ORTHODONTIC REMOVABLE APPLIANCES

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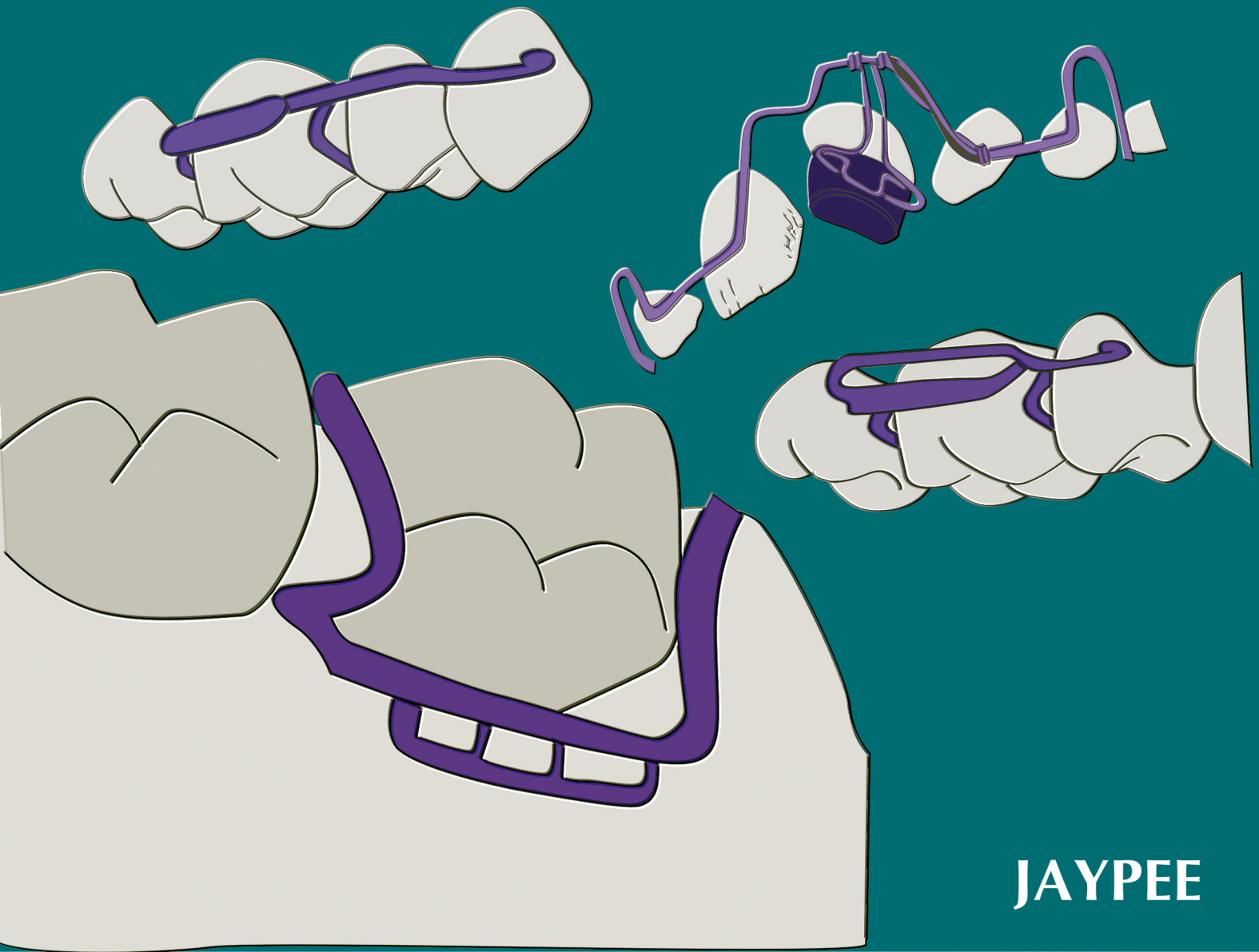

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Components of Removable Appliances

4

WIRE BENDING TECHNIQUE

Importance

By following the basic guidelines and principles of wire bending, we can accurately influence the desirable treatment that we want to give to the patient.

Approach to Wire Bending Problems

1. Use of one or two basically simple pliers.
2. The study of wire bending methods.
3. Elimination of unnecessary complications from wire work in appliance construction.

Principles and Methods of Wire Bending

1. Always hold the plier using a palm grip. Pliers should be used to hold the wire firmly and still.
2. It is easier to make a bend by pushing the wire, rather than by pulling the wire.
3. Adequate length of wire should be used so that a long end or 'tail' is available for manipulation.
4. Wire should always be arranged in such a way that the free end is held in the thumb which is used to bring pressure on the wire. The other fingers are wrapped around and help in grasping the wire.
5. Precise marking is necessary before making any bends.
6. During the wire bending procedure the plier should be held perpendicular to the floor.
7. The eyes of the operator must be at the level of the wire before giving the bend so as to ensure that the plane of the wire is not disturbed.
8. Sharp bends are made by working the wire as close as possible to the plier with the thumb as it is the only finger which gives a controlled, sustained and strong pressure around the wire.
9. If the wire has been sharply bent at a slightly incorrect position a correction can be made by gripping the incorrect portion in the tips of the plier beaks and then squeezed.
10. Smooth bends are made from a large number of small bends.

REMOVABLE APPLIANCE COMPONENTS

Classification

These components are basically classified into two categories:

1. Active
2. Retentive and anchorage

1. *Active component:* It is the member of appliance which is concerned with tooth movements and exerts force.
2. *Anchorage and retentive component:* These are the members of appliance which are concerned with holding the appliance in place and avoid any displacement of teeth. They are also called as reactive components.

Active components of an appliance are:

1. Springs
2. Screws
3. Elastics

Anchorage and retentive components of an appliance are:

1. Base plate
2. Clasps.

Classification of Springs

According to attachment (Figs 4.1A and B)

1. Attached at one end: cantilever spring
2. Attached at both ends: labial bow, coffin spring

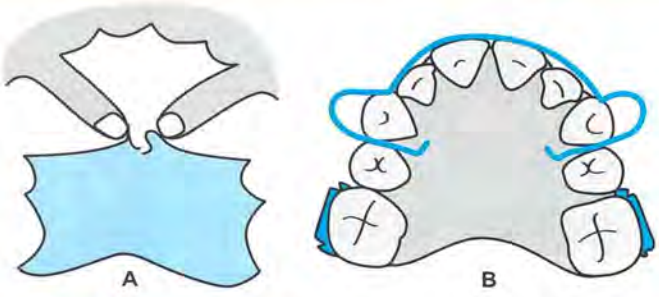

Fig. 4.1: (A) Attached at one end, (B) Attached to both ends

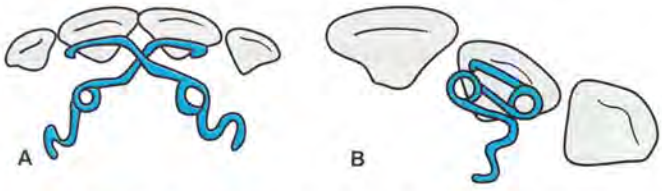

Fig. 4.2: (A) Single palatal cantilever, (B) Double cantilever

Number of arms in a spring (Figs 4.2A and B)

1. *Single cantilever:* The spring has only one arm and one coil.
2. *Double cantilever:* The spring has two arms and two coils. When two teeth are moved in same direction.

According to coil (Figs 4.3A and B)

1. *Spring with coil:* Any spring in which coil is included for its action is called as coiled spring.
2. *Spring without coil:* Any spring in which coil is not included for its action.

According to placement (Figs 4.2 and 4.3)

1. *Buccal/labial:* Spring is placed on buccal surface or labial surface of the teeth to be moved is called as buccal spring.
2. *Palatal/lingual:* Spring is placed on the palatal surface or lingual surface of teeth to be moved is called as palatal or lingual spring.

Palatal/buccal spring engages the mesial or distal surface of tooth to cause the movement in opposite direction.

According to force applied for tooth movement (Figs 4.4A and B)

1. *Push type:* Simple crown tipping by a force exerted against crown of a tooth by simple compressive contact without use of bracket or other attachment. For example, Labial wire of removable appliances is adjusted to exert refractive forces on crowns of upper incisors.

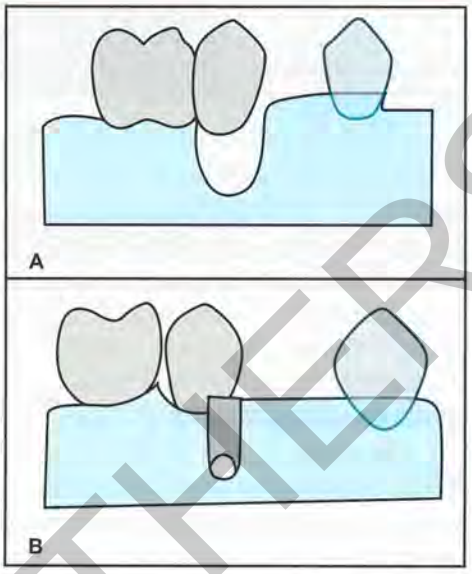

Fig. 4.3: (A) Spring without coil buccal spring (B) Spring with coil

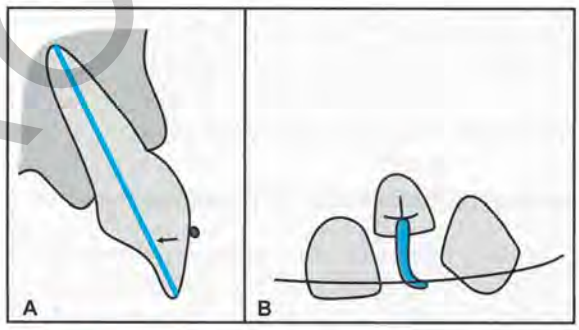

Fig. 4.4: (A) Push type of spring (B) Pull type of spring

2. *Pull type:* Simple crown tipping type force is exerted by one contact with one attachment. For example, retraction ligature.

According to design of spring (Figs 4.5A to C)

1. *Open spring:* Spring used for tooth movement is simply placed on palatal surface of plate (Fig. 4.5A).
2. *Boxed spring:* Spring used for tooth movement is protected inside a waxed chamber and above which acrylic plate is prepared. Thus a box is formed above the spring (Fig. 4.5B)
3. *Guided spring:* For smaller diameter springs, a spring of larger diameter is used to prevent the smaller and active from distortion (Fig. 4.5C)
4. *Self supporting springs* (Fig. 4.5D): Capable of standing of their own accord to the interference of the soft tissues of mouth during speech and

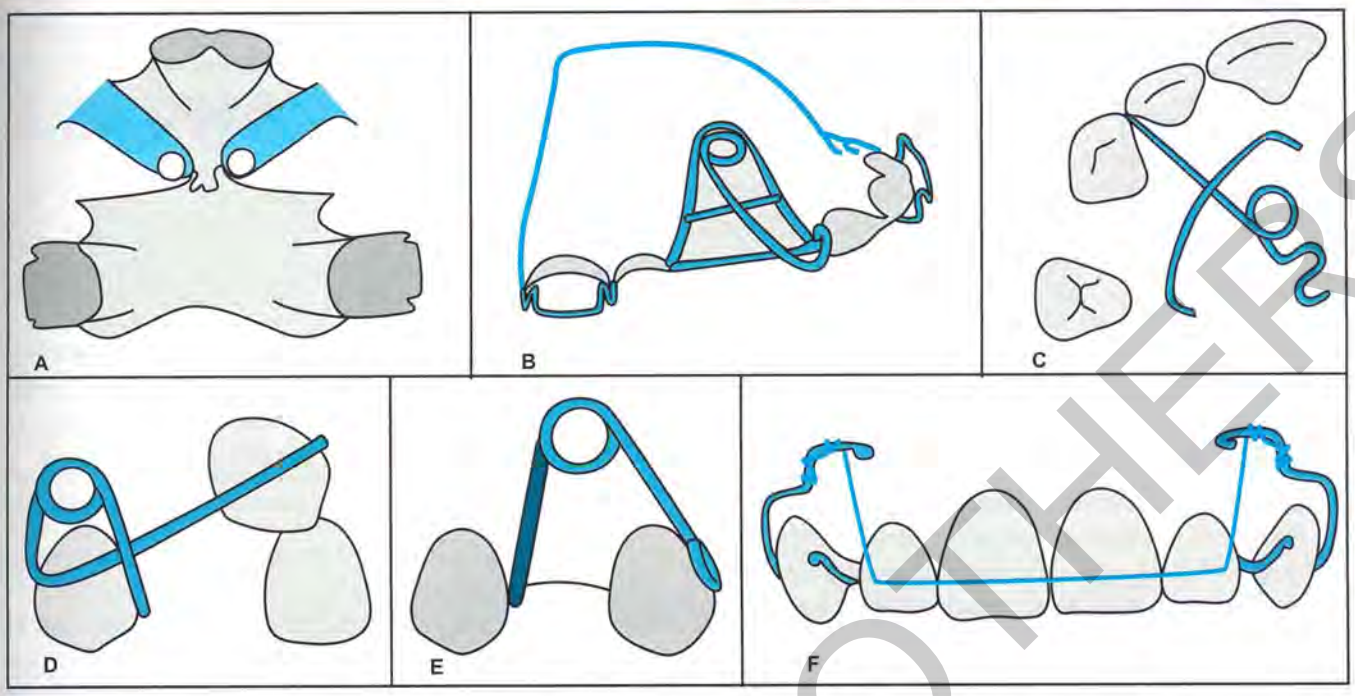

Fig. 4.5: (A) Obvious midline weakness produced by the use of bilateral open springs (B) Boxing in the spring provides protection and strengthens the base plate (C) A correctly sited guard wire is a useful accessory (D) This design may be useful where the sulcus is shallow. In this example a coil has been incorporated (E) This is an example of a well-proportional spring but the supporting arm enters the acrylic at gingival level (F) A light wire spring wound onto heavy supporting arms.

mastication without suffering damage and do not injure the soft tissues which lie against them.

Flexible enough to have useful range of action wire of 0.7 thickness is used.

Indication: when the use of heavy framework with spring is not possible self supporting spring is used. For example, buccal canine refractors (Fig. 4.5D), Palatal finger springs

5. *Supported springs:* The buccal arms of the springs are sheathed from the coil into the acrylic with hard stainless steel tubing of same but slightly larger diameter of spring to provide added strength. For example, Robert's retractor (Fig. 4.5E).
6. Appron's spring: It is a thinner gauge wire around a thicker gauge wire (Fig. 4.5F).

DESIGN OF SPRING (FIG. 4.6)

To design a spring for its action different factors are considered i.e. cantilever spring.

1. *Wire dimension:* Flexibility of wire depends on the length of wire and its diameter. Force generated by a given deflection of a simple cantilever spring is directly proportional to the fourth power of its diameter and inversely to the cube of its length.

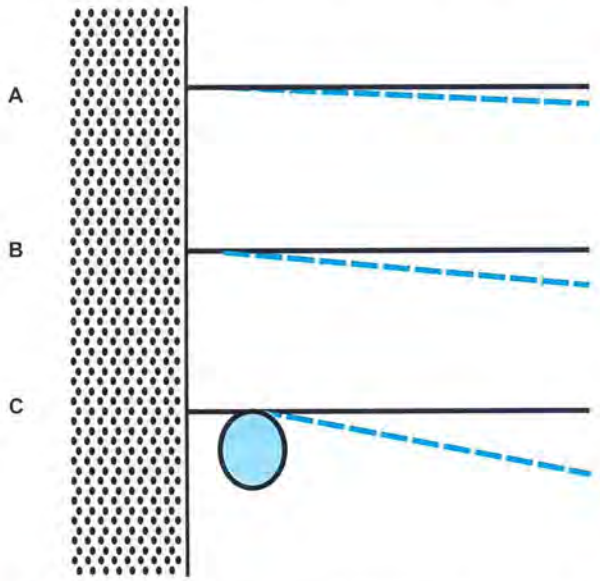

Fig. 4.6: The amount of displacement of a palatal cantilever spring to produce a force of 40 g. (A) Spring of 0-6 mm diameter (B) Spring of 0-5 mm diameter. (C) Spring of 0-5 mm incorporating a coil

$$F \alpha \frac{Edr^4}{l^3}$$

where F = force delivered, d = deflection
l = wire length, r = radius, E = Elastic modulus

2. *Deflection:* The process of bending a wire to give pressure for tooth movement. With layer deflection, patient is liable to insert the spring incorrectly.

   With smaller deflection, the force applied will drop off rapidly; thus, reactivation occurs frequently.

   Rate of tooth movement is 1 mm, so a deflection of 3 mm monthly adjustment is necessary. An activation of about one third of a tooth width will generate a force within the optimal range.
3. *Force:* For a single rooted tooth, it should be in the range of 25-40 gm. Excessive forces delay tooth movement overload anchorage and cause discomfort to patient.
4. *Direction of tooth movement:* This is determined by the point of contact between spring and tooth.

PRINCIPLES OF SPRING DESIGN (FIGS 4.7A TO C)

1. Force should be delivered at right angles to the long axis of tooth.

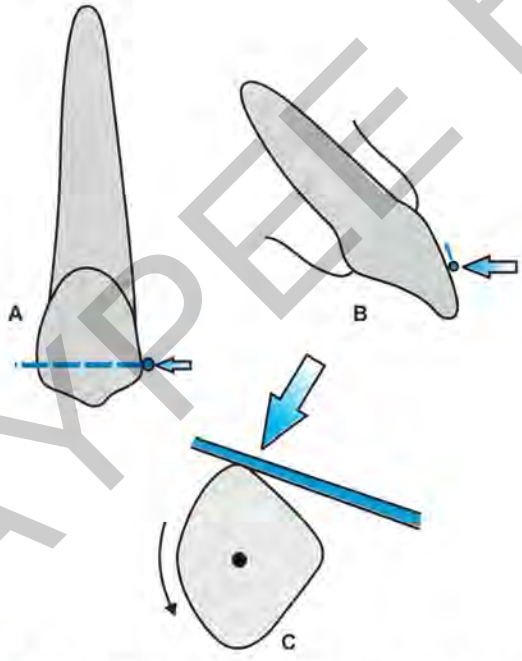

Fig. 4.7: (A) The ideal situation. It is possible to apply the force at almost 90° to the long axis of the tooth (B) Activation of a labial wire will cause it to move gingivally on proclined incisors (C) Activation of this palatal spring will tend to rotate the tooth mesio-buccally as it is retracted

2. As far as possible the force should be applied through a surface which is parallel to the long axis of tooth.
3. The force should pass through the center of resistance of tooth.

Cantilever spring components:

1. Arm
2. Coil
3. Tag

1. *Arm* (Figs 4.8A to C): It is the working end of spring, touches the surface of tooth from mesial or distal, labial or palatal side. Active arm of spring is virtually rigid and coil regarded as center from which arm pivots.

   Movement of arm will always be radial and movement of any point on it will be part of a curve with its center at coil.

   Path of movement of arm away from coil is straight line when it comes near to coil, it will be tight curve. So if the tooth to be moved, needs to travel in straight line, a long arm will be needed and if in a curve line; short arm.

   Gaugue of wire or diameter can be adjusted to suit the length of arm.

   It is necessary to turn the end of anterior arm through a right angle towards the midline of tooth and cut it off to leave 2 mm of spring which will engage the mesial edge of canine.

   Active arm of spring should remain in contact with tooth throughout its movement, so that continuous pressure is applied. It is situated in the gingival 1/3rd of the tooth to ensure bodily movement. Active arm should be long enough to be capable of activation for entire distance through which the tooth has to move.
2. *Coil (Fig. 4.9):* Introduction of a coil into a cantilever spring increases the effective length of the spring and makes it more flexible i.e. for the same activation a lower force is applied to the tooth to be moved. This increase in flexibility depends on the diameter of the coil, the number of turns, its position relative to the fixed end.

   Larger the coil, more flexible the spring.

   Due to inclusion of coil there lies an increase in range of action without increasing dimensions.

   Increase in the effective length of spring reduces the stiffness.

   Internal diameter should be about four times the diameter of wire.

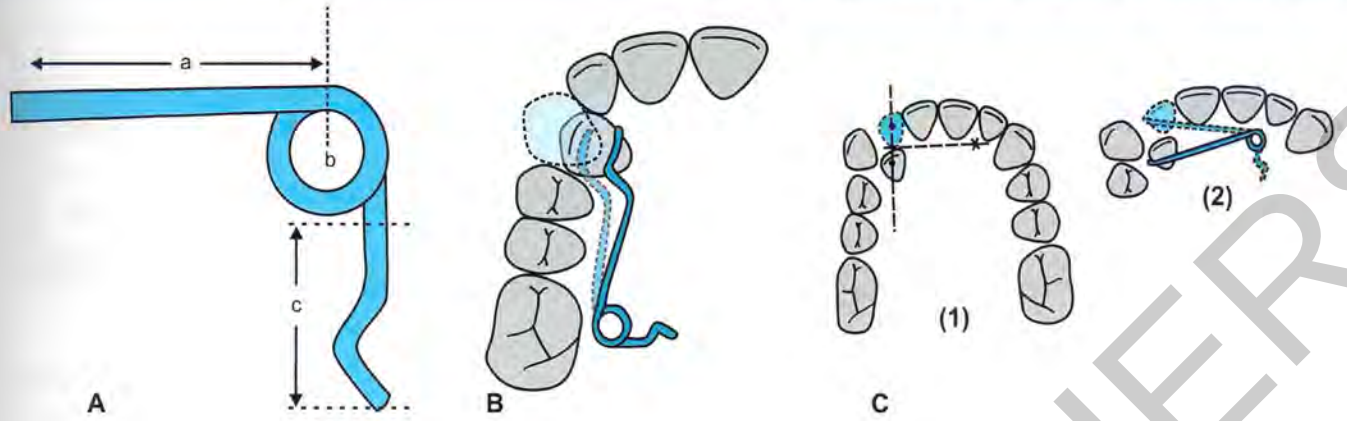

Fig. 4.8: (A) Parts of a finger spring (a) arm (b) coil (c) tag, (B) Spring with kinked arm to avoid contact with adjacent teeth (C) Geometric construction to show determination of position of coil b. Arm then maintains contact with tooth throughout its movement

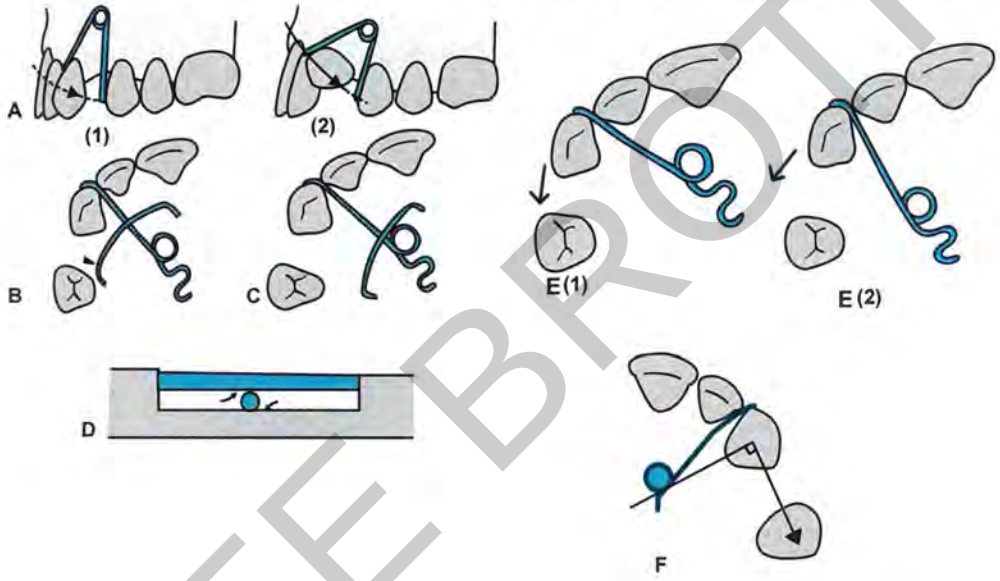

Fig. 4.9: (A) Position of coil for (A1) fully erupted tooth (A2) partially erupted tooth, (B) Incorrect, the guard wire will hinder the later stages of canine retraction (C) Incorrect, the guard wire is too close to the coil to be effective (D) Incorrect, there is insufficient clearance between the guard wire and acrylic to permit free movement of the spring. (E) The coil is correctly positioned to apply a force at right angles to the direction of desired movement (E1). Incorrect coil position is liable to produce unwanted buccal movement (E2). (F) The coil of palatal cantilever spring should lie on a line from the mid crown point on the tooth to be moved, perpendicular to the direction of movement

Spring should be activated in the direction in which the coil opens.

Flexibility of wire increases when the position of coil is close to the anchorage point i.e. at the point of attachment of spring to base plate.

More the number of turns in the coil, more flexible the spring.

Position of coil: A line is drawn joining the present position and desired position of the tooth. A perpendicular bisector is drawn to this line. Coil is placed along this line. It has stored energy and hence continuous action.

3. *Tag arm:* Length of tag should be 1/4th to 3/8th inch long.

It prevents the mesial migration of tooth means anchorage loss is prevented. End of tag is bent to remain in base plate for stability.

Distal tag arm end is bent to the mesial of tooth surface and it should be slightly shorter than mesial one, it is more convenient for base plate shape and extention on palatal surface.

ORTHODONTIC REMOVABLE APPLIANCES

Salient Features

- A complete and update text
- Explained in simplified and easy to grasp manner
- Focuses on important orthodontic removable appliances
- Covers all retentive, passive and active components, techniques of wire bending, plate construction and finishing, biomechanical consideration, practical management of different malaligned teeth, etc.

Useful for students, teachers and practitioners of dentistry.

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