



Pendulum Appliance and Its Modifications

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Abstract

Mesialization of posterior teeth (Molars) in the maxillary arch is corrected by distalization movement of the molars. In addition to previous distal movement techniques, such as extraoral force application and removable appliances, various intraoral devices have been suggested since 1980s. With the use of these intra-arch appliances the need for patient cooperation is eliminated. Pendulum and modified pendulum appliances are effective in molar distalization. Pendulum appliance with K-loop modification, implant supported pendulum appliance and Bone Anchorages Pendulum Appliance (BAPA) significantly reduced anchorage loss of the anterior teeth and distal tipping of the molar teeth.

Keywords: Anchorage; Distalization; Pendulum Appliance

Introduction

Edward H Angle put up a method for treating patients by non-extraction. He said that when teeth could be arranged by different approach, so extraction of teeth appeared inappropriate and not acceptable. The question of extracting teeth or not always exist at the time of orthodontic treatment planning. In adult patients there is no bone growth, so other techniques are needed to create space to move the teeth for treatment of malocclusion. Latest progress in fixed orthodontic mechanotherapy and changing the notion of treatment have decreased the need for extraction. In about 25% to 30% patients' upper arch expansion is beneficial and 95% of Class II patients can get better by using molar distalization, rotation and expansion. Molar distalization with headgear and elastics needs patient co-operation. However, nowadays various intraoral appliances are to be had for molar distalization minimizing patient compliance [1].

Orthodontists have long found various methods of correcting Class II malocclusions which does not involve strain on the mandibular arch and without the need of patient compliance [2]. In the 1990s, noncompliance treatments in numerous forms have become more important than ever before [2]. The Pendulum Appliance is a combination of a large Nance acrylic button in the palate for anchorage and 0.032" TMA* springs that deliver a light, continuous force to the maxillary 1st molars without affecting the palatal button due to which the appliance produces a broad pendulum like force from the midline of the palate to the maxillary molars [2].

Pendulum Appliance

Pendulum appliance turned into delivered through Dr. Hilgers [2]. It comprised of large Nance palatal button in palate for providing anchorage and 0.032" Titanium Molybdenum (TMA) springs that provide light continuous forces to upper 1st molars for their distalization without having any effect on Nance palatal button [3]. Palatal button covers midpoint of palate and connected to upper 1st and 2nd premolars by the means of occlusal rests. The 2 posteriorly positioned TMA springs are also connected to it. Pendulum appliance produces 200 gm to 250 gm of force in a swinging arc like pendulum from midline, so it is named pendulum appliance. According to Hilgers the pre-activation of pendulum is performed with bending of springs to 90° and about 30° is lost throughout insertion of appliance resulting in 60° activation for distalization of molars. Generally, activation of appliance again is not needed and molars are moved distally by 5 mm in 3 to 4 months. Anchorage burn is minimum (1.5 mm-premolar) and (1° to 2° forward inclination of maxillary anteriors). This appliance meets best possible demands of an intraoral appliance such as less anchorage loss, less patient compliance, bodily movement of molars in distal direction and least chair side time required for positioning and reactivation. There is no need of intermaxillary elastics for anchorage, so no result on lower arch. Joseph and Butchart [4], observed 5.1 mm distal movement of molars with 15.7° distal tipping of first molar and 4.9° maxillary incisors forward inclination. Bussick and McNamara [5], reported in his study that pendulum appliance is successful for molar distalization with no increase in lower facial height. It is successful when used in patients having mixed dentition.

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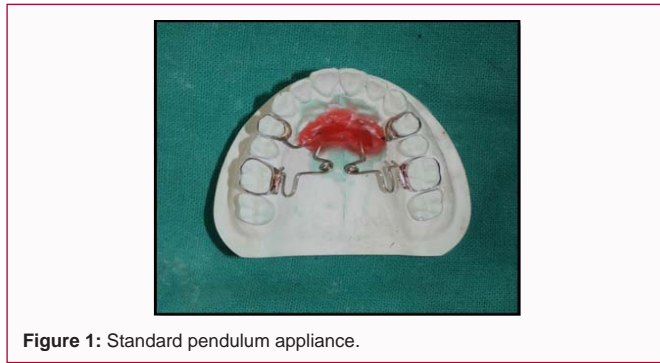


Figure 1: Standard pendulum appliance.

Acar et al. [6], in their study collate combination of pendulum appliance and buccally placed K- loop with cervical headgear. They showed that this combination prevents anterior anchorage loss and produces less distal tipping of maxillary molars. Thomali et al. [7] also concluded that pendulum appliance with K-loop and implant supported pendulum, both decrease anterior anchorage loss and distal tipping of maxillary molars. Patil et al. [8], successfully treated Class II malocclusion case in mixed dentition period with pendulum appliance. They obtained 4 mm of space from molar distalization in 4 months (Figure 1).

Fabrication

The right and left Pendulum springs are made from 0.032" TMA wire, it comprised of a recurved molar insertion wire, a small horizontal adjustment loop at midspan. The springs are expanded as close to the center of the palatal button as possible to increase their range of motion, to allow for easier insertion into the lingual sheaths, and to lessen the forces to an acceptable range. The springs are also adjusted as close as possible to the distal aspects of the Nance button, which still allows access to the acrylic for polishing. Tongue annoyance during swallowing is lessened by way of expanding the springs distal to the button. The lingual sheaths on the maxillary molars should be 0.036" so that the 0.032" wire fits loosely. The front portion of the appliance can be kept in several ways. The most secured technique of retention is to band the maxillary 1st premolars or 1st deciduous molars, solder a retaining wire to the bands, and use these teeth as the major anterior anchorage for the appliance. The Nance button should be made as large as possible to prevent any tissue irritation. It should extend to about 5 mm from the teeth, to avoid the highly vascular cuff of tissue near the teeth and to allow proper hygiene. If expansion of the upper arch is needed, a mid-palatal jackscrew can be included into the center of the Nance button. The acrylic should be cut with a Joe Dandy disc before the jackscrew is opened. The screw is operated one quarter turn every 3 days, after a week or so for patient adjustment, to produce a slow, stable expansion [2] (Figure 2).

Indications [4]

- Distal malocclusion.
- Less crowding.
- Long distal bases.
- Mesial moment of upper 1st molars due to caries and premature loss of deciduous 2nd molars.

Contraindications [4]

- Open bites (Skeletal/dental)

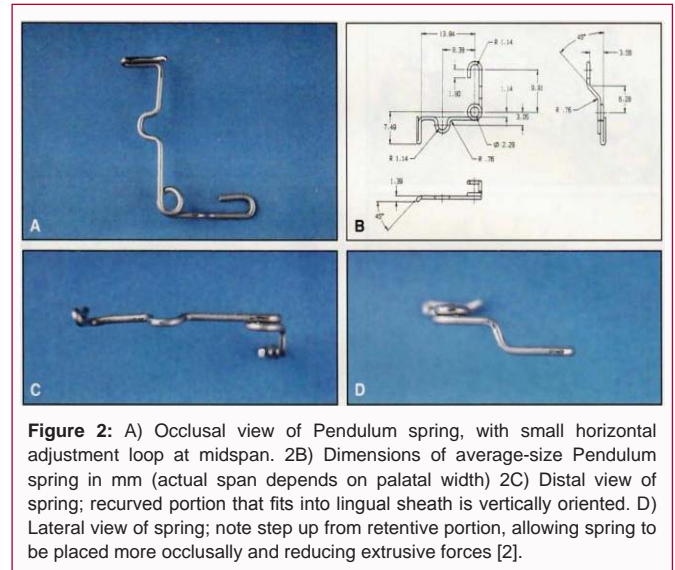


Figure 2: A) Occlusal view of Pendulum spring, with small horizontal adjustment loop at midspan. 2B) Dimensions of average-size Pendulum spring in mm (actual span depends on palatal width) 2C) Distal view of spring; recurved portion that fits into lingual sheath is vertically oriented. D) Lateral view of spring; note step up from retentive portion, allowing spring to be placed more occlusally and reducing extrusive forces [2].

- Hyperdivergent patients.
- Forwardly inclined maxillary anteriors (increased overjet).

Modifications of Pendulum Appliance [1]

- Pendex appliance
- Modified pendulum appliance/M pendulum
- Modified pendulum with removable arms
- Modified pendulum for anterior anchorage control
- T- REX appliance
- Franzulum appliance
- Hilger PhD appliance
- Mini Distalizing Appliance (MDA)
- Pendulum K appliance
- Bone Anchored Pendulum Appliance (BAPA)
- Pendulum appliance with maxillary molar root up righting bends.

Pendex Appliance [1]

- It was also proposed by Dr. James J Hilgers (1992).
- It is an intraoral appliance.
- It is modification of pendulum appliance.
- The blue print of the appliance is similar as the earliest pendulum appliance except for palatal expansion screw in the midline. It is used in Class II malocclusions to correct posterior crossbite (Figure 3).

Modified Pendulum Appliance/M Appliance (Dr. Scuzzo et al.) [9]

The horizontal Pendulum omega loop is inverted, which will allow translatory movement of both the roots and crowns of the maxillary molars. Once distal molar movement has occurred, the loop can be operated simply by opening it. The activation produces buccal and/or distal up righting of the molar roots and thus a true bodily movement rather than a simple tipping or rotation [9]. The active arms of the



Figure 3: Pendex Appliance.

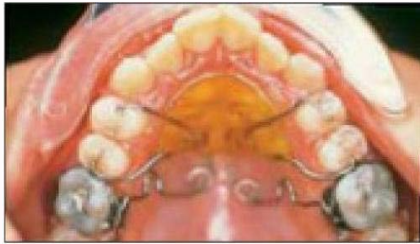


Figure 4: The modified pendulum appliance with removable arms.

Pendulum appliances are inserted into the acrylic sheaths of the Nance button. These removable arms can be reactivated during treatment without debonding and re-bonding the occlusal rests of the Nance button. Distal molar movement can then be more precisely controlled than by opening the horizontal loops in the mouth. The conventional Pendulum or M-Pendulum produces about 5 mm of distalization in 3 to 4 months [2]. With the removable arms, distal movement can be continued at a rate of about 1.5 mm per month for as long as necessary [10] (Figure 4).

Modified Pendulum for Anterior Anchorage Control

- Modified pendulum appliance is used in Group A anchorage cases.
- This design comprised of 4 removable arms which are present for both 1st and 2nd molars and 4 stainless steel tubes are fixed in acrylic button for insertion of 4 removable arms [1].
- Alberto [11] proposed one more design of pendulum appliance in which Nance palatal button is kept in position by soldering to 1st premolar bands.
- A lingual 0.036" stainless steel wire is soldered to 1st premolar bands and adapted to the lingual surface of maxillary anteriors [1].
- This change in design reduces debonding of appliance. It also strengthens anterior anchorage during distal movement of molars [1] (Figure 5).

T- Rex appliance [1]

- T-Rex appliance is used for distalization of molars and

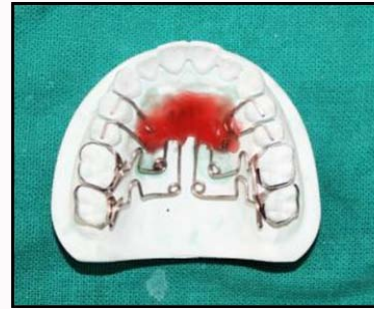


Figure 5: Modified pendulum for anterior anchorage control.



Figure 6: T- Rex appliance.

- maxillary expansion.
- This appliance consists of 2 wires which are attached from
- palatal acrylic and soldered to lingual surface of maxillary 1st molar bands.
- These wires give extra steadiness during expansion phase of treatment.
- After fulfilment of expansion, these wires are removed and distalization of molar is started [1] (Figure 6).

Hilger PhD appliance [1]

It is a modification of pendulum which is completely made from metal:

- In this appliance anchorage is obtained from banded or bonded 1st premolars with the use of wire extending from premolars to molar bands.
- The springs of appliance are placed into sheaths soldered to palatal side of expansion screw, and can be removed during expansion phase or for reactivation.
- The stabilizing wires are cut after expansion when molar distalization is started.
- This appliance is more comfortable aiding in good oral hygiene (Figure 7).

Pendulum K appliance

- The appliance comprised of an orthodontic screw which separates palatal button into 2 parts.
- Anterior part joins 4 anchorage teeth with retainer wires which are fixed to teeth with composite.
- The posterior part is made up of active pendulum springs which are pre activated by applying some bends before insertion.



Figure 7: Hilger phd appliance [1].



Figure 8: Pendulum K appliance.



Figure 9: Franzulum appliance [1].

- The appliance is reactivated by turning the screw without removing the springs from molar sheaths.
- The appliance causes bodily distalization of molars and also corrects or stops distal tipping and palatal movement [1].
- Activation in this appliance produces up righting moment on molar roots and for de-rotation of molars, toe-in bend is used which have rotated mesially inwardly [12] (Figure 8).

Franzulum appliance (Byloff et al.) [1,13]

- It distalizes the molars in the lower arch.
- It consisted of palatal button which is placed lingually and downwards to lower anterior teeth, extending from canine to canine and give anchorage.
- Palatal button is kept 5 mm wide to dissolve the reactive forces of active parts and to stop trauma to mucosal tissue.
- Nickel titanium coil springs of 18mm length are used for distalization of molars which applies force of 100 gm/side to 120 gm/side [1].



Figure 10: Mini distalizing appliance [1].



Figure 11: Bone Anchored Pendulum Appliance (BAPA) [12].

- A J shape wire slides through each coil spring and placed into corresponding tube in anchorage unit.
- The curved posterior part of wire is placed into lingual sheath of lower 1st molar band. Rests made from 0.032” stainless steel wire, which is placed on canine and 1st premolars. Active parts are present in tubes between 2nd premolars and 1st molars.
- This appliance produces bodily movement of molars with active parts being close to center of resistance of molars [1] (Figure 9).

Mini Distalizing Appliance (MDA) [1]

- This appliance is a combination of the characteristics of pendulum appliance and Rapid Palatal Expander (RPE).
- It is a full metal appliance, used for both expansions as well as molar distalization using RPE and removable TMA springs.
- Patient compliant, good oral hygiene with no tissue impingement (Figure 10).

Bone Anchored Pendulum Appliance (BAPA) [12]

It is a molar distalization technique appliance used internally for non-extraction treatment that was given by Kircelli and Pekta [14], to bring about an efficient and compliance free molar distalization without anchorage burn.

- Bone Anchored Pendulum Appliance is indicated for Class II malocclusions with moderate arch length deficiency in upper arch.
- The appliance consists of a pendulum appliance that attaches acrylic plate to the titanium intraosseous screw (2.0 mm diameter × 8 mm length) which acts as bone anchorage. 0.032” TMA springs are inserted into lingual sheaths on the 1st molar bands [12] (Figure 11).

Construction [12]

A titanium implants (2.0 mm diameter × 8 mm length) is surgically embedded in the anterior region of the median palatal suture, 7 mm to 8 mm posterior to the incisive foramen and 3 mm to 4 mm lateral to the median line. After the healing of soft tissue, impressions are made and stone models were obtained with the IMF screws in place. On the stone model, the screw head is covered with wax, and the appliance is constructed according to Hilgers descriptions. The supplementary wires that extend to the 1st and 2nd premolars are excluded. The adaptation of appliance is checked clinically & the springs are activated. The acrylic plate is connected to the screw head by using acrylic resin. Finally activated TMA springs are embedded into the lingual sheaths on the 1st molar bands.

Discussion

The Pendulum appliance effectively distalizes the maxillary molar teeth to a Class I relationship. This distalization occurs without any patient compliance. Furthermore, only 1 activation period was needed for the process to be successful [15]. These are the 2 main advantages of the appliance when compared with other appliances requiring patient compliance such as headgear and Class II elastics [3]. Distal movement of the molars appears to be more effective before the eruption of the maxillary 2nd molars [4].

Indications

- Indicated in single or bilateral distalization of maxillary 1st molar teeth for correction of Class II molar relationship in noncompliant patients [4].
- Used in gaining Space in cases where upper first molars drift mesially due to premature loss of primary molars [4].
- In non-extraction cases of mild-to-moderate crowding.
- The most important benefit of the appliance is its less dependency on patient compliance, easy to fabricate, minor transverse and vertical molar positions corrections by adjustment of the springs [15].

Conclusion

Pendulum appliance and its modifications are efficient in distalization of molars as well as premolar which was achieved with Bone anchored pendulum appliance without loss of anchorage. A pendulum appliance with K-loop modification, implant supported pendulum appliance and bone supported pendulum appliance appropriately decreases loss of anchorage of the anterior teeth and distal tipping of the posterior teeth [5].

Lesser number of studies are there with Bone Anchored Pendulum Appliance, so more studies are still needed to evaluate the effects of modified pendulum appliances on molar distalization in Class II

malocclusion treatment [15]. Tolerance with Pendulum Appliance has been excellent; most adapt to the appliance within a week. If the Pendulum springs are placed distally enough, there is no difficulty with tongue impingement during swallowing. Initial clinical findings have been encouraging. It is not unusual to see as much as 5 mm of distal molar movement in three to four months. As long as the space is properly maintained, most of the necessary Class II correction- as well as expansion and improvement of arch form- can be achieved with little or no need for patient compliance [7].

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