TURKISH JOURNAL of ORTHODONTICS

DOI: 10.5152/TurkJOrthod.2016.15-00021R1

CASE REPORT

Non-Extraction Treatment of Skeletal Class II Adult Patient with Total Maxillary Arch Distalization

Cenk Doruk[1], Özkan Semih Çankaya[1], İhsan Sami Güvenç[2]

[1]Department of Orthodontics, Cumhuriyet University School of Dentistry, Sivas, Turkey
[2]Orthodontist, Private Practice, Denizli, Turkey

ABSTRACT

In this case report, we present an extraction-prescribed Class II division 1 adult patient's non-extraction treatment by distalization of the total maxillary arch with miniscrews. The miniscrews were inserted into the mesial of the upper first molars roots as far as possible, and total arch distalization was started by a nitinol coil spring (200 g per side) extended from the miniscrew to a hook attached between the canine and lateral. The distalization amount was expected to be the distance between the miniscrew and the second premolar root per side. At the end of the treatment, 2 mm molar distalization with 3 degree tipping was achieved. Class II division I adult patients with moderate overjet can be treated without extraction using these mechanics.

Keywords: Miniscrew, total arch distalization, Cl II malocclusion

INTRODUCTION

The treatment alternatives for adult skeletal Class II patients are camouflage treatment and surgical correction.[1] In camouflage treatment, the premolars are extracted to solve crowding, retract the incisors, and provide Class I canine relationship. Another way of camouflage treatment is molar distalization. There have been many methods to distalize molars with intraoral or extraoral appliances, such as using a pendulum appliance, distal jet, or headgear.[2,3] Some disadvantages of these appliances are distal tipping, the need for overcorrection of the molars to the Class III position, forward movement of the maxillary premolars and incisors, anchorage loss at the reactive part, protrusion of the lower anterior teeth, rotation of the mandibular plane, and the requirement for patient cooperation.[1,4,5]

The use of orthodontic miniscrews can overcome many of these problems, regardless of whether a single tooth or the entire dental arch is being moved. With skeletal anchorage, the disadvantages are minimized, no patient cooperation is required, and the incisor positions and facial profile can be successfully controlled.[6,7]

Distal retraction of the whole dental arch using miniscrews was recently published and showed good treatment results.[6,8,9] The distalization force is usually applied to the canines or hooks attached on the archwire from miniscrews placed between the roots of the posterior teeth.

In this case report, we present an extraction-prescribed Class II division 1 adult patient's non-extraction treatment by distalization of the total maxillary arch with miniscrews.

CASE PRESENTATION

A 22-year-old female patient admitted to our clinic with complaints of protrusive teeth. Her facial form was ovoid and symmetric, with a harmonious orthognathic profile. Dentally, she had an Angle Class II malocclusion, a 5 mm overjet, and a 2 mm overbite, and arch length discrepancies were present in the maxillary and mandibular arches (-5 and -4.5 mm, respectively). All her third molars were congenitally absent. No pathology was noted on her intraoral and facial photographs (Figure 1). Her pre-treatment panoramic and lateral cephalometric radiographs are shown in Figure 2, 3.

Corresponding Author: Özkan Semih Çankaya, Department of Orthodontics, Cumhuriyet University School of Dentistry, Sivas, Turkey E-mail: semihcankaya@gmail.com

Received: 31.07.2015
Accepted: 26.10.2015

Table 1. Summary of cephalometric analysis

	Pre-treatment	Post-treatment
SNA°	79	78
SNB°	74	74
ANB°	5	4
SN-GoGn°	33	33
U1-SN°	103	105
IMPA°	101	103
vertT-U1E, mm	53	51
vertT-U1A, mm	48	45
vertT-U6C, mm	28	26
SBL-U1C, mm	92.5	91
SBL-U6C, mm	76	74
SBL-U6°	68	65
Overjet	5	2
Nasolabial Angle	106	115
UL to E-line, mm	-2	-3
LL to E-line, mm	3	2.5

E: Incisal edge of the most prominent maxillary central incisor; A: Root apex of the most prominent maxillary central incisor; C: centroid point of the molar and incisor crown

Figure 1. a-h. Pre-treatment facial and intraoral photographs

Pre-treatment cephalometric analysis showed the following: SNA, 79°; SNB, 74°; ANB, 5°; U1-SN, 103°; nasolabial angle, 106°; VertT-U6C, 28 mm; overjet, 5 mm; and SN-GoGn, 33° (Table 1).

Treatment Objectives

The primary treatment objectives for this patient were to achieve a Class I canine/molar relationship bilaterally, relieve crowding, correct interincisal relationship, establish good functional occlusion, and plan an appropriate retention protocol.

Figure 2. Pre-treatment panoramic radiograph

Figure 3. Pre-treatment lateral cephalometric radiograph

Treatment Alternatives

The treatment plan involved a non-extraction treatment protocol. Another option would have been to extract all her first premolars but the patient refused this option.

Treatment Progress

The patient underwent orthodontic treatment with a 0.022-inch slot Damon Q bracket system (Ormco, Glendora, California, USA). Following the leveling process, 0.017 x 0.025 stainless steel archwire was placed to the upper arch and hooks attached between the lateral and canines. In the same appointment, miniscrews were inserted into the mesial of the upper first molars roots as far as possible (1.6 mm diameter and 10 mm length; Jeil Medical Corporation, Seoul, Korea). At this stage, all the arch distal-

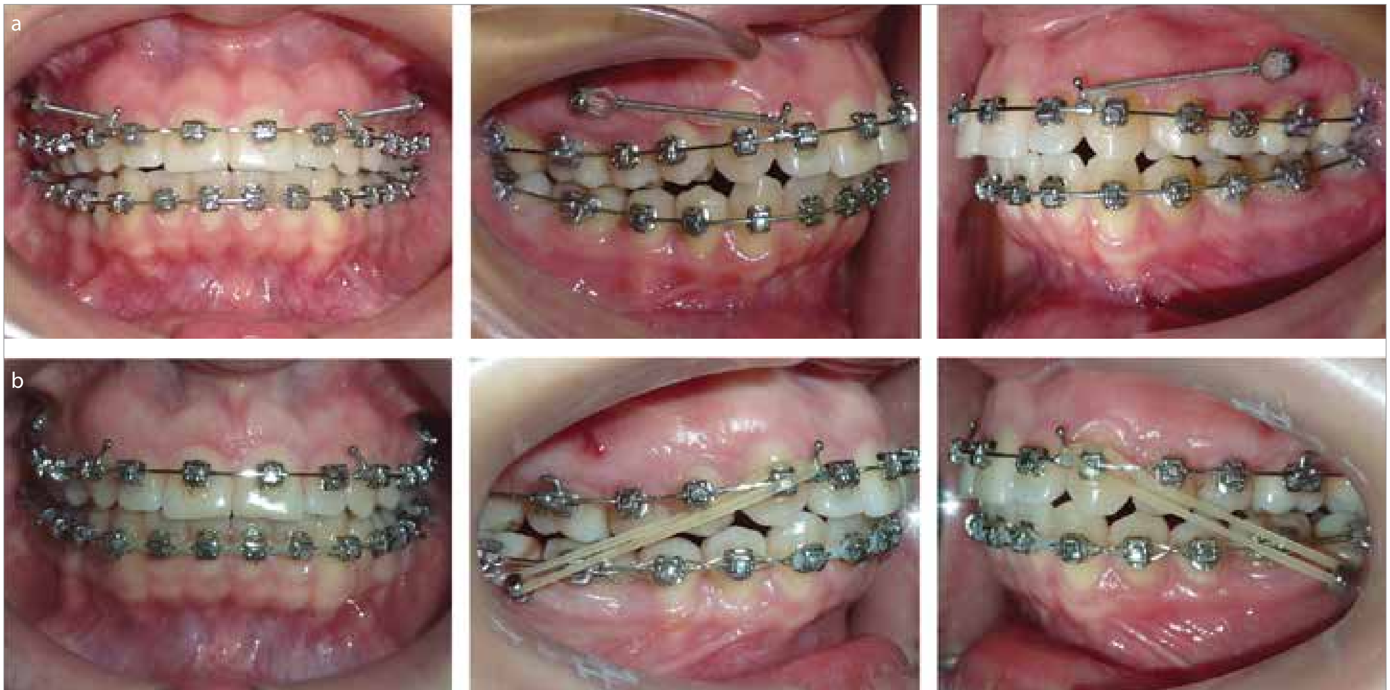

Figure 4. a, b. Miniscrews were inserted into the mesial of the upper first molars roots as far as possible (a). Miniscrews were moved to mesial of the lower first molar and Class II elastics was initiated (b)

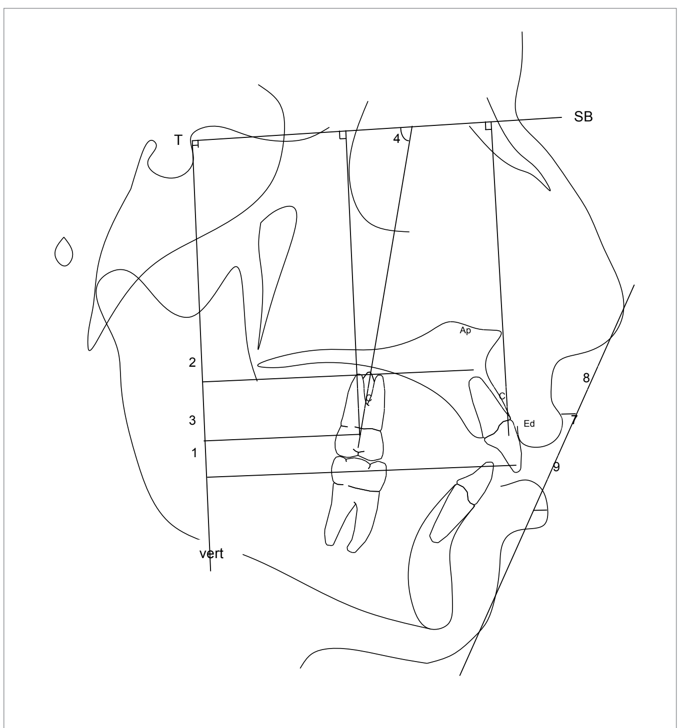

Figure 5. Cephalometric landmarks, and angular and linear measurements

ization was started by using a nitinol coil spring (200 g per side) extended from the miniscrew to the hook, and the distalization amount was expected to be the distance between the miniscrew and the second premolar root (Figure 4a). After eliminating a portion of the total overjet with this set of mechanics in 6 months, the miniscrews were moved to the mesial of the lower first molar and Class II elastics was initiated. Also, an accentuated curve of Spee was performed to the upper archwire (Figure 4b). Thus, the overbite was increased and the remaining overjet was optimized in 3 months. After the debonding process, Essix retainers were placed in both the mandible and maxilla to maintain the orthodontic correction.

Cephalometric Analysis

The cephalometric analysis was based on a reference system consisting of two perpendicular lines traced through stable basicranical structures.[10]

Stable basicranial line (SBL): A line through the most superior point of the anterior wall of the sellaturcica at the junction with the tuberculum sellae (Point T) and the fronto-maxillo-nasal suture was identified as the most anterior point of the lamina cribrosa of the ethmoidal bone. The SBL was traced through a structure that did not undergo remodeling from the age of 4 or 5 years[11] and was relatively easy to identify on lateral cephalograms.

Vertical T (VertT): A line perpendicular to the SBL and passing through Point T.

A cephalometric analysis based on this reference system comprised the following measurements (Figure 5):

- Angular measurements for assessment of the skeletal sagittal relationship: SNA, SNB, and ANB.
- Linear measurements for assessment of the dental sagittal relationships: VertT-U1Ed, VertT-U1Ap, and VertT-U6C (Ed: Incisal edge of the most prominent maxillary central incisor. Ap: Root apex of the most prominent maxillary central incisor. C: centroid point of the molar and incisor crown).
- Linear measurements for assessment of the dental vertical relationships: SBL-U1C and SBL-U6C (C: centroid point of the molar and incisor crown).
- Angular measurements for assessment of the dental angulations: U1-SN, IMPA, and SBL-U6.

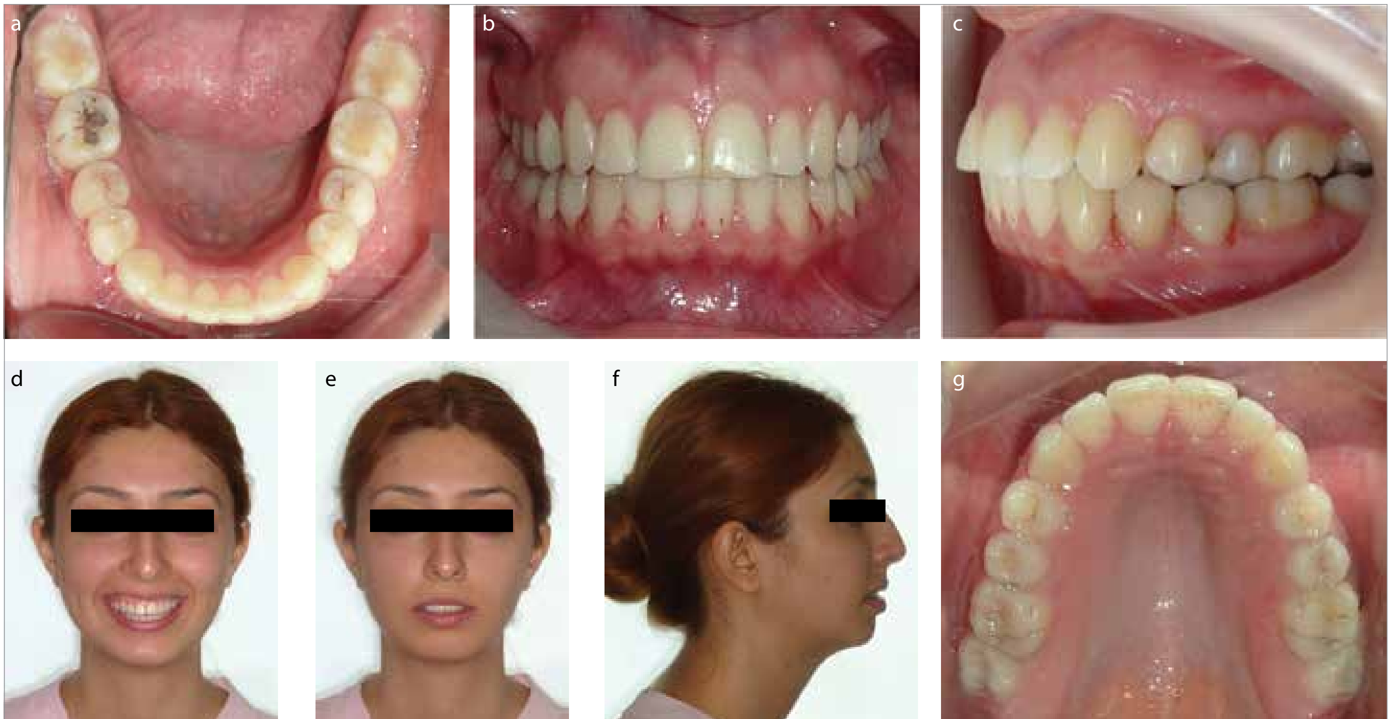

Figure 6. a-g. Post-treatment facial and intraoral photographs

Figure 7. Post-treatment panoramic radiograph

- Angular measurements for assessment of the skeletal vertical relationships: SN-GoGn.
- Angular measurements for assessment of soft tissue: Nasolabial Angle.
- Linear measurements for assessment of soft tissue: UL-E-line and LL-E-line.

RESULTS

The active treatment period was 18 months. At the end of the treatment; Cl I molar and canine relationships with ideal overjet and overbite and a more esthetic facial profile were achieved (Figure 6). The post-treatment panoramic and lateral cephalometric radiographs are shown in Figure 7, 8. Post-treatment cephalometric analysis showed results of: SNA, 78°; SNB, 74°; ANB, 4°; U1-SN, 105°; nasolabial angle, 115°; VertT-U6C, 26 mm; overjet, 2 mm; and SN-GoGn, 33°. The maxillary molar and incisors were distalized 2 mm and intruded 2 mm and 1.5 mm, respectively. The maxillary

Figure 8. Post-treatment lateral cephalometric radiograph

molar angulations were decreased 3°. The upper and lower lips were moved back very little (Table 1). The vertical dimension was not changed in spite of the significant maxillary molar distalization, as seen in the superimposition (Figure 9). After a 1-year re-

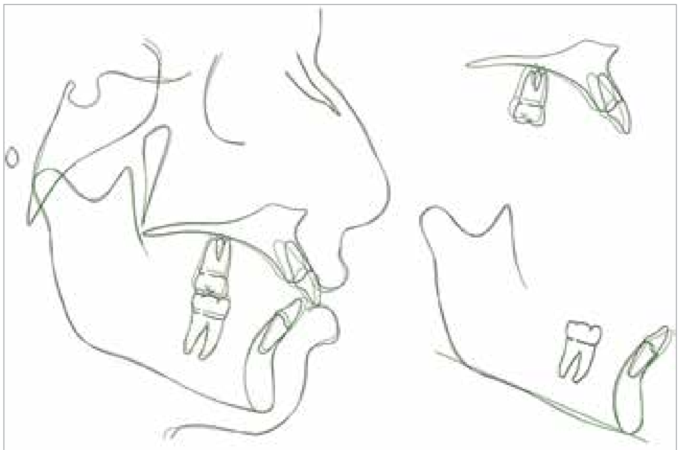

Figure 9. Cephalometric superimposition
Black, pre-treatment; green, post-treatment

tention period, the occlusal relationship was stable, and there was no relapse (Figure 10).

DISCUSSION

In the literature, there are many publications about the relationship between anterior tooth movement and the position of point A.[12,13] Chen et al.[14] reported that point A moved 1.24 mm backward, while the apex of the maxillary incisors moved 2.95 mm backward. Also Cangialosi and Meistrell[13] reported that a 3.5 mm posterior movement of the apex resulted in a 1.7 mm posterior movement of point A. Coincident with these reports, in our case, the SNA angle decreased 1° while the upper incisor root apex moved 3 mm backward (Table 1).

The upper and lower lips relative to the E-line moved distally after distal retraction by 1 and 0.5 mm, respectively. Also, the nazolabial angle was increased from 106° to 115° (Table 1). The initial arch length discrepancies of -5 mm in the maxilla and -4.5 mm in the mandible were resolved. This means that the posterior teeth were distalized sufficiently to resolve crowding as well as to obtain a better profile after distal movement of the anterior teeth.

Oh et al.[15] reported that the force from the microimplants to the canine brackets is backward and in an apical direction. With these forces, the teeth might experience distal movement and intrusion. When distal force is applied to the canines, they might tip distally, and this exerts an intrusion force on the posterior teeth by a thick stainless steel archwire. They found that the maxillar and mandibular second molars were intruded by 1.12 and 1.07 mm, respectively. In our case, we applied the force to a hook instead of the canine brackets and 2 mm molar and 1.5 mm incisor intrusions were obtained. This result suggests that, although the full dentition of the maxilla was distalized, the intrusion of the posterior teeth prevented the wedging effect and SN-GoGn angle remained stable (Table 1). Park et al.[16] reported that the intrusive movement in these mechanics does not decrease or increase the vertical dimension but rather maintains the vertical dimension. This would result in better retention.

Park et al.[6] reported that during distalization of the total maxillary dentition, the contact of the teeth on the crown acted as a resistance to movement, which created a counterclockwise moment on the anterior teeth. As a result, the crown of the upper anterior teeth showed distal movement, whereas the roots showed more distal movement. Coincident with this, in our case, the U1-SN angle was increased 2° although incisor retraction was obtained (Table 1).

With their distal jet appliance, Ghosh and Nanda[17] showed distal tipping of the maxillary first and second molars of 8.36° and 11.99°, respectively, during distalization. It was stated that the molar key could be corrected by a tipping movement of the molar, but the retention would be doubtful during distal retraction of the incisors. The molar distalizing appliances anchored by screws also showed distal tipping of the distalized maxillary first molars by 8.8°[18] and 10.9°[19]. In our case, the maxillary first molar tipped distally by 3°; this was very small compared to previous reports.[16,17] This might be explained by the fact that we used a rigid main archwire, so tipping of the teeth might have been prevented. Because of the distalizing of the posterior teeth with bodily movement, the treatment results remained stable even after one year post-treatment (Figure 10).

Oh et al.[15] and Park et al.[16] reported that the maxillary posterior teeth were distalized by 1.51±1.59 mm with approximately 3.5° of distal tipping and 1.64±1.22 mm distalization with 0.31±4.13° distal tipping, respectively. Coincident with this, in our case, the distal movement of the maxillary first molars was 2 mm (Table 1). This was less movement than shown with other molar distalizing appliances in which the maxillary first molars moved distally by 3.8 mm[16] and 3.9 mm.[17] However, because less distal tipping was obtained and the measurements were made on the centroid point of the molar crown, not on the cusp tip of the crown as in the previous studies[16,17], the amount of real distalization might be similar. The third molars were absent in our case. On the other hand, in the presence of them, to enhance distal movement of the dentition, the third molars could be extracted just before applying the distal force. Also alveolar surgery could accelerate the rate of tooth movement.[20] In this case, the limiting factor for upper arch distalization was the protrusive lower incisors, although interproximal stripping was performed. They could be retracted by the same mechanics[21], but the patient refused that because the treatment time would have been prolonged.

Ngantung et al.[22] reported that the mean treatment time was 25.7±3.9 months to complete treatment with the distal jet appliance with fixed appliance therapy. Chiu et al.[23] reported that the treatment time for the distal jet appliance was 28 months, consisting of 10 months for distalization of the molars and 18 months for the second phase of fixed appliance treatment. The treatment time for the pendulum appliance was 31 months, consisting of 7 months for distalization of the molars and another 24 months for fixed appliance therapy. In the present case, the total treatment time was 18 months. It was much shorter than the other intraoral distalizing methods[22,23]. This might be because, conventional methods follow a step-by-step treatment consisting of molar distalization and incisor retraction. However, with

Figure 10. a-e. Retention intraoral photographs at 12 months

miniscrew sliding mechanics, total maxillary or mandibulary dentition can be distalized at the same time.

The interradicular space between molars may limit the amount of en masse retraction. Recent computed tomography imaging studies showed that[24,25] the average amount of mesiodistal bone between the first molar and second premolar is 3.3 mm. Thus, if we consider that a 1.6 diameter miniscrew is used in this case, the potential extent of molar distalization is minimal, even if tipping and occlusal plane rotation contribute to the need for additional distalization of the upper dentition.[26] Therefore, a thinner miniscrew could be used in this case. To gain additional space for distal movement, we angulated the miniscrews 30-40° superiorly to the perpendicular of a plane tangent to the buccal cortical bone.[27] Paik et al.[21] reported that about 3 mm of upper-first-molar distalization can be expected. Bechtold et al.[28] reported that interradicular miniscrews for the correction of a full cusp Class II relationship will inevitably need to be removed and reinserted during treatment,[29,30] which could be cumbersome for both the operator and patient. Hence, this technique could well be indicated for the correction of end-to-end Class II, rather than full cusp Class II. It has been shown that the damage to the root surface by the titanium miniscrew during tooth movement is reversible.[31] Therefore, distalization using interradicular miniscrews, once placed in appropriate positions, may be regarded as relatively safe.

CONCLUSION

At the end of the treatment, 2 mm molar distalization with 3° tipping was obtained. Class II division I adult patients with moderate overjet can be treated without extraction by using these mechanics. In the presence of third molars, to enhance distal movement of the dentition, they can be extracted just before applying the distal force.

REFERENCES

1. Proffit WR, Jr. HWF, Sarver DM. Contemporary orthodontics. Elsevier Health Sciences; 2014.
2. Ciger S, Aksu M, Germeç D. Evaluation of posttreatment changes in Class II Division 1 patients after nonextraction orthodontic treatment: Cephalometric and model analysis. Am J Orthod Dentofac Orthop 2005; 127: 219-23. [CrossRef]
3. Carano A, Testa M. The distal jet for upper molar distalization. J Clin Orthod 1996; 30: 374-80.
4. Byloff FK, Darendeliler MA. Distal molar movement using the pendulum appliance. Part 1: Clinical and radiological evaluation. Angle Orthod 1997; 67: 249-60.
5. Graber LW, Jr. RLV, Vig KWL. Orthodontics: Current Principles and Techniques. Elsevier Health Sciences; 2000.
6. Park HS, Kwon TG, Sung JH. Nonextraction treatment with microscrew implants. Angle Orthod 2004; 74: 539-49.
7. Lee KJ, Park YC, Hwang WS, Seong EH. Uprighting mandibular second molars with direct miniscrew anchorage. J Clin Orthod 2007; 41: 627-35.
8. Park HS, Bae SM, Kyung HM, Sung JH. Micro-implant anchorage for treatment of skeletal Class I bialveolar protrusion. J Clin Orthod 2001; 35: 417-22.
9. Jung MH. A comparison of second premolar extraction and mini-implant total arch distalization with interproximal stripping. Angle Orthod 2013; 83: 680-5. [CrossRef]
10. Franchi L, Baccetti T, McNamara JA. Treatment and posttreatment effects of acrylic splint Herbst appliance therapy. Am J Orthod Dentofacial Orthop 1999; 115: 429-38. [CrossRef]
11. Viazis AD. The cranial base triangle. J Clin Orthod 1991; 25: 565-70.
12. Cleall JF, BeGole EA. Diagnosis and treatment of class II division 2 malocclusion. Angle Orthod 1982; 52: 38-60.
13. Cangialosi TJ, Meistrell ME. A cephalometric evaluation of hard- and soft-tissue changes during the third stage of Begg treatment. Am J Orthod 1982; 81: 124-9. [CrossRef]
14. Chen Q, Zhang C, Zhou Y. The effects of incisor inclination changes on the position of point A in Class II division 2 malocclusion using three-dimensional evaluation: a long-term prospective study. Int J Clin Exp Med 2014; 7: 3454-60.

15. Oh YH, Park HS, Kwon TG. Treatment effects of microimplant-aided sliding mechanics on distal retraction of posterior teeth. Am J Orthod Dentofac Orthop 2011; 139: 470-81. [CrossRef]
16. Park HS, Lee SK, Kwon OW. Group distal movement of teeth using microscrew implant anchorage. Angle Orthod 2005; 75: 602-9.
17. Ghosh J, Nanda RS. Evaluation of an Intraoral Maxillary Molar Distalization Technique Vol 110. 1996.
18. Gelgör IE, Büyükyilmaz T, Karaman AIÝ, Dolanmaz D, Kalayci A. Intraosseous screw-supported upper molar distalization. Angle Orthod 2004; 74: 838-50.
19. Kircelli BH, Pektaş ZO, Kircelli C. Maxillary molar distalization with a bone-anchored pendulum appliance. Angle Orthod 2006; 76: 650-9.
20. Ren A, Lv T, Kang N, Zhao B, Chen Y, Bai D. Rapid orthodontic tooth movement aided by alveolar surgery in beagles. Am J Orthod Dentofacial Orthop 2007; 131: 160.e1-10. [CrossRef]
21. Paik CH, Seo YJ, Baek SH. A minimally invasive modality for simultaneous bimaxillary en masse retraction. J Clin Orthod 2012; 46: 92-101.
22. Ngantung V, Nanda RS, Bowman SJ. Posttreatment evaluation of the distal jet appliance. Am J Orthod Dentofac Orthop 2001; 120: 178-85. [CrossRef]
23. Chiu PP, McNamara JA, Franchi L. A comparison of two intraoral molar distalization appliances: Distal jet versus pendulum. Am J Orthod Dentofac Orthop 2005; 128: 353-65. [CrossRef]
24. Poggio PM, Incorvati C, Velo S, Carano A. "Safe zones": a guide for miniscrew positioning in the maxillary and mandibular arch. Angle Orthod 2006; 76: 191-7.
25. Park J, Cho HJ. Three-dimensional evaluation of interradicular spaces and cortical bone thickness for the placement and initial stability of microimplants in adults. Am J Orthod Dentofacial Orthop 2009; 136: 314-5. [CrossRef]
26. TW K. Clinical Application of Orthodontic Mini-Implants. In: Clinical Application of Orthodontic Mini-Implants 2008: 275-327.
27. Park HS, Bae SM, Kyung HM, Sung JH. Simultaneous incisor retraction and distal molar movement with microimplant anchorage. World J Orthod 2004; 5: 164-71.
28. Bechtold TE, Kim JW, Choi TH, Park YC, Lee KJ. Distalization pattern of the maxillary arch depending on the number of orthodontic miniscrews. Angle Orthod 2013; 83: 266-73. [CrossRef]
29. Chung KR, Choo H, Kim SH, Ngan P. Timely relocation of mini-implants for uninterrupted full-arch distalization. Am J Orthod Dentofacial Orthop 2010; 138: 839-49. [CrossRef]
30. Choi YJ, Lee JS, Cha JY, Park YC. Total distalization of the maxillary arch in a patient with skeletal Class II malocclusion. Am J Orthod Dentofac Orthop 2011; 139: 823-33. [CrossRef]
31. Asscherickx K, Vande VB, Wehrbein H, Sabzevar MM. Root repair after injury from mini-screw. Clin Oral Implants Res 2005; 16: 575-8. [CrossRef]