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Step By Step Construction Of Orthodontic Removable Appliance

Lab-work Handout for year 4 students at The University of Mosul / College of Dentistry.

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Lab:1. Introduction

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Orthodontic Removable Appliance:

An orthodontic appliance that could be inserted and removed by the patient.

In general, Removable orthodontic appliances are considered as an interceptive orthodontic treatment and is mostly used in mix dentition period. Basically, they either resolve the treated dental problem or diminish its severity. Either way, this is definitely beneficial to the patient. However, this is a patient-dependent protocol and stability of the appliance in place is vital. The stability is accomplished mainly by retentive components (clasps) attached to the appliance. Fulfillment of the treatment objectives requires a substantial mechanical concept and designing.

Biomechanics of Tooth movement

When a force is applied to the crown of a tooth, it will displace slightly within the confines of the periodontal ligament. This small change in position will set up areas of tension and compression within the periodontal ligament. Provided that the force is applied over a sufficient period of time, remodeling of the socket will allow the tooth to move farther.

Types of tooth movements:

1. **Spontaneous tooth movement**: include tooth movements that occurs spontaneously without orthodontic force application, An example of this is

tipping toward an extraction space or **over eruption** of teeth opposite to an extracted tooth.

2. **Active tooth movement**: these movements which occur due to application of orthodontic force to the crown of the tooth. Active tooth movement could be sub-categorized into the following:

   a. **Tipping Tooth Movement:** When a force is applied at a single point on the crown trying to move the tooth, the alveolar bone will resist that movement which will result in tipping of the tooth around its center of rotation (about 40% of root length apically). This means that while the crown moves in one direction the root apex will move in the opposite direction.

b. **Translation (Bodily) Tooth Movement**: When all parts of the tooth move in the same direction for the same distance. If a tooth is to be moved bodily, a force couple must be applied to the crown in conjunction to the original force. This is not practically applicable with removable appliance since it is difficult to control the M/F ratio along the course of tooth movement.

c. **Intrusion and Extrusion tooth movement:** Is a translational movement parallel to the long axis of the tooth.

d. **Rotational movements:** Rotation of the tooth around its long axis. To achieve this type of tooth movement, the application of couple force is required.

Construction of removable appliance

Removable appliances are made in dental laboratories. However, learning the basic construction techniques is essential to master the various applications and mode of action of each of the components.

Components of removable appliance:

1. **Active components:** The active components are used for the application of orthodontic force to the teeth and are made mainly from stainless steel wires and Screws and elastics are also used in removable appliance but less frequent. An example is the Z spring.

2. **Retentive components:** Those components that are used to provide resistance of the dislodgement of the appliance from the mouth. For example of that are different types of clasps labial bows.

3. **Acrylic base plate:** Is the basic frame to which all active and retentive components are attached directly or indirectly. In addition to its function as the main frame it also plays an impotent role as an active component. for example when modified as an anterior bite plate to treat deep bite cases, also considered as an impotent retentive component as its adaptation to the palate and the engagement to the palatal undercuts of the molars and premolars will increase the retention of the appliance.

Essential construction tools

For the vast majority of removable appliances the usual set of instruments and materials are composed of:

1. Orthodontic pliers and cutters

- ***Orthodontic pliers***

These are used for all wire bending. The ends are firm, tapered, with one round end and the other pyramidal or 2 rounded in section, and meet only at the tips. The beaks meet only at the tips so that they are separated about O.6 mm at the base when the pliers are closed. This makes the beaks of the Universal pliers parallel when gripping the wire.
Tow famous pliers of this type are:

a) Angle pliers (coil forming pliers): with one cone-shaped beak and one pyramidal beak.

b) Adams pliers (universal pliers): with two pyramidal beaks.

- ***Orthodontic wire cutters***

The diagonal type of wire cutter is used and must have hardened blades.

2. Stainless steel wire;

These are used to make the active and retentive components. they can be classified according to its hardness to:

- Extra-hard
- Hard **(used in removable appliances)**
- Soft

The wires gauge range between 0.3-1.5 mm; in removable appliances we use 0.5 - 0.7 mm hard stainless steel wire.

3. Acrylic:

This is used for construction of the frame or the body of removable appliance that carry the active and passive springs. Chemical cure, light cure or hot cure acrylic could be used. Colures and additives are preferable.

4. Patient's dental cast model:

A pair of dental cast model (upper and lower arches) for the patient should be present when constructing the removable appliance. These are necessary for treatment plan and construction of the appliance.

Manual training:

The students are instructed to make the following shapes (Figure: 1) using 0.6 or 0.7 stainless steel wire. Meanwhile instructions about the correct pliers grasping, wire bending and cutting are being given.

Those shapes will introduce the student to the manual skill of wire bending and help him/her to manage future wire works accurately.

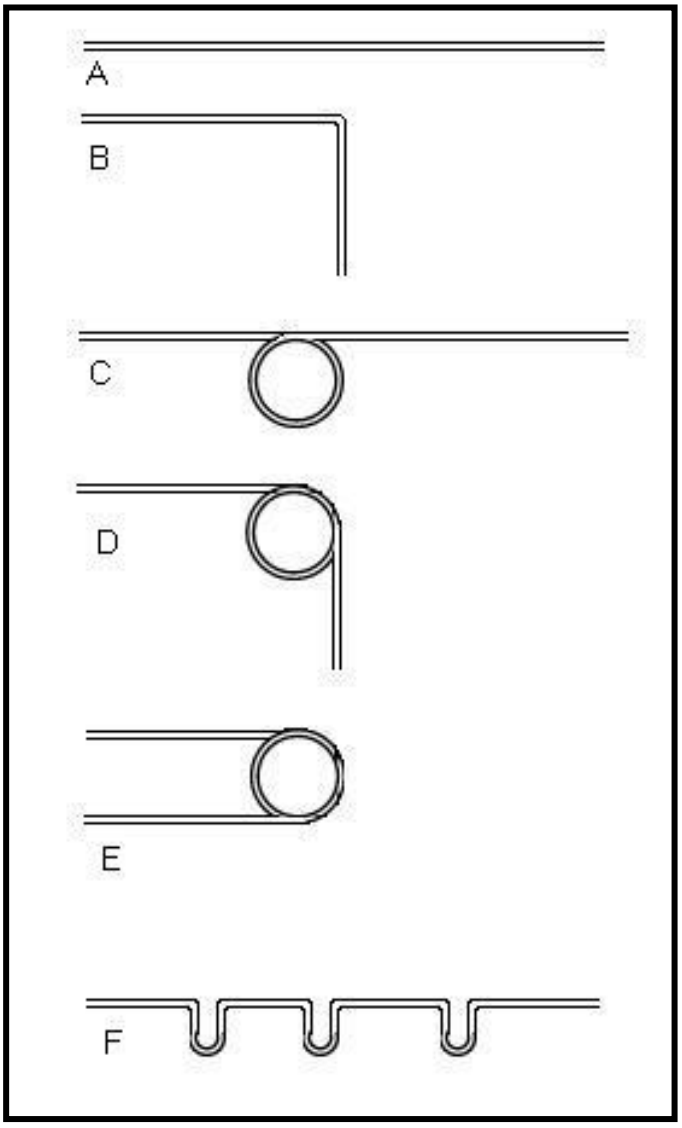

Figure1 the students are instructed to make the shapes of : A. Straight wire piece; B. 90 degree angle; C. Straight wire with coil; D. 90 degree angle with coil; E. Full turn coil; F. three well aligned vertical loops on the same wire**.**

Lab:2. The palatal finger spring

Description and design

The simplest form of this spring is a strait piece of wire embedded at one end in the acrylic base plate. The usual wire diameter is 0.5 mm or occasionally 0.6 mm. a coil is incorporated near the point of insertion into the acrylic, this increase the length of the wire and stores activation energy, thus, it will help delivering a light force over a longer range of action (figure:2A). The coil should be made as large as possible 3- 4mm . It is placed so that when activated it is tightened (the coil is placed on the side **away** from the desired tooth movement).

A coil spring of this design will usually be about 2 cm in length from the point of force application to the insertion into the acrylic. The position of the coil (distance from the tooth) is most important as it influence course of action in which the spring works.

Indications:

It is commonly used to move any tooth mesially or distally along the dental arch

Advantages:

1. Simple design
2. Provide light pressure
3. Well tolerated by the patient
4. Several springs can be added if required

Disadvantages:

- The palatal finger spring can not move teeth in labial or palatal directions.

Step by step construction of finger spring

Please note that this section is for training purpose only and the construction steps are not required in any written or verbal exam.

1. With a sharp pencil, sketch the design of the wire on the cast model according to the (description and design) mentioned above.
2. Cut a (5cm) of (0.5mm) round stainless steel wire
3. straighten off the wire piece
4. Make a very small loop (as small as possible) at one end of the wire and then bend it to be (90°)to the spring long axes. This will be the tooth end of the spring and will help tooth engagement and prevent injury from sharp wire terminal.
5. Adapt the wire on the cast model so that the tooth end is fit on the tooth side opposite to the direction of the desired tooth movement and the spring long axes is perpendicular on the direction of tooth movement. Then measure about (*15 mm) from the tooth end of the wire and put a mark on the wire.
6. Hold the wire on the mark. The round beak of the plier should be held away from the operator and from the first bend made on the wire,(keep in mined that the coil will always be away from the direction of the desired tooth movement). Start rolling over the wire around the round beak of the pliers until forming a complete coil, and the wire continues in the same direction.
7. Make sure that **the coil will be above the tooth end (active arm)** of the spring. This is a critical point of the wire design since it will keep the active arm close to the palate.

8. Re-adapt the spring on the cast model and check the following points:
   a) The spring fits on the side of the tooth away from the direction of tooth movement
   b) The coil is on the side away from the direction of tooth movement
   c) The coil is above the active arm

9. Leave about (4mm) from the coil end and mark the wire. This is the point where the wire will start to be embedded in the acrylic.
10. About (2mm) after this point, make a (45°) bend on the round beak of the pliers and start a 2 to 3 (zigzag) bends that is the retentive part of the wire which will provide the mechanical retention of the spring in the acrylic base-plate.
11. Cut the excess of the wire and adapt it on the cast model with piece of soft wax. and check the fallowing points:
   a) The length of the spring is about 2 cm from the tooth end to the point of insertion into the acrylic.
   b) The retentive zigzag does not cross the midline to the opposite side.

Boxing, Open spring and Wire guard:

These are three designs of the acrylic base plate around the finger spring. *Boxing* (figure:2B) is designed to provide the freedom of movement of the active arm and coil inside an acrylic chamber built in the base-plate. *Open spring* (figure:2C) is designed to completely remove the acrylic of the base-plate from the path of the movement and leave the active arm and the coil free without protection. *Wire guard* is the addition of a stainless steel wire be incorporate in the open spring design to prevent distortion of the spring during wearing and activation. This could be from the tongue side or occasionally from palatal side too. It could also be used with the boxing design palatally for the same reason. Those three designs will be discussed thoroughly in base plate construction labs.

Activation

It is widely believed that for a single rooted tooth a force of 30 to 50 g is enough to produce orthodontic tooth movement with minimal tipping. A tension gauge could be used to measure the force; however the usual activation is roughly one third to one half of a unit (the mesio-distal dimension of the tooth). This is about 3-5 mm. Over activated springs may be harmful to the tooth producing pain and discomfort to the patient (figure:2).

The palatal finger spring is activated by gentile **opining of the coil** with the use of angle pliers the old position of the tooth end of the spring (before activation) is marked on the base plate to be compared to the new position (after activation).

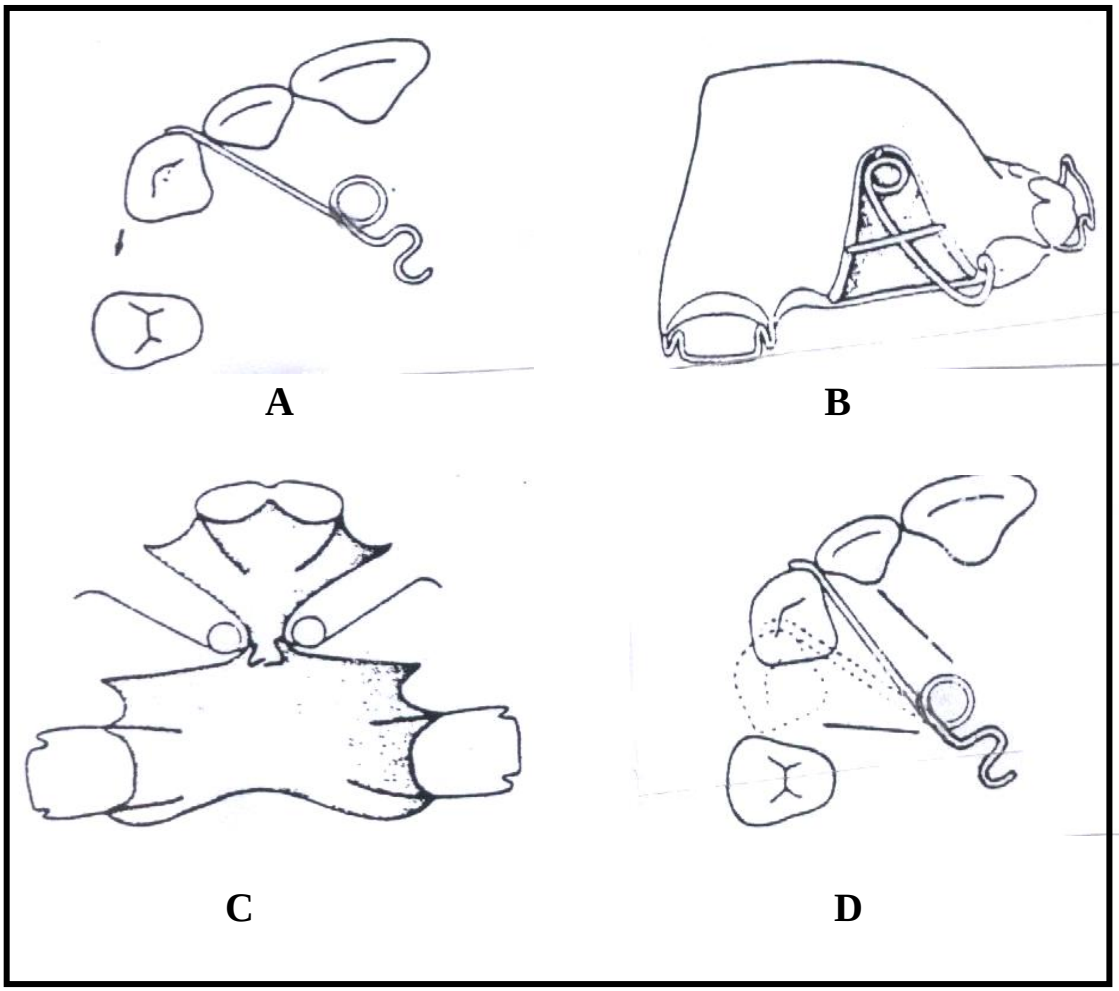

Figure2 the palatal finger spring. A: palatal figure spring design ; B: boxing with wire guard ; C: open spring ; D: activated finger spring.

Lab:3. Modified finger spring

One of the modifications to the palatal finger spring is the modified finger spring. it differs from the original one in four main points: Its action is applied labially rather than palatally; It crosses the occlusal surface; The direction of force is vertical and it needs an attachment (usually orthodontic bracket) on the labial surface of the tooth in order to apply its action (figure 3).

The gauge of the wire is 0.5mm or 0.6mm, a loop is incorporate in the wire design to increase the length of the wire and its range of action.

Indications:

For extrusion for ectopic or high buccally erupted teeth

Advantages:

1. Simple design
2. Suitable range of action

Disadvantages:

3. Can not be boxed or guarded.
4. Subjected to distortion.
5. Trauma to the vestibular soft tissues.

Step by step construction

Please note that this section is for training purpose only and the construction steps are not required in any written or verbal exam.

1. On the plaster model, sketch the wire design on the labial gingiva (figure 3). The end of the active arm

usually located at the mesial margin of the target tooth and extended distally passing over the tooth to be moved in addition to two teeth behind. This will be about 3 mm above the gingival margin. At that point a small loop 3-4mm in diameter is constructed by which the wire will change its direction occlusally, crossing the occlusal surface at the embrasure between the teeth and rolling over to the palatal side of the arch where the spring ends by a retentive zigzag form.

2. Cut about 7 cm of 0.5 mm round stainless steel wire
3. Straighten the wire piece
4. Start to form a very small loop at one end of the wire, this will be the end of the active arm of the spring and will prevent injury to the adjacent soft tissue
5. Adapt the wire to the curvature of the alveolar arch. Fit the wire in position and put a mark on the distal margin of the third tooth (according to the design drawing).
6. Hold the wire with the pliers 2 mm behind the mark point and start to form a 3-4mm loop. The direction of the loop is always away from the tooth to be moved (that's mean the coil will try to open while it is in action).
7. The coil will not take a complete turn and the wire leaves the coil at aright angle to the direction of the active arm and will be directed occlusally.
8. Fit the wire in position and check the following points:
   a. The length of the active arm is appropriate.
   b. The lop is above the active arm.

c. The wire is adapted to the alveolar mucosa (1mm away from mucosal surface).
d. The active arm runs 2-3 mm above the gingival margin.

9. After the necessary correction have been made, Fit the wire in position and put a mark on the occclusal end of the embrasure where the wire will pass above the occlusal surface of the teeth. And use the round beak of the angle pliers to make a sharp turn to the palatal side of the dental arch.
10. Adapt the wire on the palatal surface of the teeth and mucosa
11. Start to make a retentive zigzag bends starting at the point about 2mm after the lingual gingival margin where the acrylic base plate will be located, and then cut the excess wire.
12. Fit the wire in position and check the fallowing:
    a. The wire does not interfere occlusally with the opposing arch.
    b. The spring does not cross the midline
    c. The loop does not interfere with the vestibular tissues.
13. Now to finish the spring a small bend is made on the active arm
    (about 10 degrees) at the distal margin of the targeted tooth gingivally. This bend will ensure correct direction of the applied force during the course of action.

Activation:

Activation of the modified finger spring is made by opining the coil so that the active arm will be about 3

mm occlusally to the passive position (figure: 3B). This will deliver force of about 20-30g which is enough for extrusion movement.

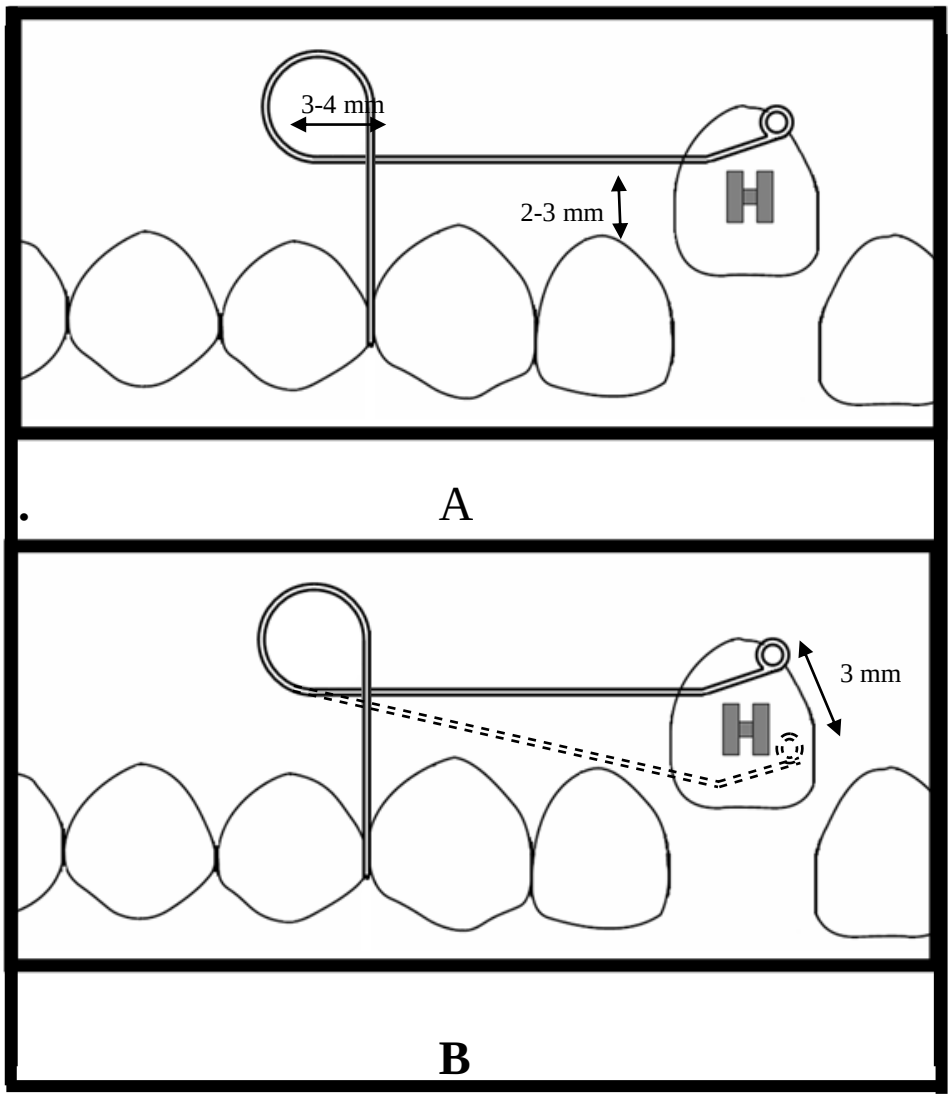

Figure3 The modified finger spring(Basic design .A:basic design; B: Activation

Lab:4 . Z-Spring (double cantilever)

This is a variant of the palatal finger spring and the commonest type in this group.

Description:

The spring is bent into the shape of the letter ' Z ' with two coils each is (2 mm) in diameter. It should be constructed with the spring compressed. The presence of two coils makes it possible for the active end of the spring to be activated in a straight line perpendicular to the dental arch.

Indications:

1. Correction of single palatally Positioned anterior tooth.
2. Correction of simple rotation (not more than 45°) when combined with active labial arch to produce a couple force.

Advantages:

1. The spring is compact and may be narrowed to small teeth such as lateral incisors.
2. The force is delivered in a straight line due to the presence of two coils.
3. The spring could be boxed and distortion is not common.

Disadvantages:

1. Not suitable for posterior teeth.
2. If the spring is made very small it can produce an excessive force during activation.

3. The reactionary force from the cingulum tends to displace the anterior part of the appliance, good anterior retention is therefore essential.
4. May produce some intrusive force.

Step by step construction procedure:

Please note that this section is for training purpose only and the construction steps are not required in any written or verbal exam.

1. Start sketching the design of the spring on the palatal surface of the cast model. The spring name is self explanatory as it will take the shape of the letter (Z) (figure: 4A). The spring is confined to the mesio-distal dimension of the tooth to be moved. starting at the mesial border of the tooth, draw a straight line 2-3 mm above the palatal gingival margin crossing the tooth to the distal side, at that point a coil of 2 mm in diameter is placed, make sure it will be confined to the tooth borders, then continue the line in reverse direction gingival to the coil till the mesial side of the tooth, at that point another coil of the same dimension is placed, also make sure that the spring is confined to the mesio-distal dimension of the tooth, now continue the line back in reverse direction gingival to the coil passing about 2 mm (nearly at the middle of the tooth dimension where a sharp turn is made to change the direction posteriorly , the line then continues straight about 6 mm then start 2 to 3 zigzag retention form.
2. Take a (5 cm) piece of a (0.5mm) stainless steel wire and straighten it.
3. Start by making a small loop (as small as possible) at one of the wires ends, this will be the active end of the wire.

4. assuming that the z-spring is mad for the upper left permanent incisor, put the wire on the palatal surface of the tooth with the small loop is pointing mesially and mark the point at the distal margin of the tooth.
5. Hold the wire about (1 mm) before the mark point and start forming the loop. The size of the loop is very small in that the wire must be held at the very end of the pliers beaks, makes sure that the coil is above the active arm (the wire end) this will facilitate the correct direction of the applied force, make a complete turn heading backward mesially.
6. Re-fit the wire in position and mark the mesial end of the tooth (the mesial and distal end represents the largest mesio-distal dimension of the tooth).
7. Repeat the coil just the same as the previous one except that the coil here is above the remaining wire, this will facilitate easier adaptation of the spring to the curvature of the palate. Complete the turn so that the remaining wire is pointed distally again. Make sure that the two coils are at the same plain.
8. Re-fit the wire in position according to the sketching and mark the wire about (2 mm) away from the second coil (nearly at the meddle of the mesio-distal dimension of the tooth).
9. Hold the wire just before the mark point and make a 90° bend (on the round beak) at the same plain with the coils. This will leave the remaining wire pointing backward.
10. Leave about (6 mm) and start a retentive zigzag bends, then cut the remaining wire.
11. If the coils are loose and were opened during construction, squeeze the spring i.e. close the coils to

the maximum is mandatory since it will increase the range of action during the active treatment.

12. Now the spring is completed in shape but is parallel on the tooth surface and not useful. The active part of the spring must apply the force perpendicular to the tooth long axes (figure 4B). This is made by a rounded bend at the start of the (6mm) straight area of the spring wire just after the 90 degrees bend; the direction of the bend is toward the palatal surface which will elevate the coils to be perpendicular to the tooth long axes. This bend could be combined with the 90 degree bend to produce the desired orientation.
13. Be aware that the tooth long axes is not the palatal surface of the tooth, it is represented on the cast model by an imaginary line passing between the labial and the palatal tooth surface.
14. the spring is then boxed with wax (same as in finger spring) and ready for the construction of the acrylic base plate

Activation:

There are two methods for the activation of Z-spring

a. By opining the first coil or the second coil alone, it will produce force at one side of the tooth which will try to rotate it.

b. By opining both of the coils which is practically done by gentile pulling of the active arm to produce elongation of the spring about (2-3 mm). This is quite enough for tipping movement and keeping the active arm parallel to the tooth surface which will produce equal force on both sides of the tooth.

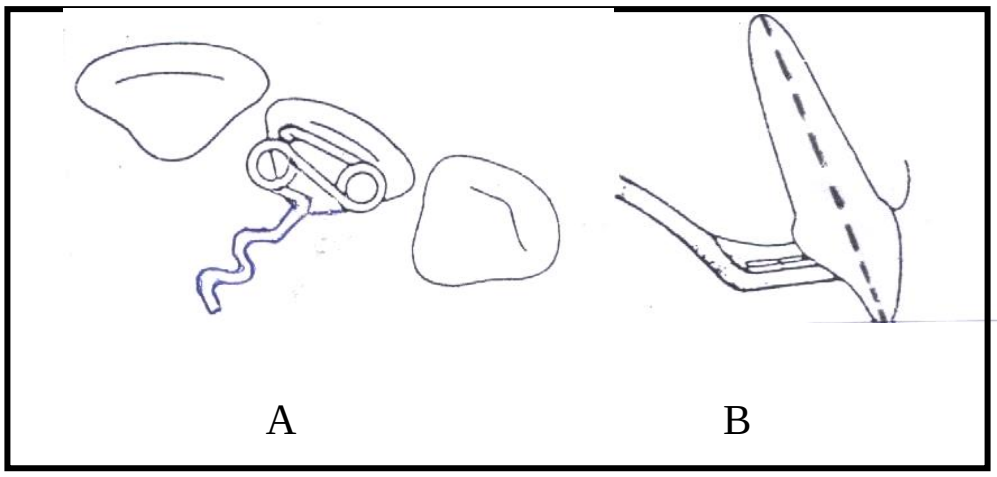

Figure4 The Z spring A:Z- spring positioned on the lateral incisor ; B: the z-spring is positioned perpendicular to the tooth long axes.

Lab:5 Double Z-Spring

This spring is simply tow Z-springs joined by their active arms.

Description:

The spring is bent into the shape of two ' Z ' facing each other (figure:5) with four coils each one is (2 mm) in diameter. It should be constructed with the spring compressed and the presence of two coils on each side of the spring makes it possible for the active end of the spring to deliver the force in a straight perpendicular to the dental arch.

Indications:

1. Correction of up to four palatally Positioned anterior teeth.
2. Correction of simple rotation (not more than 45°) when combined with active labial arch to produce a couple force.

Advantages:

1. The force is delivered in a straight line due to the presence of four coils.
2. The spring could be boxed and distortion is not common.
3. Used for correction of more than one tooth, (2-4) anterior teeth at the same time.

Disadvantages:

1. Not suitable for posterior teeth,

2. If the spring is made very small it can produce an excessive force during activation.
3. The reactionary force from the cingulum tends to displace the anterior part of the appliance, good anterior retention is therefore essential.
4. May produce some intrusive force.

Step by step construction procedure:

Please note that this section is for training purpose only and the construction steps are not required in any written or verbal exam.

1. Assuming that the double Z-spring is made for the two upper permanent central incisors, sketch the design of the spring on the palatal surface of the cast model as shown in (figure:5) . The spring will take the shape of two (Z) facing each other and joining by their active arms with four coils of 2mm in diameter.
2. Take a (15 cm) piece of a (0.5mm) stainless steel wire and straighten it.
3. Put the wire on the palatal surface of the teeth with and mark two points one on each side at the **distal** margins of the teeth.
4. Hold the wire about (1 mm) before the mark points and start forming the loop from each side. The size of the loop is very small (2mm) so the wire must be held at the very end of the pliers beaks, make sure that the coils are above the active arm as this will facilitate the correct direction of the applied force, make a complete turn heading backward mesially from both sides.
5. Re-fit the wire in position, the active arm (which is the segment of the wire between the two coils) must have a slight curvature representing the normal arch form.

6. Mark the mid-point between the two centrals, let the mark appear on both the right and the left ends of the wire.
7. Repeat the coil from each side just the same as the previous one except that the coil here is under the wire (the short piece of wire between the first and second coil from each side), this will facilitate easier adaptation of the spring to the curvature of the palate. Complete the turn so that the remaining wire is pointing distally from each coil and heading away from each other. Make sure that the four coils are at the same plain.
8. Re-fit the wire in position according to the drawing and mark the wire about (2 mm) away from the coils at each of the two ends (nearly at the middle of the mesio-distal dimension of the tooth).
9. Hold the wire just before the mark point and make a 90° bend (on the round beak) at the same plain with the coils. This will leave the remaining wire pointing backward to the palate.
10. Now leave about (6 mm) and start a retentive zigzag bends then cut the remaining wire.
11. I case the coils are loose and opened during construction, squeezing of the spring i.e. closing the coils to the maximum is mandatory since it will increase the range of action during the active treatment.
12. Now the spring is completed in shape but is adapted on the tooth surface and not useful. The active part of the spring must apply the force perpendicular to the tooth long axes. This is made by a rounded bend at the (6mm) straight area of the spring wire just after the 90 degrees bend, the direction of the bend is toward the palatal surface which will elevate the coils to be

perpendicular to the tooth long axes. This bend could be combined with the 90 degree bend to produce the desired orientation.

13. The spring is then boxed with wax (same as in Z-spring spring) and ready for the construction of the acrylic base plate

Activation:

Activation of the double Z-spring is made By opining both of the coils on each side which is practically done by gently pulling of the active arm from the right and left side to produce elongation of the spring about (2-3 mm). This amount is quite enough for tipping movement. Pulling the same amount from the right and left side will keep the active arm parallel to teeth surface which will produce equal force on both sides.

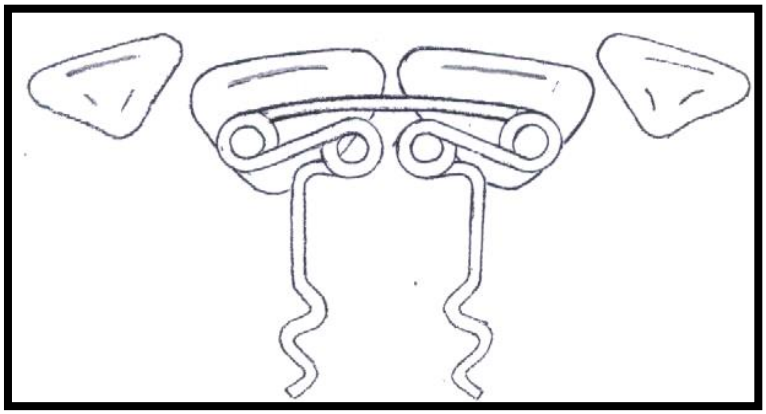

Figure5 Double Z- spring positioned on the central incisors, note that the active arm has a slight curvature representing the normal dental arch curve.

Lab:6. T- Spring .

Description:

The name is self explanatory as the spring take the shape of the letter (T). Both ends embedded into the base plate and the T shape span rests on the palatal surface of the tooth to be moved (figure:6). The addition of extra u shape loops half way up the spring increase its flexibility and provides spare wire for its extension during tooth movement.

Indications:

1. Suitable to provide buccal movement of posterior teeth.
2. Occasionally used on the anterior teeth since it will produce an inevitable intrusive force during action.

Advantages:

1. Highly unlikely to catch on the buccal surface of posterior teeth during insertion.
2. It occupies only a small space and can be used on a premolar concurrently with other movements such as canine retraction.
3. Could be boxed or guarded.

Disadvantages:

1. When used for anterior teeth, a considerable amount of intrusive force is delivered.
2. It has a small range of activation.

Step by step construction procedure:

Please note that this section is for training purpose only and the construction steps are not required in any written or verbal exam.

1. Two important points must be kept in mined during the construction of this spring:
    a. All the bends and loops must be at the **SAME PLANE**
    b. **SYMETRY** between the right and left side is of a primary importance.
2. Sketch the design of the wire on the palatal surface as shown in (figure 6)
3. Take a (5 cm) piece of 0.5mm stainless steel wire (0.6mm for molars) and start straighten it.
4. Put the wire on the palatal surface of the tooth and mark two points one on each side at the mesial and distal embrasure around the tooth.
5. Hold the wire about (1 mm) before the mark points and start forming the U shape loop from each side. The size of the loop is very small (2mm) so the wire must be held at the very end of the pliers beaks, the loops are incomplete (U shape) and the wire only turn to the opposite side from each end heading backward toward each other from both sides.
6. Put the spring on the occlusal surface of the tooth, the active arm (which is the piece of the wire including the two loops must have the same mesio-distal width of the tooth.
7. Now mark the mid point between the two loops , let the mark appear on both the right and the left ends of the wire
8. Then make a sharp turn (on the round beak of the pliers) about (1mm) ahead to the mark point from

each side so that the two wire ends will extend parallel to each other heading away from the T span with (0.5 to 1 mm) between them (figure 6).

9. Now the spring resembles the desired T shape and you can make the retentive zigzag form about 6 mm away from the loops. If additional loops is to be added then the following additional steps are taken.
10. Mark a point about 3-4mm down the first loop and let the mark appear on both sides of the wire.
11. Hold the wire with the ends of the beaks and make a 90 degree bend on each of the two sides of the wire ends so that the two ends run apart from each other. Make sure that all the bends and loops used in the construction of this loop must be at the same plain.
12. Hold the wire at the ends of the pliers beaks and start making another (U) shape loops on each side then follow the same steps of the first loop.
13. Unlike previous springs, this one lie parallel to the palatal tooth surface. The active arm touches the tooth on the gingival third of the palatal surface and the spring has a slight curvature keeping it away from the palatal soft tissue.
14. The spring is then boxed with wax (same as in Z-spring spring) and ready for the construction of the acrylic base plate

Activation:

Activation of the T-spring is made by gentile pulling of the spring away from the base-plate toward the tooth about 2-3mm Which is quite enough for tipping movement. To compensate for the positional change during the progress of the treatment, opening the coils by gentile pulling of the active arm from the right and left side to will produce elongation of the spring about (1-2 mm) and

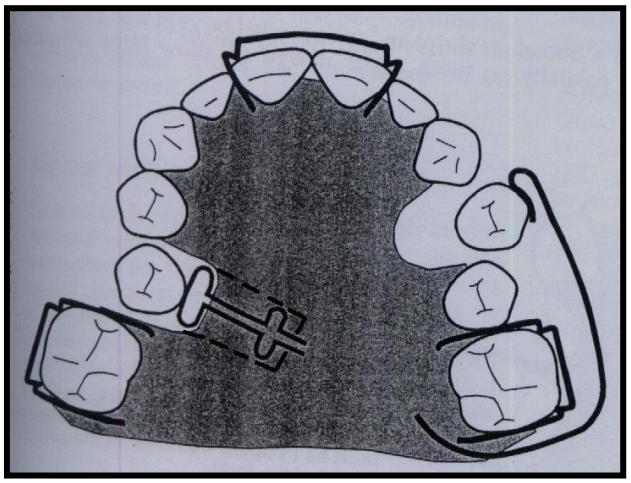

Figure6 T- spring positioned on the second premolar (occlusal view)

Lab:7. The Buccal Canine Retractor

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Description:

The buccal canine retractor is composed of a posterior arm which emerges palatally from the acrylic base plate and crosses the occlusal line up into the vestibule to support a coil from which the (L) shaped active arm (Singh 2007) is extended on the middle of the crown (mesio-distally) and curved to engage the crown mesially (figure:7), It is usually made of 0.7mm wire. The coil must be 3-5 mm in diameter and situated roughly on the line representing the centre of the extracted first premolar space. Care must be taken for the coil not to interfere with the vestibular tissues, for that reason the coil must be in position no less than 2 mm short from the sulcus depth. The end of the active arm is preferred to have a small loop to prevent injury during insertion.

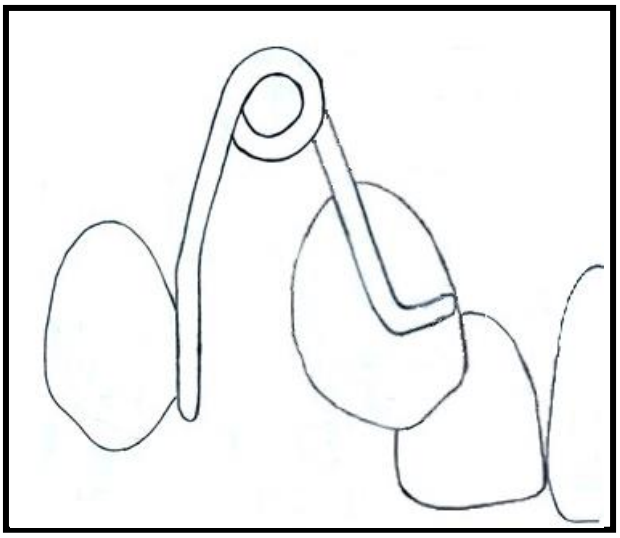

Figure7 The buccal canine retractor.

Indications:

It is typically indicated in situation where the canine overlaps the lateral incisor labially.

Advantages:

1- Offers good control on the canine during distal movement.
2- Prevent unwanted buccal movement.
4- It generally displaces the appliance less than palatal spring does.
5- Well accepted by adults because it is unnecessary to use clasping or labial bow on the anterior teeth.

Disadvantages:

1- Because of the heavy gauge of the wire, excessive force can be easily exerted on the canine during retraction.
2- It can cause trauma to the vestibular tissues.

Step by step construction procedure:

Please note that this section is for training purpose only and the construction steps are not required in any written or verbal exam.

1- Sketch the design on the cast according to the description.
2- Cut about 8cm of 0.7mm stainless steel wire and straighten it.
3- Place the wire on the buccal surface of the canine and horizontally at a mid-point of the crown (occluso-gingivally) and construct a rounded curve

that extends mesially adapted to the tooth surface ending at the farthest point that could be reached on the mesial surface of the canine.

4- On the point at the buccal midline of the crown (mesio-distally) mark a point where a (90) degrees bend will be placed to redirect the wire apically. This will form the (L) shape feature of the active arm. The active arm will extend up to the vestibule along the tooth long access.

5- With a permanent marker, put a mark on the wire at the position about 2 mm shorter to the sulcus depth.

6- Hold the wire 2 mm shorter that the mark point and start to make a loop of about 3-5 mm in diameter, note that the active arm should always be under the coil.

7- Complete the turn of the coil so that the remaining wire is directed back downward.

8- Now put the wire in position and adjust the remaining wire to point to the embrasure between the first and the second premolar while the active arm still fitted on the mesial border of the canine.

9- Mark the point at the interdental space near the gingival margin on the remaining wire piece where a light bend is made to direct the wire piece vertically at the mesial occlusal margin of the second premolar.

10- Mark the wire at the occlusal level. Hold the wire from the marked point and make a sharp bend palatally.

11- Now put the wire in position again and mark the palatal occlusal margin of the premolar where another bend is to be made to adapt the wire on the palatal surface

12- While the wire passes on the palate, a zigzag or a hook form is made for retention. This retention form is very important since the spring in its action tends to rotate in the acrylic which might cause loosening of the spring attachment and loss of.

13- Cut the remaining wire and put the spring in position then start to adapt the spring so that it will be about 1mm away from the buccal and palatal soft tissue.

14- Now check for the fallowing points while the spring in position:

a) The coil is 2mm away from the vestibule
b) The spring is 1mm away from the soft tissue.
c) If the first premolar already extracted, make sure that the wire passes mesial to the second premolar and with the occlusal level to avoid interference with the retracted canine.
d) Check if there is interference with the opposite arch in occlusion.

Activation:

Activation of the canine retractor is made by closing the coil so that the active arm move about 3mm posteriorly.

Lab:8. The Modified Buccal Canine Retractor

Many modifications have been made on the buccal canine retractor to enhance the control over the retracted canine. One important modification to the canine retractor is that made to the end of the active arm in order to increase the control during retraction, facilitate light extrusion force and to enable the palatal movement of the canine at the end of the retraction using the same spring.

Description:

Generally, the spring has the same form and shape of the buccal canine retractor also the active arm is situated at the middle of the crown (mesio-distally). The head (the end of the active arm) which is modified to have an extension mesially and distally, which is adapted on the labial surface of the canine and curved to partially cover the mesial surface and extended to engage the distal surface so as to make an excellent control over the canine (figure 8:A and B).

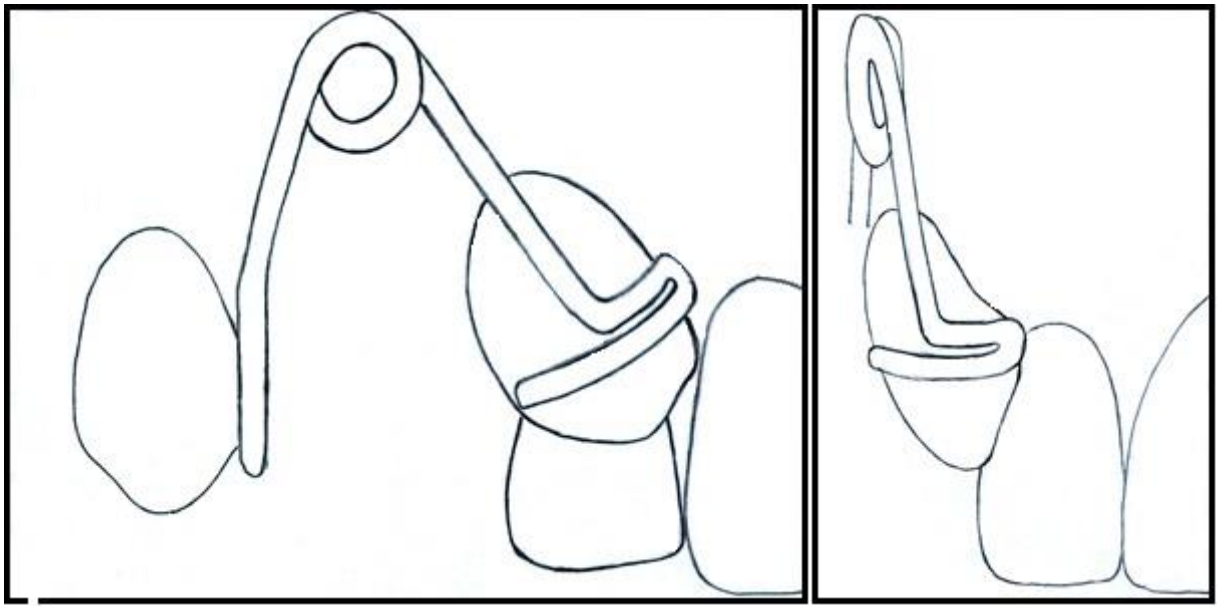

Figure8 Modified Buccal Canine Retractor. A:Side view ; B: Anterior view

Indications:

1. Where the canine overlaps the lateral incisor labially.
2. Buccally erupted canine which is situated out of the dental arch and need to be moved palatally
3. Partially erupted and high positioned canine.

Advantages:

1. Offers an excellent control on the canine during distal movement.
2. Enables extrusion and palatal movement of the canine at the end of the treatment with out the need for modification that might cause corruption of the spring.
3. It generally displaces the appliance less than palatal spring does.
4. Well accepted by adults because it is quite unnecessary to use clasping and labial bow on the anterior teeth

A B

Disadvantages:

1- Because of the heavy gauge of the wire, excessive force can be easily exerted on the canine during retraction.

2- It can cause trauma to the vestibular tissues.

Step by step construction procedure:

Please note that this section is for training purpose only and the construction steps are not required in any written or verbal exam.

1- Sketch the design n the cast according to the description.

2- Cut about 10cm of 0.7mm stainless steel wire and straighten it

3- put the wire on the labial surface of the canine so that the tip of the wire fit at the distal border of the canine just under the distal contact point and put a mark about 2mm anterior to the mesial border of the canines.

4- Hold the wire at the mark point and form a loop which leaves the remaining wire pointing distally. Now hold the wire from the bottom of the U shape loop and bend it to a right angle to make a small ledge that will adapt to and catch the mesial surface of the canine when the spring is in position. The horizontal part at the end of the wire must also be adapted on the labial surface.

5- Put the wire in position and mark the point at the centre of the crown where a sharp bend is to be made upward to the vestibule parallel to the long axes of the tooth.

5- With a permanent marker, put a mark on the wire at the position about 2 mm shorter to the sulcus depth.

6- Hold the wire 2 mm shorter that the mark point and start to make a loop of about 3-5 mm in diameter, note that the active arm should always be under the coil.

7- Complete the turn of the coil so that the remaining wire is directed back downward.

8- Now put the wire in position and adjust the remaining wire to point to the embrasure between the first and the second premolar while the active arm is still fitted on the mesial border of the canine.

9- Mark the point at the interdental space near the gingival margin on the remaining wire piece where a light bend is made to direct the wire piece vertically at the mesial occlusal margin of the second premolar.

10- Mark the wire at the occlusal surface. Hold the wire from the marked point and make a sharp bend palatally.

11- Re-position the wire and mark the palatal occlusal margin of the premolar where another bend is to be made to adapt the wire on the palatal surface

12- While the wire passes on the palate, a zigzag or a hook form is made for retention. This retention form is very important since the spring in its action tends to rotate in the acrylic which might cause loosening of the spring attachment and loss of action if it is not properly made.

13- Cut the remaining wire and put the spring in position then start to adapt the spring so that it will be about 1mm away from the buccal and palatal soft tissue.

14- Now check for the fallowing points while the spring in position:

a- The coil is 2mm away from the vestibule.

b- The spring is 1mm away from the soft tissue.

c- If the first premolar already extracted, check if the wire passes mesial to the second premolar with the occlusal level to avoid interference with the retracted canine

d- Check if there is interference with the opposite arch in occlusion.

Activation:

Activation of the canine retractor is made by closing the coil so that the active arm moved about 3mm posteriorly.

Lab:9. Adam's Clasp .

Also named as the arrowhead clasp. It was designed By *Adam's* in 1970 and since then it is the most commonly used clasp to provide retention for removable appliances. The clasp is constructed in 0.7mm wire and most commonly used on permanent first molars but can be used for almost any tooth.

A partially erupted molar which has less than 4 mm of crown generally gives poor retention. However, Adam's clasp needs only 0.25mm of undercut to provide an acceptable retention which is usually available at the mesio-buccal and the disto-buccal undercuts. In case the crown was not fully erupted, the clasp's arrowhead will push the gingival margin aside and engage the undercuts when inserted in patient's mouth; a gentle trimming of the gingival line on the cast model is feasible. When the molar is not available for retention, Adam's clasp can be modified to involve two adjacent premolars or two centrals; In this case 0.6mm wire is preferred.

Components:

1- The active parts

a. *The arrow heads:* Two small U shape loops act as two fingers engaging the mesial and distal undercuts.

b. *The bridge:* A horizontal piece of wire joining the two arrow heads and about 2-3mm away form the buccal tooth surface making roughly 45 degree angle with the long axes of the crown.

c. *The tags:* The extension of the arrow heads on each side which crosses the occlusal surface to the lingual side.

2- The retentive part

Extends from the ends of the tags down to the gingival margin and continue on both sides passing about 10 mm along the palatal or lingual soft tissue (must be 1mm away from the surface). This ends by a small hook shape loops to increase retention of the clasp.

Advantages:

1- A relatively shallow undercut is sufficient for providing an acceptable retention.
2- The bridge of Adam's clasp provides an excellent grip used for insertion and removal of the appliance.
3- Auxiliary springs, hooks and tubes for extra oral extensions could be soldered to the bridge.
4- The design has no sharp edges that may injure the soft tissues.
5- The original design can be modified to suit anterior teeth.

Disadvantages:

1- The labially inclined anterior teeth make it difficult for the arrow heads to engage the undercut at the labial surface.
2- The point where hooks or tubes are soldered on the bridge will be weakened and fracture is common at that point.
3- Adam’s clasp needs pair of undercuts (at the mesiobuccal and distobuccal embrasures of the tooth), if one of them is occupied by a spring, it will be

difficult to incorporate two wires at the same embrasure.

4- Crossing the occlusal surface at two places increases the chance for occlusal interference.

Indications:

1- Most common for retention of removable appliance.
2- Shallow undercuts.
3- Partially erupted molars.
4- Premolars and anterior teeth (after modification).

Step by step construction of Adam's clasp:

Please note that this section is for training purpose only and the construction steps are not required in any written or verbal exam.

1- Sketch the design on the permanent molar. Starting buccally by a descending vertical lines from the tips of the mesiobuccal and distobuccal cusps down to the gingival margin then join the two lines by a transverse line at the junction between the gingival and middle third of the crown. The drawing is now is similar to the English letter (H) (figure: 9)
2- If the tooth is partially erupted, carve a small piece of the gingival margin about 1-2 mm at the mesial and distal corners of the crown just behind the lines sketched on the crown.
3- Now cut about 10cm of 0.7 mm wire and straighten it.
4- Hold the wire by hands and adapt it on the horizontal line of the (H) shape figure on the crown and keep the tooth at the centre of the wire piece,

mark two points on the wire at the positions of the vertical lines.

5- Start wire bending by making a 90 degree bend at both points resulting into an angled U shape. The small wire span between the two bends will be the bridge.
6- Mark the wire at 2mm away from the first bend on both side, hold the wire with the pliers from the marked point and make a small U shape loop (around 1mm internal diameter) at the tip of the round beak of the pliers. This will result in a two small U shape loops each of them heading away from the other, those are the clasp's arrowhead.
7- Using the pliers hold the U shape loop on each side and twist it to be at 45 degree angle to the bridge in the horizontal plane and adapt it on the under cuts of the molar, make any necessary adjustments so that the arrowheads fits onto the undercuts.
8- From each side, and roughly at the same level of the bridge hold the wire with the pliers and make a sharp bent 70-90 degrees toward the tooth contacts (Sandhya 2008). This will push the bridge away from the malar crown. Then another bent bend must be made at about 2mm away from the first bend that will direct the wire toward the occlusal surface. NOTE that these two bends could be combined in one bend based on tooth anatomy and position.
9- Now fit the wire in position and check the extensions of the wire on the occlusal surface, make the necessary adjustment to adapt the two wire pieces at the embrasure interdentally.
10- While the clasp is in position, mark the wire at the lingual margins of the crown and make a sharp

bend down gingivally. Let the wire extend about 10mm on the gingival surface then a small hook shape bend may be made for retention of the clasp in the acrylic.

11- Now fit the upper and lower arches together in occlusion and check for occlusal interference, any error must be corrected.

12- For the finished Adam's clasp the following points must be checked

a. The arrowheads engage the undercuts
b. The bridge is about 2 mm away from the tooth surface
c. No occlusal interference with the opposite arch

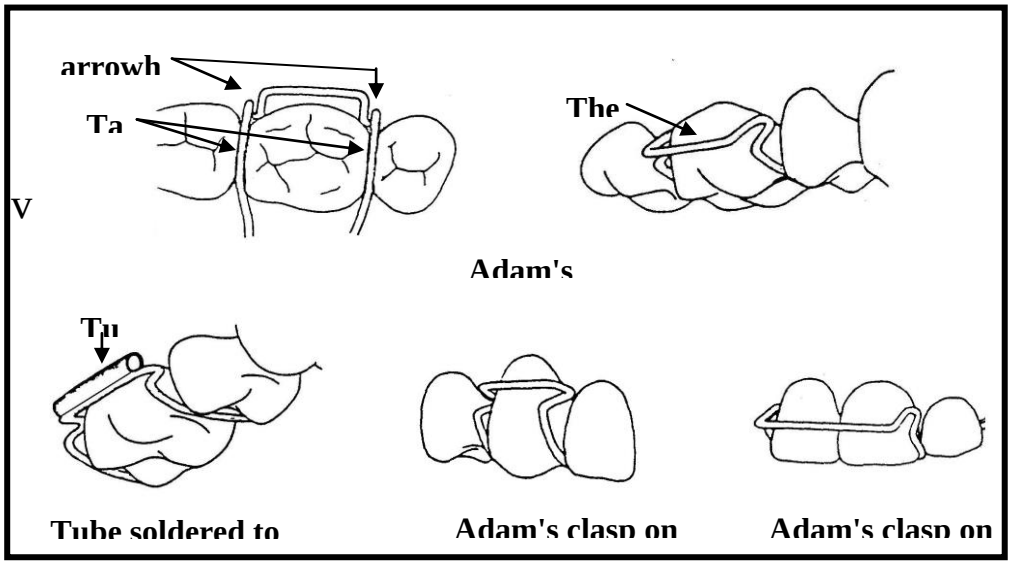

Figure9 Adam's Clasp

Lab:10. The Labial Arch

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Since it was first designed by Charles Hawley in the 1920s the labial arch has been widely used in construction of removable appliances for both active and passive purposes despite its relatively deficient aesthetic appearance.

Description:

Howley labial arch is constructed with 0.7mm wire gauge and that rigid wire give it the chance to share in retentive and active treatment and resist distortion that might be resulted from the relatively long and complicated design,

The basic design is composed of a horizontal wire piece extended on the labial surface of the four incisors, joined by vertical loops from both sides and extended to about 3mm short than the labial vestibular depth, then crossed the occlusal surface distal to the canine and extended on the palatal soft tissue, ended by hooks for retention.

Indications:

1- As an active component

a. Retraction of the anterior segment (four incisors) and treatment of minor anterior irregularities.
b. Share with the Z and Double Z springs to produce couple forces for correction of simple anterior teeth rotations.

2. *As passive component*

a. Stabilization of the corrected malocclusions when used as a retainer after active orthodontic treatment.
b. Provide anterior retention and stability of the removable appliance.
c. Act as a splint for the anterior segment to increase the anchorage of the removable appliance during active treatment.

Advantages:

1. It is useful to produce force on single or group of teeth and at the same time give retention of the appliance.
2. The same appliance used to correct malalignment of teeth will continue to retain their corrected positions.

Disadvantages:

1. It has relatively poor aesthetic appearance as it appears on the labial surface of the incisors makes it unacceptable by some patients.
2. Skill is required for adaptation of the bow and in the same time to prevent the wire from traumatizing the soft tissues.
3. Care must be taken during activation of the labial arch as a small activation might produce a very large force.
4. Subjected to distortion when it mistakenly used by patient to insert and dislodge the appliance.

Step By Step construction:

Please note that this section is for training purpose only and the construction steps are not required in any written or verbal exam.

1. Sketch the design on the cast as shown in (figure:10).
2. Take about 15 cm of 0.7mm wire. DO NOT straighten it as the curve of the wire is useful to produce a uniform anterior bow.
3. Put the wire on the labial surface of the anterior segment so that the centre of the wire piece fits against the midline between the central incisors and horizontally at the junction between the middle and gingival third of the crown.
4. Mark two points one on each side of the anterior segment at the distal border of the lateral incisor.
5. Using the pliers, hold the wire from one of the marked points and make a sharp 90 degree angle bend, repeat the procedure for both points so that the curved arch form span between the two bends fits to the dental ach while the wire pieces from both sides head toward the vestibule.
6. Now re adapt the wire in position and put a mark at both sides bout 7mm shorter than the vestibule depth, this will leave roughly 3mm of vestibular clearance after forming the loops. Grab the wire from the marked point and start to form a U shape loop directed away from the bow, the diameter of the U shape loops must be no less than 5mm.
7. Put the wire in position. Make any necessary adjustments to maintain the U shape loops in the buccal vestibule vertically and horizontally so as to have 1-2mm clearance from the soft tissue.

8. After that, mark the wire at the embrasure between the canine and the first premolar and bend the wire from that point palatally.
9. Palatally, the wire pass about 10mm ending with a small hook to provide retention in the acrylic, make sure that the wire must be 1-2mm away from the soft tissue.

Activation:

The flexibility of the labial arch is highly dependent on the length of the U shape loops, while it is relatively resilient in the vertical direction; it is very hard in the horizontal direction, only 1mm activation is quite enough to produce movement of the four incisors.

Activation of the labial arch during retraction of anterior teeth is done from the U shape loops by closing the loops so that the arch will move 1mm palatally, the activation must not exceed that because it will produce excessive force on the centrals. Care must be taken not to distort the bow or traumatize the soft vestibular tissue

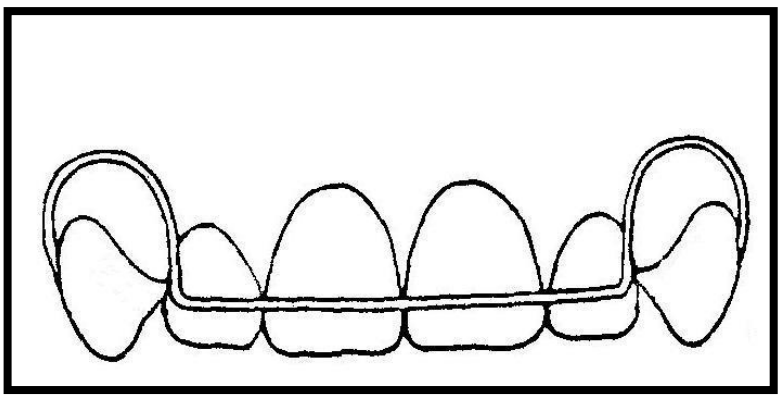

Figure10 Labial Arch , Anterior view

Lab:11. The Fitted Labial arch

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When the anterior teeth are proclined so that neither the Adam's clasp nor the labial arch was suitable, anterior retention is provided by a modification that combines both. This was named fitted labial arch.

The basic design is composed of a horizontal wire span fitted on labial surface at the junction between the incisal and middle third of the incisors and extended over two or four incisors ending from both sides by a small 2-3mm U shape loops directed gingivally. The wire then passes from both sides to cross the occlusal surface to the lingual side ending by a hook-like bends for retention in the acrylic.

Indications:

1. Proclined anterior teeth.
2. Anterior retention is required where labial arch is not suitable. An example for that is the use of unilateral canine retractor.

Advantages:

1. Simple in construction and adaptation.
2. Provide good retention of the appliance anteriorly

Disadvantages:

1. Poor aesthetic as it approaches the incisal margin.
2. May interfere with the opposite arch during occlusion.

Step by step construction:

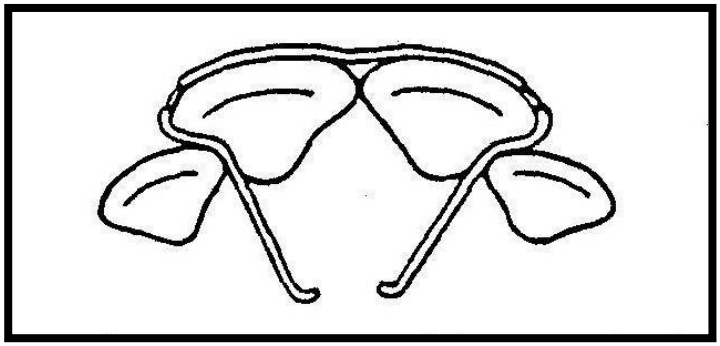
Please note that this section is for training purpose only and the construction steps are not required in any written or verbal exam.

1. Sketch the design on the cast according to the description above.
2. Make the necessary wire bending to adapt the wire horizontally on the labial surface so that it will fallow the curvature of the incisors and mark it about 4mm short to the distal end of the incisors from both sides.
3. Now hold the wire from the marked point and make a sharp 90 degree angle bend, repeat the bend for the other side.
4. Hold the wire with the pliers beaks near the first bend and start forming a U shape loop and repeat the procedure for the other side. The diameter of the loops should be about 2-3mm so that the resulted wire will fit to the dimensions of the involved teeth.
5. Re position the wire and make any necessary adjustment so that the wire fits against the labial surface of the incisors, place marks on the wire from both sides at the incisal margin where a sharp bend will turn the wire direction down to the palatal or lingual surface.
6. The wire from both sides must be extended about one cm on the palatal soft tissue ending by retentive hooks.

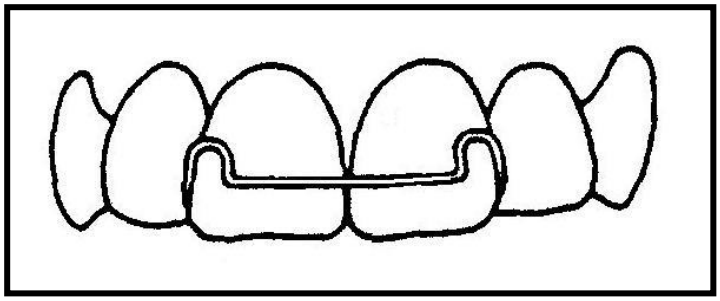
Activation or tightening of the wire:

The fitted labial arch provide retention through the horizontal bow which is fitted exactly on the labial surface of the incisors, tightening of the bow is made through the adjustment of the U shape loops that makes the bow tighter on the labial surface.

A:
Occlusal view of the fitted labial wire, note the closely fitted addaptation of the wire on the labial surface of the incisos.



B:
Short Fitted labial wire involves the two central incisors only.



C 3:
Long fitted wire involves the four incisors

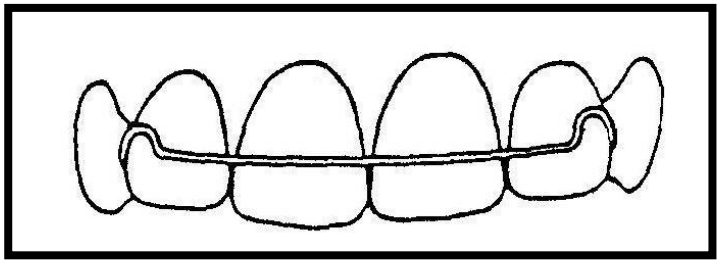


Figure11 Fitted labial arch

Lab: 12. Robert's retractor .

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This is a flexible bow constructed with 0.5 mm stainless steel wire. It is composed of a bow which extended on the labial surface of the four incisors. The bow takes the shape of an ideal arch form despite the irregularities of the anterior teeth as they will be gathered when retracted. At both ends a sharp bend will direct the wire gingivally where it will form a 3-5 mm coil not less than 3mm shorter than the full depth of the vestibule. The coil Then changes the redirected of the wire occlusally where it will cross the occlusal surface distal to the canine and turn onto the palatal surface.

Robert's retractor is highly flexible in all its parts except at the part from the coil to the acrylic base plate where it will be shielded by a 0.5mm stainless steel tube to support the structure of the flexible bow.

In this lab and only for training purpose the full design will be constructed with 0.7mm wire which is believed to be much easier in construction and adaptation.

Indications:

1. Retraction of anterior segment
2. correction of spacing or minor irregularities

Advantages:

1. This spring produces a light force and easily adjustable.

2. Because it swings backward and downward it will not slide gingivally on the anterior teeth when retracted.

Disadvantages:

1. If the supporting arms are not correctly positioned the sulcus may be traumatized
2. In case of breakage major re construction will be required.

Step by Step construction:

Please note that this section is for training purpose only and the construction steps are not required in any written or verbal exam.

1. Sketch the design on the cast model as shown in (figure 12).
2. Take about 15 cm of 0.5mm (0.7mm for training only). Don't straighten it as the curve of the wire is useful to produce a uniform anterior bow.
3. Place the wire on the labial surface of the anterior segment so that the centre of the wire piece fit against the midline between the central incisors and vertically at the junction between the middle and gingival third of the crown.
4. Adjust the wire by your hands to make an anterior bow that simulate the normal arch form of the patient. Despite the irregularities of the anterior teeth, the bow must be a uniform arch.
5. Mark two points one on each side of the anterior segment at the distal border of the lateral incisor.

6. Hold the wire with the pliers from one of the marked points and make a sharp 90 degree angle bend, repeat the procedure for both points so that the bow extends horizontally on the labial surface of the incisors while the wire pieces from both sides head toward the vestibule.
7. Now re adapt the wire in position and place a mark at both sides bout 7mm shorter than the vestibule depth, grab the wire from the marked point and start to form a 3-5mm coil, note that the active arm (near to the bow) must be under the coil.
8. Re-position the wire and make any necessary adjustment to maintain the coils in the curvature of the dental arch vertically and horizontally.
9. Inset the wire from both sides into a stainless steel tube which will extend from the coil to the acrylic Base plate in the finished appliance (this step will not be done with 0.7 wire only for training).
10. After that, mark the wire (the tube) at the embrasure between the canine and the first premolar and bend it from that point Palatally.
11. On the palate, the wire pass about 10mm ended with a small hook to provide retention in the acrylic, make sure that the wire in must be 1-2mm away from the soft tissue.

Activation:

This bow is light and flexible. An adjustment of about 3mm is suitable but the site of adjustment is very important because if the wire is activated at the point where it emerges from the supporting tube (a sight of stress concentration) it will often fracture. The bow is

adjusted by bending in the vertical limb below the coil. As the incisors retracted the bow swings downward and backwards and the level of the horizontal part will need adjustment.

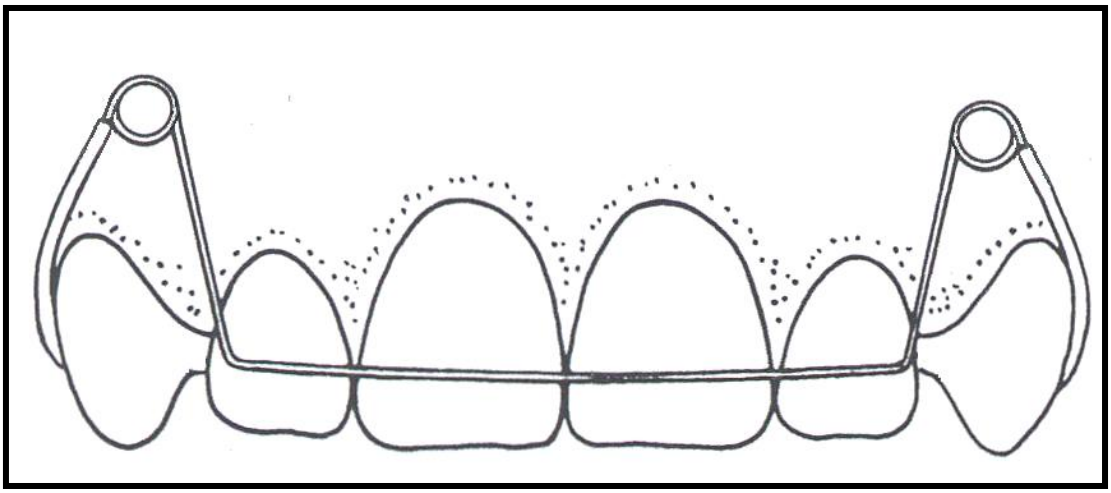

Figure12 Robert Retractor, Front view

Lab: 13 . Acrylic base plate .

The acrylic base plate constitutes the body of the removable appliance. It has thee **functions**:

1. Act as the foundation into which the retaining clasps and active components of the appliance are embedded, such as springs and screws.
2. Contribute to the anchorage during the course of active tooth movement. This might be achieved though the close fit of the acrylic to the palatal surface of the teeth and palate.
3. It could be extended to form bite planes to disengage the occlusion or produce overbite reduction.

Design:

The design of the acrylic base plate depend on the case to be treated, each case may have deferent modifications according to the components to be incorporated into the design. But there are general points that must be considered during the construction of the acrylic base plate:

1. Several types of acrylic materials could be used for construction of the base plate, but chemical cured acrylic resin is commonly used since it is economic and less labor intensive.

2. The base plate needs to be thick enough to carry the retentive and the active components, but should be as thin as possible to avoid discomfort to the patient, ideally, this should be as thick as a sheet of modeling wax (2-3)mm.

3. The base plate should normally cover most of the hard palate, finishing just distal to the first molars.
4. It should fit closely to the palate and around the teeth that are not to be moved, extends up to one third of the crown length. Whereas the teeth being moved should have enough clearance around to move freely.
5. The clasps or springs retentive parts should be embedded in the acrylic, exposure of the wire may cause future dislodgement or malfunction of the springs and clasps.

Modifications to the Acrylic base plate:

The design of the base plate may be modified to accommodate springs as in *boxing* , add an active extensions as in *Bite planes* , or to accommodate *expansion screws* to the basic design.

1- bite planes

The acrylic may be thickened palatal to upper incisors to form the anterior bite plane or may be extended on the occlusal surface of the posterior teeth to form a posterior bite plane.

a- Anterior bite plane

The principal use of the anterior bite plane is for the reduction of the overbite. This occurs primarily by alteration of the rate of eruption of the posterior teeth relative to the lower anterior. Several points must be considered during the construction of the anterior bite plane:

1. Vertically, the acrylic should be as high as that when the lower anterior teeth are in contact with the acrylic bite plane the premolars are separated by 2-3mm.
2. The posterior limit of the anterior bite plane should extend just sufficiently to engage the lower incisors.
3. The anterior bite plane should be made with the occlusal surface parallel to the occlusal plane. Inclined bite planes may cause unwanted movements. However this may be required in some cases.
4. Adjustment of the bite plane may be done by addition of acrylic which may be lost due to occlusal wear between visits.
5. If the lower incisors are irregular, adjustment of the bite plane surface is needed to provide contact with at least 3 lower incisors, then few visits later leveling of the occlusal plane is possible to lower anterior level.

b-Posterior bite plane

It is occasionally necessary to extend the base plate to cover the occlusal surfaces of the posterior teeth bilaterally to open the bite and so relief the incisal or cuspal lock while an anterior cross bite or a bucco-lingual abnormality is being corrected.

Few points must be considered during the construction of posterior bite plane:

1. The posterior bite plane should be thick enough just to disengage the interlocking of the anterior teeth and permit correction of cross bite.

2. The posterior bite plane should extend on the first molar and premolars and should be faceted to accommodate the cusps of the opposing teeth.

3. It must be simultaneously in contact in both sides, any correction must be made using articulating paper.

4. The mandible must be at a centric relation, this is achieved by putting a piece of modeling wax on the occlusal surface of the molars and premolars and instruct the patient to close in centric relation to the desired height. Then transfer the wax records with the upper and lower cast to the articulator.

5. It is important that the (tags) which is the parts of the clasp that crosses the occlusal surface must be free from acrylic of the bite plane, presence of acrylic surrounding the wire may cause limitation of the flexibility of the wire. This achieved by covering the wires with wax before applying acrylic.

2 Boxing, Open spring and Wire guard:

Those are three designs of the acrylic base plate around the palatal springs. **Boxing** (Figure 14) is to make the active arm and the coil free to move inside an acrylic chamber built into the base-plate, while **open spring** (Figure 13) is to completely remove the acrylic of the base-plate from the path of the movement and leave the active arm and the coil free without protection, the **guard wire (**figure 14**)** may be incorporate in the open spring design to prevent distortion of the spring during wearing and activation, it could be added from the tongue side or occasionally from both sides, it may also be used with the boxing design palatally for the same reason.

Boxing is made by covering the entire spring with wax except at the retentive part. The wax must also cover the area at which future activations may occur so that the spring will move freely along its range of action. The acrylic base plate material should then cover the palatal surface including the boxed spring with the same thickness which will form a bulge or elevation at the area of boxing. Then after the acrylic is set, a hot water bath will eliminate the wax leaving the spring to move in an acrylic chamber attached only at its retentive part with the acrylic.

Open spring and guard wire are made in the same manner except that the acrylic will not cover the boxed area but leave it opened with out acrylic or crossed by a piece of wire to protect the spring in case of guard wire (Figure:13) .

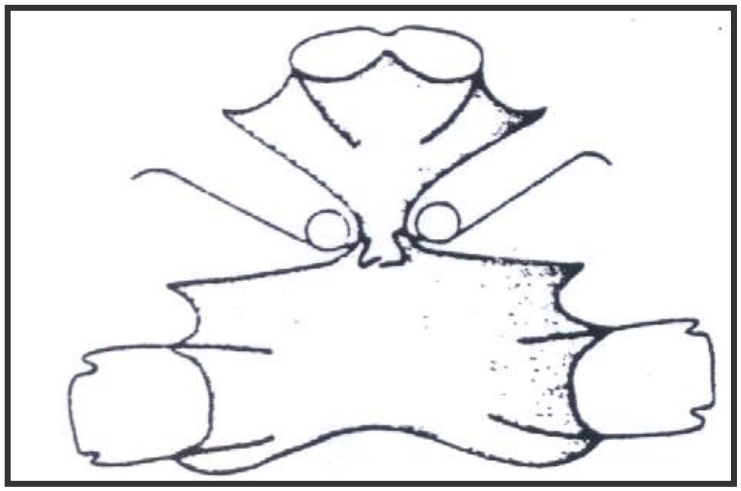

Figure13 Open spring

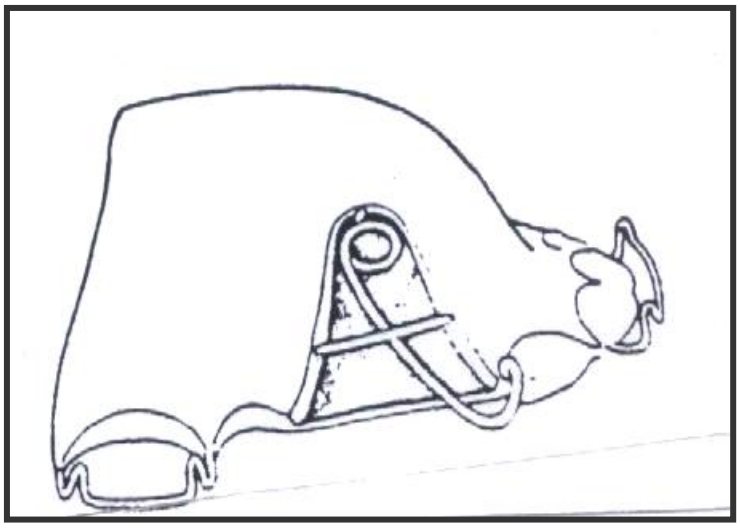

Figure14 Combined Boxing and Wire guard

Lab:14. Orthodontic Screws

3 Orthodontic Screws

An alternative method of providing orthodontic force is to use expansion screw as an integral part of the removable appliance (Figure 15). The screw normally transmits its force by means of acrylic, which comes in contact with the teeth. Many types of screw are commercially available for use in removable appliance (one dimension, two dimensions , fan shape, etc…), the type of the screw is specific for each case and have to meat the requirements of an Adequate travel, Stability and minimal bulk.

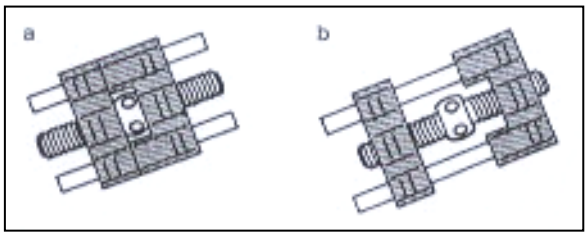

Figure15 Orthodontic Screws. A: 2sides; B: One Side.

Description:

Screws are produce by a number of manufacturers and a wide range of sizes and shapes are available.

Typically, the design has a central threaded screw, each end of which engages into a small metal or plastic block. One of this blocks caries two guide wires which lie parallel to the screw and pass through holes in the opposing block. The centre of the screw is enlarged into a small boss into which four radially positioned holes are visible. A small wire key is supplied and activation is made by insertion of the key

into one of these holes and turned like a capstan through 90 degree until it touches the guide. For further activations the procedure must be repeated with the key inserted into the next hole.

Uses:

Screws are recommended only in those few situations where spring will be unsatisfactory. Nevertheless, there are certain situations in which screws are very useful, for example

1. Expansion

It is some times necessary to increase the width of the upper dental arch or to correct a unilateral cross bite .Symmetrical widening of the upper arch could be achieved by removable appliance with suitable design containing four Adam's clasps on permanent molars and premolars. In this case the screw should be placed horizontally on the midline of the palate. In addition to a shallow posterior bite planes to prevent secondary lower arch widening (Figure 16).

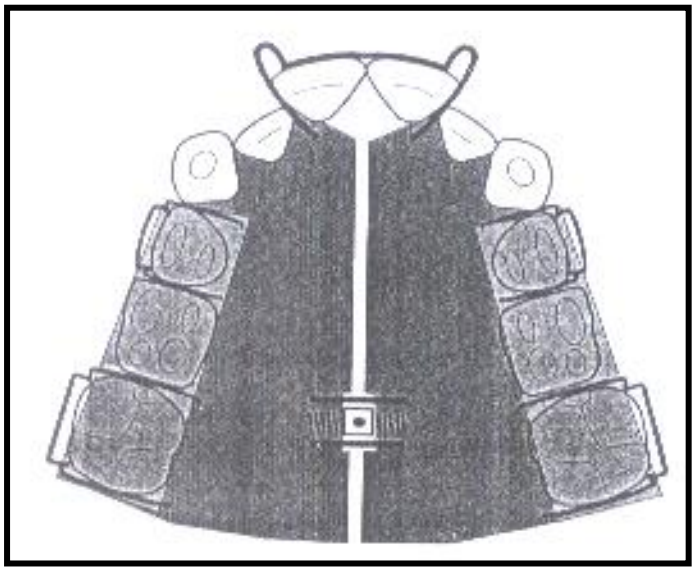

Figure16 Orthodontic Screw at the midline used for expansion

2. Distal movement:

Distal movement of molars could be achieved by a removable appliance carrying bilateral screws which will deliver distally directed force to the molars. Careful positioning of the screws will be necessary in accordance with the three dimensional orientations of the arch. A version with a screw only one side of the appliance is also useful in a situation for example if unilateral distalization of molar (Figure 17).

Positioning:

Although clasps and springs accept minor adjustment to correct faulty positioning, screws can only be corrected by cutting out the screw from the acrylic and re-fabricate it. It is therefore very important to accurately position the screw in the three dimensions during construction.

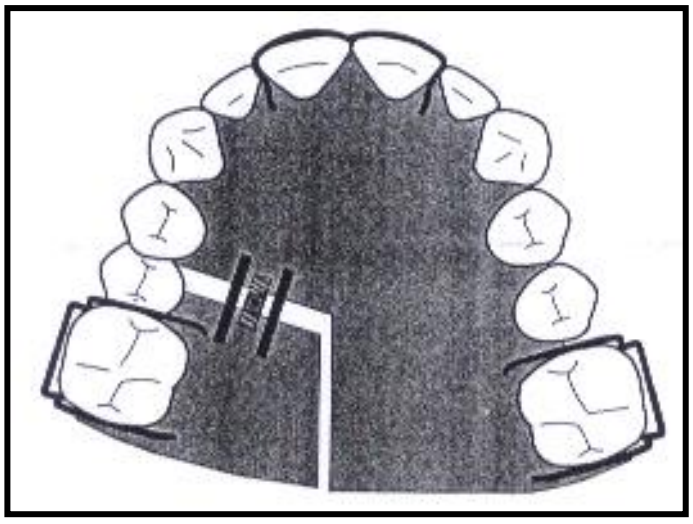

Figure17 Orthodontic Screw at one side of the arch used for distal movement.

Disadvantages

1. Most important is the bulky appliance that will cause discomfort to the patient.
2. over activation may cause difficulties in appliance incretion and will gradually lose its fitness
3. Full cooperation of the patient is required since relapse is quick and may elongate treatment time.

Adjustments:

Activation of the screw is done by inserting the key wire into one of the activation holes and turn the screw to the direction that will open the screw until the key touches the guide bars (the direction is usually marked by an arrow on the screw), this will make quarter turn. Farther activation means to repeat the previous work. Activations are done by the patient once or twice a week, each quarter turn will provide a 0.25mm opining that means about 1.5-2mm per month which is considered a reasonable amount of tooth movement.

References:

Sandhya, S.L., 2008. *Orthodontic Removable Appliance* 2nd ed., Jaypee.

Singh, G., 2007. *Textbook of Orthodontics* 2nd ed., Jaypee.