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Molar Distalization using Orthodontic Implants- A Review & A Case Report

Dr Asmita Ray[1*], Dr Vaibhav Khare[2], Dr Sangamesh B[3]

[1] P.G. Student Triveni Institute of Dental Sciences Hospital & Research Centre, Bilaspur, Chhattisgarh, India
[2] Reader, Department of Orthodontics & Dentofacial Orthopedics TIDSHRC, Chhattisgarh, India
[3] HOD Department of Orthodontics & Dentofacial Orthopedics TIDSHRC, Chhattisgarh, India
*Corresponding Author Email: rayasmita02@gmail.com

Abstract

Treatment of class II malocclusion often require maxillary molar distalization. Some of the cases can be treated by non-extraction treatment modalities such as headgear, removable appliances, and intraoral distalizers such as the Pendulum appliance, Distal Jet, and Jones Jig. Anchorage loss from proclination of anterior teeth, distal tipping and increased overjet are major concerns with most of these appliances; some also require active patient compliance22.

Keywords

Distalization appliances, Molar distalization, Skeletal anchorage, Temporary anchorage devices.

INTRODUCTION

The omnipresent question faced practically every time by an orthodontist is "Do we need to extract teeth or can the necessary space be created without extractions".? In the adult patients there is no significant growth found clinically in the bone structure; hence solutions must be found alternatively to obtain space where the teeth can be moved to correct the malocclusion. Whenever there is a space deficiency, the methods of gaining space that strikes to our mind first are - extraction, expansion and inter proximal stripping.

Current orthodontic philosophies have been oriented toward conservative treatment modalities to avoid extractions and, at the same time, to try to eliminate the need for patient cooperation. Consequently developed was a popular method for creating additional space within the arch by distalization of Molars.

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. Several appliances have been advocated to distalize molars in the upper arch (Figure-1). However the areasof particular concern during molar distalization are molar tipping and anterior movement of anchorage teeth. If the first molar is tipped back rather than moved bodily, it will not only pose occlusal problems but may not provide sufficient anchorage for distalising the teeth anterior to it.

What is Molar Distalization?

Distalization is a conservative method that is utilized in orthodontics to gain space by moving posterior teeth distally. It may be combined with other space gaining strategies, such as expansion, or can be used alone[27].

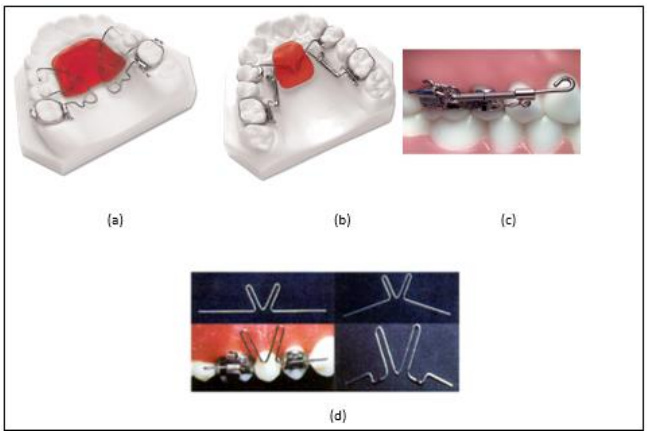

Figure 1: (a) Pendulum appliance, (b) Distal jet, (c) Jones jig, (d) K-loop distalizer

Many methods have been used for distalization. These methods differ significantly in their place, whether to be extraoral or intraoral, site of action in upper and/or lower arch.

History:

Kingsley (1866) was the first person to try to move the maxillar y teeth backwards, with help of extra oral forces. In 1892 he described in Dental Cosmos, a technique for driving the upper molars distally by means of a headgear without extraction of any teeth.

Graber (1955) stated that in treatment of Class II cases, the greatest change produced by orthodontic appliances is in the maxilla. Distal adjustment of tooth position in the maxilla alone or in conjunction with mandibular growth, is the basis for correction of the malocclusion. He noted that when using extra oral-traction on the maxillary first molar, it tips distally and does not routinely distalize bodily[1].

Gould (1957) was the first person to discuss about unilateral distalization of the molars with the help of extra

oral force. He also used cervical and occipital pull head caps for distalization of molars[2].

Graber T.M. (l969) extracted the maxillary second molars and distalized the first permanent mo1ar for correction of Class II div.1 malocclusion. He stated that distal adjustment of tooth position in maxilla alone or in conjunction with mandibular growth and elimination of functional retraction is the basis for correction of the Class II malocclusion[3].

Wieslander in 1984 constructed a special headgear-Herbst appliance and treated in the very early mixed dentition. This active treatment was followed by a period of 6 months. The changes in dentofacial pattern were registered after active treatment in comparison to an untreated control group, the maxillary teeth in a posterior direction (3.1 mm) was a combination of distal tooth movement (1.6 mm) and a change in position of the base of the maxilla (1.5 mm).[4]

Anthony A. Gianelly et al (1988) used Repelling Magnets for distalization of molars. He noticed that rate of molar movement with second molars is usually 0.75-1mm per month. Premolars and incisors moved anterior by 1 mm in 7 weeks[5].

Gianelly et al, in 1991 demonstrated use of Japanese Niti coils to move molar distally[6].

Nobert Jeckel and Thoms Rakosi (1991) used molars distalization bow to distalize the molars. It is an intraoral appliance having good control over the molars[7].

Robert G. Cash (1991) reported on an adult patient with a bilateral Class II malocclusion and an anterior open bite who had treated without extractions, using a Jasper Jumper appliance to distalize and intrude the maxillary molars. The post treatment superimposition showed that molars moved distally[8].

Jones (1992) used an open coil jig for rapid Class II molar correction. Open coil, Niti springs exhibiting 70-75 gm force over a compression range of 1-5mm to the molars. The springs are used in conjunction with modified Nance appliance. It is a predictable, rapid and painless method of distal driving of the molars[9].

Dr.Hilgers in 1992 introduced pendulum appliance which is a hybrid appliance that consists of large Nance acrylic button and 0.032” TMA spring. This appliance produces a broad, swing arc or pendulum of force from midline of the palate to the upper molars hence was called the pendulum appliance[10].

Greenfiled in 1995, developed a fixed piston appliance for rapid CII correction. This can provide bodily movement of maxillary first molars without extra oral appliances and with no loss of posterior anchorage. It has both, buccal and lingual, fixed piston and tube assembly, with piston being soldered to the molars and tube being soldered to the pre-molars. Niti coil is placed (0.036") on this piston and tube assembly and bodily movement of molar is achieved. It required no patient compliance and uses light controlled forces 1.5-2 ounce / tooth[11].

Varun Kalra, in 1995 developed the K-loop molar distalizing appliance. Hence distal driving is possible without tipping of molars and minimum anterior anchor loss. Kloop 0.017" x 0.025" T.M.A. wire can be activated twice. Each loop of "K" is 8mm long and 1.5mm wide. Legs of K are bent down and inserted into molar tube and pre-molar bracket. It has the advantage of being simple and efficient, controls tipping, of low cost and easy to fabricate[12].

Jasper and McNamara, 1995, described the use of a flexible force module (the Jasper Jumper) that can be incorporated into existing fixed appliances to correct various types of sagittal malocclusion. The treatment effects produced posterior movement of the maxillary buccal segments and anterior movement of the mandible[13].

Aldo Carano et al In 1996, developed a distal jet appliance that can distalize without the disadvantage of tipping and rotation. He used on 18 year old female and 10 year old male in mixed dentition, both presented with Class II division 1 malocclusion. In both patients, Class 1 relationship was achieved in 4 months. The appliances were well tolerated, esthetic and requires no patient cooperation[14].

Aldo giancotti, in 1998 Paola cozza, described nickel titanium double-loop system for simultaneous distalization of first and second molars, super elastic nickel titanium wires have been found as effective as other means in producing distal movement of the maxillary first molars. When the distalization is carried out before the second molars have erupted, it can reliably produce 1-2mm of space. Once the second molars have erupted, however, the distal movement can be more difficult and time-consuming, and loss of anchorage is likely. The nickel titanium double-loop system is a useful technique for class II treatment with minimal patient cooperation. It is ideal for simultaneous first and second molar distalization in the permanent dentition, when traditional intraoral forces may be ineffective in moving the first molars[15].

S.h. Kyung et al in 2003 described distalization of maxillary molars with a midpalatal miniscrew is a traditional method of controlling anchorage during molar distalization tend to cause unwanted movement of other teeth and to require patient cooperation. These disadvantages can be overcome with skeletal anchorage, which is gradually gaining acceptance among orthodontists[16].

Luis Carriere in 2004 designed CARRIERE DISTALIZER, is most effective in treating class II malocclusion without extraction and in class I cases with mesially positioned maxillary molars[17].

Greenfield in 2005 introduced newest design of GMD this applies the distalizing force only from the lingual of the maxillary molars, utilizing twin piston modules. This is a unique appliance that allows the clinician to fully control molar distalization in all three planes of space with light, continuous forces[18].

Gero S.M Kinzinger et al in 2006 introduced miniscrew-supported distal jet appliance .Elimination of the acrylic palatal button improves the patient’s access for oral hygiene. The MSDJ provide translation of the upper molar with out the constraints of patient cooperation. Mini screw

support reduces anchorage loss and flaring of the anterior teeth compared to conventional anchorage methods[19].

Beyza Hanciglu Kircelli et al in 2006 designed the bone-anchored pendulum appliance (BAPA)[20].

Stefano Velo et al in 2007 introduces an implant distal jet that reduces the anchorage loss in class II treatment there is no complications from the simple and relatively non-invasive surgical procedure, the MAS screw has shown excellent stability and the screw is also fast and easy, miniscrew anchorage does not change the shape or structure of the distal jet, thus ensuring patient comfort than compliance with auxiliary devices[21].

DIAGNOSTIC CRITERIA FOR DISTALIZING MAXILLARY MOLARS:

The criteria varied widely among the clinicians but some of the most common criteria are Class-II or end-to-end molar relationship with –

- 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.
- Low to moderate mandibular plane angle (hypo divergent).
- Good expectation for patient cooperation.

INDICATIONS OF MOLAR DISTALIZATION

1) Profile:
   - Straight profile
2) Functional:
   - Normal,healthy temporomandibular Joint
   - Correct mandibular to maxillary relationship
3) Skeletal:
   - Class I skeletal relationship
   - Normal/ short lower face height
   - Maxilla - normal transverse width
   - Brachycephalic growth pattern
4) Dental:
   - Class II molar relationship
   - Deep overbite
   - Permanent dentition
   - Maxillary first molar mesially inclined.
   - Preferably prior to eruption of second molar, the angulation of third molars is also to be taken into consideration.
   - Maxillary cuspids labially displaced.
   - Loss of arch length due to premature loss of second deciduous molar.

The indications for molar distalization can be summarized as:

- Class-II molar relationship due to maxillary dentoalveolar protrusion
- Class-II molar relationship due to impacted / high labially placed cuspids
- Class-II Subdivision cases requiring unilateral distal molar movement.
- Class-II molar relationship due to ectopic eruption of either 1st/2nd bicuspid
- Midline discrepancy cases
- Regaining the space loss due to mesial drift of 1st molars following premature loss of deciduous teeth.
- Anchorage loss during active orthodontic treatment.

CONTRAINDICATIONS FOR MOLAR DISTALIZATION

1) Profile:
   - Retrognathic profile
2) Functional:
   - Signs and symptoms of temporomandibular joint dysfunction.
   - Posteriorly and superiorly displaced condyles.
3) Skeletal:
   - Class II skeletal relationship
   - Skeletal open bite
   - Excess lower face height
   - Constricted maxillary arch
   - Dolichocephalic growth pattern
4) Dental:
   - Class I or Class III molar relation.
   - Dental open bite
   - Maxillary first molar distally inclined.
   - Mesocephalic face

The contraindications for molar distalization can be summarized as:

- Retrognathic profile (Class-II skeletal with orthognathic maxilla and retrognathic mandible).
- Skeletal and dental open bite
- Excessive lower anterior facial height (Dolichocephalic facial form)
- Constricted maxilla
- Patients with Class-I or Class-III molar relation.

CLASSIFICATION OF MOLAR DISTALISATION APPLIANCES

1. Location of appliance
   - Extra-oral: Headgear
   - Intra-oral: Pendulum, Jones Jig
2. Type of appliance
   - Removable: Lip Bumper, Cetlin Appliance, TMA – Trans Palatal Arch.
   - Fixed: Pendulum appliance, K. loop molar distalizer, Lokar appliance.
3. Arches involved
   - Intra-arch: Jones Jig, K. loop distalizer
   - Inter-arch: Sliding Jig, Fixed functional appliances

4. Position of appliance in mouth
   - Buccal : Pendulum ,Magnets
   - Palatal:Distaljet, Transpalatal arch
5. Type of tooth movement
   - Bodily movement: distal jet, fixed piston appliance
   - Tipping movement: pendulum, jones jig
6. Compliance needed from patient
   - Maximum compliance : headgears
   - Minimum or No compliance: implant supported, distal jet

TREATMENT TIMING:

Perhaps best time to initiate distalization is late mixed dentition and it may be too late after eruption of second molar. There appears to be some synergistic effect as dentition transits from primary to permanent. Because clinically erupting canines and premolars often appear to follow molars as they moved distally. Thus appliances that require some anterior anchorage like pendulum may dilute these results.

Figure 2: Pendulis[28]

CO-OPERATION:

This factor has probably driven modern day orthodontics more than any other social issue. So appliances requiring least co-operation maybe chosen.

Invariably appliances that require least in co-operation come with considerable side effects.

Recent Advances:

Recent advances in molar distalization appliance design is providing more precise control in bodily movement of teeth thus enabling better treatment options in orthodontics.

Skeletally anchored distalization appliances[23-25,28]now provide excellent alternatives for Class II treatment. Most of these are customized palatal devices, however, requiring extra steps for maxillary impressions and laboratory fabrication. Such appliances are also more technique-sensitive and involve more chair time.

The present paper describes a reverse L-shaped distalization appliance that derives anchorage support from a mini-implant in the buccal alveolar bone.

This device requires minimal patient compliance, minimally invasive procedure and no laboratory work.

Aim:

"To achieve maximum molar distalization using a minimally invasive procedure with minimal patient compliance".

Objective:

The primary treatment objective is to distalize the upper molars enough to create space for achieving ideal overjet and overbite & alignment of teeth in arch without worsening the profile.

Technique:

- First, the upper arch is aligned on continuous archwires, for .022" × .028" brackets.
- A mini-implant is inserted between the upper second premolar & first molar on both sides (Figure. 5)
- A passive .017" × .025" TMA wire segment is bent into a smooth L-shape and threaded through a nickel titanium open-coil spring.
- When this assembly is attached between the mini-implant and the first-molar & second molar auxiliary tube, it compresses the spring to generate 200-300 gm of force. (Figure. 6)
- The spring can be reactivated monthly by adding crimpable segments to the wire until the first molar is overcorrected to a super-Class I relationship.
- The premolars will be then retracted with anchorage from the molar—still supported by the mini-implant—followed by finishing and detailing.

Case Report:

A 21 years 1 month old female patient presented with an anterior proclination & mild crowding (Figure.3). Upper dental midline was coinciding with the facial midline with ideal overbite & increased overjet. The patient had a bilateral end-on canine & molar relationship. The panaromic radiograph revealed impacted 3rd molars i.r.t. lower arch.

The primary objective was to distalize the upper right & left molars enough to create space for alignment of maxillary anteriors & reduction in proclination & to finish the case in class I molar & canine relationship. (cusp-to-fossa)

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Figure 3: A 21 years old female patient with end on molar relationship bilaterally before treatment

Extraction of all the third molars was done before proceeding with any orthodontic treatment.

After two months of levelling & alignment a 1.6mm×8mm mini implant was placed between 2nd premolar & 1st molar on both the sides (Figure-5)

A reverse L-spring technique is being used currently to distalize the upper molars into a super class I molar relationship. After distalizing the molars the remaining teeth will be distalized to the resulting space.

Appliance Design:

A passive .017" × .025" TMA wire segment is bent into a smooth L-shape and threaded through a nickel titanium open-coil spring. (Figure 4).

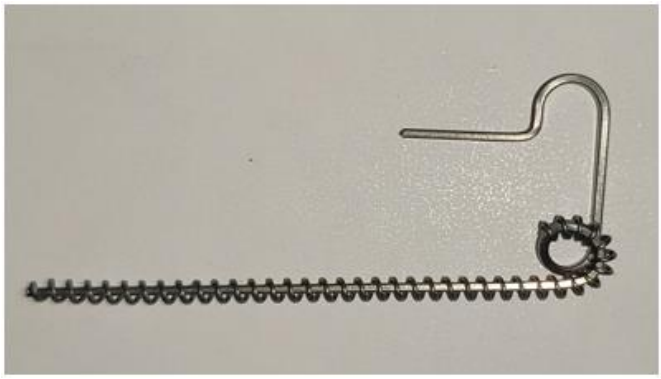

Figure 4: Appliance fabricated

Appliance Placement:

When this assembly is attached between the mini-implant and the first-molar & second molar auxiliary tube, it compresses the spring to generate 200-300 gm of force. (Figure. 6)

Figureure 5: 1.6mm×8mm mini implant was placed between 2nd premolar & 1st molar on both the sides

Figure 6: Appliance is placed between 2nd premolar & 1st molar spring is compressed to generate force for distalization

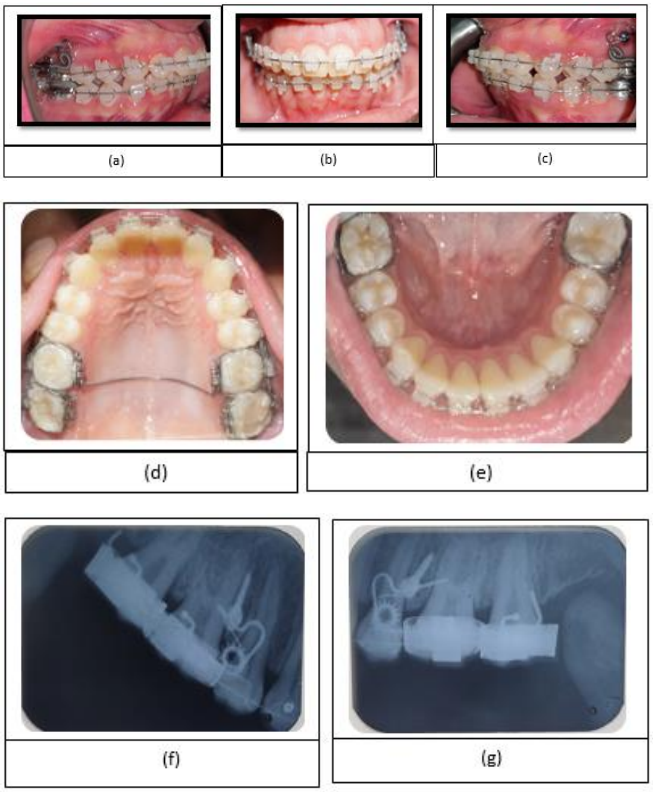

Figure 7: (a,b,c) After levelling & alignment appliance placement done. (d) Modified keles TPA to check distal tipping of molars (e) Lower arch aligned (f,g) IOPA's done to check for vertical anchorage loss which has not happened after two months of appliance placement.

DISCUSSION

The reverse L- spring appliance is specifically designed for biomechanical demands of molar distalization

Equal & opposite forces are created by the compressed push coil spring between the mini implant & the first molar (Figure-6)

The force vector on the molar & the mini implant can be split into horizontal & vertical components, moment of force is created which tends to tip molar distally

The vertical & mesiodistal placement of the mini implant directly affects the magnitude of the force vectors

When the implant is placed too close to the molar to be distalized the vertical component of force will increase which

will cause extrusion of the molars which is a potentially critical factor while planning distalization.

In the case shown here the implant is placed just distal to the molar to be distalized, due to which the vertical component of force will be more that might cause extrusion of the molar. This can be counterbalanced by giving a posterior bite block of 2 mm thickness to the patient

Graber (1955) He noted that when using extra oral-traction on the maxillary first molar, it tips distally and does not routinely distalize bodily. Sheldon[1].

Baumrind (1979) reports quantitative findings on the displacement of the maxilla and of the maxillary first molar to positions distal to those which they occupied at the beginning of appliance therapy. Results showed distalization of maxillary molars bodily with cervical and straight pull, High pull and combipull headgears caused distal tipping of the molar crowns.

Korrodi Ritto, in 1995; designed the removal molar distalization splint. Some amount of distal tipping of molar takes place. Hence the best cases treated with this appliance are those where the molars are already mesially tipped.

Napee J et al in few of his cases in which he achieved distalization using bone anchored pendulum appliance (pendulis) minor amount of distal tipping was seen[28].

In our technique distal tipping can be counteracted by using modified Keles TPA it allows constant & long lasting light force (low load deflection) with out the need with out the need of frequent reactivation, due to incorporation of helix & use of TMA wire[30].

We should note that these mechanics depends upon the generation of high frictional forces to upright the molars.

As shown by a case report by Dr Madhur upadyay et al on A Mini-Implant-Supported S-Spring for Unilateral Molar Distalization the increased resistance of sliding slows down the distal movement of molar[29].

Current approaches for correcting of class II malocclusion primarily based on elastics,skeletally anchored or fixed palatal devices which completely depends on patient compliance as shown in a study by R J Egolf et al on Factors associated with orthodontic patient compliance with intraoral elastic & headgear wear[22].

Our method requires no patient compliance & is much simpler than technique sensitive laboratory constructed palatal devices. Anterior anchorage loss can be avoided & only one mini implant is required

This approach will also provide better root control due to rigid SS wire along with modified Keles TPA & posterior bite block[26].

Considering these advantages we are expecting mini implant supported L spring appliance to be an effective aid in treating & correcting class II malocclusions to a class I molar relationship.

REFERENCES

[1] Graber TM: Extraoral force- fact and fallacies. Am J Orthod Dentofacial Orthop 1955; 4 1: 490.
[2] Eugene Gould: Mechanical principles in extraoral anchorage. Am J Orthod Dentofacial Orthop 1957; 43: 319-333.
[3] Graber T.M.: Maxillary second molar extraction in Class II malocclusion. Am J Orthod Dentofacial Orthop, 1969; 56: 331-353.
[4] Wieslander: Intensive treatment severe class II malocclusions with a headgear herbst appliance in early mixed dentition Am J Orthod Dentofacial Orthop, Volume 1984 Jul (1 - 13).
[5] Anthony A. Gianelly: Distalization of molar with repelling magnets J Clin Orthod, 1988; 22: 40-44.
[6] Anthony A. Gianelly: Japanese NiTi coils used to move molars distally. Am J Orthod Dentofacial Orthop 1991; 99: (564-6.).
[7] Norbert Jeckel, Thomas Rakosi: Molar distalization by intraoral force application. Eur J Orthod, 1991; 13: 43-46.
[8] Robert G. Cash: Adult non extraction treatment with a jasper Jumper. J Clin Orthod, 1991; 25: 43-37.
[9] Richard D. Jones: Rapid Class II molar correction with an open coil Jig. J Clin Orthod, 1992.
[10] Hilgers JJ. The pendulum appliance for Class II non-compliance therapy. J Clin Orthod. 1992 Nov; 26(11):706-14.
[11] Greenfield: Fixed piston appliance for rapid Class II correction. JClin Orthod 1995: 174-183.
[12] Varun Kalra: The K-Loop Molar distalizing appliance. J Clin Orthod 1995 298301.
[13] Jasper And Mc Namara: Correction of interarch malocclusions with fixed force module. Am J Orthod Dentofacial Orthop 1995; 108: 641-50.)
[14] Aldo Carano: The distal jet for upper first molar distalization. J Clin Orthod. 1996, 374-380.
[15] Aldo Giancotti: Nickel titanium double-loop system for simultaneous distalization of first and second molars.1998 J Clin Orthod April 255-260
[16] Kyung S.H.: Distalization of Maxillary Molars with a Midpalatal Miniscrew J Clin Orthod 2003 vol 37, no.1
[17] Luis Carriere: A New Class II Distalizer J Clin Orthod 2004 April
[18] Greenfield: The Greenfield Lingual Distalizer, J Clin Orthod 2005 September.
[19] Kinzinger: Upper Molar Distalization with A Miniscrew-Supported Distal Jet J Clin Orthod 2006 NOVEMBER.
[20] Beyza Hancioglu Kircelli: Maxillary Molar Distalization With A Bone Anchored Pendulum Appliance. Angle Orthod 2006, vol 76, no.4.
[21] Stefano Velo: Implant Distal Jet J Clin Orthod 2007 Feb.
[22] Egolf, R.J.; BeGole, E.A.; and Upshaw, H.S.: Factors associated with orthodontic patient compliance with intraoral elastic and headgear wear, Am. J. Orthod. 97:336-348, 1990.
[23] Karaman, A.I.; Basciftci, F.A.; and Polat, O.: Unilateral distal molar movement with an implant-supported Distal Jet appliance, Angle Orthod. 72:167-174, 2002.
[24] Gelgör, I.E.; Büyükyilmaz, T.; Karaman, A.I.; Dolanmaz, D.; and Kalayci, A.: Intraosseous screw-supported upper molar distalization, Angle Orthod. 74:838-850, 2004.
[25] Polat-Ozsoy, O.: The use of intraosseous screw for upper molar distalization: A case report, Eur. J. Dent. 2:115-121, 2008.
[26] Kapila, S. and Sachdeva, R.: Mechanical properties and clinical applications of orthodontic wires, Am. J. Orthod. 96:100-109, 1989.

[27] Alogaibi A. Yahya et al, Distalization in Orthodontics: A Review and Case Series: Case Reports in Dentistry Volume 2021, Article ID 8843959, page nos 15
[28] Napee Joseph Francois et al: The pendulis appliance for bone-anchored maxillary molar distalization: JCO January 2019 VOL LIII number 11 page no. 637-646
[29] Upadhyay M. et al: A Mini-Implant-Supported S-Spring for Unilateral Molar Distalization; JCO/JULY 2020, page 410-418
[30] Kallury A, Dubey J, Balani K R, Bharti C. Modified Keles TPA –An Effective Method for Molar Derotation, Orthodontic Journal of Nepal, Vol. 10 No. 1, January-June 2020.