Molar Distalization - A Review

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Abstract

The most important step of gaining space in the dental arch in treatment planning can be achieved by different methods one of which is molar distalization. Various appliances have been introduced to distalize molars by using non extraction treatment. Headgear was the first appliance which was used for this purpose but this appliance need patient cooperation and was esthetically unpleasant. Thus there were various intra oral appliance which have been introduced.

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Introduction

reatment options in orthodontics may differ depending on the type of malocclusion whenever there is space deficiency, the methods of gaining space that strikes to our mind first are, extraction, expansion and stripping .In the past, orthodontists had two main options to create the space in the arch .One was to expand the arch and the other was to extract. Angle, proposed expansion of dental arches for nearly every patient and extraction for orthodontic purpose was not necessary for stability of results or for aesthetics

In 1930's, Charles Tweed observed relapse after non-extraction expansion treatment and decided to retreat with extraction. However, we the orthodontists of today are fortunate enough to have more techniques and appliances in our hands to gain space i.e. by distalizing molar²

Molar distalization is a process in the field of orthodontics which is used to move molar teeth, especially permanent first molars, distally in an arch. This procedure is often used in treatment of patients who have Class 2 malocclusion.³ Distalization in the maxillary arch is easier than the mandibular arch because maxilla has more trabecular bone than the mandible, which has higher percentage of cortical bone. The distalization of maxillary molar is of significant value for treatment of cases with minimal arch discrepancy and mild Class-II molar relationship associated with normal mandible.Current molar distalizing appliances allow effective control and manipulation of the moment to force ratio.

This article is a review of the molar distalization appliances and techniques used, as space gaining methods have gained immense importance in recent years.

Indications of Molar Distalization

- Class-II molar relationship due to maxillary dentoalveolar protrusion, impacted / high labially placed cuspids, ectopic eruption of either 1st/2nd bicuspid
- Class-II molar relationship due Class-II Subdivision cases requiring unilateral distal molar movement.
- Regaining the space loss due to mesial drift of 1st molars following premature loss of deciduous teeth.
- Minimal crowding or spacing anteriorly.
- Mesially inclined upper first molars, anchorage loss during active orthodontic treatment.

Contraindications of Molar Distalization

- An end on or full Class-II molar relationship due to mandibular retrognathism, retrognathic profile
- Skeletal and dental openbite
- Excessive lower anterior facial height (Dolicofacial form)
- Constricted maxilla, maxillary first molar

distally inclined.

Posteriorly and superiorly displaced condyles.

Various Modalities to Distalize Molars

A. Extraoral Appliances:

To Cause Bilateral Molar Distalization I)

1. High pull headgear, 2. Straight pull headgear, 3. Cervical or low pull headgear II) To Cause Unilateral Molar Distalization

1. Power arm face-bow, 2. Swivel offset face bow, 3. soldered offset face bow, 4. Spring attached face bow

B. Intra Oral:

These appliances can be removable or of fixed type and can be categorized into two groups.

Interarch:

- Atkinson Buccal Bar
- Tandem Yoke
- Dimensional Bimetric Distalization Arch
- Modified Herbst Appliance
- Saif Springs
- Klapper Super Springs
- Eureka Springs
- Jasper Jumper
- Churro Jumper
- Sliding Jig
- Forsus Fatigue Resistance Device
- Forsus Nitinol Flat Spring
- Twin Force
- 2. Intraarch:
- Α. Maxillary Arch:

Removable Appliance: i)

- Cetlin appliance
- ACCO (acrylic cervical occipital appliance) Modified ACCO appliance
- Removable molar distalization splint
- Molar Distalizing Bow
- Segmented Removable appliance for Distalization (RMD)
- C-space regainer Fixed Appliance
- ii)
- K loop
- Pendulum appliance and its modifications. Jones jig Distal jet and its modifications
- Molar distalization bow (MDB)
- Intraoral Bodily Molar Distalizing Appliance (IBDA)
- Super elastic NiTi wire
- NiTi Coil Springs
- Magnets
- First class appliance for molar distalization
- Transpalatal arch
- Denholz appliance (Lip Bumper)
- Nance palatal appliance
- Modified Nance appliance for molar distalization
- Lokar Molar Distalizer
- Distalix Appliance
- Fixed piston appliances
- Greenfield Lingual distalizer
- Lingual Distalizer System

- "New Distalizer" appliance
- Crozat treatment
- Crickett appliance
- Distalization using Microimplant
- Distalization with Lever arm and Mini Implant system

Heal Talk

- Palatal Implant Supported Distalization.
- ZAS (Zygomatic Anchorage System)
- SAS (Skeletal Anchorage System)

B. Mandibular Arch

- Lip bumper
- Franzulum appliance.
- Modification of Distal Jet appliance.
- Unilateral Frozat Appliance
- Implant Supported Distalization.
- SAS (Skeletal Anchorage System)

Diagnostic Criteria For Distalizing Maxillary Molar

The criteria for distalization varied widely among the clinician but some of the most common criteria are;

- Class-II or end-to-end molar relationship
- Maxillary molar protrusion
- Mild or moderate crowding
- Good maxillary second molar positions
- Class I skeletal pattern
- Straight profile and straight divergence
- Normal skeletal vertical development (facial proportion should be with in normal limits).
- Normal transverse development (no cross bites etc).
- Good soft tissue drape.

Classification

via facebow or J hook.

Low to moderate mandibular plane angle (hypodivergent). Good expectation for patient cooperation.

A. Extraoral Methods of Molar Distalization

1. Headgear Headgear obtain support from

back of neck, cranial bones and can provide

three dimensional anchorage control depending

upon the type of headgear and type of force. Force is transmitted from headgear strap to teeth

B. Intraoral Methods of Molar Distalization

techniques which have recently assumed an

by Emil Herbst in 1905 and was reintroduced by

Pancharz,⁴ Herbst appliance is a passive tube

and plunger system with the exact length of the

tube determining the amount of anterior

mandibular displacement .(fig:1) Research to

date has shown that the Herbst appliance has the

ability to inhibit maxillary anteroposterior

growth and to produce an increase in mandibular

length and lower facial height. Recently it has

been reported that in many cases, Herbst

appliance therapy results in approximately

equal amounts of dental and skeletal changes.A

new design of the Herbst appliance was

important role in clinical orthodontics;

Modified Herbst Appliance

Various intraoral molar distalization

The Herbst Appliance as originally designed

introduced. It was developed by Larry White, and used stainless steel crown on the maxillary first molars and a removable mandibular occlusal coverage acrylic splint. **Bimetric (Wilson Arch)**

Introduced in 1955 by Wilson the bimetric arch consist of a labial arch made of a 0.040" posterior section and a 0.020" anterior section . Hooks for class II elastics are soldered on to the anterior end of the 0.040" section, and an adjustable omega loop is placed in the premolar region of the 0.0040 section. The appliance is activated by placement of an open coil spring between the omega loop and the maxillary first molar .(fig:2) A class I molar relationship can be achieved in as little as 6-12 week.

Cetlin Appliance

It was introduced by N.M Cetlin & Ten Hove in 1983. The removable distalizing plate is used to continue distalization of the upper molars when a super Class I relationship cannot be obtained using headgear. It is composed of 0.028" stainless steel distalizing spring.An anterior 0.017" X 0.025" arch covered by a labial screen and having 2 Adams clasps on the 1st premolars/the 1st deciduous molars for and ananterior Bite plane for retention disocclusion. (fig:3) Gentle force of approximately 30 gms is used with minimal reaction on upper front teeth. Worn 24 hr / day except during meals Always used with extra oral force.An activation of 1 to 1.5 mm/side gives approximately 30 g of distal force either bilaterally or adjusted on alternative sides Molar Distalization with Magnets

Magnets were introduced in orthodontics to generate simultaneous force fields and bioeffects that may account for observed benefits.Kawata et al., in 1987 used a tractional magnetic force, which produces a week orthodontic force that increases in magnitude sothat tooth movement occurs. Gienally et al.,⁵ in 1988 and Takami Itoh⁶ in 1991 had used a repelling type of magnetic force for distal tooth movement.In 1988 Anthony Gienally⁵ used intra arch repelling magnets anchored to a modified Nance appliance cemented on the maxillary first premolars , were activated against the maxillary first molars to move them distally.(fig:4)

Magnets in all patients were activated by tightening of the 0.014 inch ligature wire to bring the magnets into contact. Reactivation of the magnets done once every three weeks. 80% of the space created represented distal movement of molars

Jones Jig:

In 1992 Richard jones and Michel white⁷ introduced the appliance called jones jig.It is an intra oral noncompliance distalization appliance. It consists of open coil nickel titanium spring which slide over a .036 main frame, having accessories for the attachment to the headgear tube and the arch wire slot in the triple tube of the upper molar.(fig:5)An eyelet tube is then place anterior to the spring, such that when the eyelet tube is pushed distally the NiTi coil spring gets compressed exerting a distalization force on the molars.Anchorage is obtained from a palatal nance button.

Pendulum Appliance:

Introduced by Dr.Hilgers^{8,9} in 1992. Is a hybrid appliance that uses a large nance acrylic button in the palate for anchorage which is kept 2 mm away from the soft tissue, along with 0.032" TMA spring that deliver a light,

Sharma, et al.: Molar Distalization - A Review

continuous force to the upper 1st molars. Thus, the appliance produces a broad, swing or pendulum of force from midline of the palate to the upper molars. The spring can also be adjusted to expand and rotate the max 1st molars. The 0.032" recurved molar insertion wire fits into the 0.036" lingual sheath on the max 1st molar band.(fig:6) Due to the nature of the pendulum springs maxillary molars have a tendency to go lingually when distalized. To compensate for this shortcoming it is prudent to open the horizontal adjustment loop utilizing a bird beak plier, which lengthens the pendulum springs and helps prevent the unwanted lingual movement. The appliance is activated by using a bird beak plier. During activation care should be taken to prevent opening or widening of the coil. Modified Pendulum Appliance /M-**Pendulum:**

Introduced by Dr. Scuzzo¹⁰ et al in the year 1999. This was designed to overcome the unwanted tipping of maxillary molars during distalization. In modified pendulum appliance the horizontal pendulum loop is inverted, so that it will allow bodily movement of both the roots and crown of the maxillary molars.(fig:7) **Molar Distalization with Super Elastic Niti Wire:**

It was designed by Locatelli and Gianelly¹¹ in 1992. Produces 1-2 mm molar distalization, if the second molars are unerrupted .The appliance is easy to insert even after all teeth have been bracketed.Neo sentalloy super elastic NiTi Wire with shape memory regular arch form is placed over the maxillary arch. A stop is crimped to the arch wire at 5-7mm distal to the anterior opening of the molar tube and hooks are added for intermaxillary elastics between the lateral incisors &canines.(fig:10) The wire is inserted into the molar tube until the posterior stop abuts the tube. The anterior stop is grasped and the wire is forced gently distally so that it abuts the distal wing of 1st premolar bracket then ligated and is placed through the 1st premolar bracket.It exerts a 100 Gms distal force against the molars.

Distalix

In 1993, Langlade introduced a new appliance called Distalix. This appliance was originally designed from the quad helix appliance, from which it borrows the four helices, and from Hilger's distalization pendulum spring. It is constructed with a 0.032 inch blue Elgiloy round wire and can be welded on premolar and/or molar bands, or it can be completely removable, with a palatal tube on molar bands. (fig:8) It also produces very light force ranging from 250 to 350 gm this is enough to obtain molar distalization in a growing patient. Distalization is obtained after 4 to 6 months, can open spaces of 8-9mm.

Jasper Jumper:

Jasper J.J and Mc Namara James¹²in 1995 described a modification of Herbst bite jumping mechanism known as Jasper Jumperthat can be attached to fixed appliances. The force module is consist of a stainless steel coil spring that is surrounded by opaque polyurethane covering and is attached at both ends to stainless steel endcaps, in which holes have been drilled in the flanges to accommodate the anchoring unit.(fig:9) The modules are available in seven lengths, ranging from 26mm to 38 mm in 2mm increments. This interarch flexible force module allows the patient greater freedom of mandibular movement than is possible with original bite jumping mechanism of Herbst.

The appliance was designed byDr. Varun Kalra $(1995)^{13}$ to achieve bodily movement or controlled or uncontrolled tipping of molars. The K Loop is made of 0.017 x 0.025 inch TMA wire, which can be activated twice as much as stainless steel before it undergoes permanent deformation, and the loop made of TMA produces less than half the force of one made with stainless steel. Each loop should be 8 mm long 1.5 mm wide (fig:11).

Lokar appliance:

Lokar in 1996¹⁴ had introduced new molar distalizing appliance called "Lokar molar distalizer". This appliance utilizes the continuous ideal force nickel titanium spring to generate rapid molar movement while minimizing patient's discomfort. (fig:12) Before placing the appliance, it is necessary to fabricate palatal anchorage system which consist of 0.036" steel wire adapted to the palate, soldered to the anchor bands on the second bicuspids. Appliance is activated by compressing the nickel titanium coil spring by using a ligature tie from the bracket on the anchor tooth and the sliding part of the Lokar appliance.

Distal Jet For Upper Molar Distalization

Developed by Dr.Carano and Dr.Testa in the year 1996¹⁵.Developed to overcome the disadvantages of other appliance.Bilateral tubes are attached to an acrylic nance button. A coil spring and a screw clamp are slide over each tube. The wire extending from the acrylic through each tube ends in a bayonet bends that is inserted into the lingual sheath of the 1st molar band. An anchor wire from the nance button is soldered to bands on the second premolars.The distal jet is reactivated by sliding the clamp closer to the 1st molar once a month.(fig:13)

Modifications of Distal Jet a. Double set screw distal jet

- b. Conversion to Nance holding arch:
- c. Distal jet Hex Key Handle:
- d. Modified mandibular distal jet:

Eureka Spring

In 1997 Devincenzo¹⁶ described the Eureka Spring, which is a fixed inter maxillary force delivery system.It's a compression type of spring.The main component of the spring is an open wound coil spring encased in a telescoping plunger assembly. (fig:14)The mechanics of the appliance has the opposite effect to that of class II elastics in that it acts to intrude both the lower incisors and the upper molars. The effects of this appliance are entirely dento-alveolar and no orthopedic or bite-jumping effects are claimed **Churro Jumper**

The Churro Jumper, name derived from Mexican Cinnamon twist developed by Dr. Castanon et al.,¹⁷(1998), The appliance functions more like jasper jumper.Made up of 0.028 inches to 0.032 inch wire as a long series of 15 to 20 symmetrical and closely placed circles. (fig:15)These coils can be formed free hand with the bird beak plier or a 0.040 inch wire which acts as a spindle ,mesial end is an open circle that is placed over the mandibular arch wire, against the canine bracket, and squeezed,the distal terminal circleattaches to the maxillary molars by a pin that passes first through circle of the Jumper and then through the distal end of the headgear tube and finally

Sharma, et al.: Molar Distalization - A Review

cinched. It produces very little distal movement. **Klapper Super Spring**

In 1998 Lewis Klapper¹⁸introduced the Klapper superspring for the correction of class II malocclusions.Resembles Jasper Jumper with the substitution of a cable for the coil spring. This appliance is an auxiliary which is fitted to fully banded upper and lower fixed appliances. The appliance consists of bilaterally a length of multiflex nickel titanium which is bent back on itself attaching to the upper first molar tube and attaching to the lower arch wire by means of a helical loop. (fig:16) The appliance comes in two sizes, a 27mm primarily designed for extraction cases and 40 mm for non extraction cases

The New Distalizer

The new appliance for molar distalization originates form a former idea by Dr. Nicola Veltriin 1999¹⁹ with subsequent personal modifications. Appliance consists of a palatal sagittal screw for bilateral molar distalization according to Veltri, which is connected to bands on maxillary first molars and on maxillary second premolars(fig:17). The screw is activated at the rate of two quarters of a turn every week. The correction of a full class II molar relationship requires an average 3 month and a half period of active therapy.

C-Space Regainer

Introduced by Kyu-Rhim Chung, Young-Guk Park and Su-Jin in (2000)²⁰. C-Space regainer is a removable appliance used to achieve bodily molar movement without significant incisor flaring. It consists of a labial framework, formed from 0.036" stainless steel wire and an acrylic splint. A closed helix is bent into the framework in each canine region. The labial framework is extended distally to lie as close to the buccal molar tubes as possible, allowing easy insertion into the head gear tubes and improving the precision of the distal driving force.If maxillary expansion is needed, a midpalatal screw can be incorporated in the midline of the acrylic and activated 1/4 turn every 3 days. (fig:24)

Forsus Nitinol Flat Spring In 2003 William Vogt ^{21,22} introduced two new fixed intraarch spring devices for class II correction, the Forsus Nitinol Flat Spring and the Forsus Fatigue Resistant Device.

The flat nickel titanium spring attaches to the maxillary molar bands with an attached pinand-loop assembly that slides into the headgear tube from the distal and is cinched on the mesial this assembly is called the "Link 'n' Loop. Alternatively, the spring can be attached to an auxiliary sectional wire that hooks onto the main archwire in the canine region and passes distally through the first molar auxiliary tube, allowing the premolar brackets to remain on the teeth. The Forsus Flat Spring is designed to deliver 225-250g of force when it is compress 5mm for initial activation .Reactivation done by placing a crimpable stop on the archwire in front of the spring adding 1.5mm of compression. Molar distalization takes about six months in the typical adolescent patient.(fig:18)

Crozat Appliance

The Crozat appliance is based on the concept that mild stress applied in the desired direction will produce tooth movement without excessive tipping, provided ample time is given to nature to respond. Dr. George Crozat²¹

technique used molar distalization and rotation as the major source of space. The treatment of a bilateral Class II malocclusion with a good lower arch is begun with rotation adjustments of the upper molars. Then, class II elastics are added to continue distal movement. (fig:19) **Transpalatal Arch:**

TPA made from 0.032" TMA bar. TMA is more elastic and resilient than stainless steel and used to make conventional Goshgarian is arch.(fig:21) The direction of insertion of TPA into tubes is also different. The arch is inserted from distal into the tube of maxillary molar used as anchorage, and from the mesial into that of the maxillary molar to be distalized .The central omega loop is not needed because the TMA arch is not being used for palatal expansion.

Acrylic Cervical Occipital Appliance (ACCO):

Acrylic cervical occipital appliance (ACCO) was Developed by Dr. Margolis. This removable appliance exerts a continuous distalizing force on the molars, with the springs reactive forces dissipated through the acrylic button in to the palate and the maxillary teeth mesial to the molars. It consists of a labial bow over the incisor, embedded in an acrylic wrap around plate with Adams clasps on the first premolars. A round (0.028") or rectangular (0.019X 0.025) finger springs that are activated posteriorly to exerts a light, constant force of no more than 100-125gm if the second molars .And an anterior bite plane placed from canine to canine to disto-occlude the buccal segment during molar distalization .For optimal results, the ACCO must be worn full time except during meals, and the headgear for 12-14 hrs/day

Lip Bumper:

The lip bumper is a fixed functional orthodontic appliance. It works by altering the equilibrium between the cheeks, lips and tongue and by transmitting force from periodontal muscles to the molars where it is applied.Used for various purposes like molar anchorage ,therapy of habits and Space gaining in the lower arch. It is composed of a 0.045" stainless steel wire that runs in the lower vestibule from molar to molar and get inserted into the 0.045" tubes on 2 molar bands cemented to $1^{st} / 2^{nd}$ molars. (fig:22)



Fig 3: Cetlin Appliance



Fig 4: Molar Distalization with Magnets THRANKINZ Z ZANAKADA





Fig 6: Pendulum Appliance



Fig 7: Modified Pendulum Appliance







Fig 10: Super Elastic NiTi Wire



Fig 11: K Loop CHI -----

Fig 12: Lokar Appliance



Fig:13 Distal Jet

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Fig:15 Churo Jumper



Fig:16 Klapper Super Spring



Fig:17 The New Distalizer

Sharma, et al.: Molar Distalization - A Review





Fig:19 Crozat Appliance





Fig: 21 Transpalatal Arch



Fig: 22 Lip Bumper



Fig:23 Mini Implant



Fig: 24 C Space Regainer Conclusion

Among the various suggested modalities of Molar distalization, some have been investigated by clinical research, others remains hypothetical and await investigation. In this age where advancements are being made each and every day, one should expect that this lacuna will be filled in near future. The newer material like Niti, Magnets and implant supported distalizing appliance will no doubt revolutionize the procedure of the molar Distalization. Who knows one day the so called next generation force delivery system by minimotors may be delivering effective distalizing forces on the molar intraorally.

It should be remembered that patient selection for a particular method of Distalization is of utmost importance and should not be overlooked.

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