INVITED REVIEW

Molar Distalization

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ABSTRACT: Various methods of gaining space in the arch may be obtained by number of means including reproximation, expansion of the dental arches, extraction of certain teeth, distalization of canine and molars, uprighting of molars, derotation of posterior teeth and proclination of anteriors. Distalization of molars is the procedure where molars are moved posteriorly by using removable or fixed intraoral orthodontic appliances or extraoral orthopedic appliances. This article reviews the various molar distalizer, the best time for molar distalization and the current distalizer designs also.

Key words: Timing of molar distalization, Need for second molar extraction, Various molar distalizers

Correction of Class II malocclusion without extractions requires maxillary molar distalization by means of intra oral or extra oral forces. Headgears are quite successful, except for its patient compliance.

Hilgers introduced the term “Non-Compliance” to orthodontics, where patient cooperation is minimally needed. 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. 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 is 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

- Mesial tipping or migration of maxillary first molars due to carious attack of primary molars, early extraction of primary molars.

The discrepancy anterior to the first molars does not exceed 2-3mm on either side or when there is no evidence of developing posterior crowding.

An end-on full Class II molar relationship due to the ectopic eruption of either the first or second bicuspid, impacted canine, unerupted and ectopic eruption of cusps.

• Mild to moderate arch discrepancy.
• Incisors are retroclined or when the profile affords some proclination.

LIMITATIONS

• Unfavorable growth pattern.
• TMJ problem.
• Excessive proclination of anteriors.
• Posterior crowding.

James Hilgers (1992) stated that with maxillary molar distalization, there is a tendency for anterior bite to open. This open bite generally corrects by itself in brachyfacial patients but can be problems in dolicho facials with tongue thrust habits. So he recommends treating vertical growth patterns conservatively with extractions, directional headgears and transpalatal bars.

David J. Snodgrass (1960) suggested that distalization of the maxillary first molars aids in increase in vertical height. This is due to that they move closer to the bicuspid.

contact sooner with the opposing teeth during the act of closure thereby increasing the fusion.

TIMING OF DISTALIZATION

The patient should be treated before the roots of the molar to be moved, has not completed
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its growth and the orthodontic distal tipping or distal bodily movement is easier. If the treatment is delayed too long and the second molar begins to erupt, then it requires vastly increased anchorage and a very efficient appliance approach in moving first and second molars distally.

Many clinicians suggest that molar distalization is very efficient, if it is carried out when the second molar crown is at the apical third of the first molar.

UPPER MOLAR POSITION

Cephalometrically, according to Ricketts analysis, upper molar position is the horizontal distance from pterygoid vertical line or PTV lines (a vertical line drawn through the distal radiographic outline of pterygomaxillary fissure and perpendicular to the Frankfort horizontal to the distal surface of the maxillary first permanent molar).

On the average, this measurement should equal the age of the patient +3mm (e.g. a patient 11 years of age has a norm of 11+3 = 14mm; one mm is added per year for age adjustment). This measurement assists in determining whether the malocclusion is due to the position of upper or lower molar and also is useful in deciding whether extractions are necessary.

This linear measurement is an indication of the forward position of the upper molar and suggests whether sufficient space is present or not for the 2nd and 3rd molars. This measurement indicates or contraindicates maxillary molar distalization.

MAXILLARY SECOND MOLAR EXTRACTION IN MAXILLARY FIRST MOLAR DISTALIZATION

Hilgers (1992) suggested that when a great deal of distal movement is needed, it is preferable not to extract the upper first bicuspids, it is always beneficial to remove the upper second molars and let the third molars drift into place.

The extraction of second molar delivers almost double the space gained by bicuspids extraction anterior and posterior segment simultaneously.

The optimal time for extracting second molars have migrated sufficient

DISTALIZATION

I. Extraoral

Bilateral Molar Distalization
- Cervical pull Headgear
- Combi pull Headgear

Unilateral Molar Distalization
- Power – Arm Facebow
- Soldered – Offset Facebow
- Side pull Facebow
- Swivel Offset facebow
- Spring Attachment facebow

II. Intraoral

Inter Arch
- Sliding Jig
- Atkinson Buccal Bar
- Tandem Yoke (Adjustable sliding yoke)
- 3D Bimetric Distalizing Arch
- Modified Herbst Appliance
- Jasper Jumper
- Schmuth and Muller Double Plates

Intra Arch
- Sagital Appliance
- Modified Nance Appliance
- Modified Nance and Lingual Appliance
- Repelling Magnets
- Lip Bumpers and flexible lip bumpers
- NiTi Coil springs
- Superelastic NiTi wires
- Molar Distalizing Bow
- Pendulum Appliance
- K-Loop Molar Distalizer
- Jones jig
- Lokar Distalizer
- Fixed Piston Appliance
- Removable Molar Distalization Splint
- Lingual Distalizer / Distal jet
- Bonded Molar distalizing appliance

III. New

First Class appliance
- Super spring
- Palatal orthodontic implants
- Frunzulum appliance
- Frozat appliance
- Greenfield lingual distalizer
- A new Cl II distalizer
- Molar distalization
- Anchorage

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- New orthodontic anchor plates for upper and lower molars distalization.

**VARIOUS SPACE REGAINERS**
- Modified Hawley's appliance
- Slingshot appliance
- Modified Humphrey appliance
- Removable or fixed Lingual Arch with springs
- Expansion screw regainer
- Recurved Helical spring regainer
- Knee spring regainer
- Clasp rings

**NI TI COIL SPRINGS**

Gianelly et al. used Japanese NiTi coils for molar distalization. A passive 0.016 x 0.22 inch wire with stops that abut the distal wings of the premolar brackets is inserted, and the coils are placed on the wire between the first premolars and the molars. The coils are activated 8 to 10 mm by compressing and maintaining them against the molars by crimpable hooks or Gurin locks. The molars can be moved distally to 1.5 mm per month with 8 to 10 mm activation. In addition, a Nance type appliance, which is similar to that employed for anchorage control when magnets are used to move molars posteriorly is cemented onto the first premolars. The appliance extends from the incisors to the molar area and a bite plate is added to the incisal portion to disocclude the posterior teeth slightly.

When second molars are erupted, hooks for class II elastics are fixed on the arch wire between the lateral incisors and the canines, so that anchorage support by means of class II elastics can be used if deemed necessary. If no anchorage loss occurs as the molars move posteriorly, no elastics are placed. As a rule of thumb, class II mechanics are used only when anchorage loss is at least 1mm. When class II elastics are attached, a rectangular wire with 10° of incisor lingual root torque is inserted in the mandibular arch to maintain lower incisor position.

**SUPER ELASTIC NI TI WIRES**

Lacatelli et al. have described a method of molar distalization with super elastic NiTi wire. A 100g Neo Sentalloy wire with regular arch form is placed over the maxillary arch. The wire is marked in three places on each side at the distal wing of the first premolar tube and between the lateral incisors and canines. A stop is crimped to the arch wire at each of the posterior marks and hooks are added for intermaxillary elastics between the lateral incisors and canines. The wire is inserted into the molar tube until the posterior stop abuts the tube. To place the wire through the first premolar bracket, the anterior stop is grasped and the wire is gently forced distally so the stop abuts the distal wing of the first premolar bracket when ligated. Since the wire is 5-7 mm larger than the available space, the excess will be deflected gingivally into the buccal fold.

As the wire returns to its original shape, it exerts a 100gms distal force against the molars and a mesial reaction force on the first premolars, incisors. There is also a tendency for the premolars to move buccally which makes it inadvisable to use an Accuform archwire. Placing 100-150g class II elastics against the first premolars or placing the hooks between the lateral incisors and canines can control this (Fig-1).

**MOLAR DISTALIZING BOW**

Jockel and Rakosi (1991) suggested using Molar Distalizing Bow for maxillary molar distalization. The appliance consists of a 0.8-1.5 mm thick thermoplastic wire.
The appliance has also been adjustable stop.

To activate the appliance, the central section of the bow must be fitted in the anterior slot by manual pressure against the elastic resistance of the springs or loops so that the force generated is transmitted to the molar tubes. The molar tubes must be in the same plane as the anterior slot or just above it.

With certain modifications, molar distalizing Bow can distalize the first molars following distal movement extraction of the second molars. The appliance can also be used for unilateral first molar distalization even after initial eruption of the second molar. Another modification makes it possible to distalize and align lower first molars.

- The appliance cannot intrude the molars
- Molar Distalizing bow has only orthodontic effect on molar and no orthopaedic effect on maxilla
- Patient can wear for 17-18 hours. It does not interfere with sleep; it can be removed at any time.
- There is no risk of injury.
- Unilateral distalization also possible with modified molar Distalizing Bow.

The use of molar Distalizing Bow in the mandible is not restricted to molar distalization to correct crowding. The appliance has also been successfully applied to preprosthetically upright the tipped second molars. There is no vertical force during distalization with springs around the bow. Therefore, care must be taken that the molar tubes are positioned in such a way that the Distalizing Bow is in the same plane as the anterior groove anchorage or just above it.

THE PENDULUM APPLIANCE

Dr James J Hilgers (1992) developed the pendulum appliance which is a Hybrid that uses a large Nance Acrylic button in the palate for anchorage, along with 0.032 TMA springs that deliver a light continuous force to the upper first molars without affecting the palatal button. Thus, the appliance produces a broad, swinging arc or pendulum of force from the midline of the palate to the upper molars (Fig-2).

The right and left pendulum springs from 0.032 TMA wire, consist of a recurved molar insertion wire (modification simple 90 bent), a small Horizontal adjustment loop (modification elimination of this loop), a closed helix and a loop for retention in the acrylic button. The spring are extended close to centre of palatal button to have a maximum range of motion, to have easier insertion and to reduce forces to an acceptable range (Fig-2A).

Lingual sheath on the upper molars should be 0.036" to accommodate 0.032 wire loosely. Earlier Nance button was held in place with occlusally bonded rest on either the deciduous molar or the first and second bicuspid. The recent modification suggest banding the upper first bicuspid of first deciduous molars, soldering a retaining wire to bands and using these teeth as major anchorage for the appliance.

If expansion of the upper arch is needed, a midpalatal jack-screw can be incorporated in the centre of Nance button and the screw is activated one-quarter turn every 3 days, after a week. This version is known as “pend X” (Fig-3).

It is better to reactivate the springs before appliance placement by bending them parallel to the midline of the palate or perpendicular to the body of appliance. A 60 activation of the pendulum springs produce a force of 230gms per side. Molar bands are cemented and adhesive is put over the occlusal rests and smoothened. Then, the pendulum spring is brought forward with finger pressure and mesial end of the recurved loop is grasped with weingart plier and spring is seated in lingual sheath. Elastic "0" ring can be used for safe seating of the spring in the lingual sheath. As the molars are driven distally, it moves on an arc towards the midline of the appliance towards cross bite Opening the adjustment loop slightly to increase the expansion and molar rotation can counteract it. The patient should be seen about every three weeks so the spring pressure can be checked. For reactivation, spring is removed from lingual sheath, centre of helix is held with Bird Beak plier and pushing it distally toward the midline and again reinserring in the sheath reactivates spring.
Since the distal movement of the upper molars occurs so rapidly (5mm in three to four months) there is a transient bite opening due to driving these teeth back into the wedge of occlusion. This is commonly not a problem with brachyfacial types, as muscular rebound and growth more than compensate for this initial bite opening.

There are various methods of stabilization to distalized maxillary first molar in their changed position.

They are as follows:
- Overcorrection
- Quick-Nance (Hilgers)
- Short-term headgear
- Stops on arch wires
- Upper utility arch
- Push coil spring at cuspids
- Early bonding in the upper arch
- Class II elastics
- Upper lip bumper
- Hawley or clear type retainers
- Bionator
- Herbst appliance

K-LOOP MOLAR DISTALIZER

According to Varun Kalra, K-loop molar distalizing appliance can correct Class II malocclusion very effectively. The K-loop is made of 0.017 x 0.025 TMA wire, which can be activated twice as much as stainless steel before it undergoes permanent deformation. 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. The wire is marked at the mesial of the molar tube and the distal of the premolar bracket. Stops are bent in to the wire 1mm distal to the distal mark and 1mm mesial to the mesial mark. Each stop should be well-defined and about 1.5mm long. These bends help in keeping the appliance away from the mucobuccal fold, allowing a 2mm activation of the K-loop (Fig-4).

The 20° bends in the appliance legs produce moments that counteract the tipping movements created by the force of the appliance and these moments are reinforced by the moment of activation as the loop is squeezed into place. Thus, the molar undergoes translatory movements instead of tipping. Root movement continues even after the force has dissipated. If an intrusive or intrusive force
removing a total of as much as 4mm of distal molar movement is sufficient. The palatal Nance button should be large and should also be kept away from the teeth.

JONES JIG

Jones and white(7) used an open coil jig for rapid class II correction. The Jones Jig assembly, which is the product of American orthodontics, can be used with full arch fixed appliance, with partial banding or as a pre-fixed appliance treatment. 0.036 stainless steel round wire is formed to the palate on the cast and is extended as far as the canines, it is then soldered to the premolar bands. After that an acrylic button is made in the region of maximum contour of palate with the help of cold cure acrylic which was about ½” in diameter.

The sectional jig assembly which is constructed of stainless steel round wire and 0.022 x 0.028 stainless steel together at the mesial end of the molar tube and the round wire is extended till the first premolars. The jig uses an 150gms of force of 1 to 5 mm (Fig-5). The Jones Jig assembly is inserted posteriorly into the double buccal tube on the first molars.

It is activated by using ligature ties from the cleats on the second premolars to the spots on the round wire just anterior to the open coil Nitinol springs. After the molars are distalized, a Nance acrylic button is cemented joining molar to molar to stabilize the molars.

LOKAR DISTALIZER

Scott (1996) described the Lokar distalizer as a very efficient one in maxillary molar distalization. It utilizes continuous, ideal forces of Nitinol springs to generate rapid molar movement while minimizing the patient discomfort. It is easy to insert, to ligate and to use. Precise distalization can be accomplished usually with one activation. It can be used unilaterally and is easy to adjust. It can be used in early treatment or with appliance in place. Anchorage can be achieved with Nance button or by employing full sized arch with fixed appliance.

The appliance is placed in the buccal tubes distally and mesially ligating it to the premolar brackets activates it. After the distalization, Nance acrylic button is placed molar to molar for stabilization (Fig-6)

FIXED PISTON APPLIANCE

Greenfield(8) advised Fixed Piston Appliance for rapid class II correction. A 0.040 stainless steel wire is placed to the palate and brought posteriorly to the gingival third of the bicuspid bands for soldering. Enlarged Nance button is prepared. 0.036 stainless steel tubing to the buccal and lingual occlusal third of the bicuspid bands is soldered. The tube should extend parallel to the mesial surfaces of the first molars. A 0.030 size d to the buccal and lingual surfaces of first molar bands. A 0.055 Nitinol coil springs to fit the entire length of the buccal and lingual a 2 mm split ring stops are added to the mesial
of the buccal and lingual tubes on each piston assembly every 6 to 8 weeks.

This provides 25 gms of force to each piston assembly. Once the desired arch-length development has been achieved, the buccal assemblies are removed; leaving in essence, a space maintainer. The maxillary arch is bracketed for retraction and uprighting, the modified Nance button is removed and intrusion and retraction of the anterior segment begins.

**REMOVABLE MOLAR DISTALIZATION SPLINT**

Korodi Ritto (1995) developed a removable molar distalization splint. The clear splint is made from 1.5 mm Biocryl in a Biosstar machine. If both upper first molars are to be moved distally at the same time, the splint extends from the area of the upper right first or second premolar. If only one molar is to be moved, the splint extends to the terminal molar on the opposite side.

Two internal clasps are used for retention. And a Nickel Titanium open-coil spring produces about 200 gms of distal force at the beginning of the treatment. The coils are reactivated when they have been compressed as far as the bonded molar button or the molar band. After molar distalization, the splint can be used to maintain molar position while the anterior teeth are retracted.

**THE DISTAL JET / THE LINGUAL DISTALIZER SYSTEM**

A Distal Jet appliance / Lingual Distalizer System was developed that can distalize maxillary molars without disadvantages.

Bilateral tubes of 0.36 internal diameters are attached to an acrylic Nance button. A coil spring and a screw-clamp are slid over each tube. Nickel Titanium coil springs of 150 gms for children and 250 gms for adults of stainless steel springs can be used. The wire extends from the acrylic through each tube in a bayonet bend that is inserted into the lingual sheath of the first molar band. An anchor wire from the Nance button is soldered to bands on the second premolars.

Sliding the clamp closer to the first molars the Distal Jet. Once distalization is complete, sliding the clamp-spring end of cold-cure acrylic and cutting of the arms to the premolars. Maxillary molar distalization of three to five mm with presence of second molar takes approximately four months with a minimal anchorage loss. It is ideal for unilateral or bilateral molar distalization (Fig-7).

**BONDED MOLAR DISTALIZING APPLIANCE**

David Hamilton (1997) suggested the bonded molar distalizing appliance. In the upper arch, if well formed and well-positioned third molars are present, consideration of second molar extraction may be indicated. If second molars are in position and are not to be extracted, they should be banded and a sectional arch is placed between the first and second molars to prevent eruption. Control of dentition in the opposing arch is necessary to prevent undesirable eruption of teeth.

The Bonded Molar Distalizing Appliance may be incorporated with expansion appliances as either rapid palatal Expansion or Dual Arch Expansion Appliances. It may also be designed for unilateral molar distalization and may be used with face crib and protrusion elastics in Cl II crowded cases. The appliance uses Sentalloy coil springs for distalizing force. Within 5-6 months desired distalization is achieved. Space gained by molar distalization is restrained by immediate placement of removable stabilizing appliance.

**REPELLING MAGNETS**

Gianelly et al and Takami Itoh et al have used repelling magnets for distalization of molars. A modified Nance appliance to the maxillary first premolars is fixed with a wire extending from the first premolars to the palatogingival surfaces of the incisors and soldered to the framework of the appliance. The acrylic button
placed anteriorly to contact the incisors. This reinforces the anchorage potential of the conventional Nance appliance by including the incisors in the system.

An auxiliary wire is also soldered with a loop at its end to the labial surfaces of the first premolar bands so that both wires extended posteriorly to approximate the mesial surfaces of the first molar bands. The incisors brackets are placed and a passive sectional wire is ligated to maintain incisor alignment. This step is not necessary for all the patients.

The repelling surfaces of the magnets are brought into contact by passing a 0.014 ligature wire through the loop on the auxiliary wire, then tying back a washer anterior to the magnets. Thus, the magnets could only be separated if the molars moved distally or the incisors moved anteriorly.

The force exerted by the magnets begins at 200-225gms, but drops substantially as space opens. With 1mm of space between magnets, the appliance force is only 75 gms. Consequently, retying the ligature once a week to ensure at least 75 gms of force against the molars reactivates the magnets. After molars are distalized, 0.016 × 0.022 arch wire with stops is inserted to maintain the molar positions. The molars are distalized about 3 mm in seven weeks in those patients who do not have second molars. The rate of molar movement in patients with second molars is usually 0.75-1 mm per month.

Blechman and Steiger (1995) indicated that the bodily movement in most of the cases is probably attributable to the basic property that repelling magnetic pole faces avoid eccentric movements and always strive to maintain an equal air gap along their entire vertical pole dimension, when constrained to slide along a common guide wire.

Blechman and Alexander (1995) introduced miniaturized magnets for molar distalization. They choose the static magnetic forces as the distalizing modality. They found that the light force generated by “Magneforce” – the miniaturized magnets, is more than adequate for rapid, mostly transitory, molar distalization, and this force also minimizes local pathology and reactive anchorage force (Fig-8).

**FIRST CLASS APPLIANCE**

With the objective to minimize anchorage loss Fortini et al (1999) devised an appliance 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, Niticoil spring (0.010 × 0.045) of 10mm length is used to achieve bodily movement of 4-8 mm in 26-95 days.

**SUPER SPRING**

The super spring designed by Klapper (1999) is a flexible spring element that attaches between the maxillary molar and mandibular canine. It is designed to rest in the vestibule, making it, impervious to occlusal damage and allowing for good hygiene. The spring’s helical loop is twisted like a J-shaped wire. On the maxillary end as the maxillary first molar attachment.

During opening and closing move the hinge on the mandibular arc of 90°. A longer spring is used for non extraction springs for full Class II extraction.
PALATAL ORTHODONTIC IMPLANTS

Ideal implant in median maxillary suture for anchorage was originally by Träca, Mannchen (1992) implanted miniature gold fixation screws onto 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 remayloy stainless steel wire with 4.5 mm long 0.022 x 0.028 rectangular tubes are attached on each end 0.022. Damon SL brackets are welded to molar bands for receiving sectional arch wires. Distalization can be accomplished either with sagittally reactivated delta loops and long vertical legs or with straight sectional wires and push coil springs.

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. The anterior anchorage unit comprised of an acrylic button positioned lingually and inferiorly to the mandibular canine to canine. The acrylic must be at least 5 mm wide to avoid mucosal trauma 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. 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.

SPACE REGAINER

Chung et al (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. An open coil spring (0.010 x 0.040) is soldered distal to the helix and 0.028 ball clasps are used to retain the appliance. Open coil spring should be 130 percent of length between soldered point and mesial edge of headgear. When compressed it will exert 200 gms of force and more molars distally about 1-1.5 mm per month.

3D MAXILLARY BIOMETRIC DISTALIZING ARCH

The 3D maxillary biometric distalizing arch is a component of the classical twin arch technique. This appliance was used only in the final phase of finishing the occlusion, after all the corrections have been made.

The appliance consists of two sections, the anterior section of the arch (0.022") ties into the four maxillary incisors with ligature wire and the posterior (0.040) section with Intermaxillary hooks, and adjustable Omega stops fits into the 0.045" headgear tube. It is spring loaded, with 0.010” X 0.045” Eligiloy open-coil spring. In addition, the it is always used in a full maxillary base arch, usually 0.018” or 0.020” to distalize the buccal dentition. The patient is required to wear heavy 3/16” elastics (2 or 3 oz force) 24 hours per day. The use of this appliance is 3-6 months. The appliance is placed after the mandibular arch is in ideal arch alignment with a rectangular arch and if present, includes second molars. A fixed or removable lingual arch may also be placed. The molars are distalized in 1-1.5 mm distally on a base arch and the 0.040” posterior end section in the 0.045” headgear.
A modification of the Frozat (fixed Crozat) appliance initially developed by Mayes, unilateral Frozat appliance consists of two molar bands soldered to a 0.038” Blue Elgiloy or 0.040” stainless steel wire. The wire is fabricated on the patient's set up cast with lingual steps bent mesial to the molars and the distance from the alveolar process kept as constant as possible in the anterior segment. On the anchor side, the lingual arch is bent into an occlusal U - loop, distal to the solder point on the molar band, then curved around to form the lingual arm of the appliance.

Care must be taken to ensure that this arm is in contact with the lingual surfaces of all the anchor teeth and that the wire segment inserted buccally on these teeth is as rigid and passive as possible. The lingual arm and the segmental arch wire combine to form one large, multiroot anchor unit, as described by Bench with regard to the Quad Helix.

The Unilateral Frozat appliance is activated by using an Aderer three-prong plier to make a first order bend on the anchor side of the lingual arch, near the molar band. An anti-rotation bend must then be placed in the lingual arch in the region of the molar to be distalized. This activation eliminates the risk of any contact between the molar root and the lingual cortical bone. Before placing the appliance in the mouth, a distalizing force of about 180-200 g should be verified on the cast.

The appliance is inserted with caution to preserve the activation and prevent distortion of the bands. They recommend first inserting the molar band on the distalization side can be cemented without difficulty. If necessary, the unilateral Frozat appliance can be extraorally reactivated and recremented at later appointments (Fig-10).

THE GREENFIELD LINGUAL DISTALIZER: (Raphael Greenfield-2005)

The Greenfield Molar Distalizer (GMD) introduced in March 1995, is a fixed appliance with buccal and lingual pistons on each side. Placing the pistons at the gingival level reduces the distance of the applied force from the center of resistance of the molar minimizing the crown tipping moments that are seen with other distalizers. Thus, GMD produces bodily movement with almost no tipping.

There is virtually no loss of posterior anchorage during space closure, because the root lies directly below the crown. The appliance does not interfere with the occlusal plane, allowing vertical control to be maintained. For precise application of a controlled, light force, a 2 mm stop is added to each piston every eight weeks until the desired amount of distalization is achieved. Each 2 mm stop produces about 50 g of force.

An expansion screw may be added to the enlarged Nance button at any point along the midline, allowing the expansion force to be applied anteriorly or posteriorly during distalization. To maintain light forces, the screw should be activated no more than one-quarter turn every two to three weeks. Care must be taken not to over expand the molars prior to distalization, which would move the distal aspect of the molar into the cortical plate and make distal molar movement impossible.

The GMD can also be replaced by an expander using the same anchor teeth. After molar distalization, the GMD is temporarily removed, new bands are fitted, and an impression is taken for the expander. The GMD is reinserted with temporary cement until the expander is received from the laboratory. The distalizer is then removed and the expander is cemented immediately, preventing any relapse during the conversion.

LINGUAL DISTALIZER

The newest design of the GMD, the Greenfield Lingual Distalizer (GLD), applies the distalizing force only from the lingual of the .030” stainless steel wire assembly that fits into an .036” sleeve. Soldered extensions of .045” stainless steel wire are used to attach the module to the
Molar Distalization

The Carriere Distalizer is a simple and efficient fixed functional appliance for Class II treatment developed by the author with advanced computer technology, it represents an evolution of the modular Sectional Arch (Fig-11).

The distalizer is made of mold injected, nickel-free stainless steel. It is bonded to the canine and first molar t of the canine along the alv. g. provides a hook for the attachment of the Cl II elastics. This pad is the mesial end of an arm that runs posteriorly over the two upper premolars in a single curve. The posterior end of the arm is permanently attached ball that articulates in a socket on the molar pad. The Ball end sockets are designed with three dimensional virtual reality models to resemble the human hip joint, providing maximum freedom of movement in the appropriate direction. Raised surfaces on the ball articulate with corresponding depressions in the socket to limit distal rotation to -15 degree on the longitudinal axis. The joint also provides torque control of both the canine and molar.

The Distalizer comes in three sizes: 23 mm, 25 mm and 27 mm. The appropriate size is determined by measuring from the midpoint of the maxillary first molar's buccal surface to the midpoint of the maxillary canine crown, using a caliper or the supplied dentometer. In a case with an inaccessible high canine and the maxillary second molars present, the measurement can be taken from the midpoint of the second molar crown to the midpoint of the first premolar (Fig-12). The appliance is bonded to these teeth, rather than to the first molar and canine. posterior teeth can then be distalized to provide space for the blocking out upper canine.

After the teeth to be bonded are etched, a light-cured adhesive is placed on the two bonding pads of the distalizer. The molar attachment is positioned in the
center of the buccal surface with thumb pressure, and then curved. There will be adequate time remaining to position the canine pad correctly before curing it.

**Molar Distalization Using Multipurpose Implant (MPI) Anchorage**

The MPI has two parts: a retentive part in the form of a surgical miniplate with the three holes for miniscrews; a round bar extension which is 20 mm long and bendable. Formability of the extension bar makes it possible to carry the anchor to the area where it is required. The extension bar has thick and thin types; the thick one has a diameter of 0.9 mm and is recommended for use during molar distalization, while thin one has a diameter of 0.7 mm and is suitable for use during open bite treatment and consolidation.

The upper part of the MPI is adapted to the bony curvature, 5 mm mesial to the line passing from the mesial edge of the first molar tube. The round bar is extended in the downward direction to the level of the first molar tube and then bent in the mesial direction along the sulcus depth 3 mm apart from the vestibular mucosa. A 1 mm thick stainless steel round wire is soldered onto the lower surface of the custom fabricated metal sliding lock extending towards the arch wire. A horizontal U bend is made in the wire to be used in adjusting the force vector. A segmental round tube is soldered to the lower edge of the round wire at the same level as the main arch wire, to be used for compressing the open coil spring. The metal sliding lock is engaged on the mesial extension of the zygomatic implant. A 0.016” stainless steel arch wire is engaged passing through the segmental tube, a segmental nickel-titanium open coil spring is placed on the arch wire after the segmental tube, and the arch wire is engaged in the main tube of the molar band. A metal sliding lock is slid in the distal direction so that sufficient activation of the open coil spring is obtained and is fixed in that position.

**Lip Bumper**

It is also known as “Plumpers”. The Lip Bumper is a heavy labial arch wire, which is inserted into buccal molar tubes. The wire has a flange of plastic added anteriorly to engage the lip and is stopped anteriorly to the molar tubes with a vertical loop or compressed coil spring. Lip Bumpers may be used to maintain the arch perimeter, position the molar distally, or permit changes in incisal position.

Various classifications of Lip Bumpers have been given. According to Australian Orthodontic Journal, March 1990; classifications of Lip Bumpers are:

**Fabrication Classification:**
- Removable or non-removable
- Running
- Stopped
  - Loops
  - Stops
  - Offsets
- The covering material
- Covering of anterior part for lips
  - Prefabricated
  - Plastic tubing
  - Custom made with acrylic
- Various sizes and forms of wire

Another classification could be considered and that is whether a lip bumper is intended to be used for short term which is usually on a tooth moving basis, or if it is to be used on a longer term basis which is usually to try to influence lip function and growth. Longer duration usually means longer than one year.

As with Frankel's buccal shields, mandibular flexible lip bumper minimize restrictive cheek and lip pressures and allow arch development and relief of crowding, while promoting molar distalization and controlling molar rotations. The lip bumper is the best in achieving, patient's cooperation than with Frankel or Headgear.

**The Korn Lip Bumper**

This is made up of 0.045-inch stainless steel with adjustment loops mesial to the mandibular first molars. The appliance is positioned 2 mm anterior mandibular incisors at the gingival margin and inserted passively into the molar tubes. To reduce the need for patient compliance, the lip bumper is secured to the first molar band with ligature wire. The lip bumper is advanced as needed during routine orthodontic appointments (every 4 weeks) to maintain the position (Fig-13).

**Wide Lip Bumper**

The hard plastic (polypropylene) bumper design provides the necessary surface area to transfer adequate pressure from the lip to the molars while preventing the lips and the cheeks from applying pressure to the teeth.
Bayonet piston teeth to the steel wire with preformed vertical loops and posterior activated so that adjustments are bend. The vertical loops maximize lip clearance.

**CONCLUSION**

Various space gaining methods have recently been proposed and popularized. The techniques that rely less on patient cooperation include transpalatal arch, compressed coil springs, superelastic NiTi wires, flexible lip bumpers, K-loop molar distalizer, fixed piston appliance, distal jet.

Extra oral traction with head gear has been one of the methods used to distalize teeth. Though the magnets are very expensive and force with a small amount of movement. Hence the patient seeks to reactivate the appliance. The Herbst appliance is prone to breakage and is limited to use in patients who can tolerate proclination of mandibular teeth.

Despite their success in tooth movement, all these modalities have the major disadvantages of heavy dependence on the patient to comply and to follow directions.

Keeping these shortcomings in mind, the term “Non-compliance” to orthodontics was introduced. Orthodontists have well encased this term and the proofs lies in various intraoral maxillary first molar distalization techniques introduced in recent years.

**REFERENCES**


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**FLEXIBLE LIP BUMPERS**

Korn and Shapiro (1994) described the Flexible Lip Bumpers as an adjunct to Molar Distalization Therapy. The lip bumpers are made of malleable, 0.040” stainless steel wire encapsulated in polyethylene. Two types plain and looped lip bumper are available.

**BAYNE LIP BUMPERS**

Wire is encapsulated in polyethylene in the anterior portion to minimize abrasion. Two types plain and looped lip bumper are available.

**Fig. 13, Korn Lip bumper**
Molar Distalization


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