Is Canine Eruption Velocity Affected by the Presence of Allograft Within a Repaired Alveolar Cleft?

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Purpose: To assess the rate of canine eruption in alveolar clefts repaired with cancellous autograft versus cancellous autograft mixed with allograft.

Materials and Methods: This was a retrospective cohort study of patients in mixed dentition who underwent primary repair of uni- or bilateral alveolar cleft defects. Patients were divided into 2 groups based on the method of bony reconstruction (group 1, iliac crest autograft; group 2, iliac crest autograft harvested through a minimal access approach and mixed 1:2 with demineralized bone allograft). Secondary predictor variables were demographic and anatomic factors potentially related to canine eruption. The outcome variable was the velocity of canine eruption, measured as the change in vertical distance from the incisal edge to the maxillary occlusal plane (millimeters per month). Descriptive, bivariate, and linear regression statistics were computed.

Results: The study sample included 57 alveolar cleft defects; 19 were repaired with autograft alone and 38 were repaired with autograft plus allograft. The sample's mean age was 9.9 ± 2.3 years at the time of repair. Thirty-one clefts (54.4%) were part of a bilateral deformity. Canine root formation was 50% complete at the time of surgery in most patients (59.6%). Mean duration of follow-up was 23.7 ± 13.2 months. Mean canine eruption velocity was 0.20 ± 0.18 mm per month and was not associated with the method of bony repair (P = .58).

Conclusion: The use of allograft bone to augment bone graft volume results in similar rates of canine eruption compared with autograft bone alone.

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The optimal management of the alveolar cleft deformity remains a challenging problem for maxillofacial surgeons. Autograft bone, taken from the anterior or posterior iliac crest, is most commonly used for repair and considered the most optimal grating material.[1-5] The key advantage of autogenous bone is its osteogenic potential. Disadvantages of autogenous iliac harvest include donor-site morbidities (paresthesia, peritoneal violation, fracture, etc). Donor-site morbidity has been demonstrably minimized with minimal access

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techniques; however, these techniques limit the amount of bone that can be harvested.[1,2] In addition, revision of failed alveolar cleft repairs could require the surgeon to use alternative sources of bone, because autologous donor sites could have been used previously and patient or parent preference might be to avoid autogenous donor sites or a repeat open harvest. An alternative to the use of autogenous bone is allograft bone (eg, cadaveric bone, freeze-dried allogeneic bone marrow, demineralized bone matrix, etc). Decellularized and demineralized allograft bone retains its osteoconductive and osteoinductive properties and affords scaffolding by which adjacent nascent progenitor cells can undergo osteoinduction and differentiated osteoblasts can repopulate the allograft and ultimately create functionally polarized normal bone. The primary advantages of allograft bone are the lack of donor-site morbidity and abundant supply. The use of allograft bone for repair of an alveolar cleft defect was first described in 1987 and has since been shown to result in adequate healing of alveolar cleft defects.[1,2,6]

Hybrid formulations of autograft and allograft bone have been used successfully to repair deficient alveolar ridges.[7] Advantages of the hybrid mix are the presence of osteocytes within the mixture, adequate volume, and potentially decreased donor-site morbidity with minimal access harvest. Recently, hybrid formulations of allograft and autograft have been shown to result in stable repair of alveolar defects in patients with mixed dentition, with shorter operating times, improved bony healing, and no extrusion of bone graft material.[7] Although these results are encouraging, the rate of complete eruption was higher in the autograft group compared with the hybrid group, potentially an effect of follow-up time or innate differences in canine eruption velocity in allograft versus autograft.

The purpose of this study was to answer the following clinical question: Compared with alveolar clefts repaired with autogenous iliac crest bone graft, do alveolar clefts repaired with iliac crest harvested using a minimal access method and mixed with bone allograft have a comparable velocity of canine eruption? The hypothesis was that the presence of allograft would not affect the velocity of canine eruption. The specific aims with regard to this hypothesis were to *1)* identify a cohort of patients undergoing primary repair of uni- or bilateral alveolar cleft defects with autogenous or hybrid bone grafts, *2)* evaluate the velocity of canine eruption for each group, and *3)* compare the velocities of canine eruption between the 2 groups.

Materials and Methods

STUDY DESIGN AND SAMPLE

This was a retrospective cohort study of patients treated by 2 different cleft surgeons on the craniofacial team at a tertiary referral pediatric hospital during a 4-year period. Patients were included as study subjects if they underwent primary repair of uni- or bilateral alveolar cleft defects with autograft or autograft mixed with allograft and had clinical and radiographic follow-up for a minimum of 12 months postoperatively (or when the canine had erupted to the extent that an orthodontic bracket could be safely applied). Patients with incomplete records, those who underwent secondary revision for failed primary repairs, and those with incomplete follow-up were excluded. Institutional review board approval was granted for the review and analysis of patient records (protocol 11070038). All guidelines in the Declaration of Helsinki were followed at all points in this study.

STUDY VARIABLES

Predictors

The primary predictor variable was the method of alveolar cleft repair and was classified as group 1 (autogenous iliac crest alone) and group 2 (autogenous iliac crest bone mixed with allograft bone). Patients in each group represented consecutive repairs for either of the 2 surgeons. One surgeon used autograft alone harvested through a standard open anterior approach to the iliac crest. The other surgeon used allograft mixed with autograft, with the autograft harvest completed through a minimal access technique. Patients in group 1 underwent traditional open harvest of iliac crest bone (total harvest, 15 mL of cancellous bone per cleft). Patients in group 2 underwent minimal access harvest of iliac crest bone, as previously described by the senior author (A.R.K.).[1] This resulted in 5 mL of cancellous bone harvest, which was subsequently mixed with 10 mL of demineralized bone matrix and cancellous allograft (DBX Mix, Synthes, West Chester, PA), for a total grafted volume of 15 mL per cleft. Cleft repair was undertaken using the senior author's standard approach.[1,2] Postoperative management was performed according to the institutional protocol, as previously described.[1,2] Briefly, autologous marrow was harvested from the donor hip using a standard open anterior approach to the iliac crest (group 1) or a 1-cm incision immediately lateral to the iliac crest, approximately 1.5 cm posterior to the anterior iliac spine (group 2). In group 2, the incision was large enough to accommodate a power trephine (Acumed LLC, Hillsboro, OR), which was used to harvest approximately 5 mL of cancellous marrow. After completion of autograft harvest in the 2 groups, the donor site was checked for hemostasis, a 0.25% bupivacaine impregnated sponge (Gelfoam, Pfizer, New York, NY) was placed into the donor-site bone defect, and the wound was closed in layers. The operation was transitioned to the oral cavity, where the alveolar cleft defect was exposed by elevating medial