PRINCIPLES OF FIXED APPLIANCE TREATMENT

Fixed appliances form the second major division of orthodontic appliance system. In this type of appliances the patient cannot remove it, because it is fixed to the teeth by cementation or composite. They have certain important advantages, as well as certain disadvantages, when compared with removable appliances.

![Edgewise fixed appliance](image)

Fig.11.1 Edgewise fixed appliance.

ADVANTAGES OF FIXED APPLIANCES

1. Retention presents no problem, since the appliance is cemented to the teeth. This means that there is no dislodgment of the appliance by force component.
2. Multiple forces can be applied to the teeth simultaneously thus facilitating multiple teeth movement and in some cases reducing the time required for treatment.

3. Less skill is required from the patient in managing the appliance.

4. Bodily and torquing movements are produced by this type of appliances and not by removable appliances, and this is the main advantages of fixed appliances treatment.

DISADVANTAGES OF FIXED APPLIANCES

1. The main disadvantage centers round the problem of oral health, the fixed appliances are more difficult to clean than removable appliances, some need good care and motivation.

2. A further potential disadvantage is the possibility of producing adverse tooth movement; furthermore in more complex fixed appliance systems it is easy to achieve unwanted movement through reciprocal forces.

3. This type of fixed appliances should only applied by experienced dentist or orthodontist.

4. They are unsightly and treatment is expensive.

INDICATIONS OF FIXED APPLIANCES

1. Correction of mild to moderate skeletal discrepancies: as fixed appliances are used to achieve bodily movement so it is possible, within limits, to compensate for skeletal discrepancies and treat to greater range of malocclusion (Mitchell, 2001).

2. Intrusion/extrusion of teeth.

3. Correction of teeth rotations.
4. Overbite reduction by intrusion of incisors.

5. Multiple tooth movements required in one arch.

6. Active closure of extraction spaces, or spaces due to hypodontia.

COMPONENTS OF FIXED APPLIANCES

The principle components of fixed appliances are:

a) Attachments like brackets, bands, tubes, buttons and cleats.

b) Arch wires

c) Auxiliaries.

Attachments: as we mentioned, this is consisted of brackets, tubes and in some situation buttons and cleats are used. The attachment may be welded to stainless steel bands which are cemented to the teeth, or may be bonded to the teeth through one of the acid-etch retained bonding systems.

Brackets are usually fitted to the other anchor teeth and teeth which are to be moved. There are two main types of brackets, with many modifications:

- The edgewise bracket has a rectangular section slot into which the archwire fits and spurs for tying in the archwire with some form of ligature. There is different variety of these edgewise brackets as it made of different variety of width and sometimes double or triple bracket are fitted. With this type of brackets and rectangular slot we can use different types of archwire which is either round or rectangular section, which give control over tooth movement in labiolingual or buccolinguall dimension.
The Begg bracket (Begg 1956): this type differ in that it allow free tipping of the teeth both mesiodistally and labiolingually. It is almost always used with archwire of round section and force component is either built into the archwire or added in the form auxiliary springs. The archwire is held in the bracket by means of soft metal pin.

Tubes: which are usually fitted in the last molars in the arch, may be round or rectangular in section, larger tubes are used to take extra-oral arches. These tubes usually prewelded on molar band and can be cemented on molar teeth.

Buttons and cleats: can also be added to the teeth as an attachment of auxiliary forces.
Banding

The original method of fixing attachment is by welding them to metal bands, which are then cemented to the teeth with zinc oxyphosphate or similar cement; this is generally still used for molar attachments. Any leakage must be always checked otherwise plaque will accumulate and serious enamel demineralization can occur rapidly.

![Image](image.png)

**Fig.11.5** Lower first permanent molar band.

The bands must be placed accurately and the teeth have to be separated (if the contact is tight) by elastic separator or 0.5 mm. brass ligature wire tightened around the contact area, left in position for few days. The most important point here is the checking and selection of the exact and right size of band for a good fitness.

Bonding

Attachment may be fixed to the teeth directly with composite resins after acid etching of the enamel surface, and chemically cured resins are generally used. The fitting surface of the bracket is designed to allow a mechanical locking with the composite resin because there is no chemical adhesion to stainless steel.

The tooth surface is etched for about 15 seconds with phosphoric acid gel and then washed and dried, and then the attachment is fixed to the tooth with small amount of composite resin. It is very important that the attachment is positioned accurately and the excess resin is cleaned away before it sets, otherwise it will encourage plaque accumulation and gingival irritation. This method must be done with care and with
complete dryness and protection from contamination with saliva or moisture otherwise the set of material will be disturbed and the bond will fail later.

Types of Brackets According to the Materials Used

There are different types of brackets according to material used in manufacture these attachment:

- Stainless steel brackets.
- Ceramic brackets.
- Plastic brackets.
- Fiberglass brackets.
- Titanium brackets.
- Composite brackets.

Most orthodontist prefer to use metal band, to which attachment are welded in molar teeth, because it is difficult to control the moisture and to get good dryness in these areas, and so the bond strength will be affected.

Fig.11.6 Upper ceramic brackets.

Fig.11.7 Composite brackets.
Advantages of Direct Bonding over Banding

1. More esthetic.
2. Less caries and gingival damage.
3. Avoid much of discomfort.
4. Used in partially erupted teeth.
5. Tooth separation not required.
6. Detachment of bracket easily seen.

Archwires: originally archwires were made from gold alloy but these were very expensive and the stainless steel becomes the material of choice. Recently a number of titanium alloys have been introduced; these super-elastic wires have lower modulus of elasticity and so are more flexible than a stainless steel wire of the same dimensions.

However for most stages of orthodontic treatment high tensile stainless steel wires are used.

The archwires must have to satisfy many different requirements:

a) Non toxicity.

b) Resistance to corrosion.

c) Resistance to fatigue and fracture.

d) Ease of formation.

e) Economy.

f) Suitability for welding and soldering.

g) Elastic recovery and flexural rigidity (physical characters).
Auxiliaries: these are used in conjunction with the archwires to produce tooth movement. There are different types of these auxiliaries but we mention here:

- Elastics.
- Whips (rotational spring).
- Uprighting spring.
- Coil spring.

TYPES OF FIXED APPLIANCE SYSTEMS

There are many different fixed appliance systems in use which vary considerably in their methods of achieving tooth movement and in the details of their components parts:

1. The labio-lingual system: consists essentially of bands on the anchor teeth, usually first molars and labial, lingual or palatal arch attached to the bands. The force can be applied by means of springs attached to the arch or by elastics. It is possible also with this system to apply intermaxillary or extra-oral traction.

2. Multiband appliance system: the attachment of components to the teeth which are to be moved brings the appliance within the category of multiband system and add a new dimension to the treatment with this appliance tooth movement become possible and precise control.

Fig. 11.8 Lingual fixed appliance.
3. **Sectional multiband appliance:** it is not always necessary to fit a multiband appliance to the whole dental arch. Sometimes for localized tooth movements, it is sufficient only on one segment of the arch. Example retraction of canine after extraction of first premolar.

**TOOTH MOVEMENT WITH MULTIBAND APPLIANCES**

There are many ways of producing the various types of tooth movements with multiband appliance. A few of these methods will be outlined to illustrate some of appliances in common use.

- **Tipping movements:** are the most easily produced by any appliance system.

- **Rotational movements:** rotations are usually brought about by utilizing the flexibility and resilience of the arch wire. Rotation can also be achieved by adding extra forces in the form of elastic ligatures.

- **Bodily movements:** true bodily movement, without tilting, can only be accomplished with rigid control over the tooth. It is best accomplished using an archwire of rectangular section which fits accurately in the bracket of the same shape and size.

- **Torquing movements:** root torque is produced by applying force to the crown of the tooth and restricting crown movement, it can only be done satisfactory with multiband appliance.

- **Vertical movements:** extrusion and intrusion of teeth are possible with multiband systems, using flexibility of the archwire to apply appropriate forces.
EXTRA-ORAL TRACTION (E.O.T)

It is the method of achieving tooth movement, mostly in a distal direction. It is also sometimes used to try to move of maxilla distally or vertically.

a) Components of headgear: these are consist of:

1. Neck strap or head cap which may be cervical or high pull.

2. Face bow or J-hooks. Face bow consists of inner and outer arch. The inner arch inter in the tube of molar band attachment, while the J-hook attached to the archwire in the fixed appliance.

3. Elastics, which can be used to connect outer arch or J-hook to the head cap.

![Variable-pull headgear with elastic bands between the headgear and the face-bow.](image)

b) Uses of extra-oral traction: the possible uses of E.O.T are:

1. Anchorage reinforcement: the extra-oral force applied to upper arch by extra-oral arch or by J-hook, and it is used to prevent forward movement of molars. Also canine retraction and overjet reduction can be carried out without forward movement.
2. **Distal movement of upper molars:** the total force approximately 1500 g. for distal movement of molars. Wearing should be more than 12 hours in any day.

3. **Space maintenance:** E.O.T. may be used to prevent forward movement of upper molars after extraction of permanent teeth.

4. **Canine retraction:** maxillary or mandibular canines can be retracted by using J-hooks which placed over the archwire and the hook contact the mesial aspect of canine bracket, so the canine moved distally along the archwire.

5. **Overjet reduction:** overjet can be reduced either by J-hooks with an archwire with closing loops to reduce overjet, or by extra-oral arch used to move upper molar distally and also by elastic stretched across hooks or U shape on the inner arch of the bow.

6. **Incisor intrusion:** also in excessive overbite the J-hooks can be used if high pull forces are used for intrusion of incisors.

**TREATMENT STAGES WITH FIXED APPLIANCES**

Treatment with fixed appliance can be divided into four phases (Jones and Oliver, 2000):

1. **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 thin twisted steel (multiflex) or preformed superelastic nickel-titanium alloy wires.

2. **Working phase:** during this phase, horizontal and vertical dentoalveolar corrections are made. Thus overbite and over jet are reduced. More rigid wires are used and all spaces are eliminated.
3. **Finishing phase:** Larger wires 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 is very effective to start retention phase.

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