Personal Technique for Primary Repair of Alveolar Clefts

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Craniomaxillofac Trauma Reconstruction 2012;5:51–58

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Abstract

From 1969, the senior author (H.B.) has developed a technique for the repair of alveolar clefts during primary cheiloplasty at patient age of 3 months. The operation used palatally hinged mucoperiosteal flaps from the edges of the cleft to reconstruct the posterior and inferior walls of the alveolar box. The roof was reconstructed by repairing the nasal floor, and the anterior wall was reconstructed using a buccal mucosal flap from the undersurface of the lateral lip segment. Fourteen operated patients were selected to scientifically follow the long-term results of the technique. The results indicated restoration of the arch form, varying degrees of ossification in the repaired alveolar box, and eruption of canines through the repaired alveolus. One case of anterior cross-bite was observed in these selected cases. However, a limited cross-bite was present at the site of the repaired cleft in many cases.

Keywords

- ▶ alveolar clefts
- ▶ primary repair

The repair of alveolar clefts has been and still remains a controversial subject. Techniques were used to reconstruct the defect using bone grafts at the primary procedure.¹ Reports of maxillary retrusion following primary bone grafting led the majority of cleft teams to abandon this technique.² Secondary bone grafting during the mixed dentition subsequently became a well-accepted procedure.^{3,4} Several flaps were described to cover the bone grafts inserted.^{5–7} Later reports of complications included resorption of the bone graft, mucosal breakdown with loss of bone, root resorption, and failed tooth eruption.⁸ Morbidity related to donor sites was also described.⁹ Millard and Latham¹⁰ improved upon the principle of preoperative orthopedics introduced by McNeil in 1950¹¹ and proposed a custom-made orthopedic appliance fixed to the maxillary segments. This was removed 1 to 2 days before a gingivoperiosteoplasty procedure was performed. However, these appliances are expensive and time-consuming and can be psychologically harmful both to parents and child. This procedure was later criticized as producing unsatisfactory facial esthetics and dental function.

Primary periosteoplasty techniques were introduced by Skoog¹² in 1965 and were based on the assumption that bone is only formed between two periosteal layers. Some surgeons

followed Skoog's principle and employed slight modifications to his original technique and timing of intervention.^{13–15} The flaps are thin and technically difficult to raise, and their blood supply is precarious and doubtful. Their effect of midfacial growth is controversial.

In 1969, the senior author (H.B.) developed a modification of a technique that was used in Hamburg for soft tissue cover of the inserted rib grafts but without inserting bone. The rationale was to avoid the long-term bad results of the primary bone-grafting procedure while utilizing the capability of the periosteum to produce bone. This technique was presented internationally.¹⁶ All along these years, the author had satisfied, yet unrecorded, patients. Many Egyptian surgeons followed the technique with satisfactory results. As interest in the technique grew, it was decided to scientifically follow the results.

Materials and Methods

Patients

Only 14 patients, presenting with complete clefts of the primary palate with or without a cleft in the secondary palate, were included in this study. The idea of including this limited

received

February 8, 2011

accepted after revision

August 16, 2011

published online

November 7, 2011

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Publishers, Inc., 333 Seventh Avenue,
New York, NY 10001, USA.
Tel: +1(212) 584-4662.

DOI <http://dx.doi.org/10.1055/s-0031-1293524>.
ISSN 1943-3875.

number was to be able to adequately follow them. Twelve of them had unilateral and two had bilateral clefts. Nine of the unilateral cases had clefts of the secondary palate as well. There were eight boys and six girls. Eight patients had left-sided clefts and four had right-sided clefts. The age at the time of the repair ranged from 3 to 8 months, with a mean age of 5 months. In this study, the senior author (H.B.) performed half of the surgeries.

Preoperative assessment included photography, study models, and intraoral radiographs for the cleft. Three-dimensional computed tomography (CT) was done in four cases. No preoperative maxillary orthopedics was performed nor needed for our cases.

Surgical Technique

Skin markings and incisions for repair of the lip cleft was done using the Tennison lower triangular flap principle (→Figs. 1, 2, and 3). Muscles were carefully dissected as a separate layer and were released from their wrong attachments. Marginal gingivoperiosteal, palatally based flaps were raised from the anterior surface and sides of the alveolus. These flaps were reflected in a hingelike fashion to form the posterior and inferior wall of the alveolar box. Depending on the width of the cleft, additional soft tissues needed to bridge the cleft gap were taken from the adjacent lip mucosa present on the sides of cleft lip and were included with the mucoperiosteal flap. The repaired muscle and the undersurface of the periosteal flaps used to repair the nasal floor constituted the roof of the alveolar box. A buccal mucosal flap, taken from the undersurface of the lateral lip segment, was tailored to cover the anterior surface of the alveolar box. Repair of the mucosa, muscle, and lip was then done in the usual fashion.

Figure 1 Outline of the incisions in the skin, margins of the alveolus, and the buccal flap. The shaded area represents the extension of the marginal flap into the lip cleft mucosa.

Figure 2 The marginal mucoperiosteal flaps sutured together to form the posterior and inferior walls of the box. The floor of the nose repaired forming the roof of the alveolar box. The buccal flap is elevated, ready to be inset as the anterior wall of the box.

Follow-up Evaluation

The follow-up period ranged from 6 months to 7 years. Assessment of the results included clinical examination of facial form, status of eruption of individual teeth at the site of

Figure 3 The completed procedure.

the cleft, alignment of erupted teeth, dental occlusion, photography, study models of the upper jaw, intraoral radiographs to document bone formation according to modified Bergland et al¹⁷ classification, three-dimensional CT, and biopsies from the repaired cleft site.

Results

Alveolar closure at the time of primary cheiloplasty using this technique was possible in all cases regardless of the alveolar cleft width and laterality (►Fig. 4). The widest cleft gap measured 14 mm and the narrowest, 5 mm, with a mean of

9.6 mm. In 12 cases, normal arch configuration was restored. In two cases, there was a residual alveolar cleft. One of the drawbacks of this operation was the inclusion of labial mucosa in place of the attached gingiva in the alveolar arch with occasional loss of the labial sulcus. However, this was not always present in all cases and when present, it was easily corrected during the repair of the cleft of the secondary palate.

Complete ossification occurred in seven cases equal to 50% of the repaired cases (►Fig. 5), and partial ossification occurred in six cases equivalent to 43% (►Fig. 6). Minimal ossification occurred in one patient, corresponding to 7% (►Fig. 7). Biopsies were taken from the site of the repaired alveolar cleft in three cases at the time of palatal repair. In the first case, the biopsy was taken at 4.5 months postoperatively and revealed the presence of fibrous tissue containing central zones of osteoid tissue (►Fig. 8). The second biopsy taken 16 months postoperatively revealed the presence of vascularized fibrous tissue containing osteoid tissue (►Fig. 9). The third biopsy taken 20 months postoperatively showed the presence of active osteoid tissue (►Fig. 10). Tooth eruption through the repaired cleft was observed in five cases during the follow-up period in the selected patient sample. Occlusion was satisfactory in most of the followed cases especially in cases with clefts involving the primary palate only. A cross-bite restricted to the teeth adjacent to the cleft was observed in some cases of complete clefts of the lip and palate (►Fig. 11). Facial form was maintained in all followed cases (►Figs. 12, 13).

Discussion

Debate continues regarding the favorable approach in primary reconstruction of alveolar clefts between secondary bone grafting and primary gingivoperiosteoplasty. The benefits of successful secondary alveolar bone grafting have been enumerated.^{3,4,18,19} However, it is not without drawbacks including donor site morbidity, the chance for graft infection, and inadequate restoration of the cleft alveolar anatomy, primarily referring to alveolar crest height.^{8,9,20} Primary gingivoperiosteoplasty as an alternative relies on achieving

Figure 4 (A) A case of bilateral complete cleft of primary and secondary palate at the age of 3 months. (B) Basal view signifying the amount of premaxillary protrusion and alveolar gap at the right side. (C) Six months' postoperative basal view demonstrating the alveolar repair.

Figure 5 Complete ossification of the cleft and a tooth is seen about to erupt.

Figure 6 Type 2 ossification reaching three-quarters of the alveolar height.

bony union through the formation of a periosteal tunnel between the cleft alveolar segments at the time of lip repair. The principle was originally introduced by Skoog¹² and required the presence of periosteum in all four walls of the tunnel. This necessitated extensive subperiosteal undermining with subsequent controversial long-term maxillary growth.

In an attempt to reduce the extent of maxillary and alveolar periosteal undermining, Millard and Latham^{10,21} relied on presurgical infant orthopedics to minimize the alveolar gap. The technique developed by the senior author (H.B.) avoids extensive periosteal undermining by utilizing a buccal mucosal flap from the undersurface of the lateral lip

Figure 7 Type 3 ossification reaching less than three-quarters of the alveolar height.

Figure 8 Biopsy taken 4.5 months following alveolar repair containing central zones of osteoid tissue (arrow).

Figure 9 The histological specimen shows a fragment of vascularized fibrous tissue containing a small piece of osteoid tissue.

Figure 10 (A) Biopsy taken 20 months following alveolar repair demonstrating the presence of active osteoid tissue at low power ($\times 100$). (B) Same specimen at higher power ($\times 200$).

Figure 11 (A) Three-month-old child with a left complete cleft of the primary and secondary palate. (B) The same child at 4 years of age showing a good repair of the lip. (C) The occlusion of the child. Note the presence of a limited cross-bite in the area of the cleft.

Figure 12 (A) A case of bilateral cleft of primary and secondary palate at the age of 3 months. (B) The same case at the age of 7 years, showing the maintenance of facial form. (C) The occlusion at mixed dentition.

segment and part of the lip mucosa of the cleft edge, which is usually discarded, to reconstruct the alveolar box. This helps in closing wide alveolar defects without the need for presurgical orthopedics that is harmful to the child and parents.

Many articles have been published debating the importance of periosteum in bone formation and regeneration.^{22,23} Maintaining the integrity of the periosteum during gingivoperiosteoplasty surgery was reported to be essential to facilitate adequate bone fill in the cleft alveolus.^{12,21,24–26} However, we have found that this is not necessarily true. Our results have shown complete ossification in 50% of the cases despite the fact that the box was not completely periosteal. This adds a unique feature to this technique and raises the question of the true necessity of creating the alveolar box exclusively by periosteum.

Carstens²⁷ introduced the concept of sliding the adjacent gingiva posterior to the cleft and based on the buccal mucosa of the undersurface of the lateral lip segment. He called it the “sliding sulcus operation.” We have tried it in several cases but found that it entails a lot of dissection; the vascularity of the peripheral gingiva was doubtful and we lost it in one case, compromising the result.

Delaire²⁸ implemented the idea of the primary periosteoplasty but suggested postponing it. He applied presurgical

orthopedics first, then performed the periosteoplasty as an early secondary gingivoalveoloplasty at 18 to 24 months of age during hard palate repair. Brusatti and Garattini²⁹ and Meazzini et al²⁶ adopted the same principle of early secondary periosteoplasty performed at 18 to 36 months of age at the time of hard palate repair, but rather relied on the molding effect of the lip and soft palate reconstruction done earlier at 4 to 6 months of age to bring the maxillary stumps into correct alignment.

Sato and colleagues²⁰ documented the positive effect of gingivoperiosteoplasty performed during the initial lip repair on the success of alveolar repair. They avoided the need for secondary alveolar bone grafting in 73% of their patients who had gingivoperiosteoplasty. Furthermore, they revealed that undergoing gingivoperiosteoplasty before secondary alveolar bone grafting increased the number of patients who obtained satisfactory bony bridging of the alveolus compared with those who did not have gingivoperiosteoplasty performed before secondary alveolar bone grafting. They attributed this to three factors: (1) the absence of fistulae with a resultant decreased chances of infection; (2) the presence of periosteum and osteoblasts along the bone bridges in the cleft site from the previously attempted gingivoperiosteoplasty, allowing for a better environment for the integration of the bone

Figure 13 (A) A case of unilateral complete cleft of primary and secondary palate at the age of 3 months and (B) at the age of 6 years showing maintenance of facial form. (C) The occlusion of the same case. (D) Note the limited anterior cross-bite and the erupting canine into the repaired cleft.

graft; (3) the residual alveolar defect becoming reduced in size by the gingivoperiosteoplasty, which would be more successfully grafted than a larger alveolar defect that had no bone bridges.

We have found that patients who have undergone the presented technique experienced a good chance of avoiding secondary alveolar bone grafting, similar to Santiago et al.²⁵ Furthermore, the patients further benefited from the elimination of fistulae, stabilization of the alveolar segments, and more normalized eruption of the primary teeth. Long-term follow-up has proved the feasibility of this technique, and it has been the standard operation for repair of the alveolar clefts in our department for more than 35 years. It has given us consistently good results with minimal interference with facial growth.

Conclusions

The technique suggested here is simple, needs minimal subperiosteal exposure, and requires no preoperative orthopedics. Ossification was demonstrated in all successful investigated cases despite the fact that a mucosal flap only, with no periosteal lining, repaired the anterior wall of the box. This obviates the need for a second covering layer of periosteum. The good arch form produced, the spontaneous tooth eruption, and the good occlusion achieved in many cases suggest the suitability of this technique for management of alveolar clefts.

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