Unilateral Class II treatment using fixed orthodontic appliances with open coil spring, sliding hook and light Class II elastics

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Abstract

Orthodontic correction of a Class II malocclusion often requires distalization of molars. Various appliances and approaches have been designed to accomplish molar distalization. This case report describes the management of a 13 year old female patient who presented with a unilateral Class II malocclusion. Extra-oral examination indicated a convex profile accompanied by an accentuated labiomental fold. Intra-oral examination showed that the maxillary dental midline was displaced to the left and the incisors were proclined. The treatment plan consisted of a non-extraction protocol using the Damon Q system. The bracket slots were 0.022 mm and a sequence of Copper Nickel Titanium (CuNiTi) and stainless steel (SS) arch wires were used in combination with an open coil spring, sliding hook and light Class II elastics. Treatment yielded a Class I molar and canine relationship as well as midline and overjet correction.

Keywords: Fixed orthodontic treatment, Class II division 1, subdivision, non-extraction, Damon system, molar distalization

Introduction

When deciding on the correct orthodontic treatment plan, the age, anteroposterior discrepancy and compliance of the patient should be taken into account.[1] Adopting a non-extraction protocol often requires maxillary molar distalization to create a Class I molar relationship. Unilateral maxillary molar distalization presents with the added challenge of having to design and implement an asymmetric force system.[2]

Angle Class II subdivision classification describes an asymmetrical occlusion where the molar relationship is Class II on the one side and Class I on the other side. The majority of patients with this malocclusion present with a maxillary midline coincident to the midsagittal plane whereas the mandibular midline is displaced toward the Class II side.[3-5] The primary contributing factor of this malocclusion is the unilateral distal positioning of the mandibular first molar in relation to the maxillary first molar on the Class II side, creating a type 1 subdivision.[3-6] Other contributing factors to a type 1 subdivision are: an asymmetric mandible, the posterior position of the glenoid fossa and a functional shift of the mandible.[3,5-11]

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Figure 1 (a – h): Pre-treatment photographs.

A secondary contributing factor but less likely, is the mesial positioning of the maxillary first molar on the Class II side. Here the mandibular midline is coincident to the midsagittal plane and the maxillary midline deviates to the Class I side, creating a type 2 subdivision.[5,12]

Options for the correction of a Class II subdivision malocclusion can be divided into 3 distinct categories namely: non-extraction protocols, extraction protocols and orthognathic surgery. This case report describes a non-extraction approach to correct an Angle Class II division 1 type 2 subdivision malocclusion.

Case Report

A 13 year old female patient presented at a private practice concerned about the flaring of her maxillary incisors. Clinical examination revealed an Angle Class II division 1 malocclusion with a type 2 subdivision on the right hand side. Extra-oral examination indicated that the patient was dolichocephalic with a convex profile and adequate facial symmetry but with a possibility of lower lip wedging. Intra-oral examination revealed a permanent dentition with a maxillary midline deviation of 3.5mm to the left of the midsagittal plane. The maxillary arch showed mild spacing and the mandibular arch mild crowding.

Radiographic examination

Examination of the pre-treatment orthopantomogram revealed a permanent dentition with no pathology present. Third molars were developing. (Figure 2)

The pre-treatment cephalometric analysis (Table 1) indicated a Class II skeletal relationship. Figures 3 (a and b) show the pre-treatment lateral cephalogram and the cephalometric analysis done with the Dolphin® orthodontic software.

Figure 2: Pre-treatment orthopantomogram.

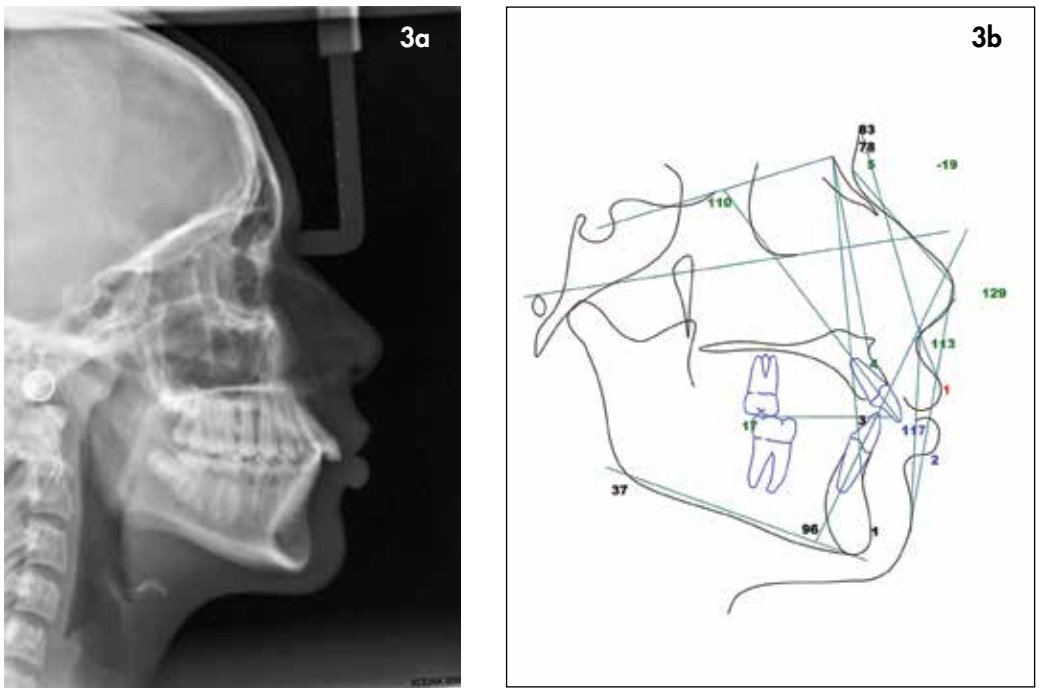

Figure 3: (a) Pre-treatment lateral cephalogram and (b) cephalometric analysis.

Table 1: Pre-treatment cephalometric analysis

Cephalometric values	Normal	Pre-treatment
Nasolabial angle (°)	102.0	112.7
Upper lip to E-plane (mm)	-5.1	0.9
Lower lip to E-plane (mm)	-2.0	2.4
Upper lip thickness at point A (mm)	17.0	15.2
Upper lip thickness at vermillion border (mm)	13.6	12.6
SNA (°)	82.0	83.4
SNB (°)	80.9	78.3
ANB (°)	1.6	5.1
Wits	-1.0	1.5
Convexity (A-NPo) (mm)	1.0	4.4
Interincisal (°)	130.0	116.9
U1 – SN (°)	102.7	110.3
U1 – NA (°)	22.8	26.9
U1 – NA (mm)	4.3	5.2
L1 – NB (°)	25.3	31.1
L1 – NB (mm)	4.0	6.1
L1 – MP (°)	95.0	96.1
MP – SN (°)	33.0	36.7
Y-axis (°)	67.0	67.4
Occlusal plane – SN (°)	14.4	17.2

Diagnosis

Soft tissue

The patient presented dolichocephalic with a convex profile and an accentuated labiomental fold.

Skeletal

Mild Class II skeletal malocclusion, (Steiner 5.1°) and convexity (4.4 mm) with a mesiognathic maxilla (83.4°) as well as mandible (78.3°) and a normal growth pattern (Y-axis 67.4°).

Dentoalveolar

Angle Class II division 1 with subdivision on the right side with proclined and protruded maxillary and mandibular incisors. Maxillary midline deviation of 3.5mm to the left accompanied by mild spacing opposed to mild crowding of mandibular incisors.

Treatment objectives

The aim of the treatment was to achieve a Class I molar and canine relationship on the right hand side and maintain the Class I molar and canine relationship on the left hand side. Further objectives were to correct the overjet, close the maxillary spaces, align the mandibular incisors and to correct the midline discrepancy.

Treatment options

A. Extra-oral appliance

Unilateral molar distalization, by making use of face bows

such as the power arm face bow, swivel- offset face bow, soldered offset face bow and spring attached face bow.[13]

B. Intra-oral fixed appliances

i) Pendulum appliance
This appliance derives its anchorage from the palate through a Nance acrylic button and the activating force from a 0.032" Beta Titanium (TMA) spring. The spring applies a light, continuous force to the maxillary first permanent molars.[14]

ii) Beneslider
Temporary anchorage devices (TADs) offer absolute anchorage through the use of skeletal structures for anchorage. The Beneslider is a maxillary device designed for distalization. It is connected to two coupled mini-implants that are placed in the anterior segment of the palate. It uses slide mechanics for distalization.[15,16]

iii) Appliances like the Jasper Jumper, Twin Force Corrector and Power Scope are fixed to the maxillary and mandibular arch wires and are normally used to correct enlarged overjets in Class II malocclusions. They can also be used to distalize maxillary molars unilaterally or bilaterally.[17]

iv) Class II elastic and nitinol open coil spring

C. Intra-oral removable appliances

Removable appliance with distalization screw.[18]

Treatment plan

The Damon Q fixed orthodontic appliance was used in the maxilla and mandible. Treatment started with 0.014 CuNiTi arch wires in the maxilla and mandible. The 14 and 15 were bonded once the 16 has been distalized.
- Standard torque brackets were used (+15°) on 11 and 21, (+6°) on 12 and 22, (+7°) on 13 and 23.
- Low torque brackets (-11°) were used on the 32 – 42.
- Standard torque brackets (+7°) were used on the 33 and 43.

A nitinol open coil spring was used between the 13 and 16. A sliding hook was placed mesial to the coil. The patient was instructed to use a 3.5oz 6.35mm Class II elastic from the hook to the 46 on a full time basis.

Traction started on a 0.016 x 0.025 SS maxillary arch wire (extending 2mm past the buccal tube) to allow distalization of the maxillary molar. This arch wire in combination with the standard torque brackets allowed retraction and loss of torque of the maxillary incisors during treatment. A 0.019 x 0.025 SS mandibular arch wire was used with elastic ligatures placed over the brackets from 33 – 43. This was necessary to obtain maximum torque expression as there is 25° play between the brackets and this arch wire. A 0.017 x 0.025 TMA arch wire was used for final detailing during finishing of the treatment.

Post treatment retention consisted of a clear removable retainer in the maxilla and a fixed lingual splint in the mandible.

Treatment progress

Figure 4 (a – e) shows the placement of 0.016 x 0.025 SS arch wire in maxilla, 0.019 x 0.025 SS in the mandible, an open coil and sliding hook and a 3.5oz 6.35mm

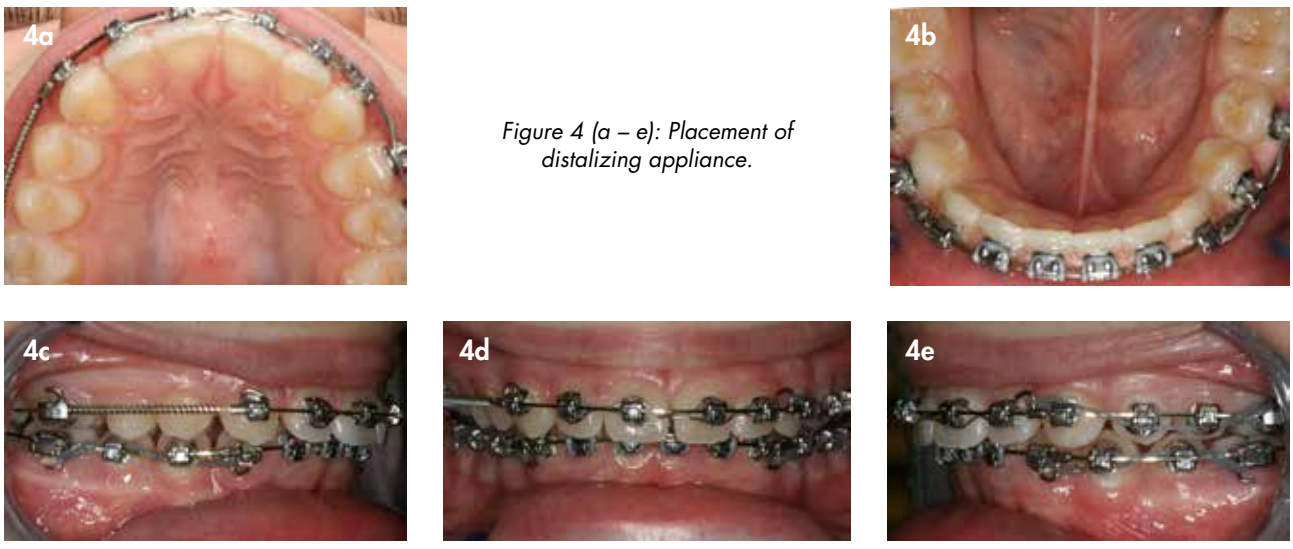

Figure 4 (a – e): Placement of distalizing appliance.

Figure 5: (a) Class I molar relationship.

Figure 5: (b) Space created distal to the 15.

Class II inter-arch elastic on the right. The maxillary arch wire extended 2mm distal to the 16 to allow for distalization while the Class II elastic was in use. The premolars were bonded as soon as a Class I molar relationship was achieved.

Figure 5 (a – b): (a) Shows the Class I molar relationship, natural distal movement of the 14 and 15 and the bonding of the 14 and 15. A 0.018 CuNiTi arch wire was used to align the premolars. A 2oz 4.76mm Class II elastic was used to maintain anchorage and to further distalize premolars (b) Space created distal to the 15.

Figure 6 (a–d): Shows the progression of midline correction. This was achieved through sliding mechanics to close spaces and to correct overjet with the use of an elastomeric chain and a unilateral Class II elastic on the right.

Figure 6 (a-d): Shows the progression of midline correction.

Table 2: Sequence of arch wires and inter-arch elastics used during treatment

Arch wires		Inter-arch elastics	
Maxilla	Mandible	Size and force	Direction
0.014 CuNiTi	0.014 CuNiTi	-	-
0.018 CuNiTi	0.018 CuNiTi	-	-
0.014 x 0.025 CuNiTi	0.014 x 0.025 CuNiTi	-	-
0.018 x 0.025 CuNiTi	0.018 x 0.025 CuNiTi		
0.016 x 0.025 SS	0.019 x 0.025 SS	3.5oz, 6.35mm	Class II
0.016 x 0.025 SS	0.017 x 0.025 TMA		

Treatment outcome

Upon analysing the final records (Figures 7 – 8, Table 3), all objectives outlined at the start of treatment were achieved. The final result showed a Class I molar and canine relationship with good interdigitation (Figure 7 a – h). The maxillary and mandibular midlines coincided with the midsagittal plane. The protrusion of the maxillary incisors was corrected (110.3° to 100.3°) the mandibular incisors showed further proclination at the end of treatment (96.1° to 100.5°) and the interincisal angle improved (116.9° to 122.0°).

Figure 7 (a – h): Post treatment photographs.

Cephalometric values

Table 3 shows the pre and post treatment cephalometric values and Figure 8 (a – b) shows the lateral cephalograms before and after treatment.

Table 3: Cephalometric values before and after treatment

Cephalometric values	Normal	Pre-treatment	Post-treatment
Nasolabial angle (°)	102.0	112.7	107.2
Upper lip to E-plane (mm)	-5.1	0.9	-0.8
Lower lip to E-plane (mm)	-2.0	2.4	0.6
Upper lip thickness at point A (mm)	17.0	15.2	15.1
Upper lip thickness at vermillion (mm)	13.6	12.6	12.0
SNA (°) 82.0	83.4	81.4	
SNB (°) 80.9	78.3	78.1	
ANB (°) 1.6	5.1	3.4	
Wits -1.0	1.5	-3.6	
Convexity (A-NPo) (mm)	1.0	4.4	3.0
Interincisal (°)	130.0	116.9	122.0
U1 – SN (°)102.7	110.3	100.3	
U1 – NA (°)22.8	26.9	18.9	
U1 – NA (mm)	4.3	5.2	5.2
L1 – NB (°)25.3	31.1	35.8	
L1 – NB (mm)	4.0	6.1	6.3
L1 – MP (°)95.0	96.1	100.5	
MP – SN (°)33.0	36.7	37.2	
Y-axis (°) 67.0	67.4	67.7	
Occlusal plane – SN (°)	14.4	17.2	22.3

Discussion / literature review

The following factors were taken into consideration for the decision to use Class II elastics for this patient.

1. Mild molar distalization was required in this case
2. Incisor retraction required no torque preservation and less molar anchorage
3. Lower incisor axial inclination was acceptable

Any inter-arch mechanics such as elastics or fixed functional appliances have a proclination effect on mandibular incisors. Unfavourable mandibular incisor inclination requires intra-arch mechanics in combination with TADs for anchorage. The further proclination of the lower incisors in this case could have been avoided with further negative torque placed into the 0.019 x 0.025 SS arch wire.

Extraction of a maxillary premolar on the Class II side is an acceptable treatment alternative for a patient with a full

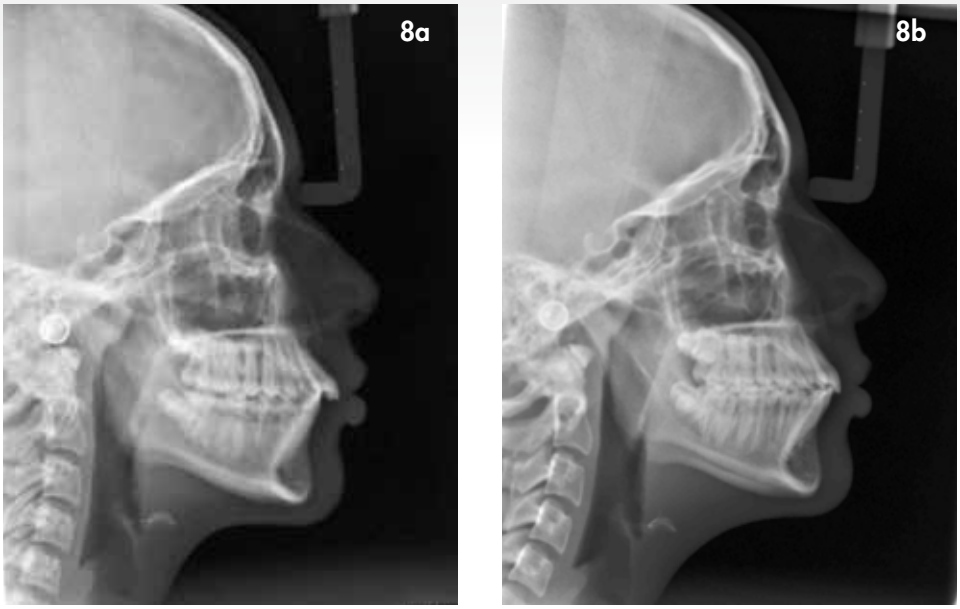

Figure 8 (a – b): cephalograms before treatment (a) and after treatment (b).

Class II molar relationship (needing 7mm distalization) and crowding in the affected quadrant.[5]

Various skeletal, dental and soft tissue aetiological factors have been identified as the cause of asymmetrical malocclusions.[19 - 22] In case of dentoalveolar origin the asymmetry can be ascribed to an unfavourable sequence of eruption, a loss of permanent teeth or premature loss of deciduous teeth. In case of a skeletal origin the asymmetry can be related to a developmental or acquired anomaly in either the maxilla, mandible or both.[23] Studies conducted by Alavi et al[3] and Rose et al[4] found that the main components of asymmetric Class II subdivision malocclusions are of dentoalveolar origin. In their studies, the skeletal component was not ruled out but found to be less prevalent in comparison.

This was confirmed by Janson et al[5] as well as Azevedo et al[24] which evaluated Class II subdivision patients with facial asymmetry and concluded that the subdivision is primarily dentoalveolar with little skeletal involvement.

There are various non-extraction approaches to correct a dental asymmetry. The most frequently utilized is the distalization of molars. Traditionally extra-oral traction was used to achieve the desired result. The headgear can be adjusted to ensure a distalizing force on the preferred side.[25,26,27] The results were favourable but, like various other approaches such as intermaxillary elastics and removable appliances, it is reliant on patient cooperation to achieve the result.[28,29] Clemmer and Hayes[30] confirmed this through a study assessing cooperation in headgear patients and found that the appliance was worn for an average of 55.8% of the prescribed hours.

Fixed intra-oral appliances have been designed to exert a continuous force to achieve molar distalization. This includes the distal jet, pendulum appliance, Jones Jig, Keles slider, Wilson arches and K-loop.[31] These noncompliance methods have been measured on cephalometric radiographs and indicated that the distalization of the maxillary molars is accompanied by distal tipping of the molars and anchorage loss due to the mesial displacement of maxillary premolars.[32] The proclination of the maxillary incisors and increase in overjet are also known side effects of these appliances.[33 - 36]

Distalizing appliances have been used in conjunction with TADs, which offer absolute anchorage through the use of skeletal structures.[37 - 46] Mini-implants have been attracting a lot of attention, due to their versatility and minimally invasive surgical nature. The disadvantage is that it requires a two phase approach as modification to the appliance is required once distalization has been achieved.[47 - 51] A device designed to solve this problem is the Beneslider. It is connected to two coupled mini-implants that are placed in the anterior segment of the palate and uses slide mechanics for distalization.[15,16]

Conclusion

- A sliding stop with a nitinol open coil is an acceptable method of non-extraction treatment in a Class II division 1 subdivision case.
- It is important to take into consideration the pre-treatment mandibular incisor inclination as Class II elastics tend to procline mandibular incisors.
- It is suggested that Class II elastics are not used in unfavourable lower incisor cases.
- The correct diagnosis must determine the individualised treatment approach and appliance selection.

Disclosure of financial interest

The authors report no financial interest in the products mentioned in this case report.

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