Utilization of Surgical Trepan for the Obtainment of Calvarial Autogenous Bone Graft in Maxillary Reconstructions

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Maxillomandibular reconstructions are traditionally performed by means of autogenous bone grafts collected from intraoral donor areas and extraoral donor areas such as clavicle, iliac bone, rib, and tibia. The calvarial bone has been studied as an alternative donor area, with a low incidence of complications and minimal postoperative morbidity. Complications such as dural lacerations associated with cerebrospinal fluid leakage and extradural and subdural bleeding were minimized due to the use of surgical trepan, allowing the diploic layer delimitation before the osteotomy, preserving the internal calvarial cortical. The purpose of this article is to suggest a new technique for the obtainment of calvarial bone grafts with surgical trepan.

Key Words: calvaria, bone graft, technique

Introduction

The rehabilitation of oral functions after natural dentition loss is a complex and multidisciplinary problem.[1] Among the difficulties found, bone loss is the most important etiological factor to be overcome.[2] Bone loss is progressive; therefore, depending on the time period of the natural dentition loss, it is necessary to use bone reconstruction techniques to enable oral rehabilitation with osseointegrated implants. Several authors agree that the autogenous bone, because of its better revascularization potential, is the best choice for most bone reconstruction procedures.[3–5] During the past several years, autogenous bone has been widely used for facial reconstruction.[6] For extensive bone reconstructions, the most common donor sites are clavicle, iliac crest, rib, tibia, and, more recently, the calvarial bone. The use of the iliac crest has a significant rate of postoperative morbidity,[7] resulting in discomfort, paresthesia, severe pain, and locomotion difficulty, in addition to a higher resorption potential. Rib grafts are associated with pneumothorax, hematoma, and visible scars.[8] Extended hospitalization is common with both grafting procedures.

Use of the calvaria has several advantages,[9] such as (1) the ability to control postoperative pain with mild analgesics, (2)

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an imperceptible scar, (3) a brief hospitalization period, (4) low postoperative morbidity, (5) low incidence of complications, (6) the offer of good-quality bone, (7) and an observed lower rate of graft resorption when compared with other donor sites.[10,11] As for disadvantages, it is possible to mention (1) contiguous operative fields (mouth and calvaria) and the impossibility of simultaneous surgery, (2) the scar exposed by baldness, (3) local loss of hair, (4) local infection of the scalp, and (5) the risk of neurologic complications and epidural hematoma in the case of laceration of the middle meningeal artery and exposition or laceration of the dura mater meninges.[12] The present article discusses the application of calvarial bone for the reconstruction of atrophic jaws, restoring the quantity and quality of the recipient site, and enabling oral rehabilitation with osseointegrated implants. Moreover, the authors suggest a technique for obtaining calvarial bone grafts with surgical trepan, minimizing the sequelae.

Surgical technique

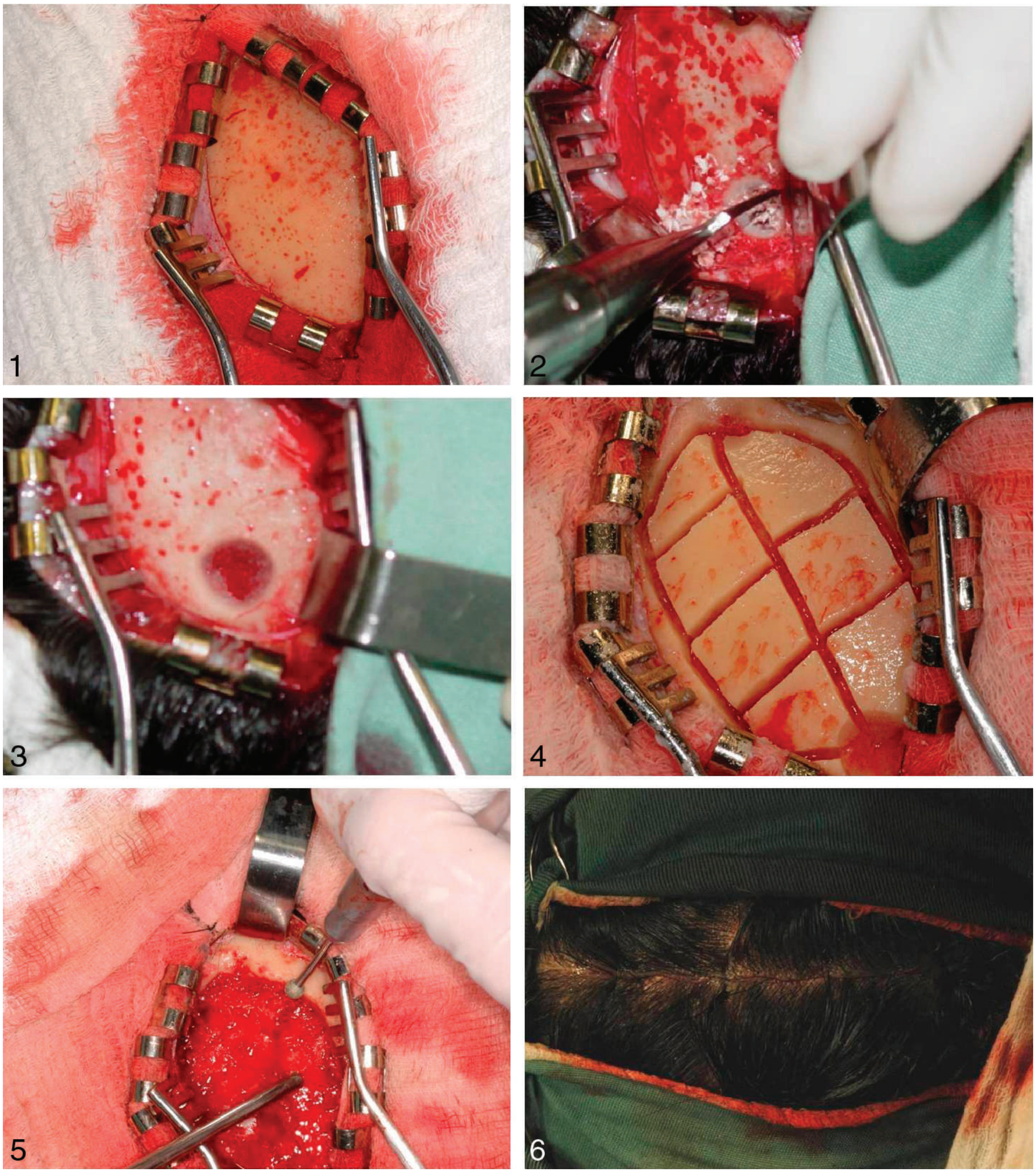
Presently, the elected donor site is the parietal bone. In this area, the diploe is thicker, thereby decreasing the risk of exposition or laceration of the dura mater. Scalp trichotomy is not mandatory; the hair is only divided, delimiting the incision area. Antisepsis is initiated with hair preparation with polyvinylpyrrolidone-iodine (PVP-I) or chlorhexidine, followed by topical application of PVP-I or chlorhexidine. Incision can be vertical or horizontal up to the pericranium, extending according to the desired amount of bone. Tissues are removed, and in the margins, clamps are used for hemostasis (Figure 1). After the desired bone area is exposed, the surgical trepan is used to determine the thickness of the calvaria external cortical (Figure 2); afterward, with the localized diploe (Figure 3), the osteotomy is performed with cone-shaped drills (no. 701 or 702). The desired bone area is delimited over its extension. The graft can be divided into smaller blocks to facilitate its removal, avoiding fractures and favoring the application and adaptation at the recipient site (Figure 4). A reduction can be performed in one of its margins, beginning with the blocks removal with curved and straight chisels and surgical hammer. The bone margin of the osteotomized donor site must be rounded (Figure 5), and the surgical wound must be copiously irrigated with physiological solution associated with an antibiotic, such as garamycin. Bleeding areas were buffered with bone wax, and the surgical flap was sutured by plans (Figure 6). Afterward, it is possible to work with the graft at the recipient site through bone blocks for application at the alveolar ridge (onlay) or through bone particles among the blocks for filling the maxillary sinus (sinus lift). After a period of 4 to 6 months of graft incorporation, the implant installation can be performed.

Discussion

Tessier[13] discussed several techniques for the removal and use of calvarial grafts. The author described the removal of both corticals and their division. One of them was used for the grafting procedure and the other for the donor site reconstruction.

Studies showed a superiority of the calvarial bone, which has an intramembranous origin when compared with the iliac bone, which has an endochrondral origin, for craniofacial reconstruction procedures.[10,14] The authors prefer the calvarial bone because of its lower tendency for resorption and lower postoperative morbidity caused by the donor site.

Endochrondral and intramembranous bones are rather different with regard to their architecture: while the intramembra-



Figures 1–6. Figure 1. Operative field obtained after incision and parietal flap. **Figure 2.** Trepan initial utilization for the localization of the internal cortical. **Figure 3.** Diploe area localized. **Figure 4.** Monocortical osteotomy and graft delimitation. **Figure 5.** Final osteoplasty of the donor site. **Figure 6.** Final suture.

nous bone is composed of 2 thick corticals with a thin cancellous layer between both of them, the bone with endochrondral origin presents a thin cortical, with a thicker medullar component.[15] Inside the cortical matrix is a higher mitogenic activity, high rates of osteocalcin, and low rates of osteonectin.[16,17]

Kusiak et al[11] demonstrated in an experimental study that the intramembranous bone is revascularizated more rapidly than the endochrondral bone. This characteristic suggests that a rapid revascularization occurs in the calvarial bone, followed by a slower resorption, contributing to the maintenance of its volume in the long term.

Ozaki and Buchaman[18] showed that the resorption does not occur in function of its embryologic origin; to the contrary, it is dependent on its microarchitecture.

Finkelman et al[19] also showed that the calvarial bone has significantly higher concentrations of growth factors (insulin-like growth factor II and transforming growth factor beta), than the iliac crest and rib. According to what was suggested, growth factors at the bones perform an important role in mediating bone repair, stimulating the compensatory bone formation after resorption. Therefore, high concentrations of growth factors in the calvarial bone suggest a higher repair capacity of this kind of graft.

Some factors make obtaining this graft difficult, such as the diploic venous lakes, common in younger patients, and the small thickness of the diploe in older patients.[20] The main complications reported in the literature are dural lacerations related to cerebrospinal fluid leakage, dural bleeding, and brain damage. Frodel et al[21] reported 121 cases with 18% of dura mater exposition, causing 6% of brain lesions. Perri et al,[20] utilizing the technique for graft obtainment with surgical trepan, reported 70 cases accomplished with 10% of dural expositions. Thus, it is possible to indicate reconstruction through a calvarial graft with surgical trepan, with higher safety and foreseeability, emphasizing lower postoperative pain, imperceptible scar, lower resorption, and better quality of the newly formed bone, which favors the initial primary stability of the osseointegrated implants.

Conclusion

The calvaria as a donor site offers a bone of high structural quality and promotes low resorption rates, favoring the implant installation in the atrophic maxilla and mandible. The bone can be collected with a low incidence of complications when accomplished by capable maxillofacial surgeons. The use of this obtainment technique with surgical trepan allows a higher foreseeability, minimizing complications and sequelae.

Disclosure

The authors have no financial interest in any company or in any of the products mentioned in this article.

Abbreviation

PVP-I: polyvinylpyrrolidone iodine

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