Case Report

Transpalatal Distraction in a Patient with a Narrow Maxilla

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ABSTRACT

An adult male patient who presented with an anterior open bite and a narrow maxilla was treated using a transpalatal distractor (TPD). Transpalatal distraction is a technique for orthopedic maxillary expansion, in which distraction osteogenesis is used. In this technique, the angulation and location of the TPD are critical because they may affect the ratio of skeletal/dental expansion. Any incorrect placement of a TPD may also damage the surrounding blood vessels and premolar roots. This case report introduces a new and easy method for the accurate placement of a TPD using the TPD transporter in an adult patient.

KEY WORDS: Transpalatal distractor; Rapid maxillary expansion

INTRODUCTION

Maxillary constriction can be corrected by several types of techniques including slow orthodontic expansion (SOE), rapid maxillary expansion (RME), surgically assisted rapid maxillary expansion (SA-RME), or a two- or three-segmented Le Fort I–type osteotomy with expansion.[1] SOE and RME are considered successful methods for widening of the maxilla in growing children. However, RME in adults may result in alveolar bone bending, periodontal membrane compression, fenestration of the buccal bone cortex, lateral displacement and extrusion of the teeth, and, finally, relapse.[2–6] SA-RME attempts to overcome some of these problems, and it is being used with increasing frequency in adults, with reports of long-term stability. However, because the appliances used are tooth borne, problems relating to orthodontic expansion still exist.[7,8]

The transpalatal distractor (TPD; Surgi-Tec NV, Bruges, Belgium) eliminates all these mentioned problems since it is fixed in palatal bone. On the other hand, the implantation of a TPD requires a surgical procedure, which may include some complications or incorrect placement of the device.[1,4] The level and inclination of the distractor may change the position of the fulcrum and center of resistance of the alveolar bone.[9,10] The high-level application of the distractor provides parallel expansion in the frontal plane.[9] However, the insertion of the TPD in an appropriate position during surgery is a challenging procedure for the surgeon.

The aim of this case report is to demonstrate a new method for the accurate placement of a TPD in a patient, which may shorten the surgery time and deal with the difficulties of the surgical procedure.

CASE REPORT

Diagnosis and Etiology

A 24-year-old male patient exhibited an anterior open bite with significant narrowness of the maxillary arch and orthognathic profile. His medical history showed no contraindication to orthodontic therapy. The patient reported that he was a mouth breather although no nasal obstruction, tonsillar hypertrophy, or abnormal tongue posture was evident. However, mouth breathing may have contributed to the development of the transversal discrepancies. The intraoral examination revealed a Class I molar relationship on the right side and a Class III relationship on the left side with a bilateral posterior crossbite. The upper dental midline was deviated to the left side (Figure 1).

Radiological Examination

A panoramic radiographic examination revealed that the patient had a left third molar in the maxilla and both third molars in the mandibular arch, whereas the maxillary right third molar had been extracted (Figure 2).

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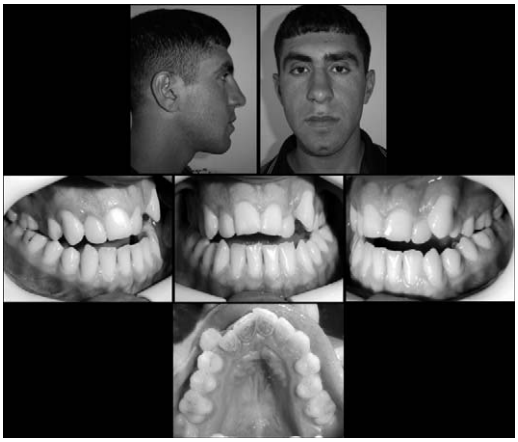

Figure 1. Extraoral and intraoral views of the patient before the treatment.

Figure 2. Panoromic film.

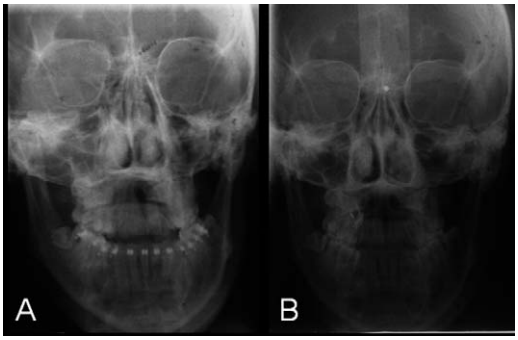

Figure 3. (A) Postero-anterior cephalometric film before expansion. (B) Postero-anterior cephalometric film after expansion.

A posteroanterior radiograph showed that the distance from maxillar jugal process (JL-JR) to the frontal facial line (ZL-AG and ZR-GA) was 19 mm on both sides (Figure 3). The cephalometric analysis showed an ANB angle of 0° and a high mandibular plane angle of SN-Ar-Go = 150°. On the other hand, the FMA angle was 42°. The maxillary incisors were retroclined (U1-SN = 97°, U1-NA = 20°). The mandibular incisors were also in a retrusive position (L1-Go/Me = 76°, L1-NB = 21°). Overbite was −3 mm, indicating an anterior open bite (Figure 4; Table 1).

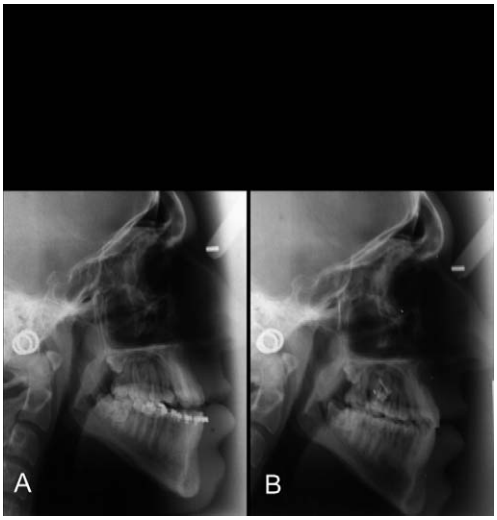

Figure 4. (A) Lateral cephalometric films before expansion. (B) Lateral cephalometric films after expansion.

Table 1. Cephalometric Measurements Before Treatment and at the End of the Treatment

Cephalometric Film Measurements	Norm	Before Treatment	After Treatment
SNA, °	82 ± 2	74	78
SNB, °	80 ± 2	74	75
ANB, °	2	0	3
NV-A, mm		−2	0
NV-Pg, mm		−3	−3
FMA, °	25	42	35
SN-Ar-Go, °	143	150	144
U1/SN, °	103	97	101
L1/Go-Gn, °	93	76	80
U1/L1, °	131	133	137
U1/NA, °	22	20	22
L1/NB, °	25	20	21
Overjet, mm		1	2
Overbite, mm			
Frontal film measurements		−3	1
JR-ZR/GA, mm		19	15
JL-ZL/AG, mm		19	15

Treatment Objectives

The treatment plan consisted of expanding the maxilla with a TPD and continuing with the orthodontic treatment.

Fabrication of TPD Transporter

TPD transporter is a simple splint made with orthoacryl containing two hooks made from 0.7 mm to 0.028″ (Leone S.p.A., Sesto Fiorentino, Italy) chromium-cobalt wire on both the right and left sides.

Before surgery, a model of the patient's upper arch

was obtained. Panoramic and AP-cephalometric films were examined to locate the roots of premolar teeth and any other important anatomic formation. The abutments were placed as parallel as possible to the occlusal plane and as superiorly as possible in the palatal vault. When the exact locations of the abutments were determined, the screw points of the abutment plates were located and marked carefully on the model. Four springs with hooks were bent and placed to fit on the marks on both sides. Two wires of the springs were placed on the mesial and distal proximal sides of the left second premolar, and the other two wires were seated the same way on the right premolar. After the hooks were located and fixed, an acrylic occlusal splint was constructed, fixing four hooks in one piece. The abutment plates were ligated to the hooks from the screw holes. The TPD transporter combined the three parts of a palatal distractor in one piece, when ready to be applied in the mouth (Figure 5).

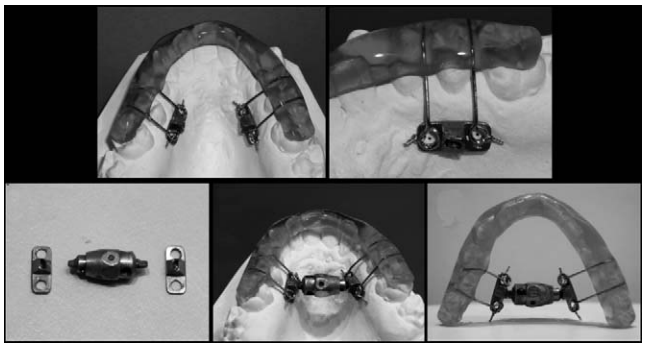

Figure 5. The view of the transpalatal distractor (TPD) transporter with TPD and abutments.

Surgical Procedure and Treatment Progress

At the beginning of the treatment, the lower arch and only the first premolar on the right maxillary arch were bonded/banded using Roth prescription brackets (0.018 inch). The bracket on the first premolar was used for ligating the distractor in case the patient might aspirate the distractor during the surgery. After the correction of the crowding in the lower arch, a maxillary osteotomy was planned. A Le Fort I–type osteotomy was performed under general anesthesia. The pterygoid junction was released bilaterally with a sharp osteotome. The titanium abutment plates of the TPD (Surgitech grade 2 telescopic distractor module) were placed with the assistance of the TPD transporter, horizontally on the palatal vault overlying the palatal root of the first molar and fixed with two titanium screws (7 mm in length and 2.3 mm in diameter; Figure 6).

Figure 6. The placement of the transpalatal distractor (TPD) with TPD transporter during the surgery.

The distraction module (module 2) was fit immediately into the slots of the abutment plates, and the screw was locked passively for 1 week. Expansion occurred at a rate of 0.33 mm/d, starting 1 week after surgery. Overexpansion was omitted because the forces were directly applied to the skeletal base. When the necessary expansion was achieved on the 15th day, the distractor was turned into a fixed retainer by inserting a blocking screw. At the 20th day, orthodontic treatment was continued by bonding the brackets on the maxillary arch. After the maxillary anterior teeth were aligned, 0.016- $\times$ 0.022-inch reverse curve NiTi arch wires in combination with vertical elastics were applied on both maxillary and mandibular arches to close the anterior open bite. The TPD was removed 4 months postdistraction with local anesthesia only. The orthodontic treatment was finalized in 9 months.

Figure 7. Intraoral and extraoral views of the patient after the treatment.

Treatment Results

At the end of active orthodontic treatment, a well-aligned dentition and harmonious facial profile were obtained. Maxillary dental crowding was eliminated, the open bite was closed, and a Class I molar and canine relationship were achieved. However, the patient had a small amount of posterior open bite on the right side (Figure 7).

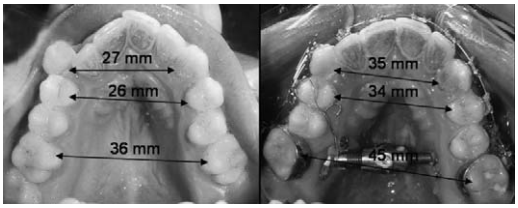

Figure 8. The view of intercanine width, interpremolar width, and intermolar width before and after the surgery. All points are the most lingual points at the gingival margin.

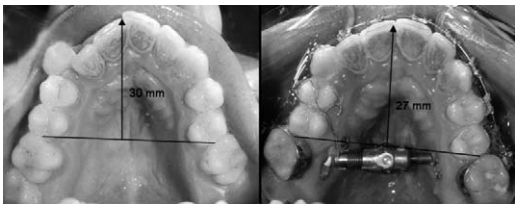

Figure 9. Arch length measurement before and after the distraction.

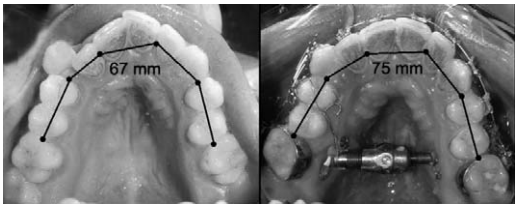

Figure 10. Arch perimeter measurement before and after the distraction.

Maxillary and mandibular study casts were obtained before expansion of the maxillary arch (T1) and at the end of expansion (T2) and were subjected to the arch measurements as described by Adkins et al.[11] The arch width was measured at the most lingual points at the gingival margin of the both first molars, the first premolars, and the canines (Figure 8). The contact points on the mesial surface of the first molars and the distal surface of the central incisors, as well as the most facial point on the most prominent central incisor, were also marked and measured as an arch length (Figure 9).

Arch perimeter measurement points (Figure 10) were chosen on the mesial aspect of the first premolars and the distal aspect of the central incisors. The expansion changes in the maxillary measurements are given in Table 2. An expansion of 9 mm was obtained at the first molars and canines, whereas 8 mm of arch width increase occurred between the first premolars. The arch length was decreased 3 mm during the period of expansion. The arch perimeter was increased from 67 mm to 75 mm.

Table 2. Changes in the Maxillary Arch (mm) Before the Expansion (T1) and at the End of Expansion (T2)

Measurement	T1, Before Expansion	T2, End of Expansion
Arch length measurement	30	27
Arch perimeter measurement	67	75
Interpremolar width measurement	26	34
Intermolar width measurement	36	45
Intercanine width measurement	27	35

DISCUSSION

The effect of expansion of the dental arch on the maxillary bases diminishes as age advances.[12,13] The midpalatal suture, the zygomatic buttress, the piriform aperture, and the pterygomaxillary junction resist maxillary widening. With increasing interdigitation of the palatal suture and the maturation of the facial skeleton, the need to release the resistance in the suture and section the lateral and posterior buttresses becomes obvious.[10] Thus, SA-RME is highly preferred in adult patients.

However, as conventional devices used for SA-RME are tooth borne, the problems relating to orthodontic expansion (ie, periodontal ligament compression, buccal root resorption, fenestration, and tooth tipping) still occur.[7,8] Lanigan and Mintz[14] also reported another complication of SA-RME, which was a case of temporary partial paralysis of the oculomotor nerve. Harzer et al[15] developed a procedure for bone-borne fixation of the hyrax screw in both halves of the maxilla with minimal surgical intervention. They did not observe any inflammation or bone loss during the expansion. Further advantages of the direct fixation method were better condition for speech and more space for the tongue. Timms and Moss[16] showed histological evidence of external root resorption and pulpal changes in nonsurgical rapid maxillary expansion cases. It is possible that similar changes could occur after SA-RME.

Rapid maxillary expansion in adults is an unreliable method, with several side effects including tipping of the anchorage teeth and a risk of increased tooth mobility as well as root and bone resorption. However Handelman et al[17] showed that nonsurgical RME in adults was a clinically successful and safe method if the expander was properly fabricated and the screw turned no more than once a day.

Transpalatal distraction uses a bone-borne device placed at a high level in the palatal vault, and hence, most of the expansion is considered orthopedic, with little or no buccal tilting of the bony segments.[9] Koudstaal et al[18] also showed a different borne-bone distractor, the Rotterdam palatal distractor, which is like the TPD. It has been developed based on the me-

chanical properties of a car jack. But it had some advantages such as a small size and no required screw fixation.

Distraction devices are levers, with a mechanical triad of fulcrum, resistance, and force. Force is characterized by a magnitude and vector, which are determined by location and orientation. Because the level and inclination of the distractor may change the position of fulcrum and the center of resistance, this is of utmost importance.[9,10] Pinto et al[9] indicated that the high level application of the distractor provides parallel expansion in the frontal plane.

When the distractor is placed at the level of the second premolar and pterygomaxillary disjunction is not performed, more expansion occurs in the anterior part of the maxilla than in the posterior part. However, the center of resistance changes when the pterygomaxillary disjunction is performed.[10] The placement of the TPD on the palate at the level of the first molars is indicated for the patient having a transverse maxillary deficiency with a lateroposterior crossbite. Therefore, the placement point and the angulations of the TPD are very important since the point-of-force application and the vector of the force may change the type of expansion.[10] Swennen et al[19] described a concept of segmental unilateral TPD after a posterior maxillary subapical osteotomy in a unilateral cleft lip and palate patient. They reported some differences compared with the original TPD procedure described by Mommaerts.[1] The TPD module was placed at the level of the first molar, and pterygomaxillar dysjunction and septal release were performed in their patient. Furthermore, segmental unilateral TPD was placed in a more asymmetric position to provide rotation of the osteotomized segment.

As a general rule, in RME and SA-RME procedures, the expansion at the occlusal level is greater in the posterior than in the anterior region. On the other hand, it can be said that the canine-molar ratio is 3 : 2, if TPD was placed at the level of the second premolar.[10] However, a parallel expansion between intermolar and intercanine width was obtained in the presented patient. This could be the result of placement of the TPD at the level of the molar region, and pterygomaxillar dysjunction was performed in this case.

Another important issue is locating some anatomical points such as the palatal artery and the roots of premolar teeth during surgery. In our technique, the application points of the TPD abutments are located on the model where the surgeon can take the time needed to locate the most appropriate position of the abutments.

The TPD transporter consists of an orthoacrylic plate and four hooks bent from 0.7 mm to 0.028″ chromium-cobalt wire, which is very easy to construct. The TPD abutments are located and marked in an appropriate position with extra care in a laboratory on the dental cast. This careful work decreases the positioning errors that may happen easily during surgery. The hooks that will carry the abutments are placed over these marks. Thus, the location of the TPD in the mouth is fixed in an appropriate position before surgery. This preparation decreases the surgery time and makes the surgery simpler as the surgeon does not need to locate the accurate location of the TPD. Besides, the TPD has proved to be a reliable and successful method for expanding the maxilla with minimal segmental tilting and without orthodontic and orthopedic relapse or dental and periodontal damage.[6,9] Proper expansion was achieved by applying a TPD, and a well-aligned dentition and harmonious facial profile were obtained in our case.

CONCLUSIONS

- Maxillary expansion using a TPD is a successful treatment method in adult patients.
- The TPD transporter combines the three parts of the TPD (two abutments and a module) and helps the surgeon to insert the TPD with an easy procedure in the correct position and in less time.

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