

# Simultaneous Closure of the Cleft Alveolus and Hard Palate with Concomitant Bone Grafting

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**Summary:** Cleft repair has been in constant evolution since its inception. Conventional repair of the cleft hard palate involves closure of nasal and oral mucosa without bony reconstitution. In many instances, this approach is adequate, but, particularly in complete clefts, the lack of bony support can lead to collapse of the maxillary arch, dental crowding, and posterior cross-bite. To address these shortcomings, our institution performs a two-staged palatoplasty with concomitant bone grafting of the alveolus and hard palate in the second stage. A retrospective review of children who underwent a two-staged palatoplasty at our institution was performed. These patients' records and images were reviewed for complications and changes in maxillary morphology. Fourteen patients with complete clefts had a two-staged palatoplasty with bone grafting in the second stage. The mean age at surgery was 37.5 months, and the mean follow-up was 16 months. One patient had resorption of the alveolar bone graft requiring additional bone grafting. The remaining patients were without complications and had good consolidation of the bone graft on follow-up imaging. Our early results support that there is a low complication rate (7% re-grafting) in those patients who underwent bone grafting at the time of cleft palate repair with early evidence of bony consolidation on imaging and clinical examination. Wide exposure during the repair allows complete grafting of the maxillary bony deficit, which is not possible with traditional alveolar cleft repair and may alleviate the shortcoming of soft-tissue closure only. Future study is necessary to determine long-term outcomes. (*Plast Reconstr Surg Glob Open* 2022;10:e4099; doi: [10.1097/GOX.0000000000004099](https://doi.org/10.1097/GOX.0000000000004099); Published online 9 February 2022.)

## INTRODUCTION

Cleft repair has been in constant evolution since its inception. Conventional repair of the complete cleft involves closure of nasal and oral mucosa without bony reconstitution followed by secondary alveolar bone grafting. Repair and bone grafting of the alveolar cleft is important for multiple reasons, including stabilization of the dental arch, eruption of permanent teeth, and support of the nasal sill.<sup>1</sup>

Over the past 2 years at our institution, we have changed our protocol to help restore the bony anatomy of

the palate and alveolus sooner in an effort to mitigate the potential problems with maxillary arch collapse later in childhood. The soft palate is repaired around 9 months of age, at which time a palatal obturator is secured with pins to cover the hard palate, and the hard palate is repaired around 2 years of age. The objective of the study is to evaluate early outcomes following the institution of this new technique.

## METHODS

### Demographics

Fourteen consecutive patients with complete clefts were operated on by a single surgeon from August 2019 to June 2020. Patients were excluded if they had prior alveolar or palatal repair. These patients' records and images were reviewed for short-term outcomes and complications.

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### Operative Technique

Oral and nasal mucosal flaps are elevated at the level of the alveolar cleft. Two large mucoperiosteal palatal flaps are elevated at the level of the hard palate based on the greater palatine vessels (Fig. 1A). Vomer flaps are elevated medially and nasal mucosal flaps are elevated laterally on the cleft sides in continuity with alveolar nasal mucosal flaps. Watertight nasal alveolar and hard palate mucosal closure are achieved.

The cortical bone in the alveolar cleft is injured using a rongeur to promote bone healing. A combination of bone chips, demineralized bone graft, and bone morphogenic protein is then placed at the level of the alveolar cleft and hard palate (see figure, Supplemental Digital Content 1, which shows the concomitant hard palate and alveolar cleft repair with bone grafting, <http://links.lww.com/PRSGO/B912>). The previously raised oral mucosal alveolar and hard palate flaps are advanced and inset to achieve watertight closure over the bone graft (Fig. 1B). A custom acrylic splint is then fabricated and applied over the repair (see figure, Supplemental Digital Content 2, which shows how a custom acrylic splint is then applied over the repair, <http://links.lww.com/PRSGO/B913>). The splint is kept in place for 6 weeks postoperatively, during which time, the parents are instructed on how to wash and rinse the splint to ensure continued oral hygiene.

### RESULTS

Pertinent baseline characteristics of the 14 consecutive patients were recorded (Table 1). All of the patients had a Veau III or IV cleft. Mean age at surgery was 37.5 months. Mean postoperative follow-up was 16 months (range 7–38 months). One patient had partial dehiscence and loss of the alveolar bone graft clinically apparent 1 month postoperatively. He underwent revisional alveolar bone grafting 2 years after his original surgery with good consolidation on follow-up computed tomography (CT) scan. The remaining patients at their most recent follow-up had good bony contour of their alveolus and palate clinically and consistent bony consolidation across

### Takeaways

**Question:** Is a palatoplasty with concomitant bone grafting of the alveolus and hard palate beneficial?

**Findings:** A retrospective review of children who underwent concomitant palatoplasty and alveolar bone grafting at our institution supports that there is a low complication rate in those patients with early evidence of bony consolidation on imaging and clinical examination.

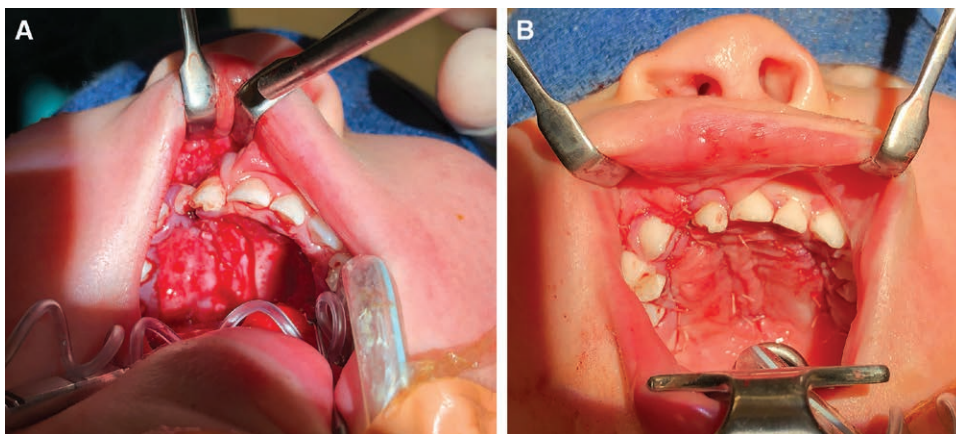
**Meaning:** Early alveolar bone grafting with simultaneous hard palate repair has a low complication rate and good clinical and radiographic bony consolidation in short-term follow-up.

the alveolar defect on 6-month postoperative CT scan (Fig. 2).

### DISCUSSION

Historically, a number of the surgeons in our cleft program performed two-staged palatoplasties (soft palate repair at 1 year of age and hard palate repair at 3–4 years of age) followed by delayed closure of the alveolar cleft with bone grafting (7 years of age).<sup>2</sup> In our experience, the major shortcoming of only closing soft tissue in hard palate repair in either one or two stages is a high rate of maxillary instability and growth limitation. This is noted in both the anteroposterior and transverse dimensions and often requires secondary orthognathic correction. In response to this observed shortcoming, we modified our protocol to include closure of the alveolar cleft at the time of hard palate repair with bone grafting.

One criticism of early maxillary soft-tissue dissection is that it may limit maxillary growth due to scarring or by interrupting vascular supply.<sup>1</sup> Primary alveolar bone grafting at the time of cleft lip repair has been demonstrated in many studies to have detrimental effects on facial growth.<sup>3,4</sup> This has led to the wide adoption of secondary alveolar bone grafting in mixed dentition before the eruption of permanent teeth in the cleft.<sup>5</sup> However, by postponing alveolar bone grafting to 2–4 years of age, other studies



**Fig. 1.** Concomitant hard palate and alveolar cleft repair with bone grafting. A, Elevation of the alveolar and palatal flaps. B, Closure of the alveolar and palatal flaps over bone graft.

**Table 1. Patient Demographics and Postoperative Outcomes**

| Patient | Gender | Age at Surgery (mo) | Cleft Type (Veau Class) | Follow-up (mo) | Minor Complications | Postoperative Fistula | Alveolar and Palatal Contour | Bony Consolidation on Postoperative CT Scan | Additional Surgical Intervention                    |
|---------|--------|---------------------|-------------------------|----------------|---------------------|-----------------------|------------------------------|---|---|
| 1       | F      | 35                  | Veau III                | 10             | No                  | No                    | Stable                       | Yes   |   |
| 2       | M      | 26                  | Veau III                | 11             | No                  | No                    | Stable                       | Yes   |   |
| 3       | M      | 51                  | Veau IV                 | 9              | No                  | No                    | Stable                       | Yes   |   |
| 4       | M      | 20                  | Veau III                | 31             | Yes                 | Yes                   | Collapsed                    | No  | Additional alveolar bone grafting 2 y postoperative |
| 5       | M      | 26                  | Veau III                | 20             | No                  | No                    | Stable                       | Yes   |   |
| 6       | M      | 22                  | Veau III                | 38             | No                  | No                    | Stable                       | Yes   |   |
| 7       | M      | 61                  | Veau IV                 | 24             | No                  | No                    | Stable                       | Yes   |   |
| 8       | M      | 79                  | Veau III                | 19             | No                  | No                    | Stable                       | Yes   |   |
| 9       | M      | 33                  | Veau III                | 7              | No                  | No                    | Stable                       | Yes   |   |
| 10      | M      | 37                  | Veau III                | 17             | No                  | No                    | Stable                       | Yes   |   |
| 11      | F      | 37                  | Veau IV                 | 11             | No                  | No                    | Stable                       | Yes   |   |
| 12      | F      | 50                  | Veau III                | 11             | No                  | No                    | Stable                       | Yes   |   |
| 13      | M      | 26                  | Veau III                | 7              | No                  | No                    | Stable                       | Yes   |   |
| 14      | F      | 26                  | Veau III                | 8              | No                  | No                    | Stable                       | Yes   |   |

have demonstrated that maxillary growth and dental arch morphology are comparable between cleft patients who underwent early bone grafting and those who did not.<sup>6,7</sup> To further substantiate this, Siegenthaler et al<sup>8</sup> demonstrate that at age 10, patients who underwent early alveolar bone grafting at ages 2–4 have similar dental arch morphology to their counterparts bone grafted at a later age. On short-term clinical follow-up, only one patient in our series has demonstrated palatal arch collapse suggesting that palatal arch morphology has remained stable postoperatively with this technique. Further longitudinal study will be needed to assess maxillary growth in our cohort.

With regards to speech outcomes, earlier palatal closure has been associated with improved speech outcomes. However, based on a systematic review by Reddy et al<sup>9</sup> examining speech outcomes between one- and two-staged palatoplasties in seven articles, only two articles reached moderate-grade quality looking at the prevalence of velopharyngeal insufficiency and articulation errors, and of those two articles, the conclusions about the above outcomes were contradictory. In our patients, at the time of soft palate repair at 9 months of age, a pin-retained palatal obturator was placed over the hard

palate defect and exchanged as the patients' growth indicated until definitive hard palate repair at 2–3 years of age. Although we do not yet have long-term speech outcomes on these patients, none in short-term follow-up required additional surgical intervention to address velopharyngeal insufficiency.

Regarding our choice of the bone graft material, although autologous iliac bone graft is the traditional medium used in many centers, it was less than ideal in our patient population. In children 2–3 years old, minimal cancellous bone stores and increased morbidity make autologous grafting less feasible. Because of this, we elected to use a combination of demineralized bone matrix and bone morphogenetic protein (DBX-BMP), an off-label use, based on the studies by Hammoudeh et al<sup>10</sup> which demonstrated equal efficacy to autologous bone grafting. With DBX-BMP only at the level of the alveolus, we noted increased resorption of the bone graft on follow-up imaging. This led us to modify our protocol to include allograft bone chips in addition to DBX-BMP. This modification demonstrated consistent bony consolidation on 6-month follow-up CT scan.

We acknowledge that this study has several limitations including small sample size and limited follow-up. We also recognize that the assessment of results of cleft surgery years before the completion of facial growth may not truly reflect the final effects of treatment. As such, we are unable to fully assess the percentage of patients who may require secondary bone grafting. However, early prediction of outcomes in this patient population is favorable. From this perspective, our preliminary evaluation of outcomes following simultaneous hard palate repair and alveolar bone grafting demonstrate that only 7% have required repeat alveolar bone grafting and demonstrate stable palatal morphology in the short-term. Although early outcomes have been favorable, further longitudinal studies are needed to evaluate long-term outcomes including speech, the need for additional bone grafting, palatal expansion, and maxillary advancement.



**Fig. 2.** Representative maxillofacial CT scan demonstrating the bony alveolar cleft 7 months postoperatively.

## CONCLUSIONS

Our early results support that there is a low complication rate (7% regrafting) in those patients who underwent bone grafting at the time of cleft palate repair with early evidence of bony consolidation on 6-month post-operative CT scan. However, further study is needed to evaluate long-term outcomes. Wide exposure during the repair allows complete grafting of the maxillary bony deficit, which is not possible with traditional alveolar cleft repair and may alleviate the shortcoming of soft-tissue closure only.

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