

The Use of Pendulum Appliance in the Treatment of Class II Malocclusion

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A case of correction of molar Class II using the pendulum appliance is described. Upper first molars were distalized into Class I, crowding was eliminated in the upper arch and space was provided to attain Class I relationship. Treatment lasted for 18 months. A two year follow up shows stability of the occlusion.

The treatment of Class II malocclusions sometimes require distalization of maxillary molars^{1,2} into a Class I relationship. It can be achieved by extra-oral traction,³ removable appliances^{4,5} and sliding jigs with Class II intermaxillary elastics. However, these treatment modalities are heavily dependent on patient compliance. The search for an appliance that would require minimum patient compliance included repelling magnets,⁶ the Herbst appliance⁷ and the pendulum appliance.⁸

The pendulum appliance uses the palate as an anchorage unit to distalize the first molars⁸ (see fig. 4a below). It contains acrylic plate that is retained in place either by clasps to the first premolars or the acrylic is integrated with a metal frame that is soldered to bands on the first premolars. Distalization arms or springs are constructed from 0.6 mm stainless steel round wire that consists of a closed helix and a U-loop. The purpose of the closed helix is to allow for activation of the distalization arms. The U-loops are incorporated mesial to the molars to allow for adjustment of the axial inclination during distalization. This wire is soldered to molar bands. Typically, an initial activation of 60° to 70° (around the width of one molar) will generate 250g of force per side. The appliance is activated extra-orally and is cemented in place as recommended by

Dr. Hilgers.⁸ The appliance is monitored at monthly intervals where it is removed for reactivation and recementation. The indications for the pendulum appliance are: (1) First phase of orthodontic treatment for unilateral or bilateral distalization of maxillary first molar teeth for correction of Class II molar relationship in non-compliant patients; (2) Space regaining in cases of mesial drift of upper first molars due to early loss of primary molars; and (3) Non-extraction treatment of mild to moderate crowding.⁹ This case report describes the treatment of Class II malocclusion by distalization of first molars into Class I.

Case Report

A 13-year-old Chinese girl received previous orthodontic treatment at our clinic for the correction of rotated upper right central incisor at the age of 9. At present, she was concerned about the appearance of her upper canines which were erupting buccal to the dental arch (figure 1 a-f).

On examination, she was presented with a Class II molar and canine relationship on a Skeletal I base, good profile and good naso-labial angle. Intraorally all permanent teeth had erupted except the third molars. The lower arch showed crowding of 3 mm and a mild curve of Spee, while the upper arch showed 6 mm of crowding and buccally erupting canines. The relationship of the upper and lower arches showed normal overjet and overbite with

Treatment objectives

- 1 the distalization of the upper first molars;
- 2 to level and align the arches;
- 3 to normalize canine and molar relationships;

both upper and lower midlines coincident with the facial midline.

No pathology was detected on panoramic radiograph (figure 2) and all four third molars were developing normally. Cephalograms were taken at natural head posture¹⁰ and cephalometric analysis (Table 1) demonstrated a Skeletal Class I relationship, normal lower anterior facial proportion and normal maxillary-mandibular plane angle. The upper and lower incisors were retroclined; 105° (Chinese norm 118°)¹¹ and 89°

Table 1 Cephalometric analysis at pretreatment and end of treatment (Chinese norms).

	Pretreatment	Post-treatment	(Chinese norms)
SNA (degrees)	84	84	82
SNB (degrees)	82	82	79
ANB (degrees)	2	2	3
SN/MnPI (degrees)	33	31	34
SN/MxPI (degrees)	2	2	8
MxPI/MnPI (degrees)	30	30	26
LAFH/TAFH (percent)	54	55	55
U1/MxPI	105	111	118
L1/MnPI	89	95	97
L1/A-Po line (mm)	4	5	6
Upper Lip to E (mm)	-0	-2	3
Lower Lip to E (mm)	2	2	4

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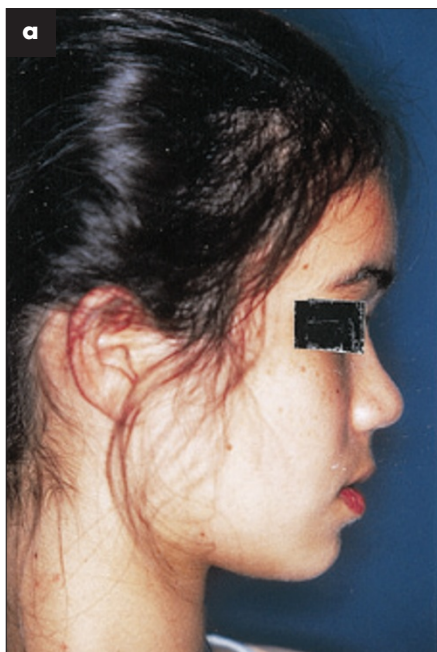
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(Chinese norm 97°) respectively.

Treatment plan

The treatment plan included the extraction of upper second molars and distalization of the first molars into Class I. This provides space required for alignment of the canines and for attaining Class I canine relationship. Furthermore, correction of the retroclined upper incisors would increase the overjet which was normal at pre-treatment (3 mm) and change the naso-labial angle which would worsen an already pleasing profile. Therefore, extraction of upper second molars allowed normalization of upper incisors inclination without changing the patient profile and provided space required for elimination of crowding and for achieving Class I canine and molar relationship. The third molars are erupting normally and should replace and extracted second molars.

Pre-treatment cephalometric analysis of the position of the lower incisors showed upright lower incisors (89°) compared to Chinese norm (97°) (Table 1) and also are ahead of the A-Po line (4 mm) compared to Chinese norm (5.5 mm) (Table 1). Therefore, space required for elimination of the crowding in the lower arch (3 mm) could be gained by the proclination of the lower incisors.

Treatment Progress :

The pendulum appliance

After extraction of the second permanent molars, the pendulum appliance was pre-activated before cementation in place. Appliance activation should not exceed the width of a first molar. The pendulum

Fig. 1a-f Pretreatment records at the age of 13.

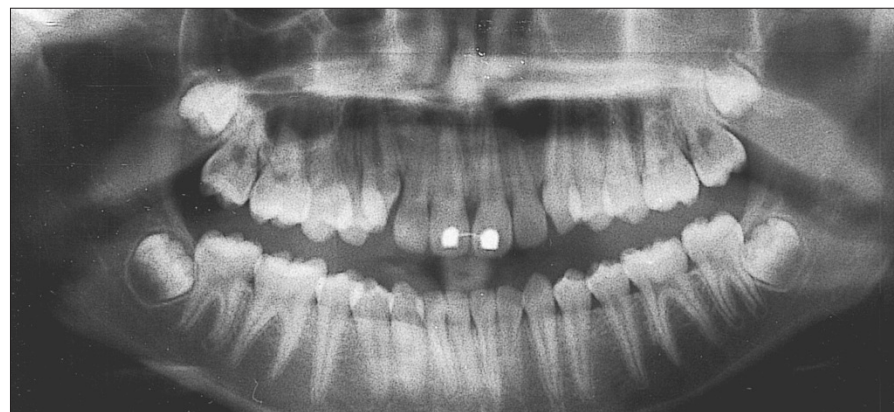


Fig. 2 Pretreatment panoramic radiograph.



Fig. 3 a, Intra-oral view of pendulum appliance. Immediate after placement. b, Intra-oral view of pendulum appliance. 4 months after placement. Please note, spaces developed mesial to the first molars.

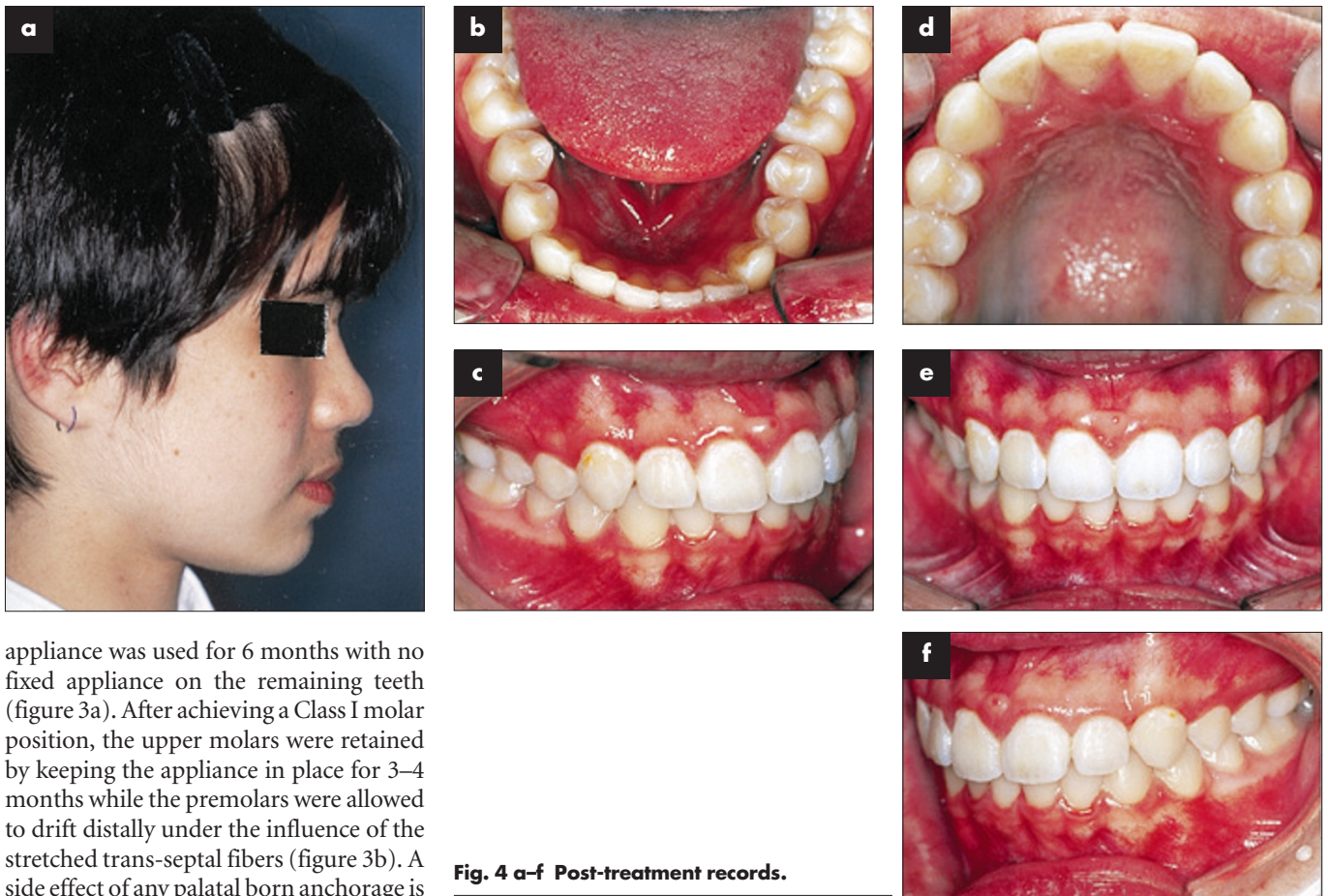


Fig. 4 a-f Post-treatment records.

appliance was used for 6 months with no fixed appliance on the remaining teeth (figure 3a). After achieving a Class I molar position (figure 3a), the upper molars were retained by keeping the appliance in place for 3–4 months while the premolars were allowed to drift distally under the influence of the stretched trans-septal fibers (figure 3b). A side effect of any palatal born anchorage is some soft tissue irritation which did not last in this case for more than a couple of days after removal of the appliances.

Fixed Appliance Therapy

Upper and lower pre-adjusted Edgewise fixed appliances were used to coordinate arches and to complete the orthodontic treatment. Treatment consisted of 14 visits over a period of 18 months. Upper and lower removable retainers were delivered at debonding. Figure 4a–f showed the post treatment records.

Treatment Results

Cephalometric superimposition (figure 5) revealed improvement in facial profile and naso-labial angle. The upper incisors were proclined by 6°, from 105° to 111° (Table 1). The lower incisors were proclined by 6°, from 89° to 95° (Table 1). Values of the angulation of both upper and lower incisors were within the Chinese norms. Correction of molar relationship resulted from the distalization of upper molars by 2 mm and forward movement of the lower molars by 1 mm. The forward movement of the lower molars was a function of horizontal mandibular growth (figure 5).

The position of the upper third molars was revealed radiographically and showed a favorable position for eruption

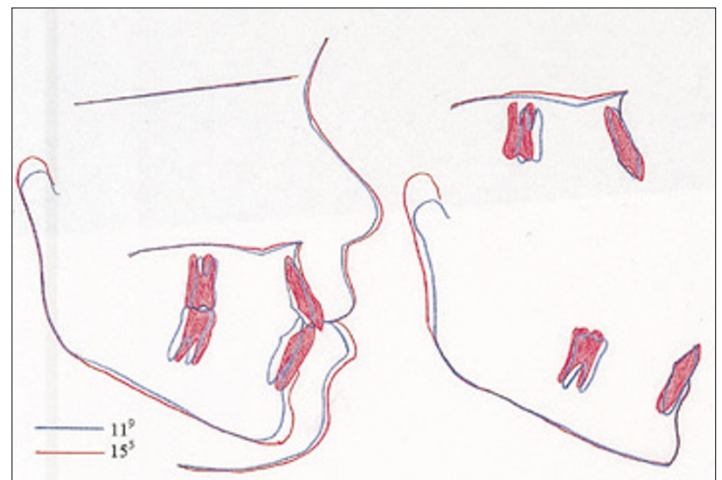


Fig. 5 Lateral cephalogram tracing superimpositions.

into the second molar extraction space (figure 6). Due to the mesial angulation of the lower third molars, a decision was made to review their eruption and the possibility to extract the lower third molars was discussed with the patient.

Discussion

The results of this case study have shown that the pendulum appliance is an effective and reliable method for distalizing maxillary molars. The major advantages of the appliance lie in its minimal dependence on patient compliance, ease of fab-

rication, allow correction of minor transverse and vertical molar positions by adjustment of the springs and, last but not the least, patient-acceptance. Although treatment results showed that the pendulum appliance primarily affects the dentition, there were also simultaneous indirect effects on the skeletal and soft tissue structures. Ghosh and Nanda¹ evaluated the intra-oral maxillary molar distalization using pendulum appliances. They reported that molar distalization is at the expense of moderate anchorage loss causing proclination of the upper incisors

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Fig. 6 Post-treatment panoramic radiograph. Please note, the favorable position of erupting wisdom teeth into the place of the extracted second molars.

and a wedging bite opening tendency when the appliance is tooth born.¹ Therefore, in the current case report, we decided to use the pendulum appliance with palatal coverage to minimise such an effect. The upper incisors, after two years of treatment, were slightly proclined, however, within the average value for the Chinese (118°). Such proclination could be a combination of the effect of the pendulum appliance as well as fixed appliance therapy.

The pendulum appliance as reported by Hilgers in 1992 can affect a favorable mesiobuccal rotation as well as bodily movement of the first molars with the incorporation of a U-loop in the spring.⁸ This could be of use to improve the Class I molar relationship and to yield additional space.

Distal movement of the molars appears to be more efficient before the eruption of the upper second molars. However, the molars will still move after eruption of the second molars. In such cases, distalization of molars could be carried out in stages where the second molars should be distalized first, followed by retention using a palatal arch bar (PAB) until distalization of first molars take place.¹² When a great deal of distal movement is needed and it is preferable not to extract the upper first bicusps, it may be beneficial to remove the upper second molars and let the third molars drift into place,⁸ which is also demonstrated in this case report.

Other variation of design suggested includes:

- A lingual sheath on the molar bands

allowing intra-oral adjustment of the springs,

- An expansion screw incorporating in the Nance button allowing space gaining and arch coordination, and
- A Nance holding arch or utility arch wires inserted for stabilization while allowing the premolars to drift distally.⁸

- 1 Ghosh J, Nanda R S. Evaluation of an intraoral maxillary molar distalization technique. *Am J Orthod Dentofacial Orthop* 1996; 110: 639-646.
- 2 Jeckel N, Rakosi T. Molar distalization by intra-oral force application. *Eur J Orthod* 1991; 13: 43-46.
- 3 Turner P J. Extra-oral Traction. *Dental Update* 1991; 18: 197-203.
- 4 Lewis D H, Fow N A. Distal movement without headgear: the use of an upper removable appliance for the retraction of upper first molars. *Br J Orthod* 1996; 23: 305-312.
- 5 Battagel J M, Ryan A. Treatment changes in Class I and mild Class II malocclusions using the en masse removable appliance. *Eur J Orthod* 1998; 20: 5-15.
- 6 Gianelly A A, Vaitas A S, Thomas W M. The use of magnets to move molars distally. *Am J Orthod Dentofacial Orthop* 1989; 96: 161-167.
- 7 Pancherz H. The Herbst Appliance. Its biologic effects and clinical use. *Am J Orthod* 1985; 87: 1-20.
- 8 Hilgers J J. The pendulum appliance for Class II non-compliance therapy. *J Clin Orthod* 1992; 26: 706-714.
- 9 Cetlin N M, Ten Hoeve A. Nonextraction treatment. *J Clin Orthod* 1983; 17: 396-413.
- 10 Cooke M S. Five-year reproducibility of natural head posture; a longitudinal study. *Am J Orthod Dentofacial Orthop* 1990; 97: 487-494.
- 11 Cooke M S, Wei S H Y. Cephalometric standards for the southern Chinese. *Eur J Orthod* 1988; 10: 264-272.
- 12 Muse D S, Fillman M J, Emmerson W L, et al. Molar and incisor changes with Wilson rapid molar distalization. *Am J Orthod Dentofacial Orthop* 1993; 104: 556-565.