OPEN

PRS GLOBAL OPEN

IDEAS AND INNOVATIONS

Pediatric/Craniofacial

Alveolar Bone Graft Stabilization with Custom Maxillary Splints

Erinn N. Kim, MD
Emily M. Graham, BSN
Fatma B. Tuncer, MD
Duane K. Yamashiro, DDS
Faizi A. Siddiqi, MD
Barbu R. Gociman, MD, PhD

Summary: For secondary alveolar bone grafting in cleft patients, the success of bone graft take is dependent upon creating an ideal environment for both bony and soft tissue healing. This is particularly challenging in patients with existing fistulas, wide clefts, and bilateral alveolar clefts, where large soft tissue mobilization is required to get a tensionless repair, and micro-motion around the bone graft is significantly higher. Herein we describe our method for manufacture and placement of a custom postoperative maxillary splint following secondary alveolar bone grafting. Our splint encompasses the palate and alveolus to stabilize the maxillary arch and protect the incision lines during healing. We find our splint to be a useful adjunct to facilitate postoperative healing following secondary alveolar bone grafting. *(Plast Reconstr Surg Glob Open 2020;8:e3214; doi: 10.1097/GOX.0000000000003214; Published online 24 November 2020.)*

INTRODUCTION

Alveolar clefts disrupt the alveolar arch and create unequal palatal segments that require reconstruction to restore form and function. Alveolar bone grafting aims to prevent arch collapse, close the oronasal fistula, allow tooth eruption, improve speech, provide support for the alar base, and enhance aesthetic appearance.[1]

Secondary alveolar bone grafting (SABG) is the principal method of reconstruction of the alveolar arch despite differing opinions on operative timing and graft material.[2] Many patients undergo expansion of the alveolar segments before alveolar bone grafting surgery to prepare the cleft site and improve the arch shape. Expansion devices are commonly discontinued after surgery, leaving the collapsing forces unopposed. Without sufficient bony stabilization following surgery, micro movements may risk the integrity of the bone graft and generate complications, including fibrous encapsulation and failure of bone graft consolidation.[3] Additionally, several factors common to cleft patients contribute to soft tissue complications after SABG, including pre-existing palatal fistulas, wide clefts, atrophic mucosa, poor oral hygiene, and tension along repair lines.[4,5]

Despite the evident need for bony stabilization and soft tissue protection after SABG, the current literature for postoperative stabilizers is limited. Our technique uses a custom-made acrylic maxillary splint that encompasses the alveolus and palate to provide immediate postoperative stability of the maxillary arch and to support healing of the bone graft and soft tissues after SABG. This technique has been successfully incorporated into our postoperative regimen following SABG in over 200 patients. This initially began with large bilateral alveolar clefts and is now used universally following secondary alveolar bone grafting. Herein we describe our technique of stabilizing alveolar bone grafts through the use of patient acrylic splints.

TECHNIQUE

An impression of the maxillary arch is taken immediately following the surgical correction of the alveolar cleft while the patient is still in the operating room. We use the alginate impression Alginelle by Lascod (Florence, Italy), as this mold changes color to indicate its readiness for use. (See **figure, Supplemental Digital Content 1,** (a) Alginate is poured into impression trays for subsequent insertion into the patient's oral cavity. (b) The alginate mold is then inserted and removed from the oral cavity to obtain an impression of the alveolus and palate. http://links.lww.com/PRSGO/B503.)

Disclosure: *All authors have no financial interests to disclose. No funding was received for this article.*

Related Digital Media are available in the full-text version of the article on www.PRSGlobalOpen.com.

From the Division of Plastic Surgery, University of Utah, Salt Lake City, Utah. Drs. Erinn N. Kim and Emily M. Graham contributed equally to this work.

Received for publication July 13, 2020; accepted September 3, 2020.

Presented at the American Cleft Palate-Craniofacial Association Meeting in Tuscon, Ariz. on April 9–13 and 4th Annual Mountain West Society of Plastic Surgeons Meeting in Squaw Valley, Calif. on March 7–10, 2019.

DOI: 10.1097/GOX.0000000000003214

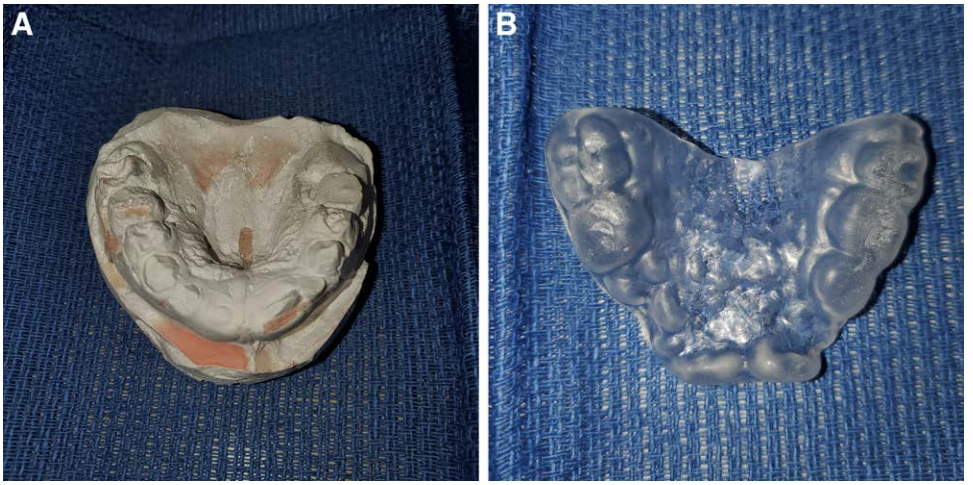

Fig. 1. Manufacturing of the alveolar splint. A, The orthodontic stone that is cut at the junction of the hard and soft palate. B, The Biocryl splint ready for insertion into the mouth.

Following the impression, orthodontic stone (Whipmix, Dortmund, Germany) is placed into the alginate mold and set aside to harden. Once the stone has hardened, it is cut posteriorly at the junction of the hard and soft palate (Model Arch Trimmer by Buffalo Dental Manufacturing Syosset, N.Y., USA) (Fig. 1A). After the stone is properly sized and cut, the orthodontic stone is placed on a vacuum-forming machine (UNSPSC: 42152102, Henry Schein, Melville, N.Y., USA) containing heated Biocryl (2 mm/125 mm Clear Splint Biocryl by Great Lakes N.Y., USA). The vacuum forming machine is turned to suction and dropped onto the orthodontic stone mold. The orthodontic stone with the newly attached Biocryl splint is then cooled. The clear Biocryl splint is then removed from the orthodontic stone using a Dremel rotary tool (Mount Prospect, Ill., USA). The Biocryl splint is then shaped to incorporate 2–3 mm below the upper buccal sulcus anteriorly as well as the hard palate (Fig. 1B). The splint is then smoothened using a dental lathe to prevent ulceration or pressure points from the splint.

While the patient is recovering in the post anesthesia care unit, the newly formed splint is inserted and secured using Poligrip (GSK, Brentford, London, UK). From obtaining the maxillary impression in the operating room to placement of the splint in the post anesthesia care unit, this technique requires 30 minutes to complete. The splint is worn for 6 weeks postoperatively to protect the repair (Fig. 2).

DISCUSSION

We have found this splint to be a useful adjunct for facilitating postoperative bony and soft tissue healing in patients undergoing SABG. Hypertrophic nonunion occurs in fracture healing when there is too much motion between healing segments of bone. Similarly, in healing of cancellous bone graft, micromovements may risk the integrity of the bone graft and generate complications, including fibrous encapsulation and failure of bone graft consolidation.[3] We postulate that by immobilizing the alveolar segments, the splint may limit micro movements around the bone graft and facilitate bony consolidation of the alveolar grafts.

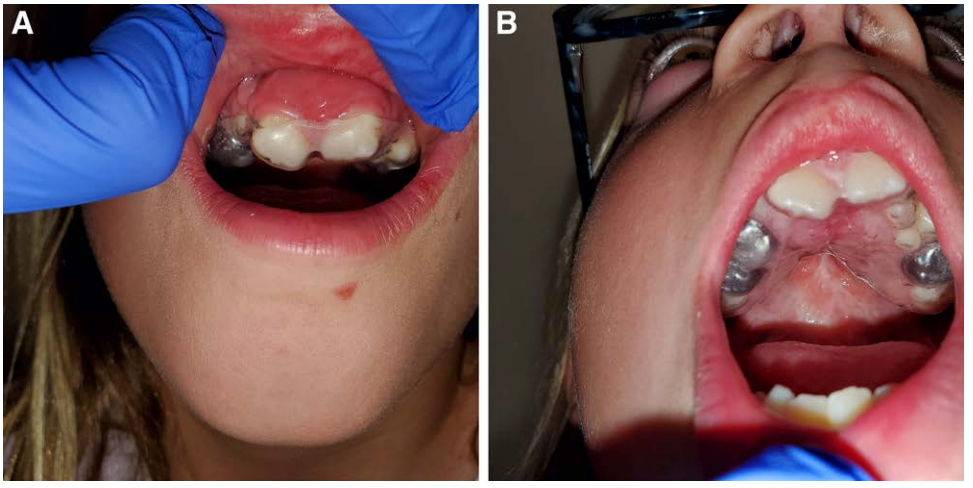

Fig. 2. The alveolar splint in situ. A, Anterior view of the Biocryl splint in situ with upper edges ca. 3 mm below upper buccal sulcus. B, Intraoral view of the Biocryl splint covering the alveolus and hard palate.

Previously described reports of splints following alveolar bone grafting are limited and describe protection of the alveolus only. There are a few cases that describe the use of rigid orthodontic wires to enhance stability of the premaxillary segment.[6–8] One case report describes the use of an acrylic maxillary splint in a patient with a bilateral alveolar cleft.[9] As such, none of the previously reported splint techniques address soft tissue protection of incision lines that may extend onto the gingiva and palate. The incidence of palatal fistulas at the time of secondary alveolar bone grafting is common at around 55% and recurrence after fistula repair is high.[5] We have modified our splint to also encompass the palate to provide a mechanical barrier that protects the incision lines and facilitates soft tissue healing. An added benefit of the palatal plate as part of the splint is that it may help facilitate earlier postoperative feeding because patients are not afraid of traumatizing their incision lines.

Potential limitations of this technique are that it is time sensitive and requires intra-operative availability of the orthodontist to take the mold, and then manufacture and place the splint in the patient's mouth before discharge from the post anesthesia care unit. However, there are several benefits of the splint: fitting of the splint does not prolong surgery, does not require an additional anesthesia session, and takes only 30 minutes from taking the mold in the operating room to fitting in the post anesthesia care unit. Additionally, the splint is user friendly. If needed, the splint can be removed, cleaned, and replaced into the mouth by parents at home, making facilitation of oral hygiene easy. Since the implementation of this technique, no increase in complications attributable to the splint has been observed.

CONCLUSION

A custom-made maxillary splint encompassing the palate and alveolus is a useful and safe adjunct in facilitating bony stabilization and soft tissue healing following secondary alveolar bone grafting.

Erinn N. Kim, MD
Division of Plastic Surgery
University of Utah
30 North 1900 East, 3B400
Salt Lake City, UT 84132
E-mail: erinn.kim@hsc.utah.edu

REFERENCES

1. Guo J, Li C, Zhang Q, et al. Secondary bone grafting for alveolar cleft in children with cleft lip or cleft lip and palate. *Cochrane Database System Rev.* 2011:CD008050.
2. Weissler EH, Paine KM, Ahmed MK, et al. Alveolar bone grafting and cleft lip and palate: a review. *Plast Reconstr Surg.* 2016;138:1287–1295.
3. Burchardt H. The biology of bone graft repair. *Clin Orthop Relat Res.* 1983;174:28–42.
4. Losee JE, Smith DM, Afifi AM, et al. A successful algorithm for limiting postoperative fistulae following palatal procedures in the patient with orofacial clefting. *Plast Reconstr Surg.* 2008;122:544–554.
5. Shankar VA, Snyder-Warwick A, Skolnick GB, et al. Incidence of palatal fistula at time of secondary alveolar cleft reconstruction. *Cleft Palate Craniofac J.* 2018;55:999–1005.
6. Behnia H, Mesgarzadeh A, Tehranchi A, et al. Stabilization of premaxilla repositioned during secondary bone grafting in complete bilateral cleft lip and palate patients. *J Craniofac Surg.* 2014;25:1554–1557.
7. Bergland O, Semb G, Abyholm FE. Elimination of the residual alveolar cleft by secondary bone grafting and subsequent orthodontic treatment. *Cleft Palate J.* 1986;23:175–205.
8. Koťová M, Dušková M, Leamerová E, et al. Postoperative fixation after repositioning of premaxilla in a patient with bilateral cleft lip and palate – case report. *Acta Chir Plast.* 2018;59:157–162.
9. Oyama T, Yoshimura Y, Onoda M, et al. Stabilization of a mobile premaxilla by cementing a bite splint with 1-stage bilateral alveolar bone grafting. *J Craniofac Surg.* 2008;19:1705–1707.