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Case Report

Dentistry Section

Comprehensive Management of Skeletal Class II Division 1 Malocclusion with Bilateral Crossbite using Haas Expander and Forsus™ FRD: A Case Report

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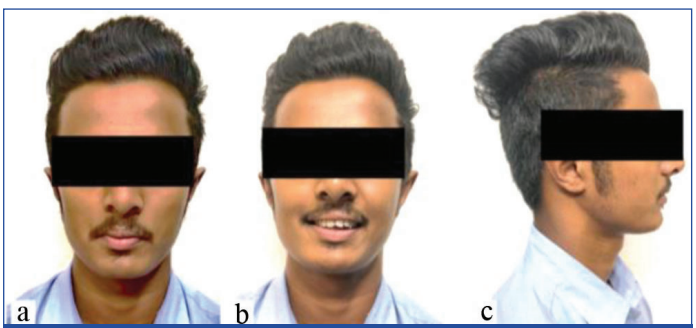
ABSTRACT

Skeletal Class II malocclusion is a jaw discrepancy where the mandible is retruded relative to the maxilla, leading to a convex profile, increased overjet, and potential deep bite. It may result from mandibular deficiency, maxillary excess, or both. This case report details the comprehensive management of a 19-year-old male patient with a Class II Division 1 malocclusion, characterised by an orthognathic maxilla, retrognathic mandible, increased overjet and overbite, and a convex facial profile. The treatment involved fixed orthodontic therapy using the McLaughlin-Bennett-Trevisi (MBT) 0.022" prescription for comprehensive tooth alignment and leveling. Maxillary expansion was achieved using a Haas expander, a tooth- and tissue-borne appliance designed to widen the upper arch. Class-II correction was carried out with the Forsus™ Fatigue Resistant Device (FRD), a Fixed Functional Appliance (FFA) that applies continuous force to advance the mandible and correct the sagittal jaw discrepancy. Following two years of active treatment, the patient achieved a well-aligned dentition, a Class I molar and canine relationship, and an improved facial profile. This case highlights the efficacy of FFAs in the non-extraction management of Class II malocclusion, demonstrating favourable dentoalveolar and soft-tissue changes.

Keywords: Convex profile, Functional appliance, Jaw discrepancy, Molar relationship

CASE REPORT

A male patient, aged 19 years, reported to the orthodontics department with the chief complaint of teeth that were positioned forward. On eliciting the history, the patient did not report any significant past dental history, medical history, or family history of similar dental or skeletal conditions. Additionally, there was no history of deleterious oral habits such as thumb sucking, mouth breathing, or tongue thrusting as reported by the patient. An apparent symmetrical leptoprosopic face form, a dolichocephalic head form, average growth pattern, decreased nasolabial angle and potentially competent lips were all observed during extraoral examination. The upper lip exhibited hypotonicity, while the lower lip displayed a deep mentolabial sulcus and hyperactive mentalis activity. Profile analysis indicated a convex facial profile. The patient's smile was asymmetrical and non-consonant, with an incisor display of approximately 60% [Table/Fig-1a-c].



[Table/Fig-1]: Pre-treatment extraoral photographs: a) Frontal; b) Frontal smiling; c) Profile.

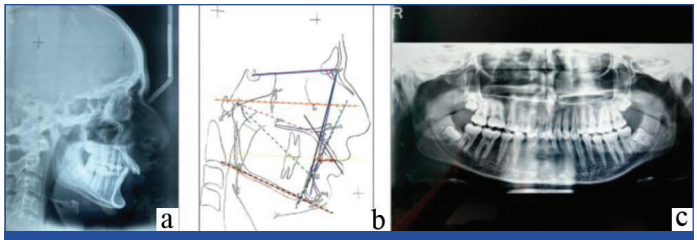
An intraoral examination revealed that all teeth in both arches, up to the second molars, were present. The zone of attached gingiva was sufficient, and the gingival health was acceptable. The size and shape of the tongue and frenal attachment were normal. The third molars had not yet erupted in either arch [Table/Fig-2a-e]. There was an enhanced overjet and overbite, along with a Class II molar and Class II canine relationship and crossbite with 26 and 36. Functional assessment showed that the patient's speech, oro-nasal breathing, and swallowing pattern were all normal. In the functional rest position, the mandible was positioned posteriorly in relation to the maxilla. There was no variation from the typical mandibular closure pattern, nor were there any indications of Temporomandibular Disorders (TMD).

[Table/Fig-2]: Pre-treatment intraoral photographs: a) Maxillary occlusal view; b) Mandibular occlusal view; c) Frontal view in occlusion; d) Left molar in occlusion; e) Right molar in occlusion.

Analysis of the study casts demonstrated asymmetrical, U-shaped maxillary and mandibular arches with a Class II molar and canine relationship bilaterally. The patient exhibited a 13 mm overjet and a 6 mm overbite. According to the cephalometric analysis, the patient had Class II skeletal bases, a horizontal growth pattern, and was at Cervical Vertebral Maturation Index (CVMI) stage VI (completion) [1]. The upper incisors were proclined, whereas the lower incisors were upright. Soft-tissue analysis revealed a decreased nasolabial angle, a deep mentolabial sulcus, and a reduced lower airway [Table/Fig-3a-c,4].

Clinical Diagnosis

- Prognathic maxilla



[Table/Fig-3]: a) Pre-treatment lateral cephalogram; b) Tracing showing all the angles (Green line shows upper airway and lower airway); c) Pre-treatment orthopantomogram.
Skeletal Class II malocclusion, Angle's Class II Div 1 malocclusion, with an average growth pattern, was the diagnosis

Parameters	Pre-treatment	Reference
SNA (dark green solid line)	77°	Orthognathic maxilla
SNB (dark pink solid line)	72°	Retrognathic mandible
ANB (black angle between SNA and SNB)	5°	Skeletal Class II
WITS (dotted yellow line)	6 mm	Skeletal Class II
U1 TO NA (degrees) (black solid line)	46°	Proclined UI
U1 TO NA (mm) (red arrow)	7 mm	Protruded UI
L1 TO NB (degrees) (light blue solid line)	14°	Retroclined LI
L1 TO NB (mm) (light pink line)	3 mm	Protruded LI
FMA (solid orange line)	24°	Horizontal growth pattern
IMPA (black dotted line)	89°	Retroclined LI
FMIA (dotted orange line)	67°	Retroclined LI
Maxillary length (dark pink dotted line)	84 mm	Reduced
Mandibular length (dark green dotted line)	111 mm	Reduced

[Table/Fig-4]: Pre-treatment cephalometric readings.

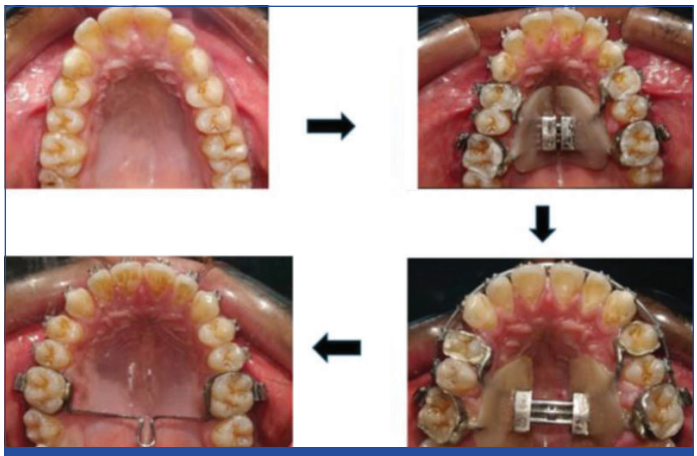
- Constriction of the maxilla
- Bilateral crossbite with #26 and #36
- Retrognathic mandible
- Deep mentolabial sulcus
- Increased overjet and overbite
- Convex facial profile
- Proclined upper incisors
- Crowding with lower anteriors
- Class II molar and canine relation on both sides
- Decreased lower airway
- Deep curve of Spee

The treatment objectives are mentioned in the [Table/Fig-5] below.

	Sagittal	Vertical
Skeletal	1. Correction of prognathic and constricted maxilla 2. Correction of retrognathic mandible- by advancing the mandible, which will also contribute to improvement in lower airway space.	
Dental	1. Correction of proclination in maxillary anteriors	1. Correction of the deep curve of the Spee
	2. Correction of overjet	2. Correction of overbite
	3. To achieve and maintain class I canine and molar relation 4. To correct crossbite 5. To relieve lower incisor crowding	
Soft-tissue	To bring off a straight profile	
	Correction of deep mentolabial sulcus	
	To get competent lips	

[Table/Fig-5]: Treatment objectives.

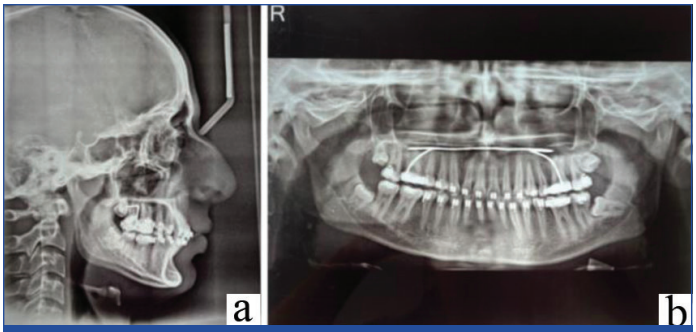
Treatment: After obtaining written informed consent from the patient, the proposed orthodontic treatment was initiated. The MBT 0.022" prescription was used to bond the upper and lower arches. Using a 0.014" Nickel Titanium (NiTi) wire in each arch, levelling and alignment were started, progressing to a 0.017"×0.025" NiTi wire. It took almost 11 months of therapy to level and align both the arches. After levelling and alignment, active expansion with Hass Appliance (Semi Rapid Expansion) [2] was done for three months, one-turn-per-day activation rate, followed by a four-month retention period. After removal of the Hass Expander, a Working Model Impression (WMI) was taken with the upper arch and placement of the Transpalatal Arch (TPA) [3] was done [Table/Fig-6]. A 0.019×0.025" NiTi preceded by 0.019×0.025"SS wire was inserted in the upper and lower arches, followed by placement of an FFA Forsus FRD [4] (32 mm) L pin module with 019*025" SS wire with labial root torque in the lower anterior segment with cinch back [Table/Fig-7], was utilised to correct the Class II relationship for five months. Following correction of Class II with the Forsus FRD appliance, the setting phase required approximately three months of treatment time. The overall treatment took approximately two years to complete and obtain stable results.



[Table/Fig-6]: Expansion progress (Top right is the pre-treatment intraoral photograph of the maxilla, second is the intraoral photograph with expander, third is the intraoral photograph of the maxilla after expansion, and fourth is the intraoral photograph of the maxilla with TPA for retention).

[Table/Fig-7]: Intraoral photographs with Forsus appliance.

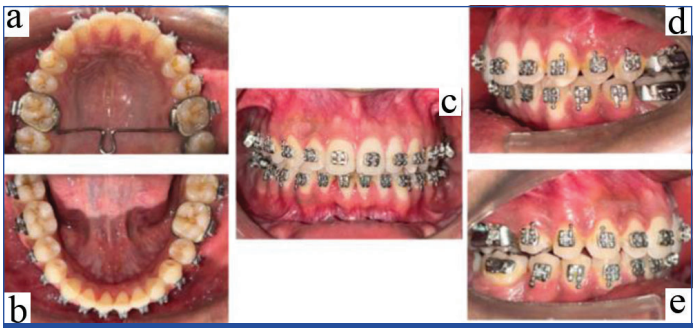
Treatment Result: After two years of treatment duration, all the treatment objectives, like correction of the incisor proclination, normal overjet and overbite, were attained. Cephalometric measurements of the patient also showed improvement after treatment [Table/Fig-8a,b,9]. Space closure was attained with a Class I molar and canine relationship [Table/Fig-10a-e]. Facial convexity was decreased, and a straight profile was attained [Table/Fig-11a-c]. The case was debonded recently, and a follow-up will be scheduled after one year [Table/Fig-12,13].



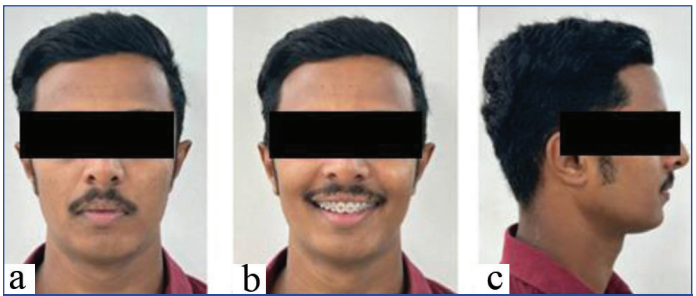
[Table/Fig-8]: a) Post-treatment lateral cephalogram; b) Post-treatment orthopantomogram.

Parameters	Pre-treatment	Post-treatment
SNA	77°	78°
SNB	72°	75°
ANB	5°	3°
WITS	6 mm	2 mm
U1 TO NA (Degrees)	46°	27°
U1 TO NA (mm)	16 mm	6 mm
L1 TO NB (Degrees)	14°	25°
L1 TO NB (mm)	3 mm	4 mm
FMA	25°	24°
IMPA	89°	96°
FMIA	67°	60°
Maxillary length	84 mm	84 mm
Mandibular length	111 mm	114 mm

[Table/Fig-9]: Pre- and post-treatment cephalometric analysis.
S: Sella point; N: nasion; A: A point; B: B point; WITS: Wits appraisal; U1: upper central incisor; L1: lower central incisor; FMA: Frankfort mandibular plane angle; IMPA: incisor mandibular plane angle; FMIA: Frankfort mandibular incisor plane angle



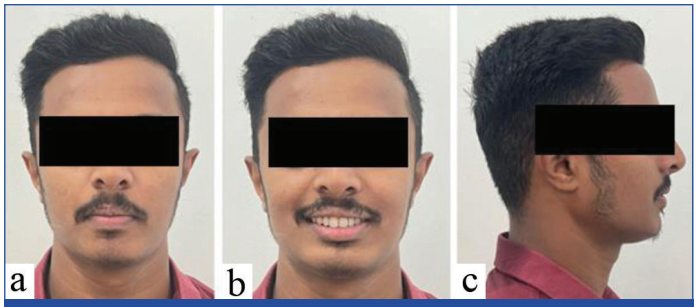
[Table/Fig-10]: Post-treatment intraoral photographs: a) Maxillary occlusal view; b) Mandibular occlusal view; c) Frontal view in occlusion; d) Left molar in occlusion; e) Right molar in occlusion.



[Table/Fig-11]: Post-treatment extraoral photographs: a) Frontal; b) Frontal smiling; c) Profile.

DISCUSSION

Radiographic evaluation of the midpalatal suture is a crucial step in determining the feasibility of Rapid Palatal Expansion (RPE) in young adults [5]. While conventional understanding suggests a straight oronasal course of the suture, recent studies indicate that it may take an oblique path, complicating radiographic interpretation [6,7]. Research suggests that midpalatal sutural



[Table/Fig-12]: After debonding, extraoral photographs.

[Table/Fig-13]: After debonding, intraoral photographs.

closure typically commences during early adolescence; however, histological findings indicate that radiographic closure does not necessarily correspond to complete fusion [8]. A post-mortem study by Persson M and Thilander B (1977), in a histological post-mortem study of individuals aged 15 to 35 years, reported that palatal suture closure was rarely observed before the third decade of life. The median percentage of ossification was 0% in individuals under 26 years and only 3.11% in individuals aged 26 years and older, suggesting that successful RPE may still be feasible in young adults [9].

Clinical trials have confirmed the efficacy of RPE in individuals aged 15 to 28 years, with failure rates being higher in older patients who may require surgical intervention [10]. Expansion protocols vary, with high activation rates (four turns per day) being associated with significant discomfort and adverse periodontal effects. Studies have recommended a more conservative approach, such as two turns per day, to improve patient tolerance and treatment success [11]. Long-term stability of non-surgical RPE has been well-documented [12]. Another comparative study by Handelman CS et al., involving 47 adults and 47 children treated with RPE, alongside a control group of 52 adults without expansion, demonstrated the long-term stability of nonsurgical RPE with an average follow-up of six years [2]. In the present case, the use of a Haas-type expander with a one-turn-per-day activation rate, followed by a four-month retention period, contributed significantly to treatment stability. These findings support the effectiveness of non-surgical RPE in young adults when an appropriate expansion protocol is followed, minimising discomfort and periodontal risks.

FFAs have been widely utilised for Class II malocclusion correction, primarily inducing dentoalveolar changes rather than significant skeletal modifications [13]. Among the available FFAs, the Forsus™ FRD has demonstrated superior sagittal skeletal effects compared to other appliances like PowerScope [14]. The Forsus™ appliance postures the mandible forward and promotes favourable dental and soft-tissue adaptations, particularly in patients who are at or near the peak pubertal growth phase [15]. However, its primary effects in individuals nearing the completion of growth are limited to dental compensations. Studies by Du X et al., and Hägg U et al., have shown that incremental activation (1.5 mm using a split crimp) yields better results than single-stage advancement by allowing gradual neuromuscular adaptation and minimising adverse effects [16,17].

The Forsus™ appliance generates continuous force through compressed springs, producing orthodontic effects in the sagittal, transverse, and vertical dimensions. In the sagittal plane, the appliance exerts a distalising force on the maxillary first molars, leading to their retroclination [18]. This retroclination contributes to overjet reduction and upper lip retraction, which was beneficial in the presented case. Simultaneously, the appliance induces mesial movement of the mandibular molars and proclination of the lower incisors, further aiding in overjet correction. While mild lower incisor proclination is advantageous for Class II correction, excessive proclination may compromise long-term stability. Studies have recommended the use of full-size mandibular rectangular archwires, negative torque in the lower incisor region, rigid tiebacks, cinchbacks, and torque-controlled brackets to counteract excessive proclination [15,19].

In the transverse dimension, Forsus™ applies lateral forces to the buccal surfaces of the maxillary molars, leading to buccal flaring and extrusion of their palatal cusps. This extrusion contributes to overbite reduction but can be controlled through the use of a TPA, rigid 0.019”×0.025” stainless steel archwires, and palatal root torque application [18].

The present case involved a 19-year-old male patient with Class II malocclusion characterised by mandibular retrusion and increased overjet. Given the patient’s skeletal maturity (CVMI Stage VI) and a positive Visual Treatment Objective (VTO), a non-extraction approach with FFA therapy was preferred. The use of Forsus™ FRD was strategically selected to achieve Class II correction while minimising overall treatment duration by integrating fixed appliance therapy and functional correction in a single phase. Unlike removable functional appliances, Forsus™ is compliance-independent, ensuring continuous force application. Additionally, the appliance contributed to soft tissue profile enhancement by improving facial convexity, although the primary mechanism of correction remained dentoalveolar.

Overall, the case illustrates the effectiveness of Forsus™ FRD in Class II correction, provided that appropriate anchorage control and expansion mechanics are implemented. The combination of maxillary expansion via a Haas-type expander, followed by FFA therapy, resulted in successful occlusal and aesthetic improvements. Future studies with long-term follow-ups are recommended to further assess the stability and periodontal implications of this treatment approach in young adults.

CONCLUSION(S)

This case report highlights the successful management of a skeletal Class II malocclusion with a non-extraction treatment approach using fixed orthodontic appliances and a Forsus™ FRD for Class II correction. The treatment objectives, including profile enhancement, correction of proclination, and establishment of a Class I molar and canine relationship, were effectively achieved. The use of a Haas expander facilitated transverse arch development, while the Forsus™ appliance contributed to mandibular advancement and overjet reduction through dentoalveolar changes. Post-treatment cephalometric analysis demonstrated favorable skeletal and dental changes, leading to an improved facial profile and functional occlusion. The overall treatment duration of approximately two years resulted in a stable outcome with optimal aesthetic and functional improvements. This case underscores the efficacy of FFAs in managing Class II malocclusion, particularly in late adolescence, where skeletal growth modification remains a viable option. Long-term follow-up will be necessary to monitor retention and stability.

REFERENCES

[1] Baccetti T, Franchi L, McNamara JA. The Cervical Vertebral Maturation (cvm) method for the assessment of optimal treatment timing in dentofacial orthopedics. Semin Orthod. 2005;11:119-29. Doi: 10.1053/j.sodo.2005.04.005.

[2] Handelman CS, Wang L, BeGole EA, Haas AJ. Nonsurgical rapid maxillary expansion in adults: Report on 47 cases using the Haas expander. Angle Orthod. 2000;70:129-44. 10.1043/0003-3219(2000)070<0129:NRMEIA>2.0.CO;2.

[3] Kupietzky A, Tal E. The Transpalatal arch: An alternative to the Nance appliance for space maintenance. Pediatr Dent. 2007;29(3):235-38.

[4] Vogt W. The forsus fatigue resistant device. J Clin Orthod JCO. 2006;40:368-77; quiz 358.

[5] Revelo B, Fishman LS. Maturational evaluation of ossification of the midpalatal suture. Am J Orthod Dentofac Orthop Off Publ Am Assoc Orthod Its Const Soc Am Board Orthod. 1994;105:288-92. Doi: 10.1016/S0889-5406(94)70123-7.

[6] Wehrbein H, Yildizhan F. The mid-palatal suture in young adults. A radiological-histological investigation. Eur J Orthod. 2001;23:105-14. Doi: 10.1093/ejo/23.2.105.

[7] Shayani A, Merino-Gerlach MA, Garay-Carrasco IA, Navarro-Cáceres PE, Sandoval-Vidal HP. Midpalatal suture maturation stage in 10- to 25-year-olds using cone-beam computed tomography—a cross-sectional study. Diagnostics. 2023;13:1449. Doi: 10.3390/diagnostics13081449.

[8] Melsen B. Palatal growth studied on human autopsy material: A histologic microradiographic study. Am J Orthod. 1975;68:42-54. Doi: 10.1016/0002-9416(75)90158-X.

[9] Persson M, Thilander B. Palatal suture closure in man from 15 to 35 years of age. Am J Orthod. 1977;72:42-52. Doi: 10.1016/0002-9416(77)90123-3.

[10] Capelozza Filho L, Cardoso Neto J, da Silva Filho OG, Ursi WJ. Non-surgically assisted rapid maxillary expansion in adults. Int J Adult Orthodon Orthognath Surg. 1996;11:57-66; discussion 67-70.

[11] Baldini A, Nota A, Santariello C, Assi V, Ballanti F, Cozza P. Influence of activation protocol on perceived pain during rapid maxillary expansion. Angle Orthod. 2015;85:1015-20. Doi: 10.2319/112114-833.1.

[12] Mohan CN, Araujo EA, Oliver DR, Kim KB. Long-term stability of rapid palatal expansion in the mixed dentition vs the permanent dentition. Am J Orthod Dentofacial Orthop. 2016;149:856-62. Doi: 10.1016/j.ajodo.2015.11.027.

[13] Zymperdikas VF, Koretsi V, Papageorgiou SN, Papadopoulos MA. Treatment effects of fixed functional appliances in patients with Class II malocclusion: A systematic review and meta-analysis. Eur J Orthod. 2016;38:113-26. Doi: 10.1093/ejo/cjv034.

[14] Arora V, Sharma R, Chowdhary S. Comparative evaluation of treatment effects between two fixed functional appliances for correction of Class II malocclusion: A single-center, randomized controlled trial. Angle Orthod. 2018;88:259-66. Doi: 10.2319/071717-476.1.

[15] Chaukse A, Jain S, Reddy MSR, Dubey R, John SM. Treatment of skeletal Class II malocclusion using the “forsus” appliance: A case report. People’s J Sci Res. 2011;4:39-42.

[16] Du X, Hägg U, Rabie ABM. Effects of headgear Herbst and mandibular step-by-step advancement versus conventional Herbst appliance and maximal jumping of the mandible. Eur J Orthod. 2002;24:167-74. Doi: 10.1093/ejo/24.2.167.

[17] Hägg U, Rabie ABM, Bendeus M, Wong RWK, Wey MC, Du X, et al. Condylar growth and mandibular positioning with stepwise vs maximum advancement. Am J Orthod Dentofac Orthop Off Publ Am Assoc Orthod Its Const Soc Am Board Orthod. 2008;134:525-36. Doi: 10.1016/j.ajodo.2006.09.064.

[18] Essentials of Orthodontic Biomechanics Book by Dr. V. P. Jayade | PDF. Accessed: May 30, 2025. Available from: https://www.scribd.com/document/791322916/Essentials-of-Orthodontic-Biomechanics-Book-by-Dr-V-P-Jayade.

[19] Franchi L, Alvetro L, Giuntini V, Masucci C, Defraia E, Baccetti T. Effectiveness of comprehensive fixed appliance treatment used with the Forsus Fatigue Resistant Device in Class II patients. Angle Orthod. 2011;81:678-83. Doi: 10.2319/102710-629.1.

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