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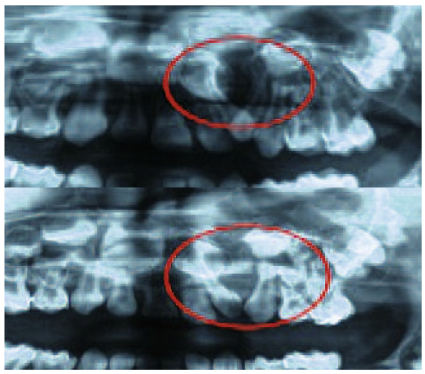
Initial treatment of alveolar gaps in cases of labio-maxillary-palatal clefts



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ABSTRACT

Treatment teams use different approaches for correcting the alveolar cleft sector of labio-palatal clefts. Age of patient, whether or not bone grafts are used, and the type of bone grafted are some of the differences. Our team performs a gingivoperioplasty with a graft of iliac cancellous bone on patients 4 to 6 years old. This procedure is carried out within the framework of orthodontic treatment designed to restore transverse dimension pre-operatively with a quad helix and to retain the expansion with 6 months of retention. The gingivoperioplasty is accomplished in a zone free of any scar tissue that might have resulted from a primary cheiloplasty followed by closure of the palatal cleft. In our view all teams must eventually utilize cone beam X-rays for their radiographic evaluations because they are the only tool that provides results of objective analysis that are of high quality and have demanded a very low level of radiation.

KEY WORDS

Labio-palatal cleft,

Bone graft,

Cone beam,

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Gingivoperioplasty.

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1 – INTRODUCTION

Surgeons should seek to achieve these goals in the primary treatment of clefts: restore normal morphology and function. While all treatment centers agree on these principles, their management protocols vary from group to group. One European study showed that there were 194 different protocols for 201 cleft treatment centers. The same discordance exists for gingivoperioplasties to correct alveolar clefts. There is a great disparity among the groups in the choice of chronology, type of bone for grafting and where to harvest it, and evaluation of results. The controversy over gingivoperioplasty focuses on many issues, when it should be performed, what precisely should be its goals, should grafts be used and if so, with what type of bone or bone substitute, what are its effects, if any, on facial growth, how to assess its results, and what type of rehabilitation to employ. The goal of this article is to use a review of the literature as a framework to discuss these various controversies and to present the management of alveolar clefts that we use in our maxillo-facial and pediatric plastic surgery service.

2 – WHAT SHOULD OUR OBJECTIVES BE?

Von Eiselsberg, in 1901, and Lexer, in 1908, are said to have performed the first maxillary bone grafts. However, it wasn't until the 1980s that real graft protocols were established by Witsenbur, then Montoya, and Boldand[3,6,26], who defined the objectives of osseous grafts in alveolar clefts. Today it is generally agreed that gingivoperioplasties should have these objectives:

- assure the stability of maxillary segments;
- close alveolar fistulas;
- improve the appearance of the gingiva;
- improve emergence pathways of teeth and support them after eruption';
- restore the alveolus to a normal condition';
- provide osseous support to upper lip and wing of the nose';
- facilitate prosthetic restorations';
- assure rather than impede facial growth.

3 – WHEN SHOULD WE PLACE GRAFTS?

Graft placements for cleft palate cases are called primary, secondary, or tertiary in accordance with the stage of the dentition in which they are made:

- a primary bone graft is made in the deciduous dentition;
- a secondary bone graft is made in the mixed dentition;
- a tertiary bone graft is made in the adult dentition.

Beginning in the early 1970s many articles noted an increase in the rate of maxillary retrusions following early initial bone grafts[18]. Following these observations Boyne[4] introduced the secondary bone graft that would subsequently be adopted in most European countries. This procedure, carried out when patients are about 9 years old, before eruption of the upper canines, fulfills desired objectives without interfering with growth of the maxilla, which, in most cases, is terminated both in the transverse and antero-posterior senses at that age[9,19].

Other treatment teams proceed with this bone graft at an earlier stage, when patients are 4 to 6 years old, in order to provide patients with enough bone for eruption of the lateral incisor (Fig. 1a to 1d)[13,22]. Commentators on this procedure note that it provides better osteointegration and maintains bone height without altering maxillary growth.

In my opinion, the gingivoperioplasty that Skoog advocates at 3 to 6 months bestows no benefits and does not obviate the need for a second graft[15].

The tertiary bone graft carried out at the end of dental eruption provides inferior osteointegration and should be employed for dealing with sequelae[6].

4 – WHAT TYPE BONE SHOULD BE USED FOR GRAFTS?

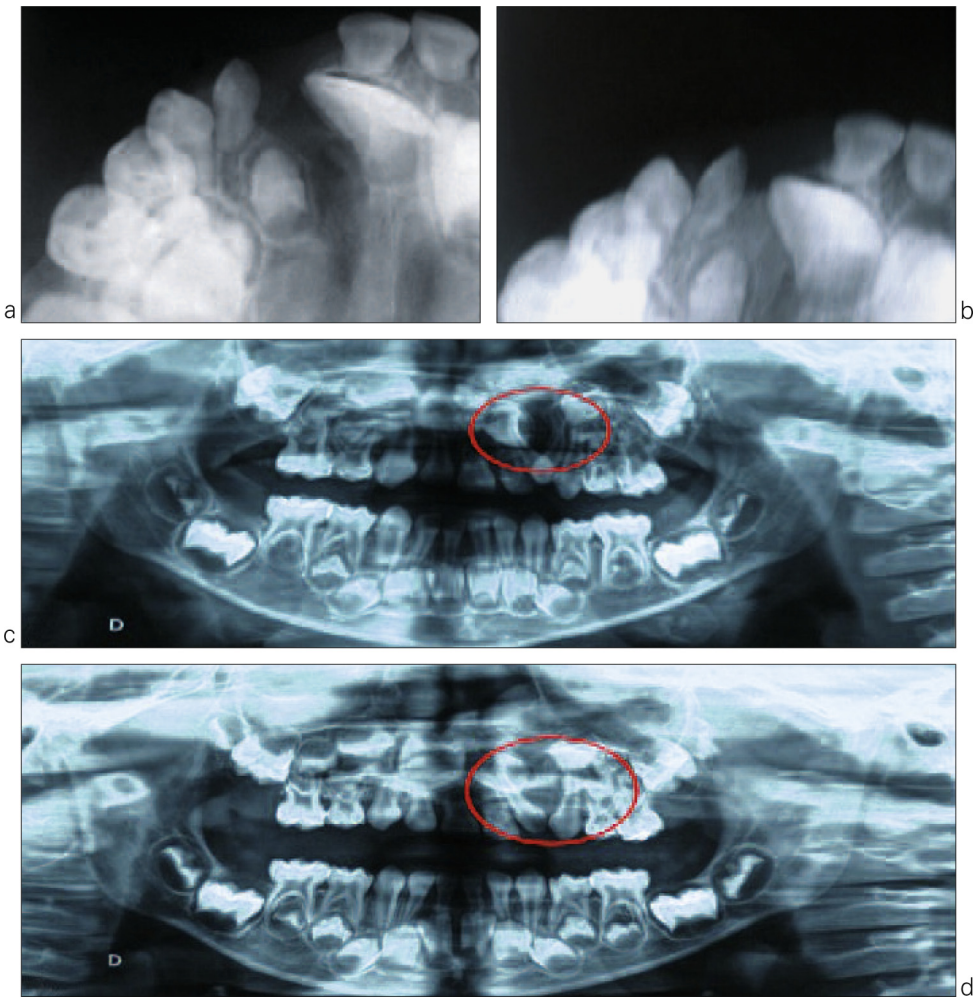
Many donor sites are available for harvesting material for grafts including cancellous bone from the iliac and tibia areas, cortical bone from the calvarium or the rib, membranous bone from the mandible, and endochondral bone from the tibia.

The choice of material for bone grafts should satisfy the objectives of achieving a maximum of osteointegration with a minimum morbidity.

A study led by Osaki[16] showed that the embryonic origin of the graft had no influence on the quality of osteointegration. Cancellous bone brings the best results in grafts serving to fill space. Surgeons most frequently employ cancellous bone to restore alveolar clefts. The prompt revascularization of cancellous bone and its rich supply of stem cells stimulate rapid integration at the site of the graft[4,9,16].

Iliac sites offer a generous supply of cancellous bone that has a low morbidity rate.

Other suitable sources for harvesting bone for grafts include symphyseal bone that has a low morbidity rate but very limited amounts of osseous material[23]; the tibia where there is a risk of damaging its epiphysis[10]; and the ribs, where there is a risk of causing pneumothorax while promising only relatively poor osteointegration in the alveolus[1].



Figures 1a to 1d
Spontaneous movement of teeth after a gingivoperioplasty and bone graft.
a and b: periapical radiographs showing rotation of an incisor after a bone graft;
c and d: panoramic films give another view of rotation of incisor.

5 – WHAT TECHNIQUE OF ALVEOPLASTY SHOULD BE USED?

5 – 1 – Periosteal grafts

These have the theoretical goal of bridging the maxillary osseous cleft with bone forming tissue so that the osteogenesis thus stimulated will unite the borders of the two separated maxillary segments. But the amount of bone creation stimulated by this procedure varies widely from patient to patient. Depending on the width of the cleft the surgeon can utilize a Skoog maxillary periosteal flap, a free periosteal graft taken from cranial

tissue as suggested by Beziat, or a periosteal graft taken from the tibia as Stricker has advocated[2].

5 – 2 – Sliding muco-periosteal flap

Surgeons usually make this type of flap by mesial sliding of the gingiva that covers the smaller segment. The incision is made further along. The sliding is made possible by an oblique buccal muco-periosteal incision in the molar region that has been left to heal after which a papilla can be adjusted mesially. This type of flap has the advantage of bringing attached gingiva to the graft and the necks of the adjacent teeth.

5 – 3 – Buccal rotation flap

With this technique, known as a finger flap, surgeons can cover the graft by rotating a mesial pedicle buccal mucosal tissue segment over it. This covering tissue will be supple, without tension, and will not lose periosteum from the smaller segment. But its essential disadvantage is adding free mucosa to a zone normally covered by attached gingiva that might lead to a labio-alveolar adhesion.

6 – EVALUATION METHODS

6 – 1 – Evaluation using panoramic and periapical X-rays

The Bergland scale[12] used in most studies, evaluates the restored interdental height (Fig. 2):

- grade 1: > 75% of the restored interdental septal height.
- grade 2: 50-75% of the restored interdental septal height.
- grade 3: < 5% of the restored interdental septal height.
- grade 4: absence of osseous continuity.

This scale overestimates the quantity of bone because it is only bidimensional and does not take into account differences at the heart of the graft.

Various authors have proposed other scales to improve Bergland's:

- the modified Bergland scale[12], which measures the height of the

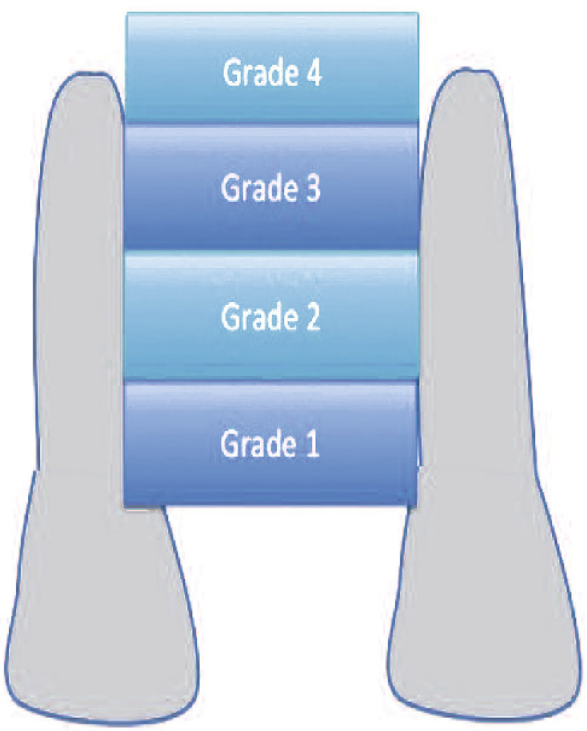


Figure 2
Diagram depicting the Bergland scale.

graft in relation to the occlusal level as well as the base level, at the piriform orifice. A measurement of the total height of the graft at the center of the alveolar cleft, in comparison with the contralateral side, completes this analysis;
- the Long scale[14] evaluates the height of the bone in the cleft and the height of supporting bone of adjacent teeth;
- the Witherow scale[25] evaluates the height of the bone on each side of the alveolar cleft.

All of the radiological scales overestimate the results of bone grafts[24], studies having included in this assessment the distortions inherent in superimposing images, and difficulties in discerning anatomic landmarks, all of which make accurate calculation of osseous volume impossible.

6 – 2 – Three-dimensional studies

Three-dimensional analyses using scanning or cone beam images, which, incidentally, emit 15 times less harmful ionizing radiation than traditional radiography, allow for a better estimate of residual bone and of its position and, in addition, provide valuable data for rehabilitation with implants (Fig. 3a to 3b).

In fact, on the same group of patients a bidimensual analysis deemed 90% of the cases to be grade 1 on the Bergland scale while in tridimensional analysis only 45% were judged grade 1[11].

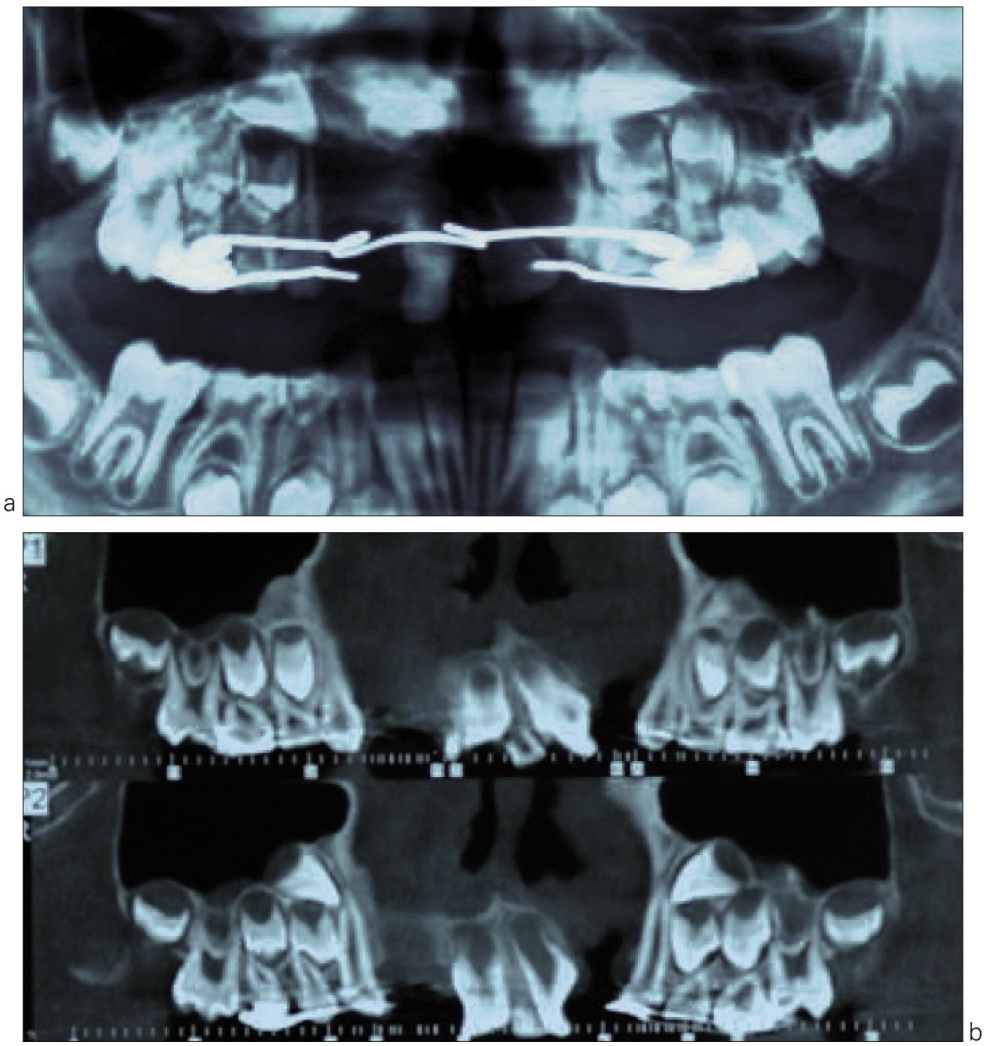
Overall, tridimensional analysis provides an excellent evaluation of the periodontal conditions of the teeth adjacent to the cleft, of their position, of the height of the bone graft and of its width, and clearly visualizes the site of an eventual osseous defect in the graft, information that can be a useful guide to later orthodontic treatment as well as a means of assessing the support available for a possible implant or the execution of orthognathic surgery.

7 – MANAGEMENT OF CLEFTS IN THE MAXILLO-FACIAL SERVICE OF THE ARMAND-TROUSSEAU CHILDREN'S HOSPITAL

7 – 1 – Review of the management schedule for labio-palatal clefts[17]

We perform the first surgical procedure for cleft palate patients when they are 3 to 6 months old by repairing their lips, noses, and soft palates.

We use Sommerlad's technique[21] to reconstruct the soft palate and Millard's method to carry out the cheilorhinoplasty. The second operation, which is scheduled to take place one year after the spontaneous partial closure of the hard palate cleft, allows for full closure on two planes of the nasal mucosa and the palatal fibromucosa, in the highly vascular zone. During these procedures the alveolar cleft is spared any surgical intervention, awaiting the gingivoperiostoplasty



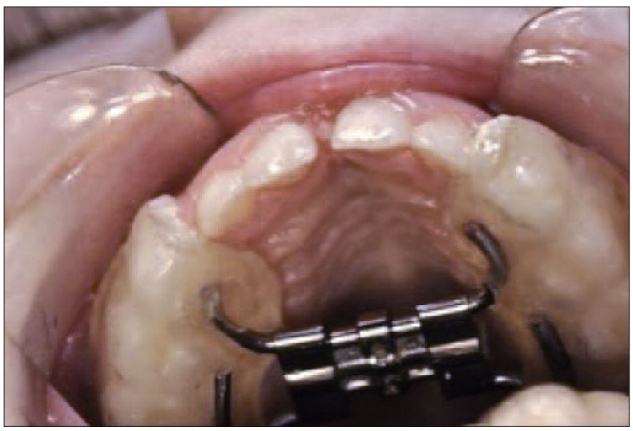
Figures 3a and 3b
Radiological discordance.
The panoramic film (a) shows a right side bone graft of grade 2 on the Bergland scale, while the cone beam classifies it as grade 3 (b).

associated with the graft, the final primary surgical intervention.

7 – 2 – Preoperative preparation

After dentofacial orthopedic expansion, when patients are 4 to 6 years old and in the primary dentition, we carry out the gingivoperiostoplasty and graft in a zone free of any scarring, after the primary graft but before eruption of permanent incisors.

Orthodontists partially correct the retruded smaller maxillary segment with expansion techniques, quad helix, or expansion screws on cemented bands or a plastic plate (Fig. 4a and 4b).

a   b

Figures 4a and 4b
Orthodontists use a quad helix or an expansion screw to correct the position of the smaller maxillary fragment.

After achieving a distance of 32 to 35 mm between maxillary canines, orthodontists use a removable quad helix as a retainer to protect the expansion gain until the surgical intervention can proceed. Cone beam and panoramic images are taken before and after surgery.

7 – 3 – Surgical technique (Fig. 5a to 5h)

The surgeon performs a gingivoperiostoplasty together with a graft.

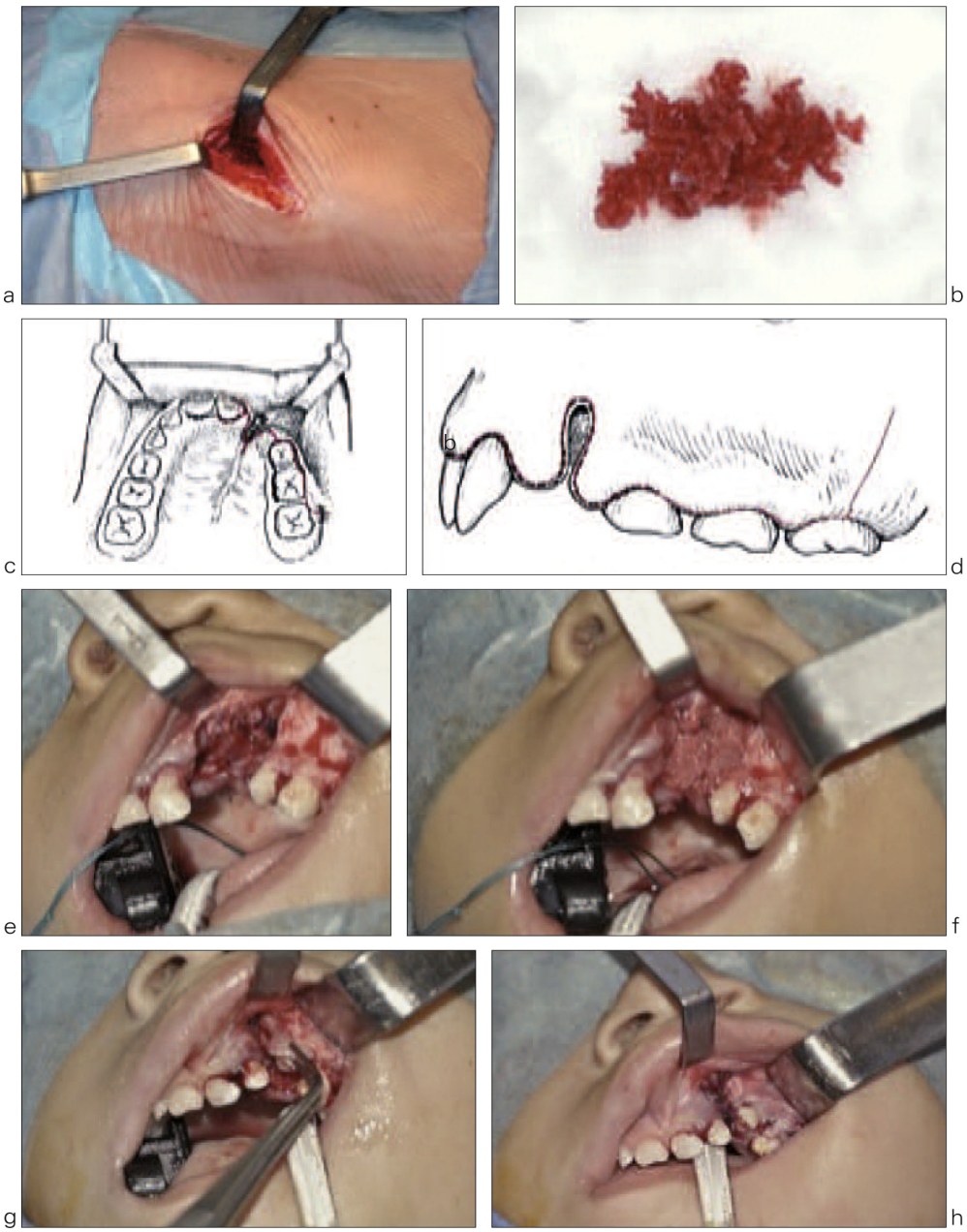
• Harvesting bone

Surgeons harvest iliac bone by making a 3 cm incision parallel to the iliac crest and offset so that the scar will be masked by even scanty clothing. They remove the bone using local anesthesia under a hinged external covering without detaching any abdominal muscle insertions.

• Gingivoperiostoplasty

For this, the surgeon makes an incision in the mucosa of the segments bordering the cleft, and then cuts around the necks of the teeth up to the molar region, the length of the small fragment. Then the periosteum is elevated carefully so as to avoid injuring the fine osseous pellicle that covers the teeth bordering the cleft. The incision is continued over all the height of the cleft up to the anterior nasal spine and the piriform orifice. The surgeon then elevates the nasal mucosa along the entire periphery of the cleft. On the palatal side this incision is made at the necks of the teeth. The surgeon then resects excess fibrous tissue as needed and reconstructs the nasal plane inclining the superior part of the cleft mucosa toward the nasal fossa, all under carefully controlled dryness.

Before inserting the graft, the surgeon determines that the closing flaps



Figures 5a to 5g
Surgical technique.
a and b: harvesting bone from the ilium where a substantial amount of cancellous bone is available;
c and d: sketches depicting the incisions made for the sliding flap;
d to g: operative photos of the sliding flap, placement of the graft, and closure in 3 planes protected from blood and saliva.

are well suited to cover the graft correctly and accept sutures that will require no tension. The surgeon inserts the initial sutures near the cheeks and then performs the palatal suturing. Then cancellous bone is placed in the cleft to fill any gaps and to obtain proper physiologic osseous volume. The surgeon then sews up the two flaps with meticulously placed sutures under no tension. Finally the interdental papillae are sutured together.

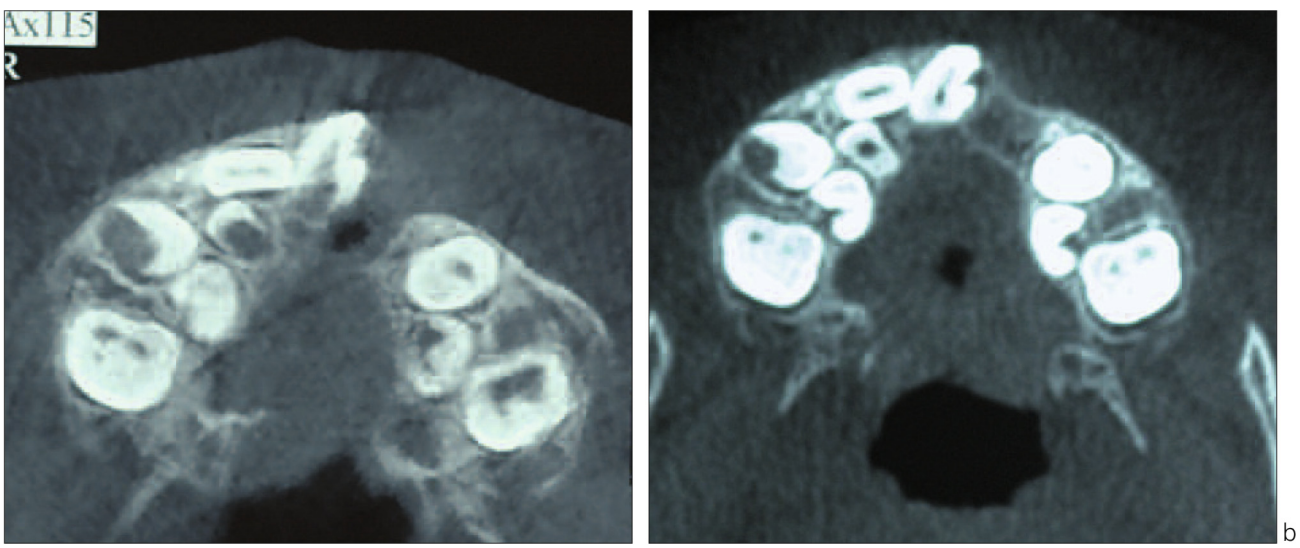
• Post-operative care

Patients waken from general anesthesia the day after their operation and are then perfused with level 1 and 2 analgesics like acetaminophen, antibiotics, and corticoids. They receive careful nursing care and rinsing of the oral cavity with sterile water, lavage of the nasal fossas with physiologic serum, and are fed with properly selected soft aliments. Their hospital stay usually lasts for four days.

7 – 4 – Post-operative evaluation

The patients are followed by:

– the surgeons who evaluate the healing of the operative site, looking for areas of osseous exposure and also monitor the iliac bone donor area to check for possible development of hematomas; the orthodontist who assesses stability of tooth alignment and monitors the status of the quad helix that serves as a retainer for six months;
– cone beam films, cephalograms, and panoramic X-rays 6 and 12 months and after the operation (Fig. 6b).



a b

Figures 6a and 6b
Preoperative cone beam image (a) then, at 6 months, an image of a left alveolar graft, in the framework of a total labio-palatal cleft (b).

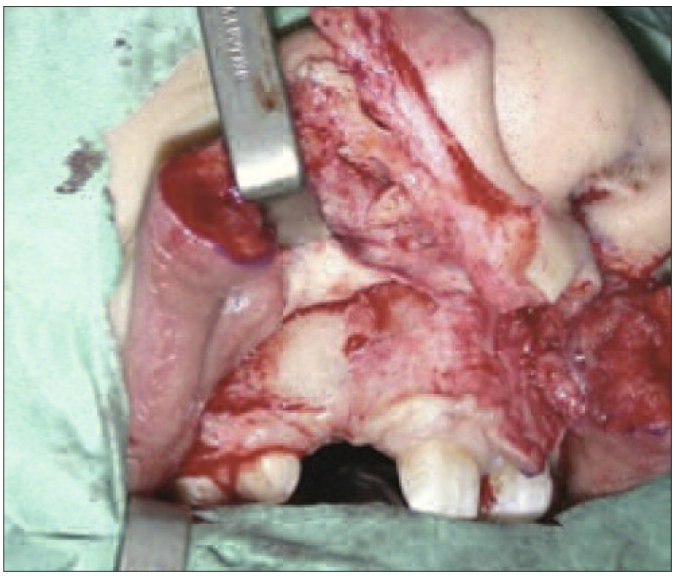


Figure 7
View of a graft, which a secondary surgical procedure has exposed, demonstrates its excellent integration with adjacent bone.

The cone beam film seems today to be the instrument of choice for evaluating the bone graft quantitatively. With it, at very low doses of radiation, practitioners can make a reliable three-dimensional analysis of the status of the graft. With it the practitioner can assess movement of dental buds and objectify the quantitative reinforcement of the graft when the lateral incisor erupts within it.

These secondary surgical procedures allow practitioners, in certain cases, to make an objective quantitative and qualitative evaluation of the graft that tissue retraction has made visible (Fig. 7).

8 – CONCLUSION

The execution of a gingivoperiosto-plasty in a zone free of any scarring reduces complications and allows for establishment of excellent quality periosteum and mucosa.

Placement of a primary graft facilitates spontaneous movement of teeth, lessening rotation of buds of central incisors, and eruption of lateral incisors when they are present.

Surgeons can harvest more than adequate amounts of cancellous bone with very low morbidity and excellent potential for osteointegration from iliac donor sites.

We are in the process of conducting a study of a large sample of patients with labio-palatal clefts who had grafts placed when they were in the deciduous dentition in accordance with our protocol.

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