Int. J. Oral Maxillofac. Surg. 2023; 52: 1262–1264
https://doi.org/10.1016/j.ijom.2023.07.005, available online at https://www.sciencedirect.com

International Journal of Oral & Maxillofacial Surgery

Technical Note
Orthognathic Surgery

Customized palatal guide and splint for maxillary expansion

J.D.P. Claus[a], J. Hidalgo[b], M.S. Almeida[a], H.J.C. Lopes[a]

[a]Instituto Bucomaxilofacial, Florianópolis, SC, Brazil; [b]Universidad Peruana Cayetano Heredia, Hospital Nacional Hipolito Unanue, Lima, Peru

J. D.P. Claus, J. Hidalgo, M. S. Almeida, H. J.C. Lopes: Customized palatal guide and splint for maxillary expansion. Int. J. Oral Maxillofac. Surg. 2023; 52: 1262–1264.

Abstract. Customization in orthognathic surgery allows better precision and a reduced surgical time. In Le Fort I osteotomy surgery, the maxillary segmentation is considered one of the most unstable procedures due to transverse instability. Various different types of palatal device have been proposed to address this instability. This note describes a customized bone-borne palatal guide and splint that may help surgeons shorten the surgical time and achieve better three-dimensional repositioning, with more postoperative comfort for the patient and occlusal control for the surgeon.

Keywords: Orthognathic surgery; Reconstructive surgical procedures; Patient-specific modeling; Maxillary expansion; Computer-aided design.

Accepted for publication 14 July 2023
Available online 4 August 2023

The segmentation of the maxilla associated with Le Fort I osteotomy is a well-known procedure to correct dental arch discrepancies.[1] Transverse correction of the maxilla is recognized as one of the most unstable movements in orthognathic procedures.[2,3] Various different types of occlusal and palatal splints with support on the teeth, aimed at providing transverse stability, have been reported.[4,5]

Patient-specific implants (PSI), which have recently been introduced in orthognathic surgery, have several potential advantages such as precision, stability, and a reduced surgical time. Most applications of these custom devices involve only drilling guides and titanium plates, allowing splintless repositioning of the maxilla.[6,7]

This note describes the use of a customized bone-borne palatal guide for positioning and maintaining the maxillary expansion postoperatively. This technique may help the surgeon with maintenance of the transverse width of the maxilla and in reducing the surgical time, with more comfort for the patient.

Technique

The first step takes place during the acquisition of data from the patient. During the intraoral dental scan, it is important to include all of the palate area in order to be able to merge these images with the computed tomography (CT) scan images, allowing the team to have information on the thickness of the mucosa. In the next step, the files are imported into the planning software (Dolphin 3D Surgery, version 11.8; Dolphin Imaging and Management Solutions, Chatsworth, CA, USA) in order to create the virtual surgical plan (VSP); a virtual patient is created in which the surgical plan and jaw movements can be defined, including the maxillary expansion.

After approval, the VSP is shared with the biomedical engineering company for design of the PSI. The digital workflow follows the same protocol as presented in a previous publication.[6] For ideal positioning of the PSI, a custom drilling guide is also required that will guide the surgeon to place the custom supragingival PSI plate as planned in the VSP. This technology allows splintless repositioning of the maxilla in the exact planned position, with high accuracy.[8]

The same concept is applied to the transverse repositioning of the segmented maxilla. With the maxilla in the

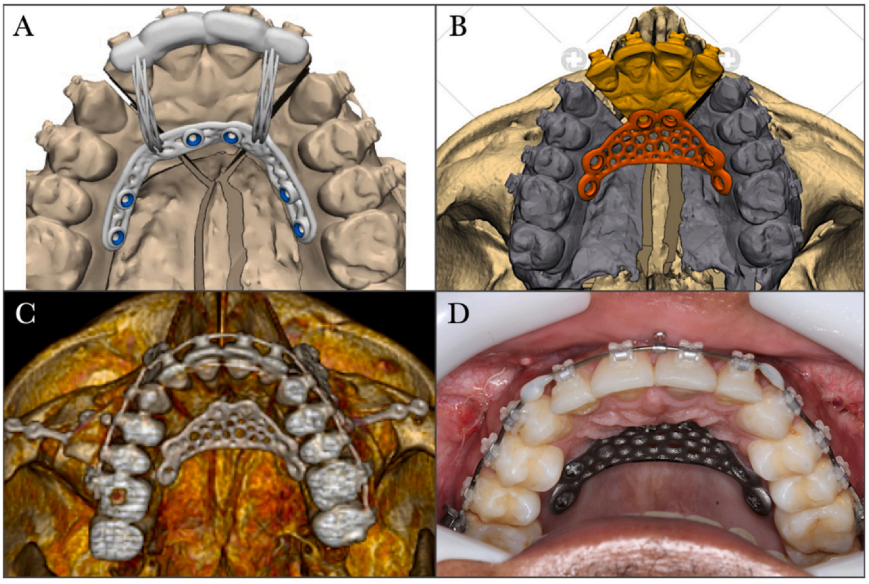

Fig. 1. (A) The drilling guide design, with the maxillary segments in the preoperative position. (B) The customized palatal splint was designed after maxillary repositioning and expansion. (C) Postoperative CT scan. (D) Postoperative clinical aspect.

preoperative position, the palatal drilling guide is first built with two holes in each segment. The position of each hole is defined according to the original anatomy (including palatal mucosa), bone thickness, position of the osteotomies, and root positions. This drilling guide is positioned and retained on the anterior teeth, avoiding mucosal compression, allowing the surgeon to secure and drill the segments (Fig. 1A).

The final palatal splint is developed and modeled to the new maxillary transverse arch with the previous holes moving together with the segments. These holes will receive the screws, which will help with the transverse repositioning intraoperatively and the transverse stability postoperatively (Fig. 1B). Considering the mechanical stability of titanium PSIs, the final palatal splint can present a delicate structure, without any tooth-support, with a maximum 2.0-mm profile to avoid discomfort for the patient afterwards.

After surgery, CT is performed to confirm the position of the palatal splint and the presence of a safe distance between the roots and the screws, in accordance with the surgical plan (Fig. 1C). In the case shown in Fig. 1, the total expansion at the first molar level was 12 mm. The palatal splint was removed early after 2 weeks and was replaced with an orthodontic device. In cases requiring maxillary expansion of > 5 mm, it is recommended that the splint is kept in place for 4–6 weeks in order to avoid relapse. Fig. 1D shows the clinical aspect prior to splint removal, showing the delicate design of the splint without any periodontal disturbance/inflammation.

Discussion

Different types of transverse splints for use after segmental Le Fort I osteotomies have been reported, all of which have been developed for the same purpose of maintaining the expansion and countering postoperative relapse forces during the retention period.[2,9] This period after segmentation and/or transverse expansion allows the ossification and remodeling of the bone, reducing the possibility of relapse and keeping the dentoalveolar segments in position. In the case presented in Fig. 1, the PSI was kept in place for 2 weeks and was then changed to a removable palatal splint. Nevertheless, it is recommended that the PSI should be retained for 4–6 weeks, followed by orthodontic retention. In this regard, the orthodontic literature reports durations ranging from 2 to 12 months, with this variation being due to the differences in the amount of expansion. For larger expansions (more than 8 mm), the current authors suggest a longer period of 6–8 weeks with the PSI in place, as it counteracts forces that may cause relapse.[10]

The occlusal splint has the advantage of positioning the occlusion in relation to the lower arch. However, it is wired to the teeth and this is associated with frequent discomfort for the patient, as well as with hygiene problems and periodontal inflammation. Similar problems have been reported with only palatal or horseshoe splints, including poor speech mechanics.[4]

The customized palatal splint described here allows the same function as conventional splints reported for transverse correction of the maxilla. There are three main potential advantages: (1) it helps in the transverse repositioning of the maxillary segments; (2) there is no interference around the teeth, thereby avoiding periodontal disturbances; and (3) the PSI process allows the fabrication of a small titanium splint with a more comfortable design for the patient when compared to the conventional methods. In addition, it fixes the segments at the bone level, which is useful in large transverse movements, whereas smaller changes (mostly rotations of the segments) may benefit from devices of other designs. Further studies (including case series) should be done to evaluate the accuracy of the transverse repositioning and the stability of the customized palatal splints.

Ethical approval

This work was approved by the Conselho Nacional de Ética em Pesquisas – CONEP (Reference no. CAAE 51595221.2.0000.0115).

Funding

None.

Competing Interests

Nothing to declare.

Acknowledgements. The authors thank CPMH (Brasilia, Brazil) for technical assistance, intellectual cooperation, and device manufacturing; Dr. Daniel Perez from the University of Texas, San Antonio with the idea for this splint.

Patient consent

Patient informed consent was obtained to publish the CT images and pictures without identification.

References

1. Posnick JC, Adachie A, Choi E. Segmental maxillary osteotomies in conjunction with bimaxillary orthognathic surgery: indications – safety – outcome. *J Oral Maxillofac Surg* 2016;**74**:1422–40.
2. Haas Junior OL, Guijarro-Martínez R, de Sousa Gil AP, da Silva Meirelles L, de Oliveira RB, Hernández-Alfaro F. Stability and surgical complications in segmental Le Fort I osteotomy: a systematic review. *Int J Oral Maxillofac Surg* 2017;**46**:1071–87.
3. Rodrigues D, Campos P, Azevedo R, Wolford LM. Morbidity of transverse expansion after segmental Le Fort I osteotomy: dental and skeletal evaluation. *Int J Oral Maxillofac Surg* 2019;**48**(Suppl. 1):S127. https://doi.org/10.1016/j.ijom.2019.03.392
4. Ismali M, Wessel J, Farrel B. Maintenance of segmental maxillary expansion: the use of custom, virtually designed, and manufactured palatal appliances without the use of an occlusal splint. *J Oral Maxillofac Surg* 2019;**77**:1468.e1–8.
5. Border M, Strait R, Vega L. Clear aligner orthognathic splints (CAOS) and custom maxillary fixation plates for surgery-first or surgery-only cases. *J Oral Maxillofac Surg* 2021;**79**:e6–11.
6. Claus JDP, Almeida MS, Zille D. Customization in minimally invasive orthognathic surgery. *Adv Oral Maxillof Surg* 2021;**3**:100114.
7. Philippe B. Custom-made prefabricated titanium miniplates in Le Fort I osteotomies: principles, procedure and clinical insights. *Int J Oral Maxillofac Surg* 2013;**42**:1001–6.
8. Karanxha L, Rossi D, Hamanaka R, Giannì AB, Baj A, Moon W, Del Fabbro M, Romano M. Accuracy of splint vs splintless technique for virtually planned orthognathic surgery: a voxel-based three-dimensional analysis. *J Craniomaxillofac Surg* 2021;**49**:1–8.
9. Alcalde R, Bloomquist D, Joondeph D. Maxillary deficiency: transverse plane discrepancies. In: Bagheri S, Bell RB, Khan H, editors. Current therapy in oral and maxillofacial surgery. St Louis, MO: Elsevier Saunders; 2012. p. 640–50.
10. Salgueiro D, Rodrigues V, Tieghi Neto V, Menezes C, Gonçales E, Ferreira Júnior O. Evaluation of opening pattern and bone neoformation at median palatal suture area in patients submitted to surgically assisted rapid maxillary expansion (SARME) through cone beam computed tomography. *J Appl Oral Sci* 2015;**23**:397–404.

Correspondence to: Instituto Bucomaxilofacial
Rua Santos Dumont 182
sala 202
CEP 88015-020 Florianópolis
SC
Brazil.
Tel:+55 48 988487091.
E-mail: cirurgiaofacial@gmail.com