal reinforced ceramics.

Brackets are fixed to the teeth directly with a composite resin after acid-etching of enamel surface, and chemical or light cured resins are generally used, this procedure is called bonding. Unlike banding, there is no need for separation. Bonding procedure has several advantages over banding, likes:

- More esthetic.
- Less caries and gingival plaque.
- Less discomfort.
- Used on partially erupted teeth.
- Teeth separation not required.
- Detachment is more easily.
- No spaces remain after treatment.
Archwires are made of variable materials and dimensions. Originally archwires were made from gold alloy but because it is expensive, the stainless steel alloy becomes the material of choice. Recently a super-elastic wire is introduced, made from titanium alloy (Nickel-Titanium, Beta-Titanium). These wires are more flexible than steel wires of the same dimensions. Archwires are available in different cross section shape and dimensions, are:

- Round archwire, described like, 0.016 or 0.018 inches.
- Square archwire, described like 0.016 x 0.016 or 0.018 x 0.018 inches.
- Rectangular archwire, described like 0.016 x 0.022 or 0.017 x 0.025 inches.

The archwire form closest to the patient arch should be chosen. Generally there are 3 basic archwire form, oval, tapered and Square.
**Auxiliaries**

These are used in conjunction with archwires to produce tooth movement. There are very small elastic rings or wire ligatures are used to secure the archwire into the bracket slot. Elastic separators are used to create spaces between two adjust teeth before banding. Intra-oral elastic of varying sizes are available for traction.

Palatal arches can be utilized to reinforce the anchorage, to achieve expansion or derotation of molars. Coil springs, either opening or closing, which made from stainless steel or nickel titanium alloys, also used to move teeth along the archwire.

**Principles Of Fixed Appliance**

Tooth movement with fixed appliances is achieved by interaction between the attachments on the tooth surface and the archwire which is tied into the attachments. As the fixed appliance is attached to the teeth surfaces, so is capable of a greater range of tooth movements than is possible with removable appliance. When the archwire pass through the bracket slot, a force couple can be generated by the interaction between them, thus rotational and apical movements are possible. The interplay between the archwire and slot determine the type and direction of tooth movement.

**Treatment Stages with Fixed Appliances**

Treatment with fixed appliance can be divided into four phases:

- **Alignment phase**

In this initial phase, crowding and rotation are rapidly dealt with to allow placement of more rigid archwires. Very flexible archwires are used during this early phase. It is more common in current practice to use preformed superelastic nickel-titanium alloy wires.
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- Working phase

During this phase, horizontal and vertical dentoalveolar correction are made. Thus overbite and overjet are reduced. More rigid wires are used and all spaces are eliminated.

- Finishing phase

Larger wire more closely fitting the bracket slot are placed. Tooth position is carefully detailed to achieve best esthetic and functional result. The final archwire is left in place passively for the last period of this phase and this very effective to start retention phase.

- Retention phase

The fixed appliance is removed and retainers are fitted. The retainers are worn full time for 4-6 months then at nighttime for 4-6 months. The retainers usually are removable appliances so they can then be gradually withdrawn to ensure teeth stability.

Fixed Appliance Systems

- Standard Edgewise Appliance

The term" edgewise" refers to the method by which a rectangular archwire is inserted into the rectangular bracket slot. In1928, the edgewise appliance was Dr.Angle's final achievement, represented the culmination of many years of effort and many different appliance designs attempting to place the teeth according to his “line of occlusion”.

Edgewise brackets are typically described by the vertical slot dimension into 0.018 or 0.022 inch. The depth of slot is commonly 0.028 inch.
By interaction of archwire with bracket slot, the tooth movement will occur in all three spatial planes. In orthodontics, these are described by the types of bend that are required in an archwire to produce each type of tooth movement:

- **First-order bends**, are made in the plane of archwire to compensate tooth widths and bucco-lingual position (in/out).
- **Second-order bends**, are made in vertical plane to achieve correct mesio-distal angulations or tilt of the tooth (tip).
- **Third-order bends**, are applicable with rectangular archwire only. They are done by twisting of wire so that the wire exerts bucco-lingual force on the tooth apex when inserted into rectangular slot (torque).

![1st order bend](image1)

![2nd order bend](image2)

![3rd order bend](image3)

In original edgewise appliance, these bends were placed in the archwire during treatment so that the teeth were moved into correct their positions.

**Pre-Adjusted Edgewise Appliance**

Dr. Lawrence F. Andrews introduced pre-adjusted Appliance to Orthodontic profession in 1972, and called it straight wire appliance. In this modern bracket system, the average values for tip and torque built into the bracket slot itself, and the bracket base are of differing thicknesses to produce an average buccolingual position. These pre-adjusted systems have advantage that the amount of wire bending required is reduced. However, they do not eliminate the need for wire adjustment since average values do not always suffice. These characteristics for each tooth are called the “appliance prescription”.
Not surprisingly, there are different opinions as to correct position of each tooth. The result is an almost bewildering array of pre-adjusted systems. All with slightly differing degrees of torque and tip. Of these perhaps the best known are the Andrews' system in 1972, the Roth system in 1976, and the MBT system in 1995.

**Lingual Appliance**

The lingual orthodontic appliances were conceived with the simple objective of making orthodontic treatment esthetic. Dr. K Fujita introduced the Mushroom arch wire appliance in the 1979. The concept of these appliances was developed before the development of esthetic brackets, like the ceramic brackets.

In the lingual bracket, the opening of the slot was set on the occlusal surface of the teeth in order to facilitate the fitting of the wire.

**Disadvantages of the Lingual Appliances:**

1. Indirect vision hampered accurate bracket placement.
2. Occlusal interferences caused frequent bond failures and at times restricted tooth movement.
3. Speech distortion.
4. The sharp edges hurt/lacerated the tongue.
5. Gingival irritation due to plaque accumulation.
6. Increased chair-side time due to difficulty in insertion and ligation of archwire.