GOOD MORNING YOUNG MINDS

SPRINGS AND RETRACTORS USED IN REMOVABLE APPLIANCES

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COMPONENTS OF REMOVABLE ORTHODONTIC APPLIANCES

Active component

- ✓ Springs
- ✓ Labial bows
- ✓ Screws
- ✓ Elastics

Retentive Component

- ✓ Clasps
- ✓ Bows

Anchorage

- ✓ Clasps
- ✓ Contact of baseplate with non-moving part
- ✓ Headgears
- ✓ Intermaxillary elastics

Baseplate

- ✓ **Forms the framework and also provides anchorage.**

Classification of springs

1. **Based on their ability to withstand forces of distortion:**

- ***Self-supported springs:***
  - i. Buccal canine retractor
  - ii. Helical loop canine retractor
  - iii. U-loop canine retractor
  - iv. Coffin springs

- ***Auxiliary springs:***
  - i. Apron springs

- ***Guided springs:***
  - i. Cantilever springs
  - ii. Finger springs
  - iii. Palatal canine retractor
  - iv. T-springs

2. Classification of springs based on their point of attachment:

- ***Free-ended springs:***
  - i. Cantilever springs
  - ii. Canine retractors
  - iii. Finger springs
  - iv. T-springs
- ***Springs attached at both ends:***
  - i. Labial bows
  - ii. Coffin springs
- ***Accessory springs attached to arches:***
  - i. Apron springs

Ideal requirements of springs

- Springs should be simple to fabricate.
- Spring should be easily adjustable.
- Should be capable of being seated in the correct position when the plate is inserted.
- Springs should fit into the space available without any discomfort to the patient.
- Should be easily kept clean.
- Should be robust and stable, i.e. should not slip when applied to a sloping tooth surface.
- Should deliver gentle forces.
- Should be able to apply forces of the required magnitude and direction for a given amount of activation.
- Should not produce unwanted tooth movement.
- Should not irritate the mucosa.

PARTS OF A SPRING

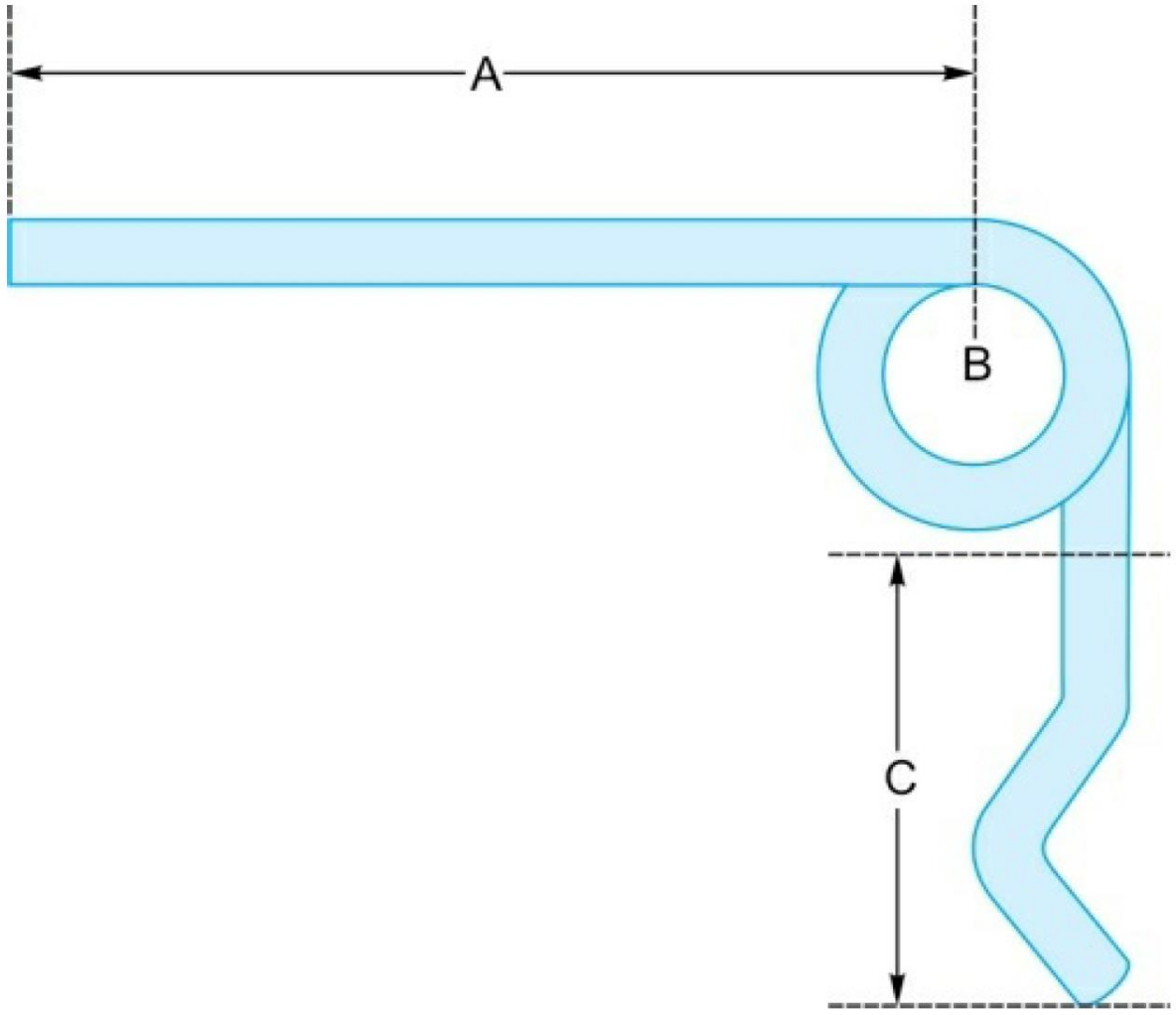


FIG. 18.18. Parts of spring: (A) active arm, (B) coil (or) helix and (C) tag on retentive arm.

Basic properties of spring

- The parts of a spring are (a) active arm, (b) coil or helix (c) tag.
- The force delivered by the appliance is calculated using the formula:

$$F \propto \frac{Er^4}{L^3}$$

Doubling the diameter increases the force or stiffness by 16 times.
➤ Doubling its length reduces the force by 8 times.

L = Wire length
r = Radius
E = Elastic modulus of the material

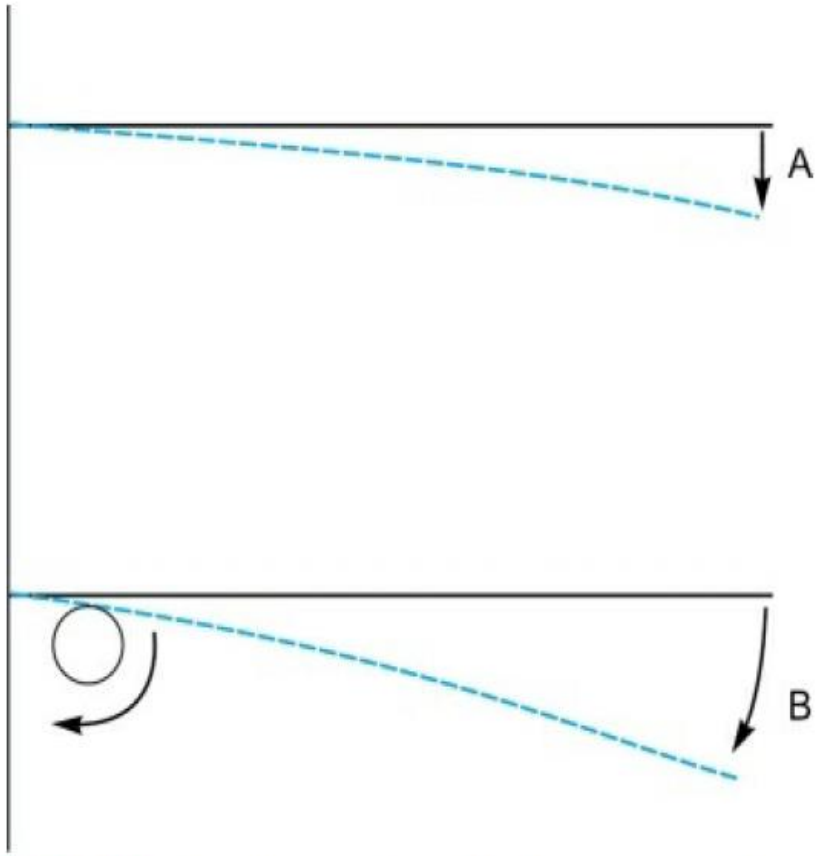


FIG. 18.19. Cantilever principle of spring and effect of incorporating coil. (A) Less deflection and (B) more deflection with incorporation of coil.

➤ The deflection for a given load is proportional to the **third power of the length of the spring and inversely to the fourth power of its diameter.**

➤ Incorporation of a coil increases the effective length of the spring and thereby increases the deflection.

$$\text{Deflection} = \frac{L^3}{D^4}$$

Coils

➤ The coil diameter should be 2.5 mm minimum.

➤ Incorporation of coil increases the effective length of the spring and reduces the force.

➤ For maximum efficiency, coil should be made in such a way that it unwinds as it is activated.

➤ ***Placement of coil*:** Coil is placed close to the attachment of the spring to the base plate. This increases the range of the appliance.

1.Buccal canine retractor

- **Wire used:** 0.7 mm or 21 gauge stainless steel wire.
- **Indication:** Buccal canine retractor is used where a buccally placed canine has to be moved both palatally and distally.
- ***Spring design***:

• It is one of the few springs where the **coil is closed for activation**.

• The end of the spring is bent at right angle to the canine to be moved.

• Then it is shaped to the tooth.

• Coil is placed as high as possible without interfering with the soft tissues.

• Tag should cross over the mesial contact point of second premolar.

• Coil should be placed in between the present and future position of canine (**distal to long axis of canine**)

• If thinner wires are used (0.5 mm), then they are sleeved to prevent distortion.

FIG. 18.21. Buccal canine retractor.

Activation of buccal canine retractor

- The coil should be activated by only 1 mm.
- It is activated by closing the coil.
- Activation is done by using 'hollow chop' pliers like Mathews or Andresen's.
- Spring is activated by bending the anterior arm using these pliers.

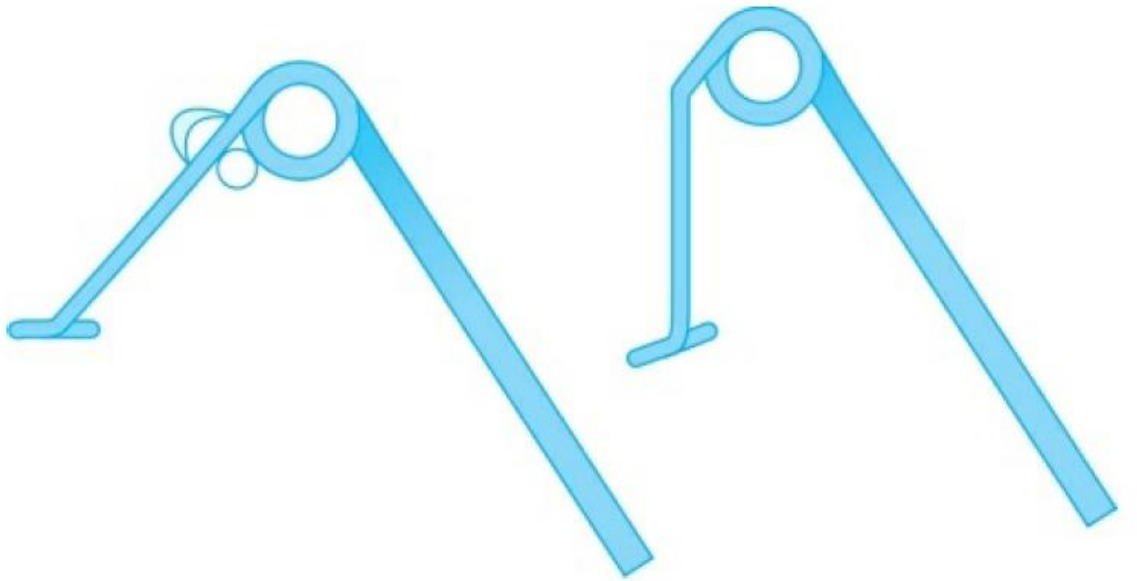


FIG. 18.22. Activation of buccal canine retractor using hollow chop plier.

2. Reverse loop canine retractor

- **Synonym:** *Helical loop canine retractor.*
- **Wire used:** 0.7 mm or 21 gauge stainless steel wire.

Indications:

1. In patients with shallow sulcus depth for retraction of canine

2. Mostly used in mandibular arch.

- ***Spring design:***

• Parts of the spring:

1. Helix/coil

2. Active arm

3. Retentive tag

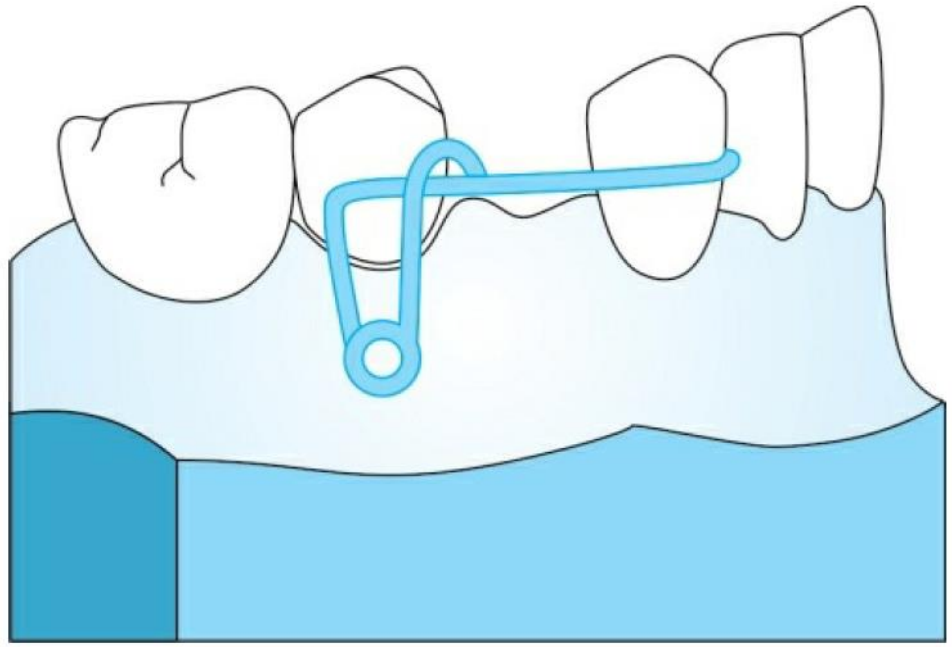


FIG. 18.25. Reverse loop canine retractor.

- The active arm starts from the mesial cervical aspect of canine. It can be made to encircle the mesiolingual aspect of canine.
- The active arm proceeds backwards up to the distal of second premolar.
- From there, a helix is made with a minimum diameter of 2.5 mm.
- The retentive part of the spring crosses the active arm in the mesial aspect of second premolar.
- The height of the coil is made according to the depth of the sulcus.

- ***Drawbacks of helical loop canine retractor:***

1. It is stiff in the horizontal plane.
2. Unstable vertically.

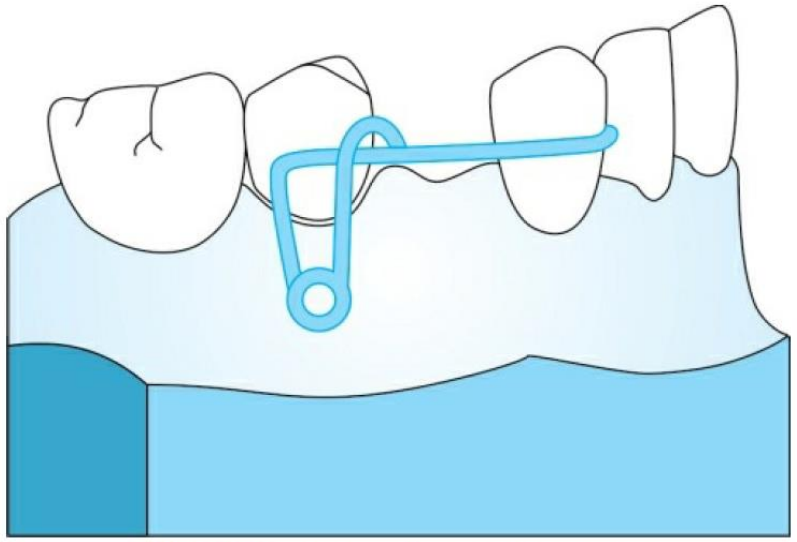


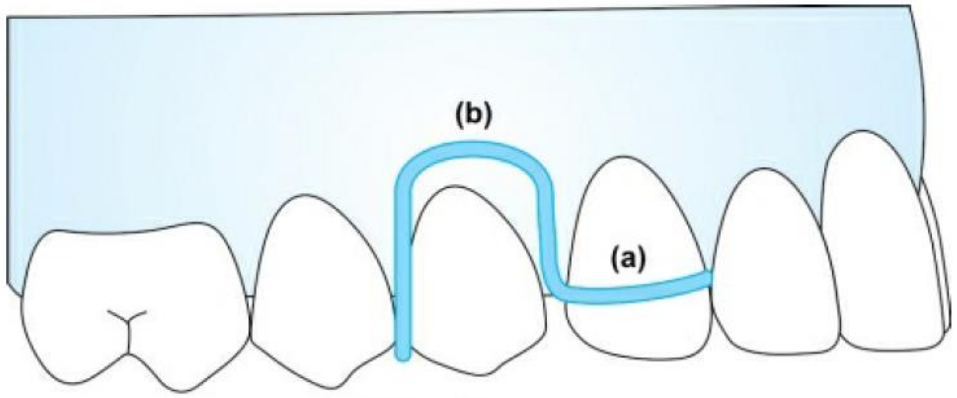
FIG. 18.25. Reverse loop canine retractor.

Activation:

- There are two methods. In both the methods, it should not be activated more than 1mm.

- **Method 1:** Consists of cutting off 1 mm of wire from the free end and reshaping it to engage the mesial surface of canine.
- **Method 2:** By opening the coil by 1 mm.

3. U-loop canine retractor



a– active arm
b– U loop

FIG. 18.26. U-loop canine retractor.

- **Wire used:** 0.7 mm or 21 gauge wire.
- Indications:

1. Indicated when only distal movement of canin is required.
2. Minimal distal movement of canine is achieved with this retractor.

Spring design :

The parts of the springs are (i) active arm, (ii) U-loop and (iii) retentive tag.

- The active arm engages the mesial surface of the canine at the cervical level and proceeds posteriorly to form the U-loop.
- The U-loop is made in a similar fashion like labial bow. The mesial end of the U-loop starts at the premolar bent at right angle, the width of the loop depends on the width of premolar.
- It extends 2–3 mm below the cervical margin.
- Finally, curved around into the interdental area between the premolars.

- *Disadvantage:*

This is the least efficient of all the canine retractors.

- *Advantages:*

- Very easy to fabricate
- Simple in design
- Not bulky.

- *Activation:*

It is activated by closing the loops by 1 mm.

4. Coffin springs

Coffin spring was introduced by **Walter Coffin.**

Wire used: 1.25 mm heavy stainless steel wire.

Indications:

1. Expansion of constricted maxillary arch
2. Correction of crossbite
3. Conditions requiring differential expansion.

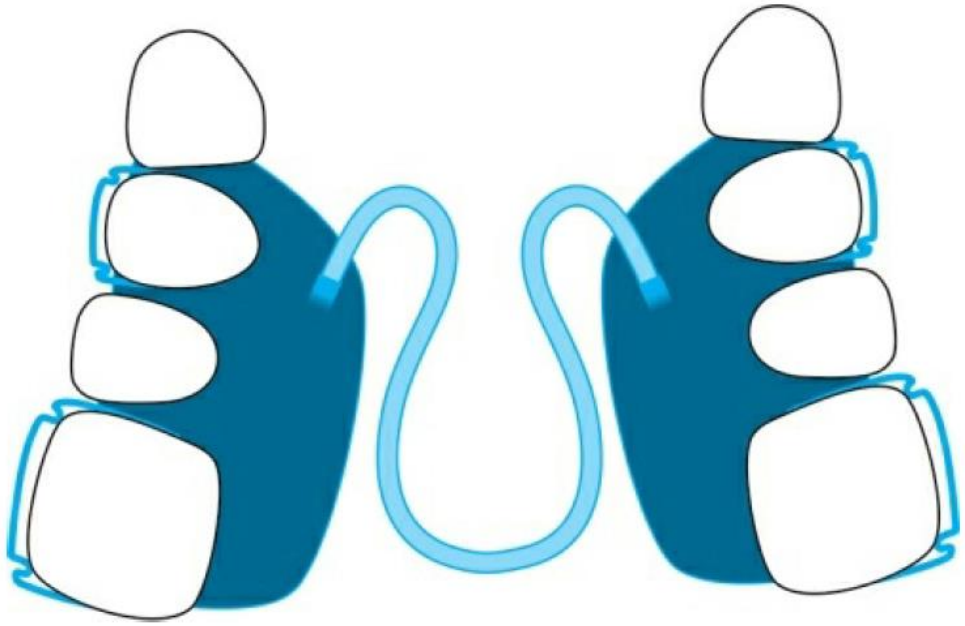


FIG. 18.27. Coffin springs.

Spring design :

- The spring consists of U- or omega-shaped loop positioned in the midpalatal region. The distal ends of the U-loop are limited to the distal of first permanent molar.
- Anteriorly, the loop gets constricted and recurved into the base plate.
- It is a continuous type of spring where both ends are fixed to the base plate.
- The wire should be placed 1 mm away from the mucosa.

Advantages:

- Cheaper when compared to expansion screws.
- Differential expansion of arch in the premolar or molar region is possible.
- Less bulky.

Disadvantage:

- Coffin spring tends to be unstable, if it is not made precisely.

Activation:

- Marking pits are made on both sides of the plate by drilling. This allows the width of the appliance to be checked.
- Pliers should not be used for activation.
- Appliance is activated by expanding the appliance manually by pulling the sides apart, first in the anterior region and then in the posterior region.
- Adequate care should be taken to maintain the two sides of the appliance in the same plane. If the plane changes, appliance may not fit properly.
- An expansion of 2–3 mm is made during activation.

II. Guided springs

- Various guided springs:

1. Cantilever springs – (a) single cantilever, (b)double cantilever
2. Finger springs
3. Palatal canine retractor
4. T spring

- ***Guided springs are so-called because they cannot resist distortion on their own. They are usually made of 0.5 mm wires. To protect the wires from distortion, two methods are employed:***

a. ***Placing guide wires:*** These are incorporated in the spring design

These curves are made in such a way that they lie above the active arm. Any distortion forces will be directed to the guide wires first which bear the brunt of the force.

b. ***Boxing of springs*** :

- To prevent damage, the spring placed on the palatal aspect can be boxed.
- When it is boxed, spring lies in the gap between the base plate and the mucosa.
- When doing this, care should be taken so that the free movement of active arm is not interfered with it.
- It should have a flat smooth surface.

1. Single cantilever spring

a– Tag, b– Coil, c– Active arm

FIG. 18.30. Single cantilever spring.

Wire used: 0.5 mm either with a guide wire or boxed in.

Indication: Labial movement of incisors.

Spring design:

A single cantilever spring consists of three parts:

- *Tag* is embedded in the acrylic resin of the base plate.
- *Coil* is the active part of the spring. It is normally made so that it tends to open on use or activation.
- *Active arm* which is in contact with the tooth to be moved.

The arm of the spring is placed at right angles to the required path of tooth movement. Coil is placed as far away as possible. If there is a crossbite, bite is raised by giving a posterior bite-block.

Activation:

- *First visit:* Activated by 1–2 mm.
- *Subsequent visits:* Activated by 2–3 mm.
- The spring is activated by opening the coil by two methods.

Method 1: Open the coil in the free arm of the spring as close as to the coil.

Method 2: Tension can be given to cantilever spring by squeezing the coil with the tip of the pliers.

- ***Modifications:***
- *Cranked cantilever springs:* Cantilever springs should be cranked, if required to keep it clear of the other teeth. Stability is better with cranked cantilever springs

2. Double cantilever springs

- **Synonym:** 'Z' spring
- **Wire used:** 0.5 mm or 23 gauge hard stainless steel wire.
- ***Indications:***

• Double cantilever springs are used when both labial and lateral movement of the incisors are required.

• Minor rotation correction can be achieved.

• When two or more teeth have to be moved labially.

FIG. 18.33. Double cantilever or 'Z' spring.

Spring design:

Spring consists of two coils.

• It is placed perpendicular to the palatal surface of the tooth.

• The length of arm varies depending upon the number of teeth to be moved labially.

• Double cantilever springs are supported either with guide wire or boxed in.

Activation:

- Spring is activated by opening the coil.
- 1. Lateral movement is produced by opening the right-handed coil.
- 2. Forward or labial movement is produced by opening the left-handed coil

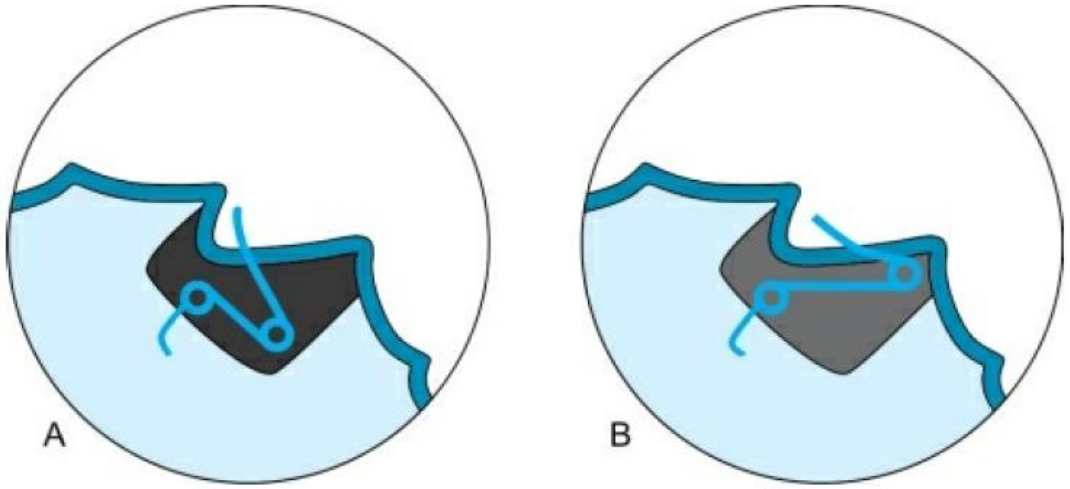


FIG. 18.34. Activation of double cantilever spring. (A) Activation of right-handed coil and (B) activation of left-handed coil.

3. Finger springs

- **Wire used:** 0.5 mm or 23 gauge stainless steel wire.
- ***Indications:***

• Mesiodistal movement of teeth.

• Closure of median diastema.

• Used for teeth in the line of arch only.

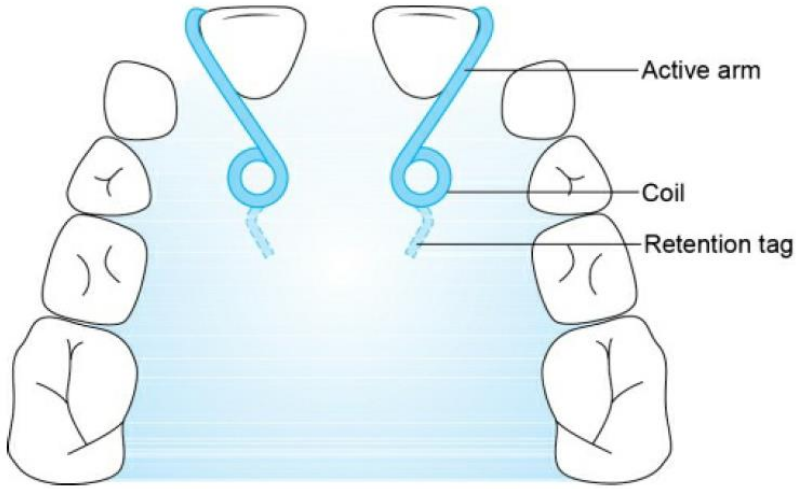


FIG. 18.36. Finger spring.

- ***Spring design:***

Parts of the springs: (i) active arm (ii) coil and (iii) retention tag.

• *Active arm* contacts tooth surface at right angles to the desired tooth movement.

• *Coil* should be placed as far away possible to have a good range of action. It is centred on the line through the midpoint of the tooth and perpendicular to its intended path. In simple terms coil should be positioned between the present and future position of the tooth to be moved. Coil size should be 2.5–3 mm.

- **For maximum efficiency, coil should be placed on the opposite side of the tooth movement.**

• For distal movement, coil is placed on the mesial aspect of the tooth. For mesial movement, coil is placed on the distal aspect of the tooth.

• The active arm, coil and retentive tag lie in the same line.

• Finger springs are either given with a guide wire or boxed in.

- ***Activation:***

• **Method 1:** Spring is activated by opening the coil by 2–3 mm.

• Pull the free arm of the spring slightly away from the point of emergence from coil.

• **Method 2:** Tension can be given to finger spring by squeezing the coil with the tip of the pliers

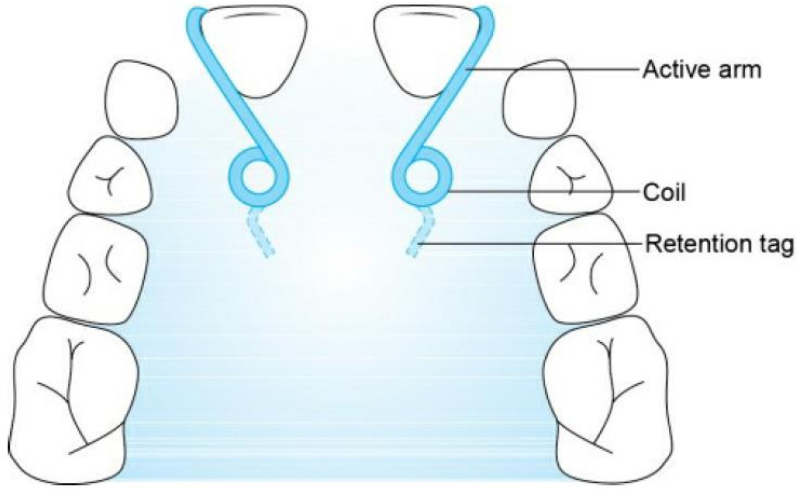


FIG. 18.36. Finger spring.

4. Palatal canine retractors

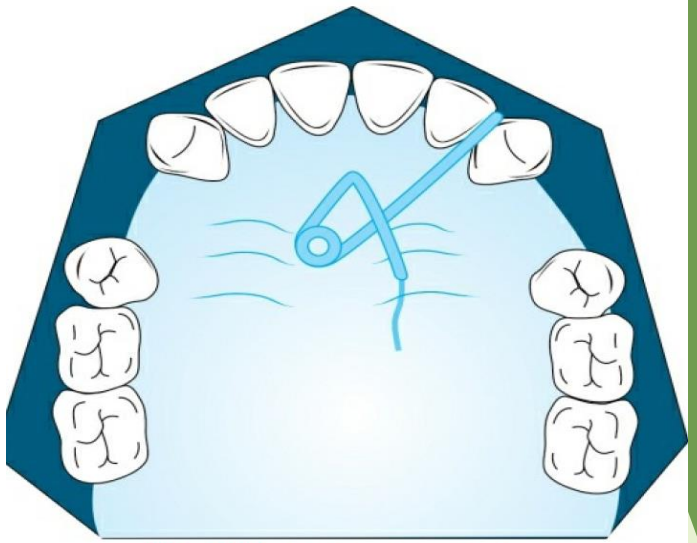


FIG. 18.37. Palatal canine retractor.

- **Wire used:** 0.5 mm or 23 gauge hard stainless steel wire.
- ***Uses:***

1. Distalization of palatally placed canine.

2. Distal movement of premolar.

Design

- Palatal canine retractor consists of three parts: (i) active arm, (ii) coil and (iii) retentive tag.

1. ***Active arm*** contacts tooth surface at right angles to the desired tooth movement.

2. ***Coil*** should be placed as far away as possible to have a good range of action. It is centred on the line through the midpoint of the tooth and perpendicular to its intended path. Coil size should be 2.5–3 mm. For maximum efficiency, coil should be placed on the opposite side of the tooth movement. For distal movement, coil is placed on the mesial aspect of the tooth. For mesial movement, coil is placed on the distal aspect of the tooth. The active arm, coil and retentive tag lie in the same line.

3. ***Retentive tag*** gets embedded in the acrylic plate.

5. T-springs

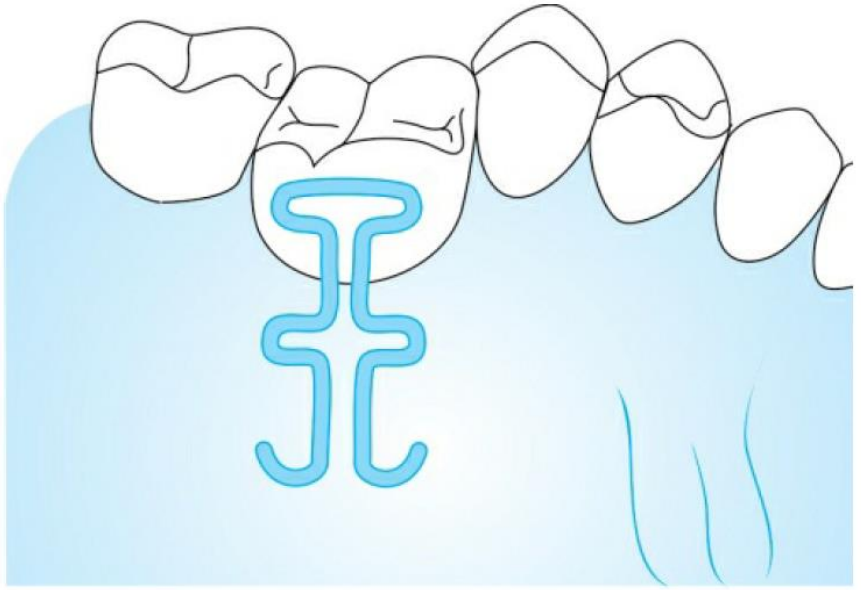


FIG. 18.38. T-springs.

- **Wire used:** 0.5 mm or 23 gauge hard stainless steel wire.
- **Indication:** Used for buccal movement of premolar and molar
- *Spring design*

• Spring is made up of T-shaped arm.

• The retentive arm is embedded in base plate.

• T-springs have got both vertical and horizontal force component. If the contact surface is vertical (e.g. premolar), the intrusive component is less.

• If the contact surface is sloping (e.g. canine), tooth intrusion might take place.

• Adjustment loops are incorporated to allow the spring to be lengthened.

- ***Activation:***
- Spring is activated by pulling it away from the base plate towards buccal direction.

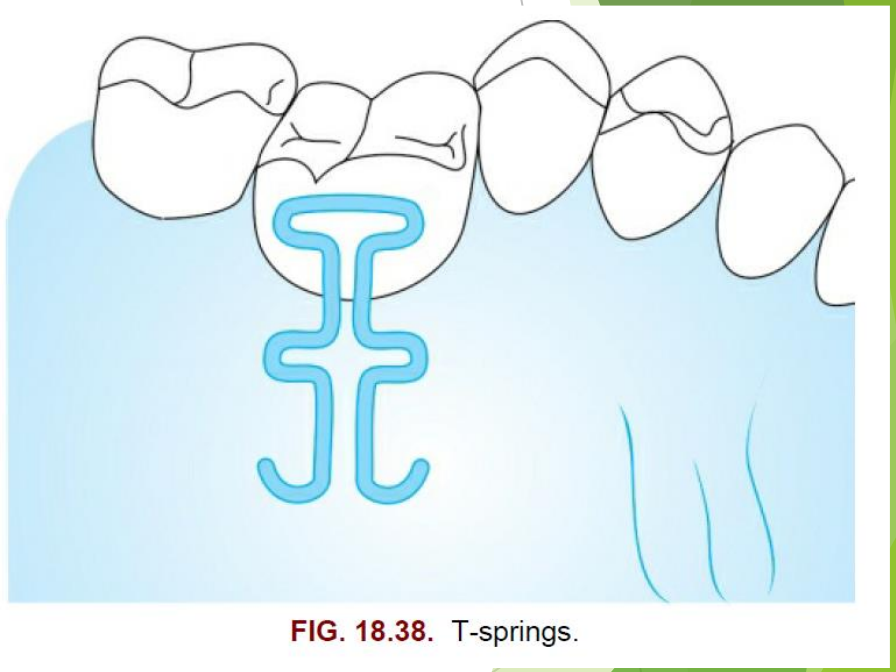


FIG. 18.38. T-springs.

Base plate

- Base plate serves to hold the components of the removable appliances.
- Base plate forms the framework of the appliance.
- 1. As a base of operation
- 2. As anchorage
- 3. As an active component
- **Maxillary plate and Mandibular plate dimensions**
- ➤ *Size:* **1.5–2 mm** thick.
- ➤ *Extension:* Extended up to distal of first permanent molar.

ACCESSORY POINTS

- Removable appliance generates ***intermittent force*.**
- Labial bow was designed by ***Charles A Hawley*.**
- The most important step in the fabrication of Adams' clasp is *establishing the bridge length.*
- The angulation of the arrowhead to the bridge in Adams' is ***45°*.**
- Split labial bow was designed by ***Bass NM** and **Robinson SN.***
- Clear acrylic is preferred to coloured acrylic as base plate material because ***areas of irritation can be detected.***
- Helix or coil is incorporated in a spring to increase the ***flexibility and range of action.***

THANK U GUYS