

Case Report

Treatment Effects and Posttreatment Follow-up of Miniscrew Anchorage-Supported Forsus FRD Appliance: Report of 2 Severe Class II Cases

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ABSTRACT

This case report presents the treatment and posttreatment follow-up of 2 boys with severe skeletal Class II malocclusion with miniscrew anchorage-supported Forsus Fatigue Resistance Device (FRDMS). Miniscrews were inserted between the mandibular canine and first premolar root area bilaterally. The FRDMS treatment duration was 13 months in the first case and 11 months in the second case. The patients were treated with fixed orthodontic treatment afterward. The first patient was followed up for 1 year and 6 months and the second patient for 2 years and 8 months after fixed orthodontic treatment Essix retainers were worn full-time for a period of 6 months and only at nighttime for the following 6 months in both cases after the fixed appliances. Lower incisor proclination was observed in both cases, although lower dentition anchorage was reinforced with miniscrews during Forsus FRD treatment. Favorable sagittal movement of the mandible was achieved in only 1 case. Overjet and molar correction were mainly at the dentoalveolar level in the other case. Occlusion was stable in the long-term. (*Turkish J Orthod.* 2014;27:164–173)

KEY WORDS: Forsus, Miniscrew, Fixed functional appliance, Follow-up period, Postretention

INTRODUCTION

Forsus Fatigue Resistance Device (FRD; 3M Unitek Corp, Monrovia, CA, USA) is a 3-piece, semirigid fixed functional appliance that was developed to overcome breakage and plastic deformation problems seen with Juser Jumper appliances. The FRD consists of a superelastic nickel-titanium open coil spring.¹ The compression of the spring exerts equal and opposite forces onto the maxillary molars as well as onto the mandibular incisors,² which results in distalization of maxillary molars and undesirable flaring of mandibular incisors.^{1–5} The FRD is compliance free, easy to install, and saves chair time.¹ Varying amounts of distal maxillary skeletal and dental movements, mesial mandibular skeletal and dental movements associated with differences in observation periods, and residual growth and development potential have been reported in previous studies with FRD.^{1,3,5}

In the literature, there are no studies evaluating the follow-up period of FRD. The only research

about fixed-functional appliances supported with miniscrews has only recently been reported.⁶ In that study, FRD was used with miniscrew anchorage (FRDMS) to reduce mandibular incisor tipping and provide advancement of mandible. This case report presents 2 severe Class II cases treated with the same miniscrew-supported FRD system and also the follow-up results in the postretention period.

Treatment Methods of Both Cases

Fixed Roth appliances with 0.018" slots were attached. Mandibular canines were bonded with 0.018 × 0.018" vertical slot brackets for attachment to miniscrews. Miniscrews (Spider screw 1.5 × 8; Ortho Technology Inc, Tampa, FL, USA) were inserted at least 1 week before the FRD application between the mandibular canine and first premolar

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To cite this article: Aslan BI, Kaygısız E, Küçükkaraca E. Treatment effects and posttreatment follow-up of miniscrew anchorage-supported Forsus FRD appliance: report of 2 severe Class II cases. *Turkish J Orthod.* 2014;27:164–173 (DOI: <http://dx.doi.org/10.13076/TJO-D-13-00005>)

Date Submitted: August 2013. Date Accepted: October 2013.

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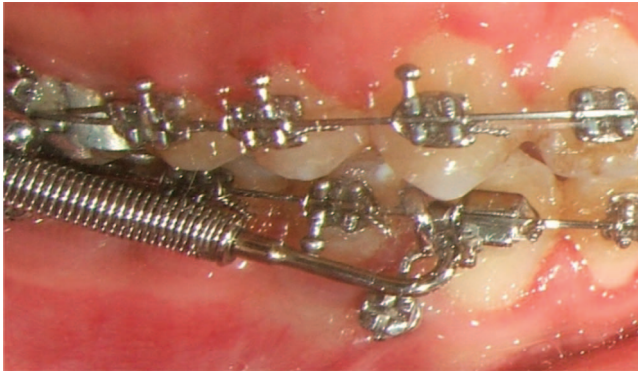


Figure 1. Forsus Fatigue Resistance Device used with miniscrew.

root area bilaterally. An indirect anchorage was established by using a 0.018×0.025 " stainless-steel archwire between the vertical slot of the mandibular canine bracket and miniscrew slot. The 0.016×0.022 " stainless-steel continuous archwires were engaged in both arches passively just before the insertion of FRD. No lingual crown torque was given to the anterior part of the lower archwire. Both arches were cinched back, and all of the teeth were 8 ligatured with each other. The maxillary end of FRD was inserted into the headgear tube of maxillary molars. The rods of FRD were placed onto the mandibular archwire, distal to the canine

brackets (Fig. 1). Patients were observed at 4-week intervals, and activation was performed as needed. The FRD was removed when the Class I molar relationship was achieved. Thereafter, fixed appliances were maintained to finalize the occlusion, and light Class II elastics were used for retention of treatment results. Essix retainers were used as retention appliances with instructions to wear them full-time, except during meals, for a period of 6 months and then at night only for the next 6 months in both cases.

Lateral cephalometric radiographs were obtained just before the insertion of FRD (T1), after the Class I molar relationship was achieved (T2), and after the removal of fixed orthodontic appliances (T3) in both cases. Posttreatment lateral cephalometric radiographs were obtained after 1 year and 6 months for the first case (T4) and at 1 year and 8 months (T4) and 2 years 8 months (T5) for the second case. The perpendicular to a constructed horizontal line, 7° to SN plane, was taken as the reference plane, as in the previous investigation.⁷ Twenty-two linear and 17 angular cephalometric measurements were used in the cephalometric analysis.

Case 1. A male patient aged 13 years 6 months with an 11% residual growth and development potential had Class II division I malocclusion associated with a retrognathic mandible. Overbite



Figure 2. Intraoral and extraoral photographs of case 1 at T1.

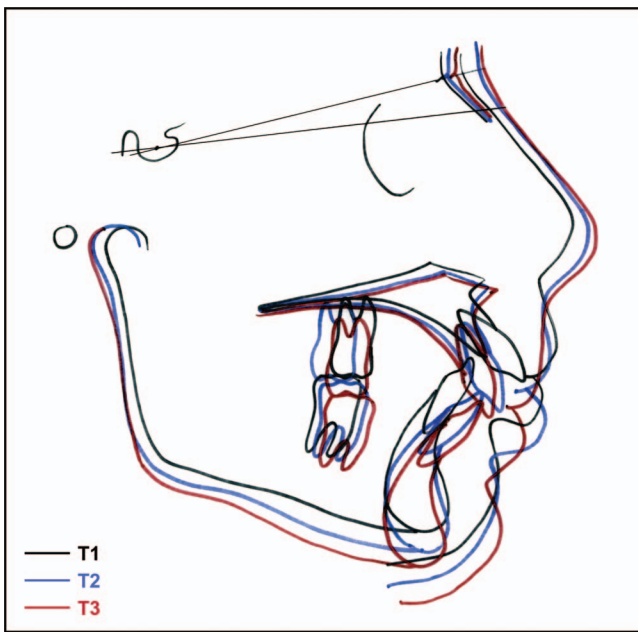


Figure 3. Total superimposition of case 1 at T1, T2, and T3.

was 7.2 mm, and overjet was 12.5 mm (Fig. 2). A Class I molar relationship was achieved with the use of FRDMS for 1 year and 1 month. A decrease in SNA (2°) and SNB (1°) angles and an increase in mandibular posterior rotation (3°) were observed (Fig. 3; Table 1). Overjet decreased from 12.5 mm to 5 mm. Retrusion of maxillary incisors (5.5 mm), protrusion of mandibular incisors (2 mm), and mesialization of mandibular molars (1.5 mm) were determined (Fig. 4; Table 1). At the end of fixed orthodontic treatment, SNA decreased by 1.5° and the SNB angle decreased by 1°. The mandible

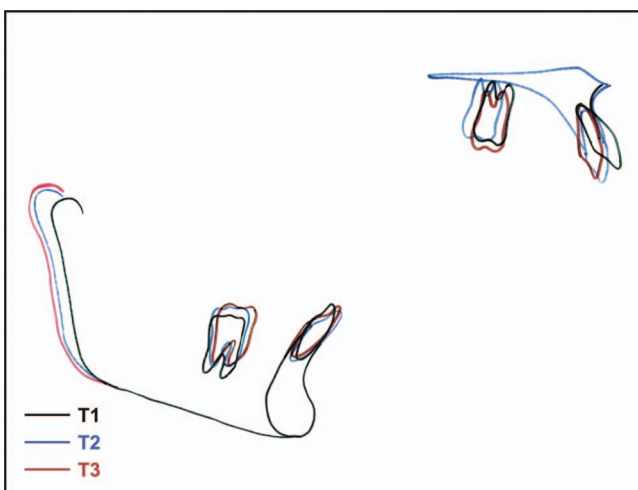


Figure 4. Local superimposition of case 1 at T1, T2, and T3.

Table 1. Cephalometric values measured before miniscrew anchorage-supported Forsus Fatigue Resistance Device (FRDMS; T1), after FRDMS (T2), after the fixed orthodontic treatment (T3), and after 1 year and 6 months of the end of fixed orthodontic treatment (T4) of case 1.

	Case 1			
	T1	T2	T3	T4
SN, mm	75	76.5	78.5	82
SNA, °	84	82	80.5	81
A-VRL, mm	75	75	76	80.5
FH/NA, °	92	89	90	90
SN/ANSPNS, °	7	8.5	8	7.5
SNB, °	75	74	73	73.5
B-VRL, mm	61	61	60	65
Pog-VRL, mm	63.5	62.7	62	66.5
Ar-Pog, mm	106.2	110	114	120
FH/NPog, °	86	85	84	84.5
ANB, °	9	8	7.5	7.5
N-A-Pog, °	168	168.5	169.2	168.5
N-Me, mm	116.5	122.5	128.5	133.5
ANS-Me, mm	64.5	68.5	73	76.5
S-Go, mm	78.5	80	85	89.5
SN/GoGn, °	28	31	30.5	31.5
Ar-Go-Me, °	114	116	118	120
ANSPNS/GoMe, °	22.5	23.5	24	23
U6-VRL, mm	43.2	39	41	45.5
U6-HRL, mm	61.5	61.5	66	69
U6/HRL, °	77	78.5	80	90.5
L6-VRL, mm	38.5	40	41	45
L6-MP, mm	30.5	33	34	34.5
L6/MP, °	84.2	80	77	90
U1-VRL, mm	86	80.5	77	82
U1-HRL, mm	71.5	78	79	81.5
U1/HRL, °	124	109	102	102.5
L1-VRL, mm	74	76	75.5	80
L1-MP, mm	46	43.5	46	52.5
L1/MP, °	106.5	118.5	115	113
Molar rel., mm	4.7	1.5	0	0
SN/OP, °	10.5	21	19	17
U1/L1, °	108	110.5	119	120
OJ, mm	12.5	5	3.5	2.5
OB, mm	7.2	5	2	4.5
Lbsup-VRL, mm	95	94.5	91	97
Lbinf-VRL, mm	90	90	85.5	91.5
Pog'-VRL, mm	76.5	76	77	81.5
Labiomental, °	82.5	95	111	110

derotated slightly. Overjet and overbite decreased by 1.5 mm and 3 mm, respectively, and occlusion improved. Retrusion of upper and lower lips and an increase in labiomental angle were observed (Figs. 3 and 5; Table 1).

At 1 year and 6 months after the end of fixed orthodontic treatment, the maxilla and mandible continued to grow sagittally (Figs. 6 and 7). Overjet



Figure 5. Intraoral and extraoral photographs of case 1 at T3.

decreased to 2.5 mm. Local superimpositions revealed stable maxillary and mandibular incisor positions (Fig. 8).

Case 2. The male patient aged 13 years 4 months with a 7% remaining growth and development potential presented with Class II division I malocclusion associated with prognathic maxilla and retrognathic mandible. Overbite was 4 mm and overjet was 10 mm (Fig. 9). Class I molar relationship was achieved with an 11-month FRDMS treatment. A skeletal correction was observed in the sagittal direction due to mandibular forward movement. Mandibular plane angle decreased by 2° (Fig. 10). Slight proclination of mandibular incisors was observed (Fig. 11). Overjet decreased from 10 mm to 1.5 mm, and overbite decreased from 4 mm to 0.5 mm. After removal of FRDMS, fixed orthodontic treatment was continued for 1 year. Slight posterior rotation of mandible was observed due to Class II elastics. Mandibular and maxillary incisors slightly retruded (Figs. 10 and 12; Table 2).

After 1 year 8 months following fixed orthodontic therapy, the maxillomandibular relation (ANB) and mandibular plane angle were stable (Figs. 13 and 14; Table 2). Minor changes in overjet and incisor positions were observed (Fig. 15). At the end of 2 years and 8 months of postretention period, overjet increased to 3 mm and overbite decreased to 1.5 mm. Maxillary and mandibular incisor inclinations were nearly preserved according to local superimpositions (Fig. 15; Table 2). Angle Class I molar and canine relationships were maintained (Fig. 16).

DISCUSSION

In this case report, FRD was supported with miniscrews, as described in the recent study by Aslan *et al.*,⁶ in order to improve mandibular advancement and minimize anchorage loss in mandibular dentition, and a follow-up period of treatment results was evaluated. The sagittal position of the maxilla did not change markedly in both cases because of the restraining effect of the

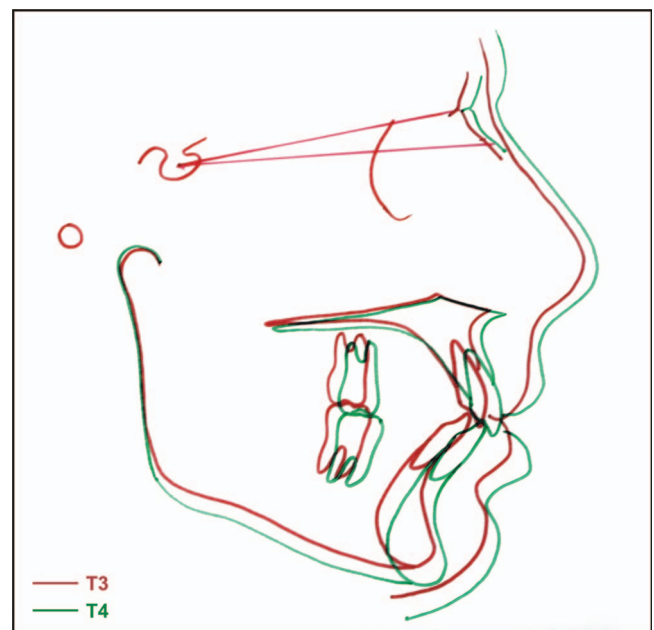


Figure 6. Total superimposition of case 1 at T3 and T4.



Figure 7. Intraoral and extraoral photographs of case 1 at T4.

FRDMS, which is consistent with the results of Weiland and Bantleon.⁸

In the present cases, different mandibular responses were obtained with FRDMS. In case 1, the mandible moved vertically and rotated posteriorly, whereas in the second case, forward movement and anterior rotation of the mandible were observed. These diverse results might be due to different individual growth patterns. Baccetti *et al.*⁹ reported limited reestablishment of Class II growth characteristics close to completion of active craniofacial growth and insignificant growth differences between Class I and II subjects after late puberty.

Some studies reported significant stimulation of mandibular anterior growth,^{8,10,11} whereas others reported no change on the sagittal position of the mandible^{6,12,13} with fixed functional appliances. Franchi *et al.*¹² stated that limited influence of FRD on mandibular anterior translation was due to the strength of appliance. A pronounced increment in mandibular growth was achieved with Herbst, which is a rigid fixed functional appliance.¹⁴ In the recent study by Aslan *et al.*,⁶ it was reported that no significant change was achieved in the sagittal position of the mandible, although FRD was supported with miniscrews. This result was explained by the resistance of miniscrews against the forward force direction of FRD. No significant change was found in the vertical growth pattern in other fixed functional studies.^{4,10,11}

Overjet decreased effectively by 7.5 mm in the first case and 8.5 mm in the second case. In the first case, overjet correction was totally dentoalveolar, and the contribution of maxillary incisor retrusion was more than mandibular incisor protrusion. However, in the second case, mandibular advancement also contributed to overjet correction. Franchi *et al.*¹² and Aras *et al.*⁴ stated a 5-mm decrease in overjet with FRD.

Proclination of mandibular incisors is an undesirable effect of the functional therapies^{1,5-7} and is reported to be unstable.^{15,16} Various options to



Figure 8. Local superimposition of case 1 at T3 and T4.



Figure 9. Intraoral and extraoral photographs of case 2 at T1.

prevent mandibular incisor proclination such as negatively torqued mandibular incisor brackets^{7,12} and sectional arches⁵ for the treatment of Class II malocclusions have been evaluated by several

studies. In these present cases, prominent proclination of mandibular incisors was observed, although the lower dentition anchorage was encouraged with miniscrews, which may be due to the prolonged use of the FRD appliance. Aslan *et al.*⁶ found significantly less incisor tipping in the miniscrew-supported FRD group ($3.61^\circ \pm 5.07^\circ$) compared with the FRD group ($9.29^\circ \pm 3.81^\circ$).

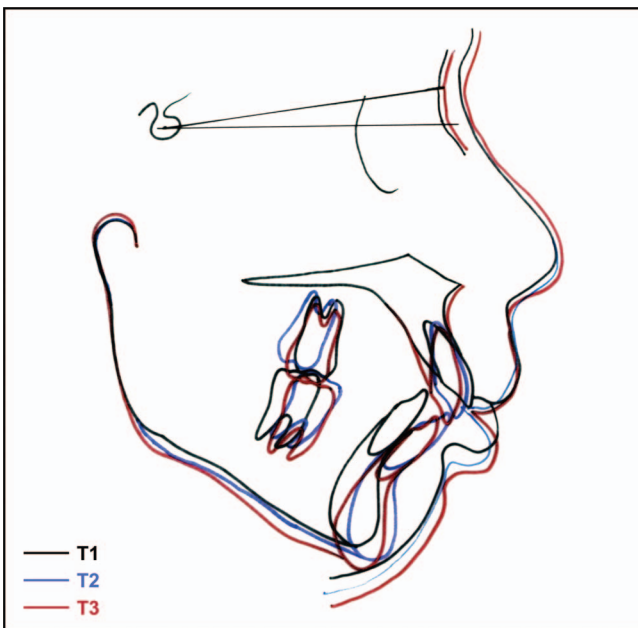


Figure 10. Total superimposition of case 2 at T1, T2, and T3.

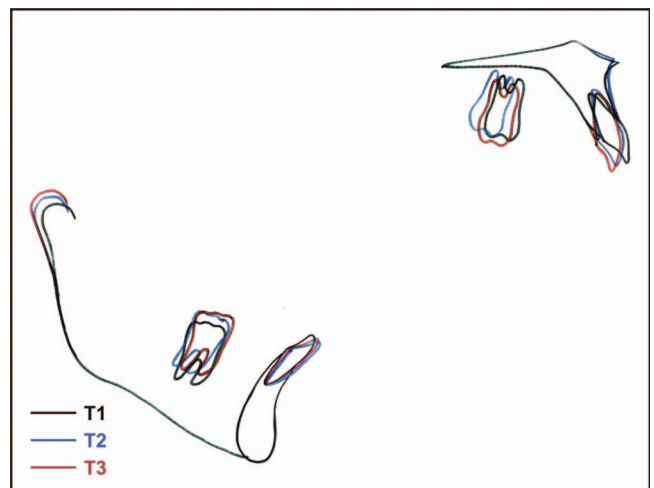


Figure 11. Local superimposition of case 2 at T1, T2, and T3.



Figure 12. Intraoral and extraoral photographs of case 2 at T3.

In these cases, FRDMS was applied without leveling, and 0.016×0.022 " stainless-steel continuous archwires were engaged passively to benefit more from the residual growth potential. Less proclination might be observed if larger-dimension archwires were used.

During the follow-up period, labial tipping of mandibular incisors retroclined strikingly in both cases, which is in concordance with Ruf and Pancherz,¹⁷ who also reported a significant relapse in the proclination of mandibular incisors during the follow-up period of the Herbst therapy.



Figure 13. Intraoral and extraoral photographs of case 2 at T4.

Table 2. Cephalometric values measured before miniscrew anchorage-supported Forsus Fatigue Resistance Device (FRDMS; T1), after FRDMS (T2), after the fixed orthodontic treatment (T3), after 1 year and 8 months follow-up period by the end of fixed orthodontic treatment (T4), and after 2 year and 8 months follow-up period by the end of fixed orthodontic treatment (T5) of case 2

	Case 2				
	T1	T2	T3	T4	T5
SN, mm	71	71	72	72	74.5
SNA, °	83	83.5	83	83	83
A-VRL, mm	70.5	71	71	71.5	74.5
FH/NA, °	90.5	91	90	90	91
SN/ANSPNS, °	9	9.2	10	9	10
SNB, °	73	75.5	74	74.5	73.5
B-VRL, mm	53.5	57.5	54.5	56	56.5
Pog-VRL, mm	52	57	54	53.5	55
Ar-Pog, mm	103	106	108	110.5	114.5
FH/NPog, °	81.5	83.5	82	82.5	83
ANB, °	10	8	9	9	9.5
N-A-Pog, °	162	166.5	164.5	165	164
N-Me, mm	120.5	123.5	126.8	128.5	133.5
ANS-Me, mm	70.5	73	75.8	77	81
S-Go, mm	74.5	80	80.5	83	88.5
SN/GoGn, °	37.5	35.5	36.2	36.2	36.2
Ar-Go-Me, °	131	132	131.5	133	134.5
ANSPNS/GoMe, °	30.5	28.2	27.2	27.2	27.2
U6-VRL, mm	37.5	33.8	34.5	36.5	38
U6-HRL, mm	60.5	58.5	62.5	65	66.5
U6/HRL, °	76	62.5	71	76	73
L6-VRL, mm	32	37.5	34.5	35.5	36.5
L6-MP, mm	29	32.5	33.5	30.5	33.5
L6/MP, °	74.5	82.8	74	78	80
U1-VRL, mm	78	74	71	71.5	74
U1-HRL, mm	73	76.2	78.8	79.5	82.5
U1/HRL, °	117.5	103.5	95	98.5	98.5
L1-VRL, mm	68.5	72.5	68.8	69.5	71.5
L1-MP, mm	44.5	43	44.5	47	47
L1/MP, °	105	114	103	107	105
Molar rel., mm	5.5	-3.7	0	1	1.2
SN/OP, °	18.5	24.7	24.5	22	25
U1/L1, °	110.5	113.5	131	125	126
OJ, mm	10	1.5	2.8	2	3
OB, mm	4	0.5	2	2	1.5
Lbsup-VRL, mm	90.5	89.5	89.5	89.2	90.5
Lbinf-VRL, mm	84.5	87.5	84	84.8	85
Pog'-VRL, mm	63	67	66	66	69
Labiomental, °	103.5	135.5	115	136.5	141

Maxillary molars distalized and mandibular molars mesialized and extruded in both of the cases because of the direction of force applied with FRD. the lower lip protruded in only case 2 as a result of mandibular forward movement. The labiomental angle increased in both cases by FRDMS treatment, consistent with other studies.^{7,11}

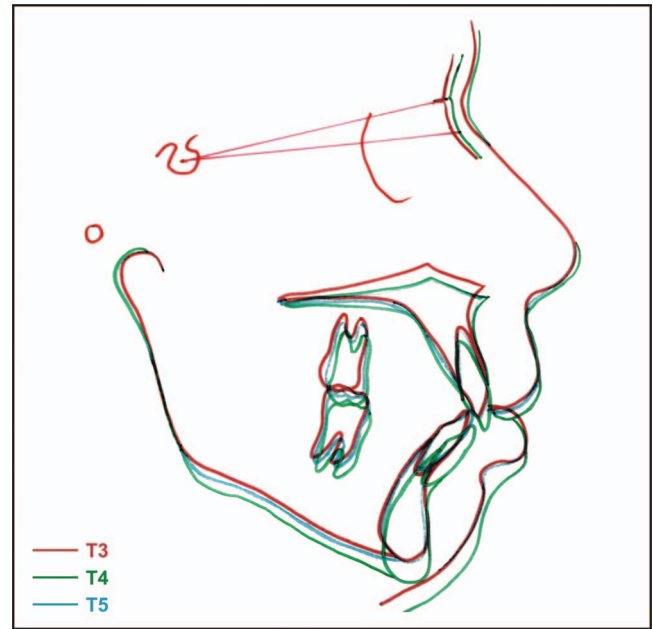


Figure 14. Total superimposition of case 2 at T3, T4, and T5.

The maxilla and mandible continued to grow in the sagittal and vertical directions, and occlusion was stable in both cases during the follow-up period. This finding is in accordance with long-term results of removable functional appliances.^{18,19}

CONCLUSIONS

- FRD used with miniscrews was effective in the treatment of severe Class II malocclusions.



Figure 15. Local superimposition of case 2 at T3, T4, and T5.



Figure 16. Intraoral and extraoral photographs of case 2 at T5.

- Mandibular incisor proclination was observed in both cases, although mandibular dentition anchorage was reinforced with miniscrews.
- Favorable sagittal movement of the mandible was achieved in only 1 case because of different individual growth patterns. Overjet and molar correction were mainly at the dentoalveolar level in the other case.
- Satisfactory occlusion was achieved at the end of fixed orthodontic treatment, which was stable in both cases in the long-term.

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