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Evaluation of success of alveolar cleft bone graft performed at 5 years versus 10 years of age☆

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ABSTRACT

Background and purpose: Although alveolar cleft bone grafting is the most widely accepted approach, controversies remain on the operative timing.
Methods: A consecutive retrospective series of 28 patients who received alveolar bone grafting was examined and divided into 2 groups depending on the age at the time of bone graft. Group A (14 patients) was operated at a mean age of 5.2 years [range, 4–7] and Group B (14 patients) at a mean age of 10 years [range, 8.5–13].

All the children were assessed clinically and by Cone Beam Computed Tomography (CBCT) before bone grafting and 6 months post-operatively. Cleft and bone graft dimensions, volumes were assessed using Osirix v.3.9.2. Residual bone graft coefficient (Bone Graft Volume on 6-months Postoperative CBCT/Alveolar Cleft Volume) was calculated. Complications, tooth movement or dental agenesis were also reported.
Results: The sample was uniform within both groups, considering cleft forms, pre-surgical fistula rate and cleft volume. Residual bone graft coefficient reached 63.3% in Group A and 46.2% in Group B ($p = 0.012$). Results of residual bone graft are also influenced by tooth eruption through the graft ($p = 0.007$ in Group A and $p = 0.02$ in Group B).
Conclusions: This 3D analysis highlighted higher success of alveolar bone grafts when children are operated earlier around 5 years.
Level of evidence: Therapeutic study. Level III/retrospective comparative study.

1. Introduction

In patients with cleft lip and palate, managing residual alveolar cleft is essential to restore maxillary segment union and stability, allow tooth eruption, close alveolar fistula, and provide support to the lip and the nose (Witsenburg, 1985).

However, different modalities may be used. Before the 1970s, primary osteoplasty was routinely performed until Robertson (Robertson and Jolleys, 1968) and Rherm (Rherm et al., 1969) showed its adverse developmental effect on maxillary growth. Secondary alveolar bone grafting has since been developed and is now well established following the original work of Boyne and Sands (1972). The bone that is most commonly used is the cancellous iliac bone, but the tibial shaft, mandible, rib, and calvaria may also be used.

The procedure is usually performed when the patient is between 9 and 12 years old, in a mixed dentition, before eruption of the canines so that they may erupt through the grafted site.

More recently, other authors (Borstlap et al., 1990; Lilja et al., 2000; Talmant et al., 2002) have advocated that alveolar bone

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Table 1
Patient characteristics and distribution of cleft forms.

	Group A	Group B
Age at time of alveolar bone graft (years)	5.2 (4; 7)	10 (8.5; 13)
Number of patients	14	14
UCLA	2	2
UCLP	10	9
BCLP	2 (1 only grafted on 1 side)	3 (1 only grafted on 1 side)
Number of grafts	15	16
Sex ratio	4 F/10 M	3 F/11 M
Retro-alveolar fistulas	3	3
Orthopedic maxillary expansion	13	13

UCLA = unilateral cleft labio-alveolar; UCLP = unilateral cleft lip and palate; BCLP = bilateral cleft lip and palate.

grafting be performed before the eruption of maxillary lateral incisors, when the patient is between 4 and 6 years old. The graft allows the lateral incisor to erupt through the grafted bone, and these authors reported better results in terms of residual bone height.

The primary aim of this study was to compare the results of bone grafts performed in patients at 5 and 10 years of age. The secondary aim was to show the value of Cone Beam Computed Tomography (CBCT) in bone graft assessment.

2. Material and methods

Twenty-eight consecutive pediatric patients received secondary alveolar bone grafts between January 2012 and February 2013 at our institution.

Inclusion criteria were as follows: (a) Children had to have undergone operation by the same surgeon; (b) Children had residual alveolar clefts. The same operations were performed during the first year of life (3 months: Millard lip closure without gingivo-periosteoplasty; 6 months: one-stage palatoplasty using Veau–Wardill flaps); (c) No patients belonged to a syndrome; (d) No attempt at previous grafting had been done.

Patients were divided into two groups. Group A (14 patients) received secondary bone graft at a mean age of 5.2 years (range: 4–7 years); and Group B (14 patients) underwent operation at a mean age of 10 years (range: 8.5–13 years). Patient characteristics and distribution of cleft forms within both groups are presented in Table 1. Fistulas located right behind the maxillary arch, also known as retroalveolar fistulas, were also recorded.

In each group, 13 patients required maxillary transversal expansion before grafting.

Secondary alveolar bone grafting was performed following previously described principles (Boyne and Sands, 1972; Abyholm et al., 1981; Bergland et al., 1986), and the cancellous bone harvested from the iliac crest was used.

Patients were asked to begin to brush their teeth 1 day after surgery and to have a full liquid diet for 10 days and then to eat food that did not need to be chewed for an additional 3 weeks.

All children were assessed clinically and by CBCT (QR Newtom 5G, 1 slice/0.15 mm) the day before bone grafting and 6 months after surgery. Tooth movements were recorded on clinical examination and CBCT images. Early and late complications were also reported.

2.1. Data acquisition

Preoperative CBCT was used to assess cleft volume and dimensions, whereas postoperative CBCT allowed estimating the residual graft volume.

All data recorded in Digital Imaging and Communications in Medicine (DICOM) format were transferred to Osirix v.3.9.2 software.

On preoperative CBCT images, the maximal height, maximal width, and maximal length of the cleft were measured using the rulers along the edges. On postoperative CBCT images, the same dimensions were reported for the graft.

Maximal graft dimensions are expressed as a percentage of maximal cleft dimensions.

Alveolar clefts and bone grafts were delimited on each slice using the drawing tool. The X, Y, and Z planes, as well as scanning information, were used to delineate the measurement areas for the alveolar cleft and the graft. This way, the alveolar cleft volume was measured on transversal areas between two sagittal planes and two coronal planes (an upper area on the nasal floor and a lower area on the tooth cervix). These planes were based on the limit between the bone and the air on the noncleft side. Multiplanar views or a single plane in the full-screen window could be selected to facilitate graft edge location, as well as the corresponding preoperative image superimposition. Collection of these slices was stacked to produce a 3D volume (Fig. 1). The volume of the entire structure was calculated and shown by the system.

The residual bone graft coefficient (%) was calculated using the following formula: Bone Graft Volume on CBCT image 6 months post surgery/Alveolar Cleft Volume.

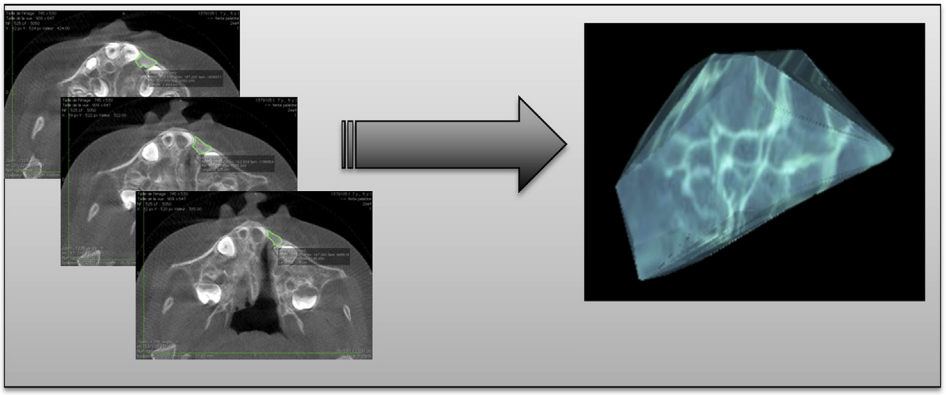

Fig. 1. Example of bone graft volume acquisition. The alveolar bone grafts were delimited on each slice using the drawing tool. Transversal areas were superimposed to produce a 3D volume using *Osirix v.3.9.2* software.