Effective Means of Intraoral Molar Distalization
- An Overview

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Correction of Class II malocclusion without extractions requires maxillary molar distalization by means of intraoral or extraoral forces. Although headgears have proven undoubtedly useful in the correction of this skeletal anomaly, the constancy of forces and the dependence on patient cooperation is of concern.

Since the 1980s various intraarch devices have been introduced such as the K loop (V. Kalra), NiTi coil springs (Gianelly), Superelastic NiTi wires (Locatelli), Repelling magnets (Gianelly), Fixed Piston appliance (Greenfield), Pendulum appliance (Higlers), Lokar Distalizer (Scotti), Distal Jet (Carano) as well as combination of extraoral and intraoral forces (Cetlin and Tenhoeve). Researchers have focused on the simplicity and efficiency of these intraarch devices, which improves the continuity and constancy of forces. Oral hygiene is easier to maintain and the need for patient compliance is eliminated. A modified Nance appliance has often been applied in conjunction with these force delivery systems to increase anchorage during distal movement or keep the molars in position following distal movement. This paper presentation is an attempt to update information regarding various intraoral distalizing appliances available currently and discusses patients treated successfully by using NiTi coil springs (Ortho organizer) by distalization for correction of class II molar relationship.

Introduction:

Correction of Class II malocclusion without extractions requires maxillary molar distalization by means of intraoral or extraoral forces. Although headgears have proven useful in the correction of skeletal problems, as well as in providing anchorage for extraction cases, the dependence on patient cooperation is heavy.

William Kingsley (1892) described for the first time headgear apparatus with which Class I molar relationship of the molar could be achieved successfully. Kloehn in 1947 started a long and beneficial series of investigations and clinical applications of occipital anchorage to the maxillary dentition. The headgears over the years have shown to be effective in maxillary molar distalization with movements in all planes of space. With the recent trend more towards non extraction treatment, several intraarch devices have been advocated to distalize molars in the upper arch. Researchers have focused on the simplicity and efficiency of these intraarch devices, which improves the continuity and constancy of forces. Oral hygiene is easier to maintain and the need for patient compliance is eliminated. Certain principles, as outlined by Burstone, must be borne in mind, when designing an ideal intraoral molar distalization appliance.

Molar distalization is a technique that has added a new column in the practice of every orthodontist to produce consistent, predictable and high quality results. The goals of practising with efficiency and profitability are positively affected.

Since space is easier to gain in the maxillary arch than in the mandible because of increased trabecular structure of supporting bone and increased anchorage afforded by palatal vault, the distalization of maxillary molar becomes of
significant value for the treatment of cases with mild to moderate arch discrepancy and Class II molar relationship associated with a normal mandible.

Indications:
- An end on or full Angle's class II molar relationship due to maxillary protrusion, impacted, unerupted and ectopic eruption of cuspids.
- Situation requiring distal movement of molars.
- Mild to moderate arch discrepancy.
- Class II molar relationship associated with normal mandible.

Timing:
A favourable time to move molars distally appears to be in the mixed dentition, before the eruption of the second molars, and an efficient force system to move molars distally is a continuously acting force.

Principles of Appliance Design:
- Magnitude of forces and moments.
- Moment to force ratio.
- Constancy of force and moments.
- Bracket friction.
- Minimal loss of anterior anchorage.
- Bodily movement of molars to avoid lengthening of treatment and unstable results.
- Ease of use.
- Cost.
- Minimal chairtime for placement and reactivation.

Limitations:
- High angle retrognathic type of pattern.
- Third molars that have erupted or close to eruption impede distalization.
- Treatment in vertical growth pattern should be done conservatively with extraction.

The present study is an attempt to update information regarding various intraoral distalizing appliances available. This article will also present and discuss results obtained in few patients treated in the Department of Orthodontics, Faculty of Dental Sciences, King George's Medical College, Lucknow after distalization using Nance appliance and NiTi coil springs.

Intra Oral Methods for Distalizing Molars
1. Repelling Magnets
Intra arch repelling magnets (Fig. 1) used to distalize molars were introduced by Gianelly et al. (1988). These are prefabricated repelling Samarium-Cobalt magnet (SmCo5) with a pole face 2 x 5 m. The magnets are attached to headgear tube of maxillary first molar bands and repelling surfaces are brought into contact by 0.14" ligature wire. Forces measure to 200-225 gms but drop substantially as space opens beyond 1 mm. Movement of 3 mm is seen in 7 weeks if second molars are absent and 0.75-1 mm per month if present. Anchorage is reinforced by Nance appliance and Class II elastics against an 0.016" x 0.022" sectional arch wire. The rate of molar distalization using magnaforce is less than that observed with conventional mechanotherapy. This is in agreement with the findings of Owman et al. and is supported by the work of Samuels that tooth movement is proportional to force with some biologically defined limits.

2. 3-D Bimetric Distalizing Arch
These are modular phase appliances designed for multidirectional functional class II treatment and were introduced by Wilson and Wilson (1987). Maxillary molars and buccal segments are distalized bilaterally or unilaterally without headgear. It is excellent if given in Class II Div 2 cases. It distalizes molars to end on position and allows posteriorly locked mandible to advance immediately to Class I position. Class II elastics allows the functional release of any mandibular growth potential. The anterior segment is of 0.022" Truchrome arch while posterior segment is of 0.040" end section with omega loops. Elgiloy open coil springs of 0.010" x 0.045" are placed between omega loop and buccal tubes for activation. Movement achieved is 3 mm in 2 months. Significant increase in inter bicuspid width is possible with 3 D Bimetric Distalizing Arch (Fig. 2) acting as 24 hour buccinator muscle restrictor. Arch should be adjusted free of buccal teeth to avoid impingement of cheeks. It retracts rapidly and is useful even in intrusion of anterior teeth.
teeth. It is not recommended for long face syndrome patients.

3. Superelastic NiTi Wire:

Locatelli et al\(^6\) (1992) used a 100 gm NeoSentalloy wire (superelastic Nickel-Titanium wire) with shape memory for molar distalization. Crimp stops just distal to first premolar bracket are placed 5-7 mm distal to anterior opening of molar tube and hooks between lateral incisors and canines. Excess wire is deflected gingivally into buccal fold. As wire returns to original shape, it exerts 100 gm distal force against molars. Anchorage control is by placing Class II elastics exerting force of 100-150 gm and is reinforced with Nance appliance cemented to premolars. If first molars do not move at least 1 mm per month a 200 gm 0.018" x 0.025" NeoSentalloy wire can be placed. Advantage lies in its ease of insertion even after all teeth have been bracketed.

4. Jones Jig (Fig. 4, 5)

Jones and White\(^7\) (1992) used an open coil NiTi spring to deliver 70-75 gms of force over a compression range of 1.5 mm to the molars. Anchorage is from Nance appliance which can be attached to either first premolars, second premolars or deciduous second molars. Reactivation of coil springs requires little chair time. Patients are seen at 4 – 5 week intervals and is a rapid method of correction of Class II relationships. Correction usually takes place in 120-180 days.

5. Lokar Molar Distalizer:

Lokar Distalizer was introduced by Scott\(^8\) (1992). The prefabricated assembly (Fig. 6) consists of mesial sliding component inserted into archwire tube of molars. Lokar appliance is best in
conjunction with Nance button constructed on second premolars (Fig. 7). Molar tubes are not used, therefore extraoral and lip bumper forces may be applied concurrently. The Lokar Distalizer is activated by compressing spring 1 to 2 mm short of complete compression and movement is 1-3 mm in 5-6 weeks. This appliance is offset to the buccal and rests along the buccal surface of premolars.

6. Pendulum Appliance

This device was designed by Hilgers (1992) and is a hybrid appliance (Fig. 8,9) using Nance acrylic button in palate for anchorage along with 0.032" TMA springs delivering light continuous broad swinging arc or pendulum of forces to upper first molars. The lingual sheath is made of 0.036" for easy fit of 0.032" TMA spring. Activation before appliance placement i.e. by spring being parallel to mid sagittal plane which produces 60° activation after insertion. Force exerted is 200-250 gm per side and movement achieved is 5 mm in 3-4 months. Pendulum can also be incorporated with mid palatal jack screw for expansion along with distalization (Pend-X) (Fig. 10). The screw is activated one quarter every 3 days. It is not recommended for dolichofacial types with tongue thrusting.

7. Modified pendulum

Scuzzo et al. (1999) modified the original appliance and called it Pendulum M and claimed that Pendulum M (Fig. 11) ensures true bodily movement of molar crowns and roots. Horizontal pendulum loop was inverted from the basic design. Activation is by simply opening it. This activation produces buccal and distal uprighting of molar roots and thus a true bodily movement. Springs are activated to 40-45° resulting in 125 gms of force on each side. Terminal ends are straight rather than looped in original appliance and there is little need for reactivation.
8. Fixed piston appliance:

Most intraoral distalizing appliance tend to tip maxillary molar crowns distally. Greenfield\(^1\) (1995) designed an appliance for bodily movement of maxillary molars. The appliance components comprises of 0.036" SS tubing (soldered to bicuspids) and 0.030" SS wires (soldered to first molars). Nance can be reinforced with 0.040" SS wire (for control of anterior anchorage). Superalastic NiTi wire having 0.055" (internal diameter) is used and 2 mm split rings as stops to mesial of buccal and lingual tubes are added every 6-8 weeks. Force exerted is 50 gms per tooth and movement achieved is 1 mm per month. It does not interfere with occlusal plane\(^1\) thus maintaining control of vertical dimension.

![Fig. 12: Fixed Piston Appliance](image)

9. K-loop molar distalizing appliance:

Introduced by Kalra\(^1\) (1995). This appliance consists of a K-loop to provide force and a Nance button to resist anchorage. K-loop is made of 0.017" x 0.05" TMA wire with each loop being 8 mm long and 1.5 mm wide and is placed between first premolar and first molar (Fig. 13). Activation is by 20 degree bends in appliance that produce moments that counteract the tipping moments created by the force of appliance. Thus molar undergoes translatory movement instead of tipping. Root movement continues even after the force has dissipated. Single activation produces 4 mm distal molar movement in 6 to 8 weeks and 1 mm anchorage loss is seen during 4 mm molar distalization.

10. Distal jet:

Carano and Testa\(^1\) (1996) designed an appliance that can be used for either unilateral or bilateral Class II correction. It consists of bilateral tubes of 0.036" internal diameter attached to acrylic Nance button (Fig. 14). NiTi coil springs exerting a force of 150 gms for children and 250 gms for adults is recommended. The springs are clamped on the tube to exert a distal force. Bodily movement is achieved as the force passes close to the center of resistance. Reactivation is done by sliding the clamp closer to first molar once a month. Once distalization is completed the appliance can be converted to a Nance retainer or passive Nance appliance. Movement of 2-3 mm is seen in 4 months.

![Fig. 14: Distal Jet](image)

11. Modified Distal jet appliance:

Quick and Harris\(^1\) (2000) modified the original Distal Jet appliance. The basis of the modification is the rear entry of sliding section into lingual molar sheath so that the appliance pulls rather than pushes the molar distally (Fig. 15). The doubled back wire

![Fig. 13: K-Loop Molar Distalizing Appliance](image)

![Fig. 15: Modified Distal Jet Appliance](image)
is inserted into the lingual sheath from the distal side. Either 0.030 or 0.032" wire is the most preferred wire for sliding. Desired activation produced is by compressing the coil spring between distal end of the tube and the stop soldered to the sliding wire. To reactivate the appliance, the safety ligature is cut and the sliding wire is pulled out distally and a new longer section of coil is placed over wire. No screw or Allen wrench is used, thus simplifying the activation procedure.

12. Fixed palatal Expander:
Maxillary arch constriction and mesiopalatal rotation of upper first molars are two components of most Class II malocclusions that must be corrected either before or during sagittal correction. Snodgrass16 (1996) designed an appliance (Fig. 16) and incorporated rotation and distalization components of Pendulum appliance in his new design. It consisted of a framework of 11 mm expansion screw, two 0.032" TMA Pendulum springs and occlusal rests. Springs were preactivated 8-10 mm distally and the screw is activated twice a day till desired expansion is achieved. It is useful in treating unilateral class II with midline discrepancies.

13. NiTi Coil Springs:
Pieringer et al17 (1997) used Sentalloy red coil springs (GAC) exerting a force of 150-200 gms on sectional arch wires from first premolars to molars (Fig. 17). The concept of using coil springs for distalization was introduced by Miura who used 100 gms superelastic coils. Gianelly18 used Japanese NiTi coil springs exerting 100 gms of force to move maxillary molars distally. Movement achieved is 1-the 1.5 mm per month. Anchorage unit is anterior acrylic button for palatal support. Distalization is accomplished early in treatment and any undesired the movements can be corrected in succeeding phases.

14. Superspring II:
The Super spring II designed by Klapper19 (1999) is a flexible spring element that attaches between the maxillary molar and mandibular canine (Fig. 18). It is designed to rest in the vestibule, making it impervious to occlusal damage and allowing for good hygiene. The spring's open helical loop is twisted like a J hook into the mandibular archwire. On the maxillary end, a special oval tube serves as the maxillary first molar attachment. During opening and closing movements, lower helical attachment hinges on the mandibular archwire through an arc of 90° (Fig. 19). A longer spring is used for nonextraction cases and shorter springs for full Class II extraction cases. Moderate continuous distalizing force upto 5 oz is exerted. Excellent for TMD patients who require orthodontic treatment after splint therapy.
15. **First Class Appliance:**

With the objective to minimize anchorage loss, Forlini *et al.* (1999) devised an appliance (Fig. 20) for rapid distalization of maxillary first and second molars. The vestibular component comprised of formative screws soldered to the buccal side of first molar bands. Split rings are welded to second premolars and stop screws maintain distal position of molars after active movement has been completed. Palatal component comprised of wider butterfly shaped button. NiTi coil spring (0.010" x 0.045") of 10 mm length was used to achieve bodily movement of 4-8 mm in 28-95 days.

![Fig. 20: First Class Appliance](image)

16. **Palatal Orthodontic Implants:**

Idea of implant in median maxillary suture for anchorage was originally by Triaca. Mannchen (1999) implanted miniature gold fixation screws into the alveolar bone between roots of teeth in young patients. Maxillary suture is a more reliable location than the alveolar bone between roots of teeth, for anchorage in adults. The basic principle of the appliance is to provide a rigid platform that is not attached to any single tooth. A yoke shaped palatal bar - 0.036 x 0.072" made of Remaloy stainless steel wire with 4.5 mm long 0.022 x 0.028" rectangular tubes are attached on each end. 0.022" (Fig. 21). Damon SL brackets are welded to molar bands for receiving sectional arch wires. Distalization can be accomplished either with sagitally preactivated delta loops and long vertical legs or with straight sectional wires and push coil springs.

![Fig. 21: Palatal Orthodontic Implants](image)

17. **Franzulum Appliance:**

Gaining space in the 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 which depend on patient compliance for their success. Byloff *et al.* (2000) devised the Franzulum appliance based on pendulum for distalizing mandibular molars (Fig. 22). The anterior anchorage unit comprised of an acrylic button positioned linguually and inferiorly to mandibular anterior teeth and extending from mandibular canine to canine. The acrylic should be at least 5 mm wide to avoid mucosal trauma and to dissipate the reactive force produced by the reactive components. Rests on the canine and first premolars are made of 0.032" stainless steel wires and tubes between the second premolars and first molars receive the active components (Fig. 23). The posterior distalizing unit uses NiTi coil springs (GAC) about 18 mm length which apply an initial force of 100-120 gms per side. The active part of the appliance runs lingually at a level close to the center of resistance of the molars to produce an almost pure bodily movement.

![Fig. 22: Franzulum Appliance](image)

![Fig. 23: Franzulum Appliance](image)
18. **C-Space Regainer:**

Chung *et al.*\(^{24}\) (2000) used a removable appliance called the C-Space Regainer to achieve bodily molar movement without significant incisor flaring. It consists of a labial framework formed from 0.036" SS wire, and an acrylic splint. A closed helix is bent into the framework in each canine region (Fig. 24). An open coil spring (0.010"x0.040") is soldered distal to the helix and 0.028" ball clasps are used to retain the appliance. Open coil springs should be 130% of length between soldered point and mesial edge of head gear, When compressed it will exert 200 gms of force and move molars distally about 1-1.5 mm per month.

![Fig. 24: C-Space Regainer](image)

**Critical Appraisal:**

In the mixed dentition, the appliance should not be placed until full development of the maxillary first molar roots. In most Class II cases, the intraoral distalizing appliances accomplishes its goal within six months without the need for patient cooperation. In all of these systems, orthodontic forces are applied to the crowns of the upper first molars and the molar movement consists mainly of tipping and rotation of the crowns as openly acclaimed by Gianelly, Jones, Hilgers, Carano, Kaira. None of the intraoral appliances for molar distalization have been completely successful in avoiding undesirable biomechanical side effects as advocated by Jeckel. Although Scuzzo *et al.*\(^{10}\) modified pendulum appliance and Green fields *et al.*\(^{11}\) fixed piston appliance have claimed that their appliance can produce true bodily movement of the maxillary molars, we strongly believe that 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 assumes an upright position. Patient compliance with headgear is usually required to attain net bodily movement. Since distalization is usually accomplished early in treatment and any undesired movements can be corrected later on, second phase of molar uprighting is necessary in which patients often must wear headgear. So, we recommend distalization with Nance appliance and coil springs which is easy to fabricate, economical and effective for achieving the main objective of molar correction from class II to class I.

**Presentation of cases treated by distalizing molars using Nance holding and NiTi open coils springs.**

**Case 1**

A 12 years old female came with a complaint of protruding upper front teeth. The patient had good facial esthetics and harmony of facial lines. She presented with end on molar relationship on both sides with overjet of 7 mm and overbite of 5.5 mm. Maxillary arch length discrepancy was 8 mm. Upper incisor inclination to SN and PP was 118° and 128° respectively and incisal edge 5 mm in front of NA line. Upper molar to PTV was 9 mm. Both SNA and SNB were within average normal range. Tuberosity space was sufficient to accommodate both third molars.

Treatment plan involved distalization of first molars to overcorrected Class I relation, Nance holding arch was attached to first premolars and 010 x 030 NiTi open coil spring (Ortho Organizers) was compressed 10 mm in excess of interbracket span between first premolars and first molars. During this period of stabilization Class II elastics were applied on upper premolars from lower molar ( lower stabilizing arch was placed beforehand). The desired molar relation was achieved within 4 months and then a modified Nance was given on first molar for stabilization. Upper Molar to PTV decreased to 7 mm and bite was opened by 3.5 mm. Cephalometric superimposition showed bodily movement of molars during distalization with insignificant tipping and an anchorage loss of 1 mm (Table 1).

**Case 2**

A 13 years old female came with a complaint of forwardly placed upper front teeth. The patient had good facial esthetics and harmony of facial lines. She presented with end on molar relationship on
both sides with overjet of 6 mm and overbite of 6 mm. Maxillary arch length discrepancy was 8 mm. Upper incisor inclination to SN and PP was 102° and 115° respectively and incisal edge 5 mm in front of NA line. Upper molar to PTV was 7 mm. Both SNA and SNB were within average normal range. Tuberosity space was sufficient to accommodate both third molars.

Treatment plan involved distalization of first molars to overcorrected Class I relation. Nance holding arch was attached to first premolars and 010 × 030 NiTi open coil spring (Ortho Organizers) was compressed 10 mm in excess of interbracket span between first premolars and first molars. The desired molar relation was achieved within 4½ months and then a modified Nance was given on first molar for stabilization. Upper Molar to PTV decreased to 6 mm and bite was opened by 3 mm. Cephalometric superimposition showed bodily movement of molars during distalization along with insignificant tipping and an anchorage loss of 1 mm (Table 2).
Case 3
A 15 years old female came with a complaint of irregularity of upper front teeth and labially blocked out canines. The patient had good facial esthetics and harmony of facial lines. She presented with Class II molar relation of 4 mm on both sides with overjet of 3 mm and overbite of 5 mm. Maxillary arch length discrepancy was 7 mm. Upper incisor inclination to SN was 91° and to Palatal plane was 102° and incisal edge 4.5 mm in front of NA line. Upper molar to PTV was 15 mm. Both SNA and SNB was within average normal range. Tuberosity space was sufficient to accommodate both third molars.

Treatment plan involved distalization of first and second molars en masse to overcorrected Class I relation, Nance holding arch was attached to first premolars for anchorage and 0.010 x 0.030 NiTi open coil spring (Ortho Organizers) was compressed 10 mm in excess of interbracket span between first premolars and first molars. The desired Class I molar relation was achieved within 5 months. Upper Molar to PTV decreased to 11 mm and bite was opened by 2 mm. Cephalometric superimposition showed that the molars during distalization had tipped and an anchorage loss of 1.5 mm was observed (Table 4).

Case 4
A 14 years old female came with a complaint of forwardly placed upper front teeth. The patient had good facial esthetics. She presented with Class II molar relation with overjet of 7 mm and overbite of 6 mm. Maxillary arch length discrepancy was 10 mm. Upper incisor inclination to SN and PP was 108° and 117°. Upper molar to PTV was 11 mm. Tuberosity space was sufficient to accommodate both third molars.

Treatment plan involved distalization of first molars to overcorrected Class I relation, Nance holding arch was attached to first premolars and 010 x 030 NiTi open coil spring (Ortho Organizers) was compressed 10 mm in excess of interbracket span between first premolars and first molars. The desired molar relation was achieved within 5 months and then a modified Nance was given

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from 110° to 116° i.e. signifying dentoalveolar protrusion. IMPA decreased from 85.6° to 84° and FMA increased by 2°. After this skeletal correction, molars were in an end on relationship with mild maxillary anterior crowding and dentoalveolar protrusion. These factors led to distalization of molars to achieve Class I molar relationship and eliminate crowding. Distalization was accomplished by NiTi open coil springs and molars were distalize 3 mm from each side to achieve super Class I molar relation (Table 5).
1.5 mm/month with 8 to 10 mm activation of 100 gm coils with little loss of anchorage. Since the reaction force of the coil moves the wire anteriorly, the function of the stop against the premolar brackets is to ensure that the wire cannot move past the first premolars thus placing the reaction force on the Nance appliance. Accordingly the anchorage unit remains the palate as well as the function of the stop against the premolar.

- Inferences:

Molar distalization if done on careful selected cases with critically planned biomechanics can correct molar relation and provide some useful arch dimensional movements occur along with the desired distalization. No correlation could be established between amount of distalization or duration of treatment and the amount of tipping.

Since distalization is usually accomplished early in treatment, any undesired movements can be corrected in succeeding phases. Therefore we strongly believe that the advantages of the Nance appliance with NiTi coil springs outweigh their disadvantages.

References: