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CLINICAL APPLICATIONS OF THE DISTAL JET IN CLASS II NON-EXTRACTION TREATMENT

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ABSTRACT

The use of so-called "distalization" mechanics to correct Class II malocclusions is a common treatment modality. This type of mechanotherapy is typically used in patients with maxillary skeletal and/or dentoalveolar protrusion. Most traditional approaches to molar distalization require considerable patient compliance to be successful. More recently, the subjectivity and problems of predicting patient behavior have led many clinicians to devise appliances that minimized reliance on the patient and which are under the control of the clinician. A distant relative of the pendulum appliance is the Distal Jet, as another method of distalizing molars without active patient compliance. This appliance has many features in common with the pendulum appliance, but it has two distinct advantages. First, the upper molars are distalized without the lingual movement that occurs with the pendulum appliance. Second, the Distal Jet can be converted to a Nance holding arch easily after molar distalization is completed. Complete sequences of Class II correction after molar distalization in growing as in adult patients are described.

INTRODUCTION

Class II is a heterogeneous group of malocclusions that represents the highest percentage of malocclusions in orthodontic practice. Patients with maxillary dental-alveolar protrusion, without major skeletal problems and with minimal or no lower crowding are indicated to be treated with molar distalization. As well as these cases, non-compliant patients with a dental Class II malocclusion can also benefit from distalization of the upper arch.

Historically, extraoral traction (headgear) has been used to distalize the maxilla and the maxillary teeth. Angle (1887) used extraoral traction of many different designs. Kloehn (1961) advocated early treatment as an advantage to guide the growth of the maxilla, and "gentle force to move the teeth that need to be moved." The aim of treatment was to move the maxillary teeth distally into a correct functional relationship with the mandibular teeth.

Graber (1955) noted that when using extraoral traction on the maxillary first molar, without the

presence of the erupted maxillary second molar, the first molar tips distally and does not routinely distalize bodily. To prevent tipping of the maxillary first molar, Cetlin (1983) combined extraoral force (headgear) part-time with intraoral force (removable appliance) full time. A constantly acting force by the removable appliance tips the crown distally while the headgear controls root position, resulting in bodily movement of the molar. The maxillary second molars erupt normally, without impacting, while the second premolar follows the first molar distally. All of the preceding treatment alternatives require patient compliance.

In an attempt to obtain quick, easy to repeat orthodontic therapies which do not require patient compliance, new treatment modalities have recently been proposed to distalize the upper molars in the complex field of Class II non-extraction therapies (Wilson 1978, Cetlin and Ten Hoeve 1983, Gianelly et al 1989, Jones and White 1992, Locatelli 199, Hilgers 1992, Bondemark and Kurol 1992, Bondemark et al 1994). Despite effectively distalizing, these appliances still produce a discreet amount of mesialization of the anterior anchorage, proinclination of maxillary incisors and distal tipping of the maxillary molars.

A recent study by Rana and Becher (2000) considered the treatment effects of the Wilson distalizing appliance and they reported that the molars moved distally about 1mm and tipped posteriorly 2°. They also reported flaring of the maxillary anterior teeth (3,5°) and extrusion (2,7mm).

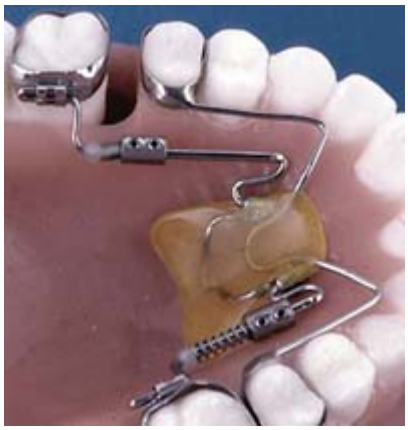
Ghosh and Nanda (1996) evaluated fourty-one patients treated with the Pendulum appliance and found fifty-seven percent was molar distalization and forty-three percent maxillary first premolar and anterior anchorage loss. The authors also reported an average distal tipping of 8.36°, while Joseph and Butchart (2000) reported an average distal tipping of the maxillary first molar of 15.7°. Bussick and McNamara (2000) suggest that the Pendulum appliance is used most effectively in patients with deciduous maxillary second molars for anchorage and unurepted permanent maxillary second molars in order to reduce undesirable bite opening.

Brickman et al (2000) in a recent article haveexamined the clinical results of seventy-two consecutively treated patients with the Jones jig. The results of this study indicate that the Jones jig sample showed changes similar to the Pendulum sample (Gosh and Nanda 1996).

The Distal Jet, a relatively new lingual distalization appliance, has been recently developed by Carano and Testa (1996). This lingual appliance has three dinstinct advantages: the maxillary molars are distalized without the lingual movement that occurs with the Pendulum, it can be easily converted into a regular Nance holding arch and it produces less molar tipping with more bodily movement (Carano and Testa 1996, Carano et al 1996, Carano and Testa 1997).

The aim of this article is to illustrate the Distal Jet and the sequences of the complete correction of Class II malocclusions in growing and adult patients.

DESCRIPTION OF THE DISTAL JET



The Distal Jet is made up of two bilateral tubes attached to a Nance button. This can be soldered to the first or second premolars with bands or with adhesive meshes. By using the first premolars there will be spontaneous distal drifting of the second premolars during molar distalization, but an increased amount of anchorage loss during distalization. By using the second premolars there is minimum anchorage loss with a longer treatment time due to the need of distalizing canines, first and

Virtual Journal of Orth
http://www.

second premolars en mass. In mixed dentition the second deciduous molars are routinely chosen as anchorage up until one third of the roots have not been resorbed. On each side , a bayonet wire , inserted into the lingual shealth of the first molar band can flow through the tube. A nickel-titanium coil spring and a screw clamp are slid on each tube (fig. 1). The distalizing force is exerted by the total compression of the coil spring, which is obtained by sliding the clamp distally and blocking it in the new distal position. The collar is mantained in position with the mesial screw, while the distal screw is used for retention only.

Because the line of action of the distalizing force passes close to the centre of resistance of the molar, bodily distlization is obtained . The force exerted by the precalibrated spring measures 180 or 240 grams at the time of maximum activation. It is suggested to use the 180 gr. spring with the first molars, while the 240 gr. spring with the first and second molars in place (fig.2).

The Distal Jet is able to distalize first and second molars together, even if the force is applied only on the first molar. Once the desired amount of distal movement of the upper molars has been achieved, Carano and Testa (1996) suggest converting the appliance into a Nance retainer by removing the adjustment collar and spring assembly and adding light-cure or cold-cure acrylic to the basewire.

The arms to the premolars are then removed sequentially or all at once, according to the desires of the clinician. Another method of converting the Distal Jet in a holding retainer for the molars is by using the double setscrew (Bowman 1998). Once the first and second upper molar distalization is completed, the Distal Jet can be converted into a molar retainer just blocking the clamp with the mesial screw on the tube and the distal one on the bayonet wire (Fig.3).

The activation collar is loosened and moved anteriorly, gaining access to the coil spring. It is recommended to remove the spring by grasping a free end of the coil with a plier (e.g., small Weingart) and peeling the spring outward from the bayonet wire. The distal end of the tube, into which the bayonet wire enters, can be seen. The collar with the double setscrew can be slid over this junction, and the mesial

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setscrew can be tightened against the tube while the distal setscrew is secured against the bayonet wire, locking the tube and the wire together to prevent molar movement.

Then it is suggested to remove the wires that connect the premolars to the palatal acrylic by means of a diamond bur in a highspeed handpiece. If there is any mobility of the double-back wire within the lingual sheath, the Nance acrylic may lift away from the palatal mucosa. In order to avoid this problem, the lingual sheath can be crimped with a utility plier. In addition, the bayonet wire or tube can be bent with a three-prong plier to adjust the pressure of the acrylic against the palatal mucosa.

CLINICAL EFFECTS OF THE DISTAL JET

Recently some more detailed data on the clinical effects of upper first and second molar distalization with the Distal Jet have been obtained from a clinical study on 25 patients (Carano et al 1996).

The results of this study were:

1) The Distal Jet produces upper molar bodily distalization with a disto-inclination limited to only 0.6 degrees for each mm of distalization.

2) The loss of anchorage is about 20% of the total space opened mesially on the first molar.

3) The bodily distalization obtained with the Distal Jet does not increase mandibular divergence.

4) The Distal Jet is comfortable for the patient, does not require cooperation and is absolutely aesthetic.

For adults it is recomended to extract the third molars before distalization takes place. The interference of the third molars could be an obstacle that could jeopardize upper molar distalization.
Nevertheless there are cases in which third molars could be left in place. Those are the patients in which third molars are still impacted and are not in close contact with the roots of the second molars. Another interference to molar distalization is an improper construction or position of the Distal Jet. If the distal ball stop is in close contact with the palatal mucosa, soon after the first millimeters of distalization it would compress the palate and inhibit molar movement. The ball stop has to be 1-2 mm away from the palate (Fig. 4).

A totally improper positioning of the Distal Jet could create an increment of friction into the

telescopic unit. A high level of friction could also be another cause of reduction of molar distalization.

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The sequence suggested for proper positioning of the appliance is:

1. Complete tooth separation for precise band fit and placement (fig.5)

2. Accurate and complete impression and working model.

3. Space mantainence until the Distal Jet comes back from the laboratory.

4. Ligation of molar bands to the modified Nance unit for ease of handling and placement.

5. Check fitting of the Distal Jet before cementing.

6. Cementation as one integral unit.

CLASS II CORRECTION IN MIXED DENTITION

Molar distalization is just the first important step in the final correction af a Class II malocclusion. While the proper molar position is easily obtained with the Distal Jet, progress and finalization of treatment could be complicated by the need for patient compliance and for anchorage stability during the sequential distalization of premolars, canines and incisors.

In mixed dentition the traditional approach for the completion of treatment after molar distalization is correcting overjet by means of upper and lower utility arches and Class II elastics (Carano and Testa 1996). The incisors, the deciduous canines and the deciduous molars are distally moved en mass and not in sequence. The utility arches are really indicated for these cases because the deciduous teeth can be skipped, the overbite can be kept under control and the sagittal occlusal relationship can be corrected with Class II elastics. After the Class I molar relationship and the proper overjet have been achieved, the permanent teeth will usually erupt in the proper position and only final alignment will be required. Although the time of wearing Class II elastics is just a few months longer than the time needed for molar distalization with the Distal Jet, the patient compliance and the stability of the lower arch as anchorage are fundamental. A combined approach with a first phase with the Distal Jet and a second phase with the Jusper Jumper (to hold the upper first molars while they are used as anchorage for retracting, by means of elastic chain, premolars and canines) (Bowman 1998) could eliminate patient cooperation, but it does not reduce the anchorage requirements on the lower arch nor does it reduce the time for brackets (in a case that very probably would need another phase with fixed appliances later on in permanent dentition).

Compliance, anchorage request and duration of treatment were the variables that the authors felt were reduced for a better treatment.

A new sequence in Class II mixed dentition cases, where the major objective is to eliminate the request of anchorage

Virtual Journal of Orth

on the lower arch after molar distalization, has been recently proposed :

1. Molar Distalization (Fig. 6).

2.Conversion of the Distal Jet into a regular Nance button (Fig.7).

3.No active treatment and waiting for natural distal drifting of the mixed dentition (Fig.8).

4.After 6 months the Nance button of the D. J. is removed and substituted with a new Nance button.

5.No active treatment and waiting for natural permanent eruption. The permanent

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teeth will usually erupt close to a proper Class I occlusion.

6. Finalization with multibrackets (Fig.9). None or minimal Class II elastics is necessary

The advantages of this treatment strategy are: reduction to a minimum of the time for wearing a fixed appliance, minimal request of anchorage to the lower arch and rapid finishing phase with permanent dentition.

CLASS II CORRECTION IN PERMANENT DENTITION

The first step in treatment is the positioning of the Distal Jet and its initial activation. The open coil springs have to be totally compressed once a month, until the Class I molar relationship has been reached. The Distal Jet has to be the only appliance on the upper arch until Class I molar relationship has been achieved. In fact, cases in which fixed multibrackets were positioned during the activation of the distalization appliance, have shown to have less stability of the anchorage unit (Patel 1999).

After distalization, the molars must be held in their new position, as there is significant mesial relapse. To avoid this, the authors suggest a double control of the anchorage: a palatal (the Distal Jet transforms to a regular Nance button) and and labial anchorage (the arch wire with a mesial stop to the upper first molars). The distalization of the premolars and canines proceeds en mass and not in sequence. The lower arch acts as an anchorage for Class II elastics which will be used to correct the cuspid relationship. In order for the lower arch to be stable with intermaxillary elastics, it must be prepared with a full size rectangular archwire. After correcting the canine relationship, the Nance button and the mesial stops should be removed, and we can use Class II forces to distalize the incisors. At the end of treatment the patient is given an upper Hawley retainer and fixed retainer in the lower arch from 3 to 3. The patient is recalled every month in the first year and every four months the second year for observation and any adjustments that may be necessary.

THE DISTAL JET IN LINGUAL ORTHODONTICS

Today's orthodontist can attest to an increase in the demand for orthodontic care by adults. To meet this demand, extensive research and development over the past 20 years have aimed at providing a truly "invisible" edgewise appliance (Gorman et al 1983; Kurz and Gorman 1983; Smith et al 1986; Gorman 1991).

In cases where upper arch retraction is indicated, the Distal Jet is a suitable appliance for lingual treatment, because it is aesthetic, does not require patient compliance and effect molar distalization with a bodily movement. The combination of lingual brackets on the anterior teeth (incisors) and a distalization device has two advantages : it corrects the deep bite and increases the speed of molar distalization by removing the occlusal interferences. Once the first and second upper molar bodily distalization is completed, the Distal Jet can be converted into a

molar retainer. The combination of a distalizing device, such as the Distal Jet, with a following Class II elastics phase in patients where maxillary dental retraction is needed, represents an effective and reliable strategy for Class II correction without extraction.

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Clinical Case

Diagnosis

A.C.. was an 18-year-old student. He had an asymmetric Class II div.2 with a regular skeletal pattern with the upper left canine ectopically positioned and 4mm excessive overbite. His cephalometric analysis indicated acceptable norms, with the exception of an excessive interincisal angle of 151 degrees. His periodontium was healthy and maxillary third molars were present. His panoramic x-ray was otherwise unremarkable. There were no restorations on the lingual surfaces or other complications to lingual bonding (Fig.10).

Treatment Plan

The overall treatment objectives were to distalize the upper left molar, reduce the overbite and correct the canine positions. The treatment plan involved:

1. Distal Jet for upper molar correction with lingual brackets on the incisors for the deep bite correction.

2. Lingual brackets on the upper arch, first molar to first molar with a ,012" SS archwire with omega loops for upper molar stabilization. The lower arch was treated with labial mechanics, starting with .014" SS archwire.

3. Level and align with .014" and .016" SS archwires.

3. Retract and close space of the distalized side of the upper arch with elastomers and Class II elastics. The distalized molar was retained in Class I relationship with an omega stop on the upper lingual archwires.

4. Torque and finishing with .016"´.022" SS on the upper and .017".025" SS.

5. Fixed retention from 3 to 3 in the lower and a Hawley retainer in the upper arch.

Treatment

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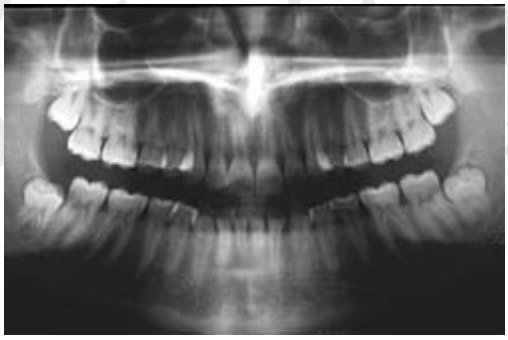

Impression with the upper molar bands were taken after 7 days of separators. The working model with the molar bands in place were delivered to the lab and the four separators were replaced on the upper first molars. The Distal Jet was positioned (May 3 1997) and lingual brackets were indirect-bonded on the four upper incisors. After four months the proper Class I molar relationship was achieved on the left side and the deep bite was corrected. The Distal Jet was converted into a regular Nance button and left in place for two months (Fig. 11).

During this phase the alignment of the lower arch was started with labial brackets. Lingual brackets were indirect-bonded from first molar to first molar (November 12, 1997). The Nance button was removed and an initial .012" SS archwire was placed with omega stop mesial to the first upper molars (Fig. 12).

After one month the lingual archwires were replaced with .014" SS and .016" SS and the buccal mechanics progressed to .016"´.022" SS. Elastic thread and Class II elastics were placed to close space and retract the maxillary anterior teeth on the left side (Fig. 13).

At seven months, .016"´.022" SS lingual arches and .018"´.025" buccal archwire were placed. Lingual Class II elastics were initiated from the maxillary lateral incisors ball hooks to the lower first molars (fig.14).

After 14 months of active treatment it was felt that the major treatment objectives had been

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met.

Nineteen months after initiation of treatment all brackets and bands were removed.

Cephalometric analysis shows lower posterior extrusion and some maxillary anterior intrusion, presumably as a result of the bracket bite plane. The mandibular plane angle, however, appeared to remain the same. The third molar were erupted.

Retention

The patient was given an upper Hawley retainer and a fixed retainer in the lower arch from 3 to 3. The patient has been recalled every month in the first year and every four months the second year for observation and any adjustments that may be necessary (fig.15).

CONCLUSIONS

Although several other appliances for upper molar distalization have been recently proposed in the literature, the Distal Jet has some peculiar features that differentiate it from the others. It applies a constant force through the centre of resistance of the molars, it delivers controlled tooth movement in all three planes of space (sagittal, transverse and coronal) and it can be easily converted into a retainer for the distalized molars. During its functioning the reciprocal forces are uniformily dissipated thruogh the palatal button to the underlying mucosa with no palatal irritation (Carano and Testa 1996, Carano et al 1996, Carano and Testa 1997). In a report by Carano et al (1996) on 25 patients, the treatment effects of the Distal Jet were studied through the analysis of intraoral photographs. The investigators relied on these photographs because of the difficulty in obtaining clear images on cephalometric X-rays, indicating dental changes occurred during distalization. Direct clinical measurements were obtained as well. They reported an average space opening mesial to the upper first molar of 0.9 mm per month. They found that 80% of the increased space was due to distal movement of the upper first molars and 20% due to anchorage loss anteriorly. Carano and Testa also noted other occlusal changes, including minimal distolingual molar rotation and variable amounts of molar expansion. Patel (1999) also confirmed the bodily distalization of the molars with minimum anchorage loss (30%) and no effects on the skeletal vertical height, while he found more flaring of the incisors during the use of the Distal Jet. The differences in anchorage loss between the two studies is explained by the fact that the second sample had brackets on the upper arch during treatment (Dr. Bowman's sample), thus causing instability of the anchorage unit. The authors, infact, recommend the use of the Distal Jet before brackets are palced on the upper arch.

Once the desired amount of distal movement of the upper molars has been achieved, Carano and Testa (1996) suggest converting the appliance into a Nance retainer by removing the adjustment collar and spring assembly and adding light-cure or cold-cure acrylic to the basewire. The arms to the premolars are then removed sequentially or all at once, according to the desires of the clinician. Bowman (1998) also has suggested the incorporation of an additional setscrew in each adjustment collar. The double setscrew design is useful when converting the distal jet into a Nance holding arch.

One of the challenges that arises in any treatment that involves intentional molar distalization is the consolidation of the arches after posterior molar movement has been completed. In addition to the Nance button, Carano and Testa (1996) have suggested the use of fixed appliance combined with simultaneous use of an arch wire with two stops mesial to the molars. In non-compliant patients it has been suggested (Carano and Testa 1997, Bowman 1998) to use fixed appliances combined with the simultaneous use of a Jasper Jumper appliance. This fixed force module is added to maintain the distalization of the maxillary molars, to provide anchorage during anterior retraction with closing-loop or sliding mechanics, and to encourage a more favorable pattern of craniofacial growth.

Although molar distalization is a mojor step in Class II non-extraction treatment, other not less

important phases of treatment have to be properly undertaken if a good Class I occlusion is the final tretment objective.

A step forward in Class II non-extraction treatment in growing patients, treated with the Distal Jet, is the reduction of the need for anchorage from the lower arch. Because the distalized molars cannot be considered stable anchorage for retracting premolars and canines in sequence, in the past the use of intermaxillary forces (class II elastics or Jusper Jumper) were recommended for the distalization of the canines, premolars and incisors. Even if a Nance button is left in place, bone remodelling has not completed the maturation of the deposition front, therefore the molars would rapidaly drift back if a mesial force is applied. Participation of the lower arch for anchorage purposes is a necessity more than a choice and the consequent lower flaring is the acceptable negative side effect for a treatment with any kind of distalization mechanics. Clinical experiences focusing on the total lack of compliance, on the elimination of anchorage request to the lower arch and on the reduction of time of active therapy have brought to a new treatment sequence in Class II growing patients. In mixed dentition patients molar distalization with the Distal Jet is the only therapeutic intervention. The other teeth will spontanously drift backwards in a proper occlusion. A simple finishing phase after complete eruption is needed with none or minimal Class II elastics.

On the contrary, in the permanent dentition the use of intermaxillary forces for the retraction of the premolars, canines and incisors is still necessary. The sequence after molar distalization, suggested in this article, is the simplest procedure to totally correct Class II malocclusions for adult patients and the use of Class II elastics is limited in time and does not require too much patient cooperation.

A distalizing appliance that is totally esthetic is more versatile than a visible device, because it could be useful either in labial or in lingual orthodontics. It was belived that lingual orthodontics differs enough from labial orthodontics to require a different approach to case selection and treatment planning. The differences result primarily from the position of the brackets on the lingual surfaces of the teeth, from the bite-opening effect of the maxillary anterior lingual brackets on the lower incisors and from the mechanical responses of the lingual brackets and wires. While in labial technique one can easily combine brackets with palatal or lingual auxilliaries (expansive or distalization devices, button or bar for anchorage), this is not possible when lingual brackets are in place. The use of auxilliaries was only limited to those that can be coupled with lingual brackets, with a consequent limitation to traditional orthodontic mechanics. Furthermore the bite plane built into the maxillary anterior brackets usually causes disclusion of the posterior segments. In certain cases, such as a low mandibular plane angle and deep bite, the bite opening is beneficial. There are, of course, times when the bite opening is not desirable- as with a high mandibular plane angle. Class II maloclusions may already have a downward mandibular growth pattern, and further downward and backward rotation exacerbates the problem. Finally lingual orthodontics, because of the difficulties in gaining spaces, has traditionally been more extractive than labial orthodontics.

In the present article an original approach for Class II non-extraction treatment with a truly "invisible" technique has been illustrated. The combination of lingual brackets on the anterior teeth (incisors) and a distalization device has two advantages : it corrects the deep bite and increases the speed of molar distalization by removing the occlusal interferences. Also in lingual orthodontics the combination of a distalizing device such as the Distal Jet with a following Class II elastics phase in patients where maxillary dental retraction is needed represents an effective and reliable strategy for Class II correction without extraction.

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