ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 10, Issue, 10, pp.74614-74621, October, 2018

DOI: https://doi.org/10.24941/ijcr.32493.10.2018

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

REVIEW ARTICLE

MOLAR DISTALIZATION- A REVIEW

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ARTICLE INFO

Article History:
Received 06th July, 2018
Received in revised form
27th August, 2018
Accepted 29th September, 2018
Published online 31st October, 2018

Key Words:
Non-extraction,
Class II molar relation,
Molar distalization.

ABSTRACT

Non-extraction orthodontic treatment implies the correction of malocclusion and thereby improvement in facial profile, aesthetics and smile without sacrificing permanent tooth/teeth. Every clinician is tempted to treat his cases by non-extraction mode of treatment, and this mode of treatment is more desirable for patients undergoing orthodontic treatment. There are a number of methods (Arch expansion, interproximal reduction, proclination of teeth, molar derotation, use of functional appliances) to gain space to resolve limited crowding and protrusion so that some malocclusions can be treated without extraction. Each method has its own advantages and disadvantages and specific indications. A child with class I bases and acceptable profile, with minimal space requirements for relief of crowding or mild protrusion can possibly be best treated without sacrifice of tooth material. In the last two decades, orthodontic treatment strategies have been shifted towards nonextraction treatment and several methods which were not so popular, were lately modified for adaptation in current practice. Intraoral molar distalization is one such example. This article provides a comprehensive review of the various methods used for molar distalization.

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Citation: ***Dr. Abdul Baais Akhoon and Dr. Syed Zameer,*** **2018.** "Molar distalization- A review", *International Journal of Current Research*, 10, (10), 74614-74621.

INTRODUCTION

Class II malocclusions, which are the most numerous among orthodontic cases, can be resolved by several procedures.
Correction of class II malocclusion without extraction requires maxillary molar distalization by means of intraoral or extra-oral forces. Molar distalization is a technique by which molars are distalized by internal or external appliance to gain arch length in non extraction cases , mostly maxillary molars are distalized in a class II div 1 cases where sagittal correction is required and mandible is normal.

Indications For Molar Distalization

In a growing child

to relieve mild crowding
causes permanent increase in arch length of about 2mm on each side.

Late mixed dentition: Upper molars are distalized to get a class I relation.

End on molar relationship with mild to moderate space requirement (Fig. 1)

- Cases with a full cusp class II molar relationship (Fig. 2)
- Class I malocclusion- with highly placed /impacted canine
- Lack of space for eruption of premolars due to mesial migration of permanent first molars
- Good soft tissue profile
- Borderline cases
- Mild to moderate space discrepancy with missing 3rd molars/2nd molars not yet erupted
- Normal or hypo divergent growth pattern

Contraindications

- Patient with retrognathic profile
- When Patients with vertical growth pattern
- 3 molars have erupted or close to eruption
- Patients with skeletal or dental open bite.

Radiographic assessment

- Absence of upper 3rd molars offer better prognosis
- Posterior crowding as indicated by distal angulation of the molars make distalization unsuitable.

Case selection

- Late mixed dentition
- Normal or near normal mandibular arch
- Dental class II with skeletal class I
- 3rd molars-absent
- Profile considerations- well developed nose and chin
- High MPA- Contraindicated
- Space discrepancy- not very severe.

Classification

1. Location of appliance
   - Extra-oral
   - Intra-oral
2. Position of appliance in mouth
   - Buccal
   - Palatal
3. Type of tooth movement
   - Bodily movement
   - Tipping movement
4. Compliance needed from patient
   - Maximum compliance
   - Minimum or No compliance
5. Type of appliance
   - Removable
   - Fixed
6. Arches involved
   - Intra-arch
   - Inter-arch

Various appliances used for Molar Distalization

- ACCO appliance
- Bimetric distalizing arch
- Cetlin appliance
- Distal jet appliance
- Magnets
- Fixed piston appliance
- First class appliance for molar distalization
- Herbst appliance
- Jones jig
- K-loop molar distalizer
- Lokar molar distalizer
- Pendulum appliance
- Super spring II
- Superelastic nickel titanium wire
- Franzulum appliance
- Lip bumper
- Implants

Pendulum appliance

James J Hilger , JCO 1992 (Fig. 3)

- Nance button
- .032 TMA springs
- Broad swinging arc (Pendulum) of force from midline of palate to upper molars

Standard Pendulum appliance

Pendulum springs consists of

- Recurved molar insertion wire
- Horizontal adjustment loop
- Closed helix
- Loop for retention in acrylic button.

The springs are extended as close to the center of the palatal button as possible

- to maximize their range of motion,
- to allow for easier insertion into the lingual sheaths,
- to reduce forces to an acceptable range.

The anterior portion of the appliance can be retained in several ways:

- In the first appliances that were made, the Nance button was held in place with occlusally bonded rests on either the deciduous molars or the first and second bicuspids
- At present, the most stable method of retention is to band the upper first bicuspids or first deciduous molars, solder a retaining wire to the bands, and use these teeth as the major anterior anchorage for the appliance
- The Nance button should be made as large as possible to prevent any tissue impingement. It should extend to about 5mm from the teeth, to avoid the highly vascular cuff of tissue near the teeth and to allow adequate hygiene.

Preactivation and placement (Fig. 4)

- Springs are bent parallel to midline of the palate
- Molar bands cemented
- Anterior portion of appliance later cemented
- Pendulum spring brought forward and engaged in lingual sheath.

Advantages

- Excellent patient tolerance
- Upto 5mm distalization in 4 months
- Distalization + Expansion
- Patient compliance not needed.

Pend-X

- If expansion of the upper arch is needed, a midpalatal jackscrew can be incorporated into the center of the Nance button

- The screw is activated one-quarter turn every three days, after a week or so for patient adjustment, to produce a slow, stable expansion.
- This version of the appliance is called a "Pend-X".

The Pendulum springs are so efficient in expanding and rotating the upper first molars that Pend-X can be used for three or four months at the beginning of treatment whenever any expansion or change in anterior arch form is indicated.

Fig. 1 End-on molar relation

Fig. 2 Class II molar relation

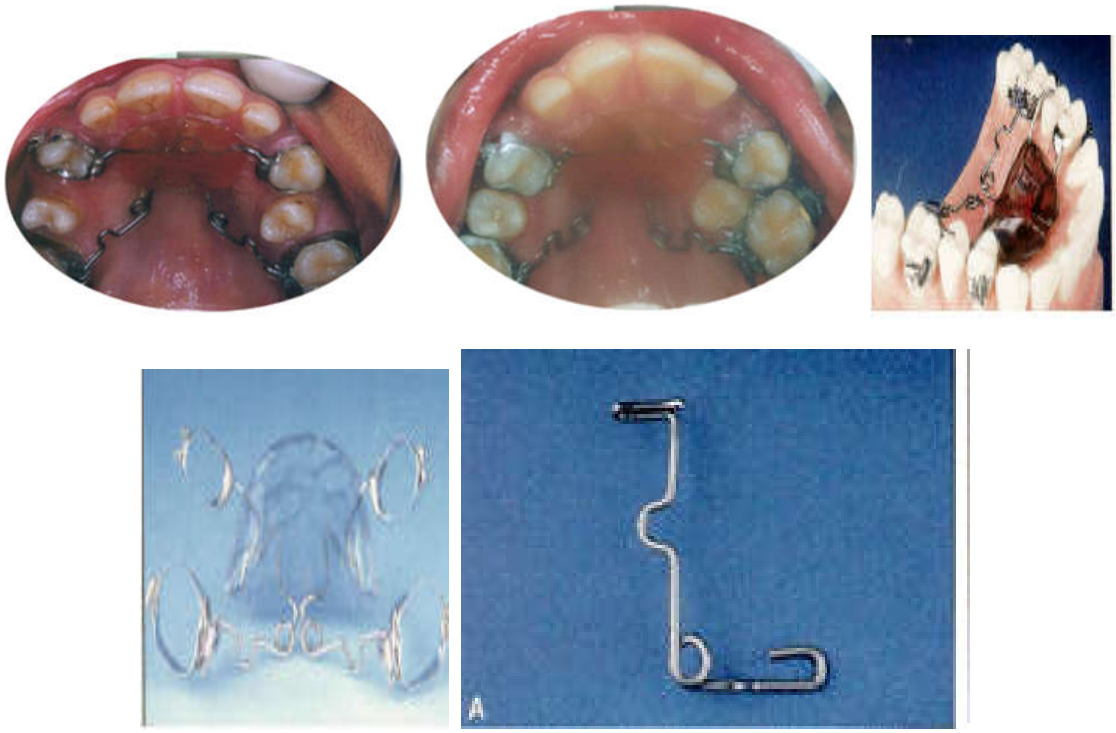

Fig. 3. Pendulum Appliance

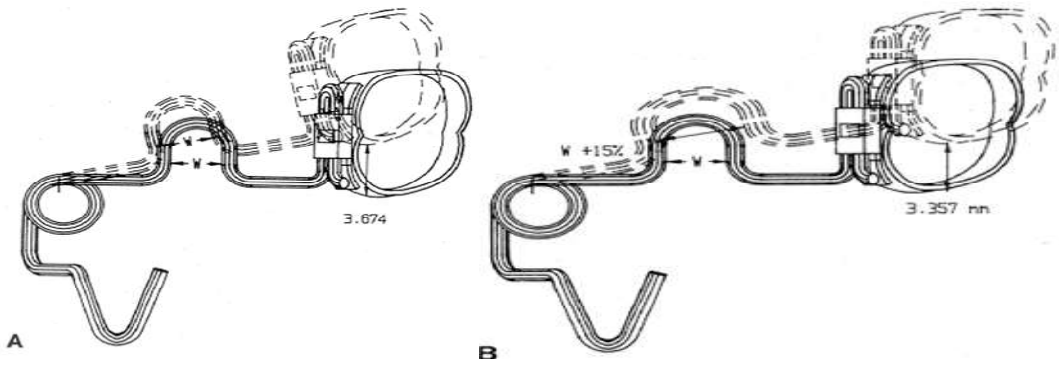

Fig. 4. Activation of Pendulum Appliance

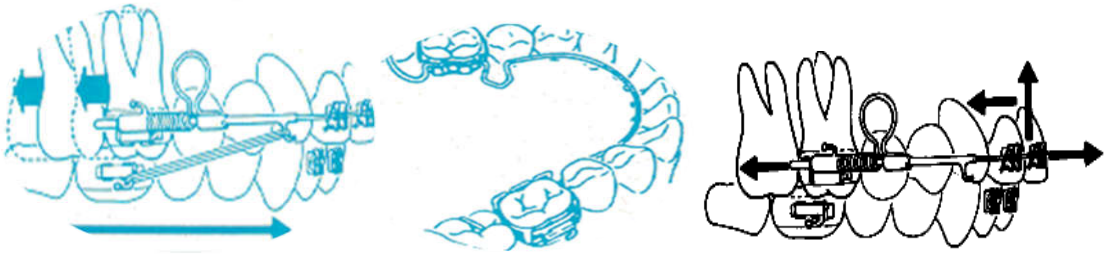

Fig. 5. Wilson Distalizing Arch

3D Bimetric Distalizing arch (Wilson and Wilson, JCO 1987). These are modular phase appliances designed for multidirectional functional class II treatment. Maxillary molars and buccal segments are distalized bilaterally or unilaterally without headgear, using a 3D Bimetric Distalizing Arch and 3D mandibular Lingual Arch with Class II elastics.Elgiloy open coil spring is placed between omega loop and buccal tubes for activation (Fig. 5). In many Class II, division 2 cases, distalizing to an end-on position allows the posteriorly locked mandible to advance immediately to a Class I position. Class II elastics allow the functional release of any mandibular growth potential.

ACCO Appliance, Bernstein JCO, 1969

- Acronym for acrylic cervical occipital anchorage
- Removable appliance with headgear
- Distal mass movement of buccal segments
- Dr. Leonard Margolis – harness growth.

Appliance design

Labial bow: .022 x .028 wire

Loops to receive NWHG between the central and lateral on each side.Wire covered with acrylic for good retention (Fig. 6).

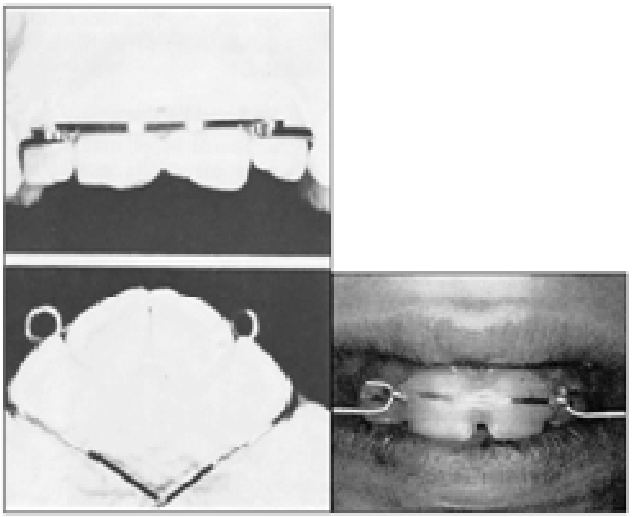

Fig. 6 ACCO Appliance

Advantages

- Mass distal movement of buccal segments
- Applying distal force to the maxilla and mandible
- Regain lost arch form
- Eliminating much use of class II and or class III elastics.

Super elastic Nickel Titanium Wire

Locatelli et al used super elastic nickel titanium wire with shape memory (NeoSentalloy) to move maxillary molars distally.

Fabrication: Neo Sentalloy wire with regular archform is placed over the maxillary arch. Three markings are made. Stops are crimped and hooks are added. Wire is inserted such that posterior stop abuts mesial end of molar tube, anterior stop abuts distal of premolar. Anchorage is reinforced by class II, or Nance appliance.

Modified nance appliance for unilateral distalization

TRACY J REINER (JCO 1992, Jul)

Modification of the traditional nance holding arch. The class I side - 0.036" stainless steel wire framework like that of a quad-helix. This arm was designed to resist the horizontal moment that would rotate the molar distally and cause expansion in the bicuspid region. The active, Class II side - an arm is bent similar to a quad-helix, with the most anterior terminus soldered to a first bicuspid band. An .020" omega loop is soldered to the anterior end of the framework, which allows the distal end of the loop to slide distally as it was opened for activation. A 10mm, open-coil spring is added between the omega loop and the first molar band assembly. After cementation of the appliance, the omega loop is opened enough to compress the coil spring to a length of 7mm, which had previously been measured to deliver about 150g on a force gauge.

JONES JIG (Richard D. Jones JCO, 1992)

Jones Jig, uses an open-coil nickel titanium spring to deliver 70-75g of force, over a compression range of 1-5mm, to the molars (Fig. 7). The appliance is designed to be used with any mechanotherapy of the orthodontist's choice.

- Heavy round wire
- Light wire
- Fixed Sheath
- Hook
- Sliding Sheath
- Open coil spring

A modified Nance appliance is critical to the use of the Jones Jig. The difference from a conventional Nance appliance is that this can be attached to either the first bicuspids, second bicuspids, or deciduous second molars (Fig. 8).

Advantages: Jones jig produces the distal molar movement to a class I relationship with second molars erupted or unerupted, in the mixed or permanent dentition, unilaterally or bilaterally and in the growing and non growing individuals.

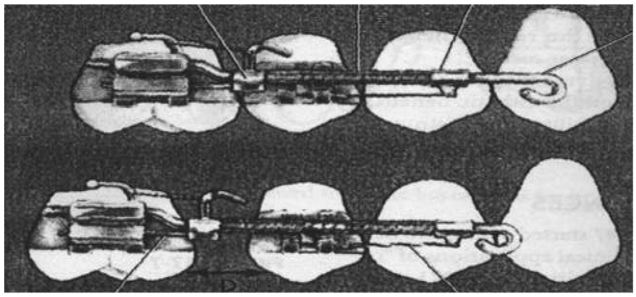

Fig. 7. Jones jig

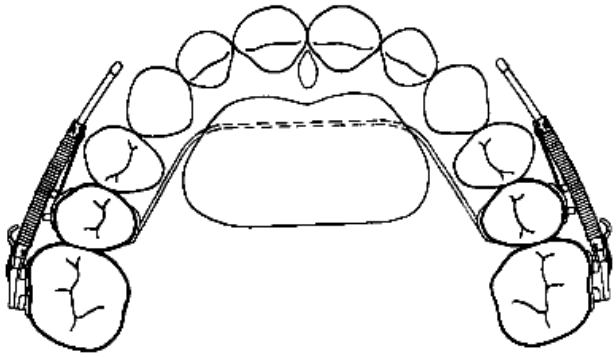

Fig. 8 Modified Nance appliance banded to second bicuspids, with Jones Jig assemblies tied in place

Disadvantages

- The appliance is contraindicated in cases of extreme vertical growth patterns
- Mucosal irritation.

Distalization of Molars with Repelling Magnets

Gianelly et al (1988) used intra-arch repelling magnets to distalize the maxillary molars. The magnets are attached to headgear tube of maxillary first molar bands and repelling surfaces are brought in contact by passing a .014" ligature wire. The force exerted by the magnets (Halda tension gauge) measure 200-225g but drop substantially as space opens beyond 1 mm .

- The molars are distalized about 3mm in seven weeks if second molars are absent .
- The rate of molar movement in patients with second molars is usually .75-1 mm per month.
- Anchorage loss is reduced by reinforcing the modified Nance appliance.
- Some patients show mild inflammation of the palatal tissues but this usually disappears within a week
- Magnets are relatively easy to insert and are well tolerated and do not require patient cooperation.

Distal jet appliance (Carano and Testa , JCO 1996)

- Bilateral tubes of .036" internal diameter attached to an acrylic nance button.
- A coil spring and a screw clamp slide over each tube.
- Wire extending from acrylic through tube ends in a bayonet bend-inserted into lingual sheath.
- Only difference from the pendulum and jones jig is that, the line of force application is 4-5mm apical to centroid because of bayonet bends and therefore translation occurs (Fig. 9).

The Distal Jet is reactivated by sliding the clamp closer to the first molar once a month. Once distalization is complete, the appliance can be converted to a Nance retainer simply by replacing the clamp-spring assemblies with light-cured or cold-cure acrylic and cutting off the arms to the premolars .

Advantages

- The rate of molar movement is comparable
- Can be converted into a passive nance appliance,
- Relatively easy to insert, well tolerated and esthetic, and requires no patient cooperation.
- Can be used for either unilateral or bilateral class II correction.

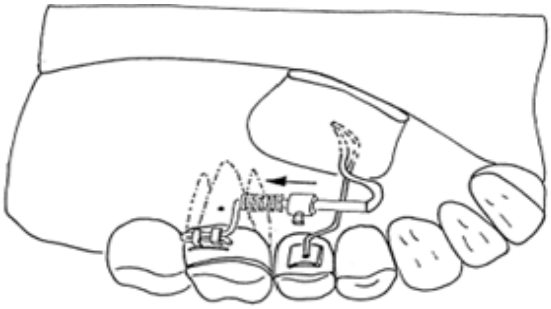

Fig. 9 Distal jet appliance

Fixed Piston Appliance (Greenfield , JCO 1995)

- Most maxillary molar distalizing appliances tend to tip the maxillary first molar crowns distally to an overcorrected Class I position while tipping the molar roots mesially.
- Unless a supplemental force system is used to provide a moment that torques the root distally, a significant amount of anchorage may be lost as the molar relapses to an upright position.

Fixed piston appliances produces bodily movement of the maxillary first molars without extraoral appliances with no loss of posterior anchorage.

The appliance components are:

- Maxillary first molar and first bicuspid bands
- .036" stainless steel tubing (soldered to the bicuspids)
- .030" stainless steel wires (soldered to the first molars)
- Enlarged Nance button, reinforced with an .040" stainless steel wire
- .055" superelastic nickel titanium open-coil springs (Fig. 10).

Advantages

- Bodily movement of first molars with no loss of posterior anchorage.

- Does not require patient compliance.
- Reduces treatment time.
- Maintains arch width after expansion.
- Light controlled forces.

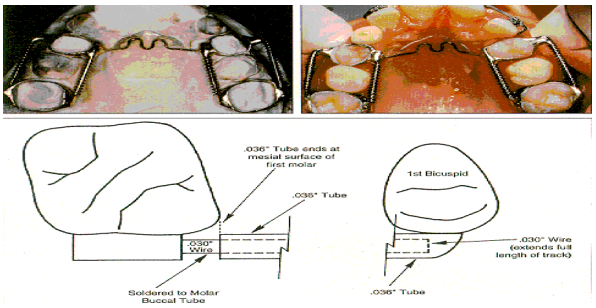

Fig. 10 Fixed piston appliance

The first class appliance for rapid molar distalization: As for distalization, various methods are used but clinical results with the distal jet seem to indicate that maxillary molars are distalized in a bodily manner and that minimal patient cooperation is required. However anchorage loss in the anterior segment is the major concern. To minimize this anchorage loss FOITINIA, LUPOL M and PARRI M developed a new type of appliance for unilateral or bilateral distalization of the maxillary first molars.

Appliance components

Vestibular components

- Formative screws soldered to buccal sides of 1st molar bands.
- Split rings welded to 2nd premolar or 2nd deciduous molar bands to control vestibular screws.

Palatal components

- Modified nance button in butterfly shape for added stability and support during retention.
- Nickel Titanium coil springs approx. 10mm in length, fully compressed b\w molar and bicuspid and \or 2nd deciduous molar band to prevent molar rotation and development of posterior cross bite.

Indications: The first class appliance distalizes the first molars bodily, even when the second molar is present.

It can be used in either the permanent or the mixed dentition, in the following types of cases:

- Dental or skeletal class II cases characterized mainly by maxillary protrusion.
- Low angle, deep bite cases.
- Patient with crowded arch and deficient arch length.
- Uncooperative patients.

Lokar Molar Distalizing Appliance: Introduced by SCOTT, 1992

The prefabricated assembly consists of mesial sliding component inserted into archwire tube of molars (Fig. 11). Lokar appliance is best used in conjunction with nance button constructed on second premolars

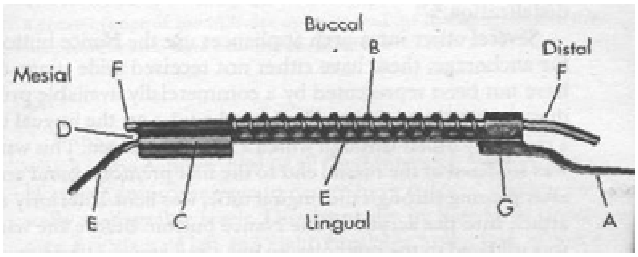

Fig. 11. Lokar molar distalizing appliance

A- Inserts into molar attachment with a rectangular wire
B- Compression spring
C- Sliding sleeve
D- Groove
E- Flat guiding bar
F- Round posterior guiding bar
G- Immovable posterior sleeve.

Klapper Super Spring II: Introduced by Lewis Klapper, 1997 for the correction of class II malocclusion. Flexible spring element that attaches between the maxillary molar and mandibular canine. The spring's open helical loop is twisted like a J hook into mandibular archwire (Fig. 12).

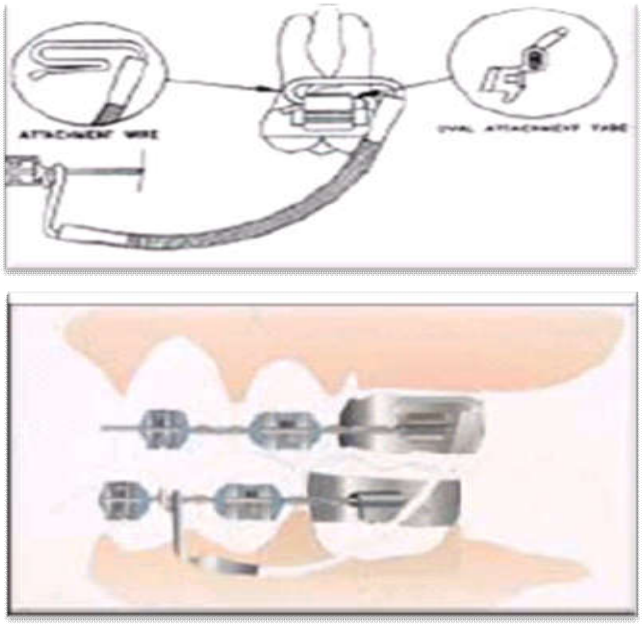

Fig. 12. Klapper super spring

Disadvantages

- Requirement of special buccal tube
- Limitation to maximal opening
- Potential injury to patient when breakage occurs
- Extended wear may cause distal root tipping to the maxillary molars
- Excessive palatal root torque.

K-Loop Molar Distalizer: Introduced by Valrun Kalra (1995). The appliance consists of a K-loop to provide the forces and moments and a Nance button to resist anchorage. Made up of 0.017 x 0.025" TMA wire. Each loop of the K should be 8mm long and 1.5mm wide. The legs of the K are bent down 20° and inserted into the molar tube and the premolar bracket (Fig. 13).

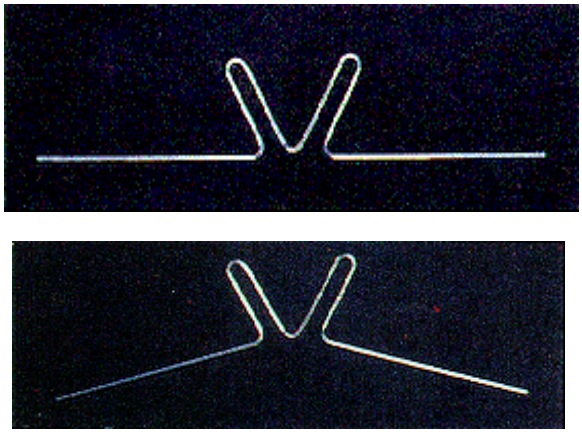

Fig. 13 . K Loop molar distalizer

The wire is marked at the mesial of the molar tube and the distal of the premolar bracket. Stops are bent into the wire 1mm distal to the distal mark and 1mm mesial to the mesial mark (Fig. 14). Each stop should be well defined and about l.5mm long. These bends help keep the appliance away from the mucobuccal fold, allowing a 2mm activation of the K-loop (Fig. 15). The 20° bends in the appliance legs produce moments that counteract the tipping moments created by the force of the appliance, and these moments are reinforced by the moment of activation as the loop is squeezed into place.

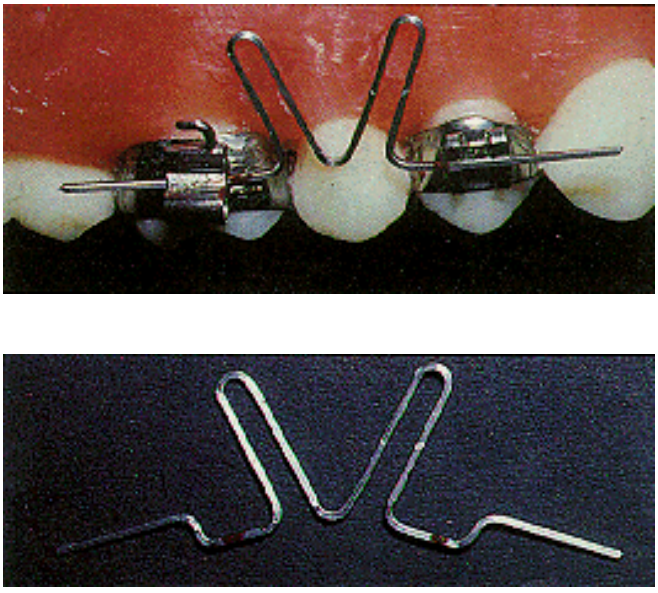

Fig. 14. Stops made in the K Loop

Thus, the molar undergoes a translatory movement instead of tipping. For additional molar movement, the appliance is reactivated 2mm after six to eight weeks. In most cases, one reactivation, producing a total of as much as 4mm of distal molar movement, is sufficient.

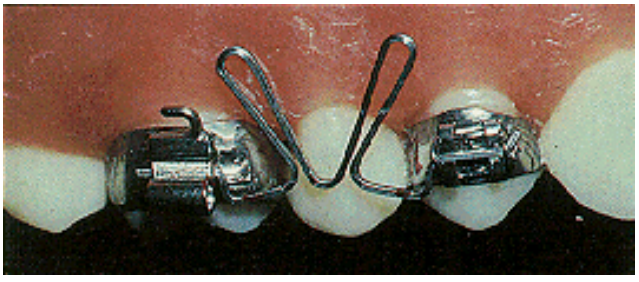

Fig. 15. Activated K Loop engaged

Reactivation of loop : Open loop 1mm at (1), Open loop 1mm at (2) and Open loop at (3) to regain 20˚bend of the mesial and distal legs (Fig. 16).

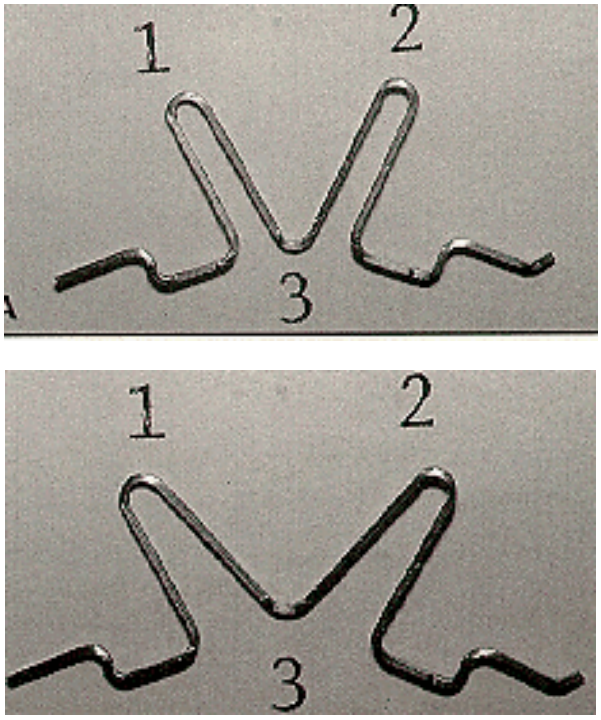

Fig. 16. K Loop Reactivation

Franzulum appliance (Friedrich Byloff et al JCO, Sept 2000): Gaining space in mandible is more difficult than in the maxilla. The most commonly used intraoral appliances are lip bumpers, lingual arches and removable appliances with screws or springs. Anterior anchorage : acrylic button-5mm wide. Rests on canine and premolars - .032 wire. Tube from acrylic button to receive active component. NiTi coil springs-100-200g/side. J-shaped wire inserted into tube (Fig. 17).

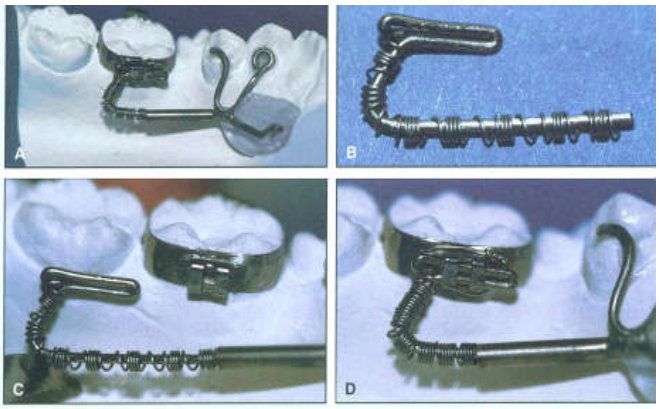

Fig. 17. Franzulum appliance

Distalization Using Headgears: Very efficient method. Reciprocal forces are not transmitted to other teeth. Molar movements depends on direction of force in relation to the C Res of the molar and magnitude of force**.**

High pull Headgear: Produces intrusive and Posterior direction of pull. Used in Long face class II patients with high MPA. Force through c res – Intrusion and distal movement of molar (Fig. 18).

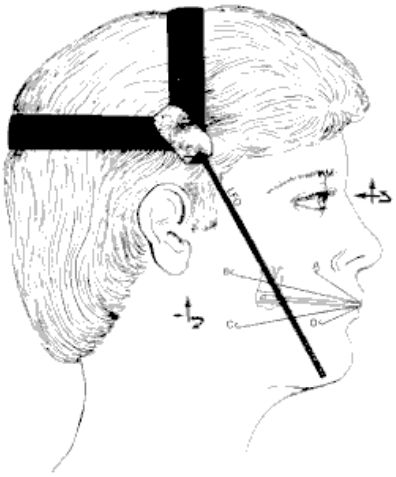

Fig. 18 High pull headgear

Cervical Headgear: Used in Short face Class II maxillary protrusive cases with low MPA and Deep bites. Extrusive and distalizing effect (Fig. 19).

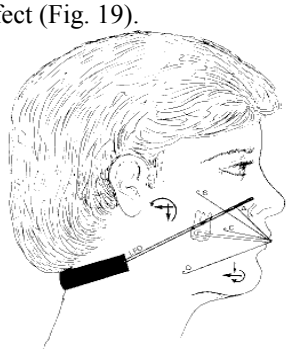

Fig. 19. Cervical headgear

Distalization Using Implants:

When osseointegrated implants were developed for prosthetic dentistry, orthodontists began to explore the possibilites of using them as anchorage devices.

Implant selection on the basis of location:

- Midpalatal implants
- Palatal interdental implants
- Buccal interdental implants

Mid-palatal implants: good primary stability because of utilization of cortical bone.

Advantages

- Never impede tooth movement
- Line of action can be regulated according to the type of tooth movement needed
- Stability can be obtained in patients less then 15 years of age.

Palatal Interdental Implants

Advantages: Use of the palatal space to regulate the line of action and the presence of more available interdental space.

Disadvantages

- Impedement of tooth movement
- Surgical procedure involved is more difficult.

Buccal Interdental Implants

Advantages

- Ease of implantation
- Simple application in treatment.

Disadvantages: Hinders the movement of adjacent teeth.

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