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Distal Jet and its modifications: A review

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Abstract
Space gaining in orthodontics is an important step for correction of various malocclusions. There are various methods used for gaining space such as extractions, proximal stripping, expansion and molar distalization etc. Molar distaliztion is method in which posterior teeth are moved in distal direction. Varieties of intra oral and extra oral appliances are used to move teeth distally in the arch. Intraoral appliances gain more popularity due to their advantages over extra oral appliances; the most important is their non-dependence on patients. In this article we will discuss about intra oral appliance that is Distal Jet appliance and its modifications.

Keywords: distalization, extraction, distal jet, intra oral appliance

Introduction
Edward angle put the Non-extraction proposal for treating patients. According to him when teeth could be saved by other methods, so extraction of teeth seemed inappropriate and unacceptable. The question of extracting teeth or not always remains at the time of orthodontic treatment planning. In non- growing patients there is no bone growth, so alternative approaches are needed to create space to move teeth for correction of malocclusion. Recent advancements in orthodontic mechanotherapy and changing concepts of treatment have decreased the need for extraction. In approximately 25-30 % patients maxillary expansion is helpful and 95% of class II patients can get better by using molar distalization, rotation and expansion [1].
Distalization is the process of gaining space within the arch by moving the terminal molars in a distal direction. The ideal time for distalization is during the mixed dentition period, prior to eruption of the second permanent molars. It is definitely much easier to move one molar distally as compared to two (ie first and second permanent molars). The amount of space gained is roughly equal to the amount of distal movement of molars. This approach is becoming popular due to the fact that the psychological trauma from extractions that is removing otherwise healthy teeth- can be avoided. Since space is easier to gain in the maxillary arch than in the mandibular arch because of increased trabecular structure of supporting bone and increased anchorage provided 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 normal mandible [2]
Molar distalization is one of the traditional approaches for class II molar correction and space regaining with a normal mandible and it could be achieved by using either intraoral appliance (IOA) or the extraoral appliance (EOA). The main advantage of intraoral appliance over extraoral appliance is being not dependent on patient compliance. There are various problems related to use of extraoral appliance such as, like wearing time and esthetic impairment etc, which lead to evolution of intra oral appliances like Jones Jig, lokar distalizer, keles slider, pendulum appliance, carriere distalizer etc. Nowadays Miniplates and mini-implants are increasingly appreciated in molar distalization and have ushered a new era in orthodontic treatment because of their ability to provide absolute anchorage [3].
Use of Temporary Anchorage Devices (TADs) is increasing because of their strong anchorage, which can avoid anchorage loss of premolars and flaring of incisors during molar distalization. Many types of TADs, including endo-osseous implants, miniplates, miniscrews and microscrews can provide reliable and stable anchorage to distalize arch or molars [4].
As the number of adult orthodontic patients is increasing nowadays, who want more esthetic treatment options and they do not prefer treatment with conventional fixed appliances. Align Technology Inc developed invisalign technique which is esthetic alternative to conventional fixed mechanotherapy [5]. Aligners can also provide a class II correction by a sequential maxillary molar distalization with a high predictability (88%) of the distalization movement of upper molars if supported by the presence of attachments on the tooth surface. Clear aligners are suitable for distalizing maxillary molar up to 2-3 mm without significant mesiodistal tipping movement [6].

Indications for molar distalization

Molar distalization is not a universal option for every class II malocclusion case. Appropriate case selection is necessary for better results. Molar distalization is indicated in following cases:

- Class II malocclusion or end on molar relationship.
- Well aligned arches.
- Long distal bases.
- Mesially positioned maxillary first molars due to caries or early loss of primary second molars.
- Anchorage loss during active orthodontic treatment [7].

Distal Jet for upper molar distalization

Dr. Carano and Dr. Testa [8] in the year 1996 developed distal jet appliance. This was developed to overcome the disadvantages of other appliance. It is a fixed lingual appliance that can produce unilateral or bilateral molar distalization typically in 4-9 months without relying on patient cooperation. The appliance permits simultaneous use of full bonded appliances, thus avoiding the need for two phase treatment.

Appliance Design:

Appliance consists of bilateral tubes of 0.036" internal diameter which 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 button through each tube ends in a bayonet bend 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 (fig.1).

The distal jet is reactivated by sliding the clamp closer to the 1st 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/ cold cure acrylic and cutting the arms of the premolar.

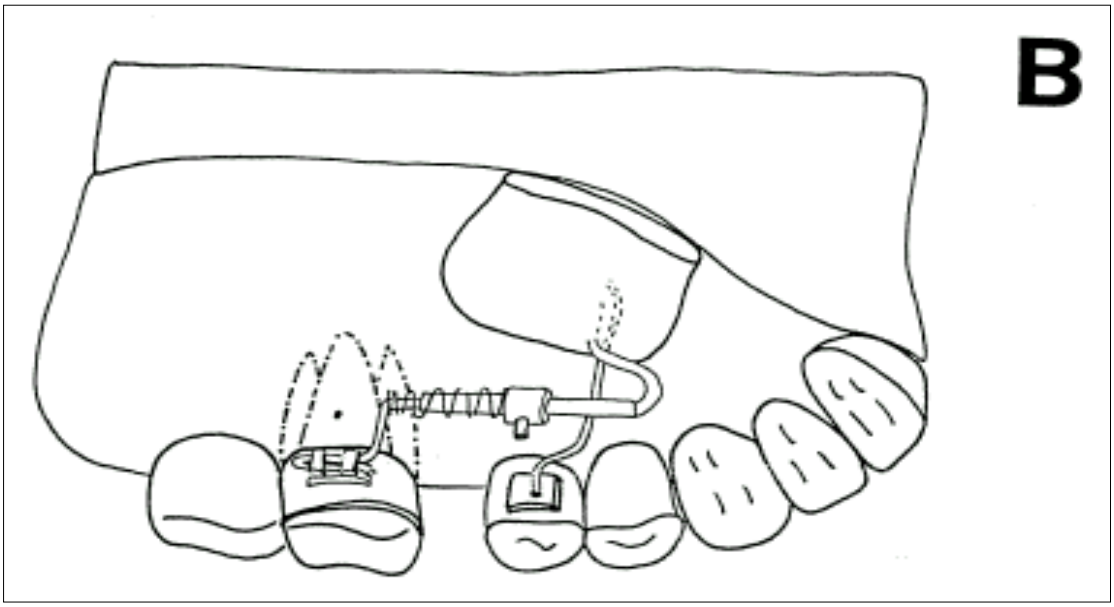

Fig 1: Distal jet appliance

According to the author the rate of molar movement with distal jet appliance is comparable to that reported with magnets and NiTi coil springs but was achieved without tipping or rotation and with no loss of anchorage.

The distal jet is relatively easy to insert, is well tolerated & esthetic & require no patient cooperation. It can be used for either unilateral / bilateral Class II correction.

Several clinically useful modifications of the original appliance have been proposed.

Double set screw distal jet [9].

This modification incorporates use of two sets of screw into the activation collar for a more reliable conversion of Distal Jet to Nance holding arch. (fig.2). After completion of molar distalization, the activation collar slide mesially to gain access to the coil spring. The free end of coil is grasped with a plier to remove it and it is peeled outward from bayonet wire. The double set screw collar slide back to this junction, mesial screw is set on the tube, and distal screw is set on bayonet wire, locking the two pieces together to prevent molar movement.

The premolar supporting wires are sectioned where they enter the acrylic button, using a high speed hand piece and diamond bur. The premolar bands can later be replaced without the lingual support wires. The lingual sheath on the first molar may be crimped with a utility plier to reduce any play of the double back wire inserted into it and thus prevent rotation of the acrylic button away from the palate. The bayonet wire or tube can be bent with a three prong plier to adjust the pressure of the acrylic button against the palate.

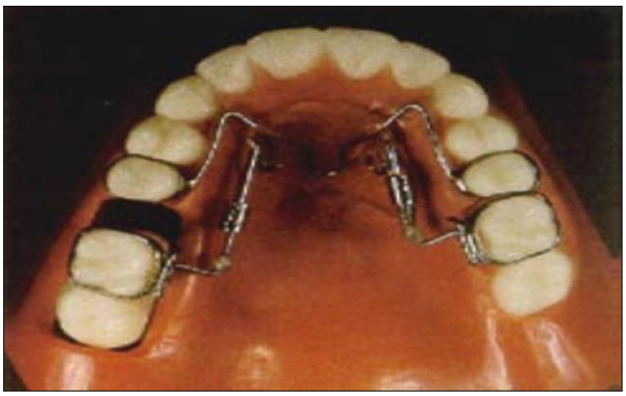

Fig 2: Double-set-screw modification of Distal Jet

Modification of Distal Jet for Molar Rotation

Distal rotation of the maxillary molars is a common treatment goal in the correction of class II malocclusion. Simple helical loops in the bayonet wires of the distal jet can be used to produce distal molar rotation, or to upright mesially tipped maxillary molars. These loops are activated with a utility plier before seating the appliance. Elastomeric chain is extended from attachments on the bicuspid bands to the molar bands to hold them in position during insertion of the preactivated appliance [9]. (fig.3)

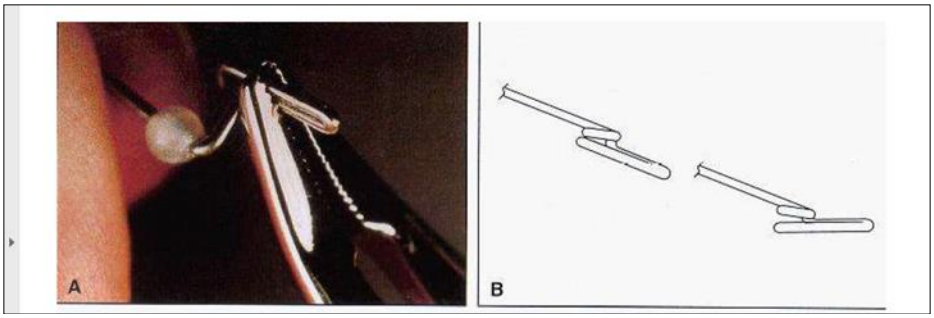

Fig 3: (A) Activation of rotational bayonet wire with utility plier prior to its insertion into lingual molar sheath. (B) Activation of rotational bayonet by bending doubled-back portion. (C) Forces involved in rotation and distalization of maxillary first molar using Distal Jet modified for molar rotation.

Modified mandibular distal jet

It was designed to upright mesially tipped 1st molars, when the original design is applied to mandibular 2nd molars. The distal bayonet bends often impinges on soft tissue in buccal vestibule, altering the appliance to reduce its extension into the vestibule permits the use of either a molar band with button attachment or a direct bonded button, in cases of partial tissue impaction [9].

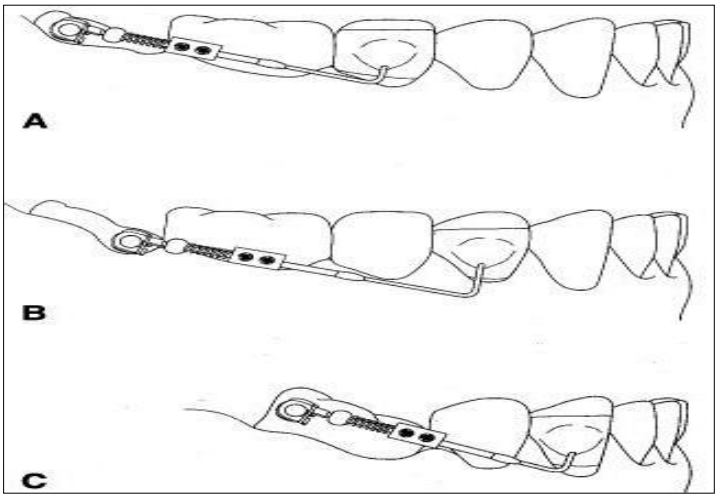

Fig 4: Modification of Distal Jet for mandibular molar uprighting, with bayonet redesigned to avoid tissue impingement in buccal vestibule

Distal jet Hex Key Handle

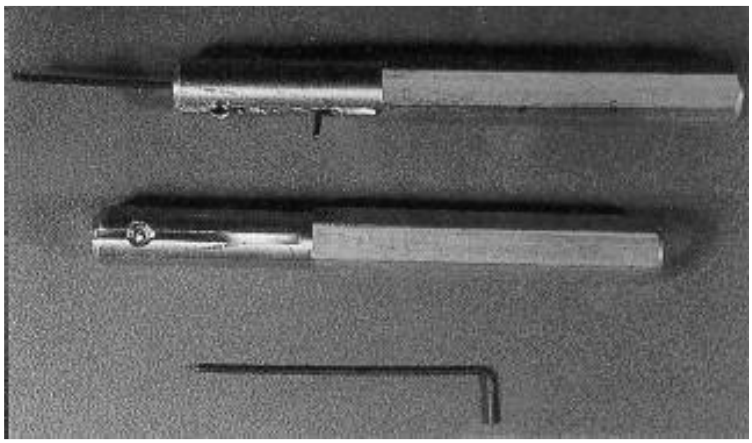

Fig 5: Hex key handles with replaceable keys.

A tiny wrench is used to activate distal jet appliance which makes it difficult to handle and aspiration is a concern. An autoclaveable hex key handle, makes the key easier to use [9].
In 2000 Andrew N. Quick and Angela M.P [10] has described another modification of the Distal Jet which eliminates some of the difficulties of conventional distal jet.

Appliance Design
The basis of the modification is the rear entry of the sliding section into the lingual molar sheath, so that the appliance pulls rather than pushes the molar distally. The double back wire is inserted into the lingual sheath from the distal. The foot should be a little longer than the sheath so it can be tied back to the sliding section with an elastomeric or metal ligature. Use of a ligature wire is recommended to avoid accidental breakage and possible ingestion (fig.6).
Either 0.030 or 0.032" wire is suitable for the sliding sections. Support tubes for corresponding internal diameter are embedded in the acrylic Nance button. Care must be taken when bending the distal potion of each sliding wire to allow enough clearance from the tuberosity of the palate when the wire is removed.

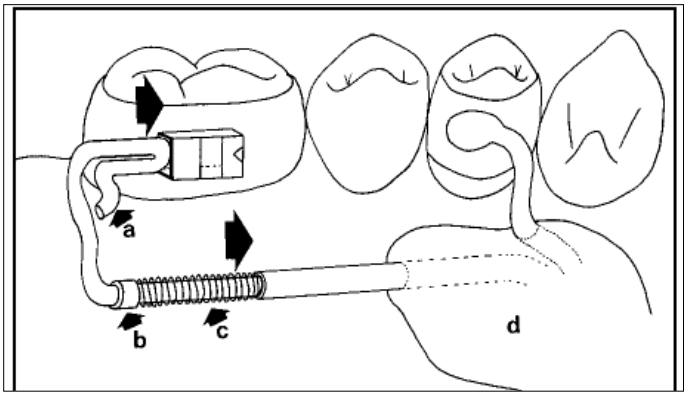

Fig 6: Distal Jet with rear entry (large arrows) into palatal sheath on molar band.

The desired amount of activation is achieved by compressing the coil spring between the distal end of the support tube and a stop soldered to the sliding wire.

Reactivation
The safety ligature is cut, the sliding wire is pulled out distally, and a new longer section of coil is placed over the wire. The sliding section is then reinserted as before. This process allows controlled activation of the appliance, with the coil lengthened in precise increments. Alternative method of reactivation would be to add beads or sections of tubing to reactivate the spring.

The distal Jet simplified and updated
In 2002 Aldo Carano *et al.*,[11]introduced new design of distal jet to overcome the following difficulties with the conventional appliance.
1. Inadequate visibility of the screw.
2. Difficulty in accessing the hex-head opening.
3. Stripping of the screw, activation wrench, or both during treatment.

4. Inability to obtain positive engagement of the lock on the tube to fully compress the spring.
5. A feeling of "looseness" of the appliance in the retention phase.

Changes to the Appliance

The locking mechanism of the Distal Jet, which plays the central role in both molar distalization and retention, consists of three interacting components,- lock, screw, and activation wrench. In conventional appliance for patient comfort, screw and wrench were small enough to accommodate the dimension of the lock. So, sometimes they were prone to failure in some situation.

For this difficulty, author changed the manufacture of the lock from a machining process to a casting process using Metal Injection Molding technology and fully redesigns the lock for better functionality and efficiency (fig 7).

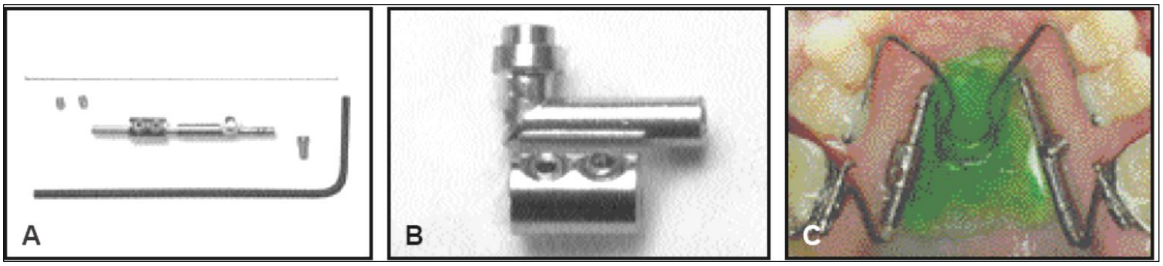

Fig 7: Distal Jet appliance with modifications

So, screw and activation wrench become larger and more durable. Also, screw is placed more mesially than in the previous lock, making access easier. The horizontal barrel of the lock has been extended by 7mm, extending the working range of the appliance and simplifying activation and conversion. New barrel has also been made much narrower to improve patient comfort, to allow more precise positioning of the tube and piston.

A minor but important change has been made in the tiny distal stop that provides resistance to the spring for compression. This metal stop has a tighter tolerance to prevent "creep" on the wire, its diameter (0.5 mm narrower than the present stop) and profile match up with the new lock to form a seamless junction of parts.

Appliance Activation

After the Distal Jet has been cemented, either a stainless steel ligature or separating elastic may be used to tie the sheath and wire together. Insert activation wrench into the recess in the 0.050" hex screw head. Using the wrench as a guide, slide the lock back to compress the spring completely, and tighten the screw.

Patient should be seen monthly during molar distalization. To reactivate the Distal Jet, insert the wrench, loosen the screw, compress the spring completely, and tighten the screw.

Conversion of the Distal Jet to Retainer

After the molar distalization is completed, the distal jet is converted to a passive appliance to retain the molars in their new positions (fig.8C)

Fig 8: (A) Before treatment (B) Molar distalization with Distal jet. (C) Appliance modified for retention.

Steps involved in conversion of active appliance to retaining appliance

1. Open the screw, and decompress the coil spring.
2. Peel the spring from the bayonet wire (piston) by grabbing the mesial end with a slim nosed Weingart or other plier and pulling in one continuous motion.
3. Slide the lock firmly against the stainless steel stop, and tighten the screw (fig 9C) The locking mechanism has been designed to accommodate as much as 7.5 mm of distalization- the mesiodistal width of a bicuspid.
4. Squeeze the terminal end of the lock tightly onto the bayonet wire to lock the unit together and keep the bayonet from moving out of the palate (fig 9 D,E).
5. The same result can be achieved by tying a stainless steel or elastomeric ligature from the vertical leg of the bayonet wire to the vertical arm of the lock. (fig 9F,G), or both technique can be used together for maximum security.
6. Cut the arms connecting the palatal acrylic to the premolars.

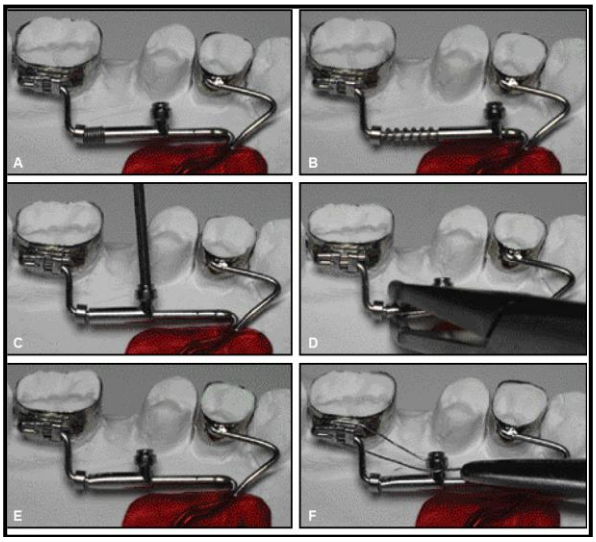

Fig 9: (A) Screw is opened & coil spring decompressed. (B) Spring is then peeled off bayonet wire. Lock is slide against steel stop, & screw is tightened. (C) terminal end of lock is squeezed tightly onto bayonet wire using special plier.(D)locking unit together and stainless.(E,F)elastomeric and ligature may be tied from vertical leg of bayonet wire to vertical arm of lock.

Unilateral Distal Molar Movement with an Implant Supported Distal Jet Appliance

In 2002, A.L. Karaman *et al.*, [12]used a modified distal jet appliance that was supported by a palatal implant placed at the anterior edge of the rugae region of the palate for molar distalization.

Appliance Fabrication:

Molar bands with palatal tubes are fitted to the upper first molars. An anchorage screw of 3 mm in diameter and 14 mm in length was placed at the anterior palatal suture, 2-3 mm posterior to the ***Canalis Incissivus*** under local anesthesia.

During, the same visit, alginate impression was taken and cast was prepared for the construction of the appliance. On the upper dental cast, a stainless steel tube one mm in diameter was adjusted to the implant. Anchor wires 0.8 mm in diameter were soldered to the tubes for occlusal rests on the first premolars. The 0.9 mm wire extended through each tube, ending in a bayonet bend that was inserted into the palatal tube of the first molar band. For force application, nickel titanium open coil springs 0.76 mm in diameter were adjusted (fig 10).

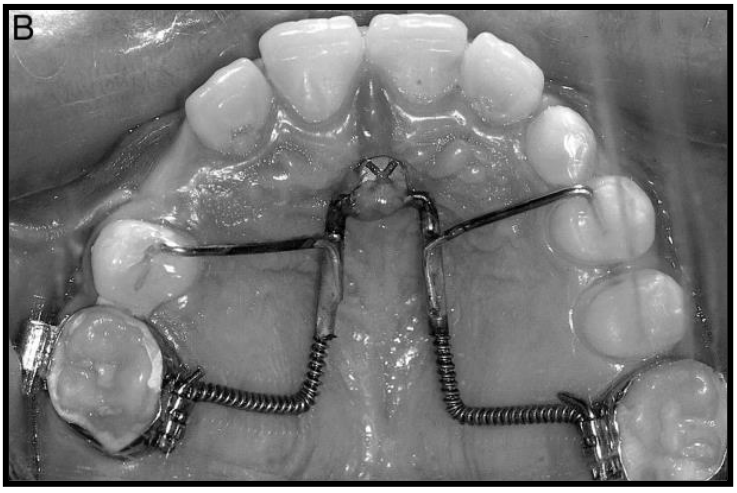

Fig 10: Anchorage screw with distal jet appliance attached.

Implant supported distal jet appliance was attached to the anchor premolars with light cured composite adhesive. The joint between the implant and the tubes was secured with composite material to eliminate plaque retention and increase the stability of the appliance. Force arms were placed in the tubes, and the appliance was activated.

After completion of the distalization, screw was removed with no discomfort to the patient during the removal. An upper Hawley appliance was worn full time for retention.

In conventional intraoral distalization appliance, the anchor unit, which consists of the first and second premolars connected through a wire frame and acrylic coverage in the palatal depth, is unable to completely resist the reciprocal mesial force of the appliance. But by use of the palatal implant as an anchorage unit, no anchorage loss is observed at premolar and incisor region.

Advantages

Stability against rotational movements.
It can be possible to immediately load the implant and apply bilateral or unilateral force application.
Ease of insertion and removal.
Adequate distal movement of the molar achieved without the loss of anchorage.

Conclusion

Molar distalizaion is one of the useful methods for non-extraction orthodontic treatment especially in correcting class II malocclusion. Distal Jet has many advantages such as esthetic appearance, easy placement and activation, minimal requirement of patient compliance, less molar tipping and easy conversion to Nance holding arch after completion of molar distalization. Various other appliances and modifications are evolving day by day to achieve maximum benefits. Therefore to obtain good and acceptable results, an appropriate diagnosis and treatment planning is needed. It also needs proper knowledge and understanding of various methods in terms of selection of appliance for a individual case as per requirement, cost, patient compliance, treatment time and stability of result.

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