Case Report

Use of Zygomatic Anchors during Rapid Canine Distalization:
A Preliminary Case Report

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Abstract: Rapid canine distalization is a technique involving periodontal ligament distraction. The primary aim of this technique is to distalize the canines without anchorage loss and to shorten the duration of orthodontic treatment. After the rapid canine distalization, the healing process of the periodontal ligament is similar to rapid palatal expansion and requires a consolidation period. The long consolidation period of the technique conflicts with the second aim. Skeletal anchorage systems seem to compensate for this conflict because they can be also used for retraction of incisors during consolidation period. This case report presents the orthodontic treatment of a 16-year-old female, who had a bimaxillary retrusion and a dental Class II division I malocclusion. Upper first premolars were extracted and, while the canines were being distalized rapidly by periodontal ligament distraction, the incisors were retracted using a zygomatic anchorage system. The treatment of the patient was completed in five months without any anchorage loss. (Angle Orthod 2006;76:137-147.)

Key Words: Zygoma anchors; Rapid canine distalization; Periodontal distraction; Anchorage

INTRODUCTION

Orthodontic treatment sometimes requires the extraction of two or four premolars and requires time. Anchorage is critical in the treatment plan of premolar extraction cases. In conventional canine distalization and incisor retraction, headgear use is inevitable if serious anchorage control is needed. However, extraoral appliances negatively affect patient cooperation and usually are rejected by adults. To both reduce the treatment period and to provide maximum anchorage without patient compliance, new techniques such as rapid canine distalization by periodontal distraction

| TABLE 1. Cephalometric Measurements of the Case at Pretreatment, Posttreatment, and One-year Follow-up Stages |
|-----------------|-------|-------|-------|
|                | T1    | T2    | T3    |
| SNA            | 75    | 75    | 75    |
| SNB            | 71    | 70    | 70    |
| ANB            | 4     | 5     | 5     |
| NV-A           | 3     | 3     | 2     |
| NV-Pg          | 11    | 11    | 11    |
| S-N            | 74    | 74    | 73    |
| S              | 135   | 135   | 135   |
| Ar             | 138   | 143   | 144   |
| Go             | 129   | 127   | 127   |
| Ar-Go          | 50    | 53    | 51    |
| Go-Gn          | 80    | 80    | 80    |
| Y Axis         | 65    | 63    | 64    |
| SN/ANS-PNS     | 10    | 9     | 9     |
| SN/Occ.        | 21    | 21    | 22    |
| SN/Go-Gn       | 41    | 41    | 43    |
| ANS-PNS/Go-Gn  | 30    | 30    | 34    |
| Co-A           | 90    | 91    | 90    |
| Co-Gn          | 121   | 121   | 123   |
| N-Me           | 136   | 136   | 137   |
| N-ANS          | 60    | 57    | 57    |
| ANS/Me         | 79    | 80    | 82    |
| N-ANS/ANS-Me   | 61.2/74.8 | 61.2/74.8 | 61.65/75.35 |
| S-Go           | 85    | 85    | 84    |
| S-Go/N-Me      | 62%   | 62%   | 61%   |
| 1/SN           | 108   | 91    | 98    |
| 1/Go-Gn        | 93    | 98    | 98    |
| 1/1            | 121   | 129   | 124   |
| 1/NA           | 10    | 3     | 3     |
| 1/NA           | 33    | 17    | 20    |
| 1/1-NB         | 8     | 8     | 8     |
| 1/NB           | 23    | 33    | 32    |
| Pg-NB          | 4     | 4     | 4     |
| Holdaway       | 2     | 4     | 4     |
| E-Line         | −2/+2 | −5/-1 | −3/-4 |
| Overjet        | 10    | 3     | 4     |
| Overbite       | 0     | 2     | 2     |

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and skeletal anchorage systems have been developed.

Distraction osteogenesis may be defined as the gradual mechanical traction of bone segments at an osteotomy site to generate new bone. It was first described by Codvilla in 1905, but the rules of the technique were defined by Illizarov. Distraction osteogenesis has been applied to the craniofacial complex recently. The greatest application in the craniofacial skeleton has been mandibular lengthening, and midfacial advancement is a newer application.

Liou and Huang applied distraction osteogenesis
Anchorage control is fundamental to orthodontic treatment. External force systems or intraoral appliances may be used to increase the anchorage of posterior teeth, and a decision should be made according to the requirements of the patient. Unfortunately, conventional intraoral appliances are unable to provide maximum anchorage, and extraoral appliances are usually rejected by adult patients for social reasons. In addition, mesial movement of molar teeth may be observed even if the patient wears the headgear for 14 hours. These handicaps forced the development of new anchorage systems. Osseointegrated (rigid) dental implants, surgical screws, miniplates, and microimplants are popular techniques that have recently been used to enhance orthodontic anchorage. Numerous clinical14±21 and animal studies have revealed the potential of these systems to provide anchorage for orthodontic forces.22±24

Clerck et al25 developed the Zygoma Anchorage System (ZAS), which is composed of a slightly curved titanium miniplate with three holes. The curve makes it easy to fit against the bone. The miniplate is connected to the fixation unit with a round 1.5-mm bar. The fixation unit is a cylinder that consists of a vertical 0.032 † 0.032-inch slot. There is a locking screw in this vertical slot that is used to fix the wire in the slot.

In this report, treatment of an adult patient who had excessive overjet is presented. Upper first premolars were extracted, and rapid canine distalization was performed by periodontal ligament distraction. During canine distalization period, zygomatic anchorage system was applied, and the incisors were leveled and retracted by immediate loading. Orthodontic treatment was completed in five months through the combined use of
rapid canine distalization and ZAS. To our knowledge, this kind of combined treatment procedure has not been reported previously in the dental literature. This is a preliminary report of an investigation that is planned, involving numerous patients to reduce the duration of the orthodontic treatment while providing maximum anchorage control.

CASE PRESENTATION

Diagnosis

A 16-year-old, female who had a Class II division I malocclusion was referred to the Department of Orthodontics for treatment. Her chief complaint was the malalignment of the upper anterior teeth. Intraoral examination revealed a bilateral Class II canine and molar relationship, excessive overjet, a tendency to open bite, and a mild malalignment, especially in upper right lateral incisor and canine region. It was also observed that the maxillary dental arch was deviated to the left side, creating a midline shift (Figure 1). The extraoral examination revealed a convex profile with a slightly prominent chin, indistinct subnasal sulcus, and a symmetrical face (Figures 2 and 3).

Cephalometric analysis indicated an SNA of 75° and an SNB of 71°. Point A and point B were three and 11 mm behind the NV line (Nasion-Frankfort Horizontal), supporting the bimaxillary retrusion diagnosis. However, an ANB angle of 4° revealed a nearly skeletal Class I relationship between the maxilla and mandible. It was also determined that the length of the effective mandible (Co-Gn = 121 mm) was long according to the effective maxilla (Co-A = 90 mm), and the corpus length (Go-Gn) was 80 mm, whereas the SN plane was 74 mm. The saddle angle was 135° and showed a posterior positioning of the condyle.

Cephalometric evaluation revealed posterior rotation of the palatal plane, occlusal plane, and mandibular plane. The anterior (N-Me) and posterior (S-Go) facial heights ratio was 62% revealing that the patient had a normal skeletal pattern. When dental measurements were evaluated, protrusion of maxillary incisors was determined. The axial inclination of the lower incisors was normal. Overjet and overbite were measured as 10 and zero mm, respectively (Table 1).

Treatment objective

The clinical, radiographic, and study model examination revealed that the patient had a skeletal Class I and dental Class II division I malocclusion. Because the patient was an adult, camouflage treatment was planned with extraction of the upper first premolars to eliminate the overjet and correct the midline shift. The molar relationship was Class II before treatment, so maximum anchorage was required for protection. Because the patient did not agree to the use of a headgear, surgical procedures would inevitably be neces-
necessary to provide maximum anchorage. However, to reduce the treatment period, rapid canine distalization through distraction of the periodontal ligament was planned, and tooth-borne intraoral distraction devices were constructed.

**Distraction device**

The device consisted of three sections modified from a conventional Hyrax screw. The anterior section included a retention arm (with a rectangular tip) for the canine tube and two nongrooved slots for the sliding rod and screw. The posterior section consisted of a round sliding rod (1.5 mm), a retention arm (with a rectangular tip) for the first molar tube, and a grooved screw socket. The third section was the screw (2.5 mm), produced in a military establishment (Figure 4). A 360° activation of the screw caused one mm of distal movement in the canine tooth. Details about the construction of the distractor have been described by Sayin et al.\textsuperscript{12}

**Surgical procedure for periodontal distraction**

After the first premolar extraction, a vertical osteotomy was performed in the buccal and lingual interseptal bone between the canine and first premolar teeth. The two vertical osteotomies were connected with an oblique osteotomy extending toward the base of the interseptal bone to weaken the resistance. Osteotomies were performed inside the socket. Details and illustrations about the surgical procedure were presented by Sayin et al.\textsuperscript{12}

**Distraction protocol**

The distractor was activated 90°, three times a day with eight-hour intervals. Activation was begun just after the extractions and surgical procedures. The canine teeth were distracted into their desired position within three weeks, and a Class I canine relationship was attained. The distractor is presented in Figure 5. The patient was closely monitored by periapical radiographs taken weekly during the distraction period, and no apical root resorption was observed on apex of canines (Figure 6).

**Surgical procedure for the placement of zygoma anchor**

Zygoma anchors (Surgi-Tec, Bruges, Belgium) were implanted under local anesthesia after the distractors were cemented and brackets were attached on the incisors. A mucoperiosteal flap was elevated after an L-shaped incision, consisting of a vertical incision at the mesial of the inferior crest of zygomaticomaxillary buttress, was performed. The upper part of the zygoma...
FIGURE 8. Retraction of incisors.


FIGURE 11. (A–C) Final cast models.
FIGURE 12. (A,B) Panoramic radiographs before and after treatment.

FIGURE 13. (A–C) Cephalometric radiographs before treatment, after treatment, and one-year follow-up.

FIGURE 14. Cephalometric superimposition on the cranial base before (A) and after (B) treatment.
anchor was adjusted to fit the curvature of the bone crest, and three holes were drilled at the appropriate points. The appliance was fixed to the bone by mini-screws. The cylindrical fixation unit of the zygoma anchor was exposed to the oral cavity between the roots of molar and second premolar teeth at a 90° angle to the alveolar bone. The wounds were closed with 3.0 suture material (Polyglactin 910, Ethicon, Johnson-Johnson, Brussels, Belgium), and one week later the sutures were taken. The surgical procedure is shown in Figure 7.

Incisor retraction

Immediately after implantation of the anchors, a 0.016-inch archwire was bent to level and retract the incisors and was attached in the brackets and anchors. At the end of the three-week distraction period, the distractors and the archwire were extracted. A hook was constructed from a 0.9-inch laboratory wire and fixed to the vertical slot of the anchor by a locking screw. A 0.016 × 0.016-inch stainless steel archwire, consisting of a crimpable hook at the mesial of the lateral incisor, was inserted in the brackets. Intraoral Class I elastics were attached between the hooks on the anchors and the crimpable hook (Figure 8). The patient was instructed in how to apply the elastics, and she was advised to use them at all times except when eating.

The incisors were retracted efficiently in an average of three weeks, and the ZAS were removed under local anesthesia. At the last stage of the treatment, intermaxillary elastics were used to correct the midline and 0.016 × 0.022-inch and 0.017 × 0.025-inch blue Elgiloy finishing archwires were inserted. The patient wore a Hawley retainer for one year after fixed appliances were removed (Figures 9 and 10).

Cephalometric superimpositions

The analyses of linear and angular changes were done by superimposing on the cranial base, maxilla and mandible.

Evaluation of pre- and posttreatment cephalograms (T₀-T₁) revealed that the 10-mm overjet was reduced to three mm, whereas an overbite of zero mm was
increased to two mm. Dental norms revealed that the upper incisor teeth were retruded and the lower incisors were protruded during the treatment. Because of these alterations, the angle between the axial inclinations of the upper and lower incisors increased from 121° to 129°. The superimpositions revealed that the upper molars did not move to the mesial, whereas the lower molars showed mesial drifting and distal tipping because of the intermaxillary elastics used to correct the midline.

The superimposition of the cephalometric radiographs, taken at the end of the treatment and one year later (T₁-T₂), revealed a slight protrusion of the upper incisors. However, the lower incisors were more stable at the one-year follow-up (Table 1).

**DISCUSSION**

Adults often reject orthodontic treatment for social reasons and the prolonged treatment period. Orthodontic treatment alternatives are limited in adults because they do not have a potential of skeletal development. Anchorage control is another difficulty, especially when maximum anchorage is required. To minimize the orthodontic treatment period and to prevent the anchorage loss, new techniques have been developed. In this case, rapid canine distalization by periodontal distraction and ZAS were used.

The philosophy of canine distraction can be summarized as rapid distalization of the canines through the extraction socket. Canine distalization ends in three weeks, whereas the posterior teeth are still in a lag period. The lag period provides the anchorage control of posterior teeth in this technique. However, rapid canine distalization has a disadvantage. The healing process is like those in the midpalatal suture after RPE, so the consolidation period should be a minimum of two months for reorganization of the new bone mesial to the canine tooth. Additional anchorage units such as a headgear while the incisors were being retracted or an extension of the consolidation period is required. Both of these choices, however, conflicted with our aim to reduce the treatment period and to provide maximum anchorage without using extraoral force. In addition, the chance of obtaining rapid incisor retraction through the new bone tissue formed distal to the lateral incisors would be lost if the consolidation period was prolonged to two months. Another disadvantage of the prolonged consolidation period was the risk of secondary bone resorption that would occur in the same region during incisor retraction.

In recent years, skeletal implant systems, like miniscrews, microimplants, or miniplates have been used for various purposes. Microimplant or miniscrews are small enough to be placed in the interseptal alveolar bone. They are directly implanted through the gingiva without elevating a mucoperiosteal flap and can be immediately loaded after the insertion. The only disadvantage appears to be the risk of damaging the roots of the teeth adjacent to the screws, while implanting the appliance.

Clerck et al developed a ZAS to avoid this disadvantage. In this study, the ZAS was preferred for incisor retraction. Because of the excellent mechanical retention, immediate loading is possible after the application of the system. ZAS is performed to the inferior border of the zygomaticomaxillary buttress, between the first and second molars, so it does not have any risk of damaging the roots of the teeth.

When ZAS is placed to enhance anchorage, two methods can be used. After the posterior teeth are ligated to each other, the ligature wire may be fixed to the cylinder of the ZAS so that posterior block does not drift to the mesial during canine distalization or incisor retraction. The second method is to attach the intraoral elastic or open coil directly from the ZAS to the teeth that are to be retracted.

Posterior teeth are not used as the anchorage unit,
so they do not move. Distal movement of the posterior block may be observed because of the distal force applied through the archwire and periodontal ligament. In the presented case, the second choice was preferred and, during the retraction of the incisor teeth, we applied the force between the hook fixed to the vertical slot of the anchor and the archwire. The aim of the hook was to situate the power arm at the level of incisors’ center of resistance and to control the force vector. The appliances were accepted by the patient in a short time. She did not feel any pain after the periodontal distraction surgical procedure. We did observe edema and pain after the surgery of the ZAS, so an oral antibiotic, analgesic, and mouth rinse were prescribed for daily use during the next five days. No inflammation was observed around the implants during the treatment, and the treatment period was not an uncomfortable experience for the patient.

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CONCLUSIONS

• Rapid canine distalization and zygoma anchors are two new orthodontic approaches that can be used together.
• Combined use of these techniques shortens orthodontic treatment period and provides absolute anchorage for canine distalization and incisor retraction without patient compliance.
• Early intraoral improvement motivated the patient and increased cooperation.
• Combined use of these two new concepts seems promising for the reduction of orthodontic treatment time.

REFERENCES