



Miniscrews as a Modified Palatal Implant

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Abstract

As an alternative to an orthodontic palatal implant this project evaluated two sagittally in the midline of the palate positioned titanium mini-screws as indirect anchorage elements. Over the whole treatment period no complications were observed. The orthodontic treatment was successfully completed. The measurements of lengths and widths carried out on 3D scanned models confirmed the stability of the molar anchorage reinforced by this kind of modified palatal implant.

Introduction

Anchorage control is the prerequisite for any successful orthodontic treatment. The efficiency of the headgear as a mean of anchorage and distalization depends on patients compliance of the. Intraoral, non-compliance means of distalization like the pendulum [1-3], the nance, Niti coils [4], Magnete [5], distal jets [6] or molar sliders [7] do work very efficiently, but their use is linked to some degree of anchorage loss, which in turn results in upper front teeth protrusion and increase of overjet [1,4,8,9]. Implants present a valuable anchorage alternative, whereby both so-called on plants [10], as subperiosteal anchorage and endosseous implants are used [11,12]. As early as 1984, Roberts et al. [13] studied tissue reactions to orthodontic forces transmitted by implants. The efficiency of osseointegrated titanium implants has been proven by numerous histological and clinical studies. It has even been possible to demonstrate that orthodontic load has a positive impact on per implant bone regeneration and remodeling, thus finally leading to increased stability [14-16]. Branemark et al. [17] used endosseous implants for orthodontic anchorage even for long lasting force application because of their stability based on osseointegration. Wehrbein et al. [18] introduced a palatal implant that was 6mm long and 3.3 mm in diameter, while Triaca et al. [19] evaluated an implant with a width of 7.5 mm and a length of 3 mm. These implants are mostly inserted bicortically into the palate and are loaded after a healing period of 3 to 6 months to get sufficient osseointegration [14,19-21]. Despite its proven stability [11,22], the size and design of the propound orthodontic implant on the one hand and alveolar atrophy on the other hand limit the scope of application. In addition, the surgical procedure, the time period of healing and a sophisticated difficult hygiene regime cause stress to patients [14,19-21]. Implants inserted for restorative reasons offer a further anchorage opportunity at a preprosthetic stage. The drawbacks are the requirements according the implants position and angulation from a prosthetic point of view. So-called mini implants have been introduced recently, which have been described as a valuable alternative for application of orthodontic anchorage for various dental movements [23-26]. The first advantage is definitely the simple surgical insertion. Immediate loading, the possibility of positioning interraderic, being a size of 1 mm to 2 mm in diameter and 4 mm to 14 mm in length and low costs are further advantages of mini implants. Finally these implants can be removed easily after orthodontic treatment because of only partial osseointegration [27]. Nevertheless, described complications are soft tissue irritations and proliferation, injuries of adjacent roots and finally the early loss of the implants [28]. The aim of this study was to introduce mini implants as an alternative to standard palatal implants.

Materials and Methods

A 13.6-year-old male patient of skeletal class III was introduced to the Orthodontic treatment for alignment of the crowded out tooth 13 and the receded second premolar (Figures 1-3) by maximum anchorage support of the first molars. Baseline diagnostic and treatment data: cross bite on the left side, malocclusion of the teeth was class III 1/4 on both sides, SNA 77°, SNB 79°, Wits -8,5 sagittal

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Received Date: 27 Jul 2017

Accepted Date: 11 Sep 2017

Published Date: 18 Sep 2017

Citation:

Wendl B, Muchitsch AP, Winsauer H, Walter A, Droschl H, Jakse N, et al. Miniscrews as a Modified Palatal Implant. J Dent Oral Biol. 2017; 2(14): 1089.

ISSN: 2475-5680

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Figure 1: Mini Screw.



Figure 2: Enoral pre-treatment photograph.

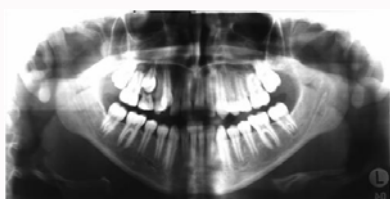


Figure 3: Panoramic X-ray (pre-treatment).



Figure 4: Clinical treatment photograph.

and vertical overbite and overjet were evident. Treatment goals: Alignment and Distalization of the teeth 13, 14, and 15 using overlay mechanics (super elastic wires, elastic chains) and anchorage support of the first molars (Figure 4 and 5). Anchorage was planned by micro implants, for this two implantation screws (Dual top micro anchorage screws: Type G with slot 0.022" by 0.025", 1.6 by 10 mm with gingiva protection -TIGER DENTAL, Bahnhofstrasse 59, A- 6900 Bregenz (Figure 1)), 10 mm long and 1.6 mm in diameter, were placed behind the nasopalatine canal, bilaterally to the palatal suture. An acrylic splint was used to guide the implantation in the presurgically planed correct position (Figure 6 and 7). For insertion the area was selected according to the recommendations of high bone support by Bernhart et al. [2]. This means 6 mm to 9 mm posterior to the nasopalatine foramen and 3 mm to 6 mm paramedian to avoid the mid-palatal



Figure 5: Clinical treatment photograph.



Figure 6: Acrylic Splint for Insertion.



Figure 7: Surgical Insertion.

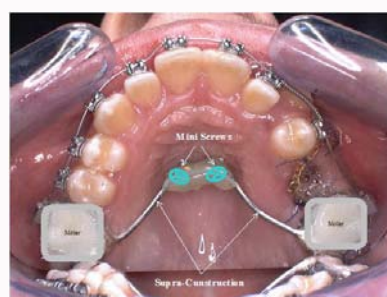


Figure 8: Schematic and clinical set up of the supra construction.

suture. The supraconstruction was a transpalatal 1, 1 mm steel wire which was soldered to the molar bands. In detail the transpalatal steel wire were moulded as counterpart of the miniscrew to establish contact. This was followed by fastening the transpalatal steel wire to the head of the screw by means of a stainless steel ligature. Finally, a light-curing composite adhesive was used to get a rigid link between the screw head and the transpalatal steel wire (Figures 5, 8 and 9). To evaluate the maximal molar anchorage, the initial and final models were scanned three dimensionally. The object was scanned from above with a laser ray, in steps of 0.6 µm. The reflection of the laser off the object is recorded by an optical measuring unit and electronically processed, so the model can be presented digitally.

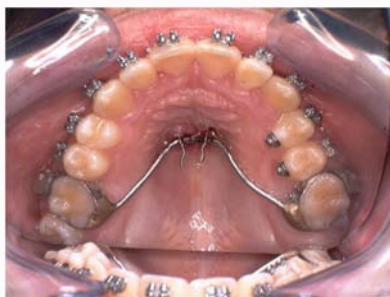


Figure 9: Clinical treatment photograph.

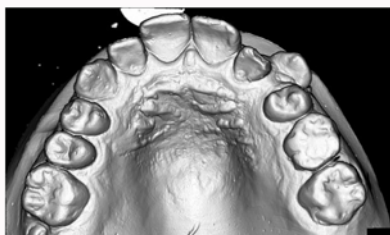


Figure 10: Scanned 3D-Modell pre-treatment.

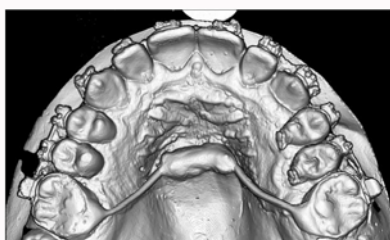


Figure 11: Scanned 3D-Modell post-treatment.

This scanning process was carried out independently by two people, each doing it twice, to facilitate a comparison of measurements and detection of any scanning irregularities. The models scanned in 3D mode are shown in Figure 10 and 11. The last step was measuring the distances from 3 different points on the occlusal molar surfaces (molars 16, 26) to the most mesial point of the tip of the papilla, and the measurement of the transverse constant (molars 16-26). This was carried out from several points on the occlusal surfaces of the implant supported molars.

Results

The clinical treatment goals were achieved (Figures 9, 12 and 13). Teeth 13 and 15 were successfully aligned and maximal molar anchorage has remained clinically stable. As for the skeletal conditions, there was even some improvement of the ANB-difference through increased growth of the maxilla (SNA: 79°, SNB:

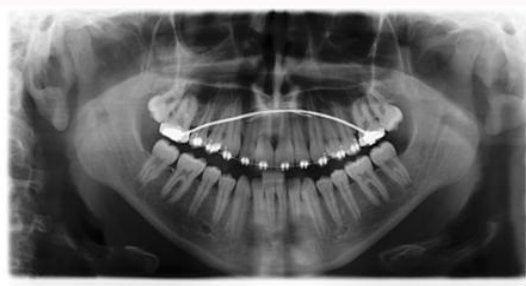


Figure 12: Panoramic X-ray post-treatment.



Figure 13: Enoral post-treatment clinical.

79°). The measurements of length (upper molars to papilla incisiva) and transverse width of the 3D scans of the models are summed up in Table 1. The maximal difference recorded in both measurements (length and transverse) was 0.5 mm, and there was also good correspondence between the two separately conducted scans, which showed a maximal difference of 0.1 mm.

Discussion

The measurements conducted showed differences of only up to 0.5 mm. The figures recorded by two separately undertaken scans corresponded well, showing up a maximal difference of 0.1 mm. This is proof of the good positional stability of the inserted miniscrews. By placing two miniscrews parasagittally, rotation control was achieved. Dual top screws are self-drilling and -cutting. They can be implanted into the upper jaw without pre-drilling, which takes only a few minutes. For the lower jaw, cantering of about 1mm is recommended because of the greater bone density. This minimally invasive procedure means only little strain for the patient. The hexagonal screw facilitates axial drilling, avoiding slipping and tilting. The practical design of the screwdriver handle also contributes to the secure placement of the screw, and the desired high primary stability. This means simple and safe application for the orthodontist. Positioning the screw is carried out under local anesthetic and its removal is possible without any anesthetic. This can be explained by the absence of osseointegration, which is prevented by the quality of the material and the smooth surface of the implant. Additionally no dental computerized tomography to avoid nasal cavity perforation (which can be caused by inserting palatal implants) or difficult surgical procedure (like on plants or zygomatic plates placement) is necessary. Wehrbein et al. [29] compared 1.2 mm by 1.2 mm steel wire transpalatal braces with ones dimensioned 0.8 mm by 0.8 mm and found that the deflection rate with the weaker dimensioned wire was up by a factor of 4.5. As there was also an increase of tilt that was proportional to the increase of load, the application of a palatal implant as distalizing anchorage

Table 1: Descriptive statistics.

	N	Min.	Max.	Mean	Standard Deviation
Transversal Scan 1	5	-0.522	0.518	0.027	0.373
Transversal Scan 2	5	-0.478	0.378	-0.015	0.314
Transversal Difference	5	-0.044	0.140	0.041	0.070
Molar - Papilla Incisiva Scan 1	6	0.0114	0.533	0.323	0.165
Molar - Papilla Incisiva Scan 2	6	0.116	0.506	0.328	0.125
Difference Molar Papilla Incisiva	6	-0.172	0.189	-0.006	0.131

should be carried out with a steel wire of 1.1 mm in diameter, as demonstrated in our case study. Gelgör et al. [30] found that a 14 mm implantation screw increases stability significantly. However, only one screw of 14 mm length and 1.8 diameters was used to distalize upper jaw molars on both sides. 88% of the distalizing force resulted in molar distalization and only 12% in reciprocal anchorage loss, which was reflected in a 1° protrusion of the incisors and an overjet increase of 0.5 mm. In this clinical case study, two parasagittal mini screws, 10 mm in length and 1.6 mm in diameter, were placed to achieve rotation stability, too. Schnelle et al. [31] demonstrated that adequate bone material for placing implants is available only in the lower half of the root. This area, however, is mainly covered by mobile gingiva, which would again mean a greater risk of loss. In the lower jaw, the buccal surfaces and the retromolar region provide adequate width and sufficient cortical bone to allow the use of implantation screws with a 1.2 mm to 1.3 mm diameter and 4 mm to 5 mm length. The buccal cortical surfaces in the upper jaw are thinner and less compact, so micro-implants of 6 mm to 8 mm in length and 1.2 mm to 1.3 mm in diameter should be used here. For palatal implants the thickness of the mucosa should be measured first. To achieve at least 6mm of bone insertion, screws of 10 mm to 12 mm length and 1.2 mm to 1.3 mm in diameter are required [32]. According to Yun et al. [33], the soft tissue on the palatal incline is two to three times as thick as on the buccal side, but the central palatal region 4mm behind the papilla incisiva is covered by only 1mm of mucosa. In addition, this area offers much high value cortical bone [34,35]. There are different accounts of the success rates of these mini implants. A success rate of 97% is contrasted by studies that show a loss of 30%, with the failure rate in the lower jaw higher than in the upper jaw. Factors with a negative impact, like the age of patients being over 40, the design of the implant, the material, low bone density, placement in posterior areas, and inflammatory reactions in the neighboring areas can lead to implant mobility [36-38]. Miyawaki et al. [39] recommend the use of screws with a diameter larger than 1mm in their study. Apart from this, 2.3 mm diameter screws or even mini plates, which even have a success rate of 100%, should be used for patients with large mandibular plane angles, which so often go together with thin cortical bone. The prevention of inflammations and the restriction of load to less than 2N also promise success. Thus, taking into account surgical aspects, including implant placement, the general health of the patients and perfect hygiene (chlorohexidine rinse), successful application can be expected.

Conclusion

Titanium micro screws are compliance independent and stable direct or indirect (using supra-constructions) elements of orthodontic anchorage. Placing two screws paramedial in the palate and linking them to the adequate supraconstruction guarantees sufficient stability even under adequate load. It will be possible to make use of this construction as a cost effective modified palatal implant.

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