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Autologous Corticocancellous Bone Graft Viability After Reversed Placement

Ters Çevrilerek Yerleştirilen Otolog Kortikokansellöz Kemik Greftlerinin Yaşayabilirliği

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ABSTRACT

Objective: The aim was to present early and late period findings in patients who underwent reconstruction with corticocancellous bone grafts using the technique of inverting the cancellous side of the graft to the side with better blood supply.

Method: Patients repaired with corticocancellous bone grafts using this technique between 2018 and 2019 were retrospectively reviewed. The etiology and localization of the defects, the size of the bone graft, the type of soft tissue and early and late complications were documented. Six months later, bone scintigraphy was examined and the viability of the grafts was checked.

Results: There were seven patients with an average age 42. Three patients had maxillary, two mandibular and two frontal bones have defects with the sizes between 3x1.5 cm and 10x4 cm. Random flaps for coverage and plates for fixation were used in all patients except one. Graft fail occurred for one patient and bone reconstruction was postponed until after debridement. All grafts show osteoblastic activity on scintigraphy, except the patient with osteomyelitis.

Conclusion: Using the cancellous side of the corticocancellous bone grafts to be applied to the side where the blood supply is relatively better gives good results.

Keywords: autologous, bone graft, reversed, viability

ÖZ

Giriş: Kortikokansellöz kemik grefti ile rekonstrüksiyon yapılan ve greftin kansellöz tarafının daha iyi kanlanmaya sahip olan tarafa çevrilmesi yöntemi uygulanan hastaların erken ve geç dönem bulgularının sunulması amaçlanmıştır.

Yöntem: 2018-2019 yılları arasında alıcı bölgeye konarken ters çevrilerek kortikokansellöz kemik greftlemesi prosedürüyle onarımı yapılan hastalar retrospektif olarak incelendi. Defektlerin etiyolojisi ve lokalizasyonu, kemik greftinin boyutu, örtücü yumuşak doku tipi ve erken ve geç dönem komplikasyonlar araştırıldı. 6 ay sonra kemik sintigrafisi ile incelenerek greftlerin canlılığı kontrol edildi.

Bulgular: Yaş ortalaması 42 olan 7 hasta vardı. Üç maksilla, iki mandibula ve iki frontal kemiğin etkilendiği 3x1,5 cm ile 10x4 cm arasında değişen defektler mevcuttu. Biri hariç tüm hastalarda kapama için random flep ve tespit için plak kullanıldı. Bir hastada greft enfekte oldu ve resorbe oldu,debridman sonrası kemik rekonstrüksiyonu planı ertelendi. Bu hasta dışındaki tüm greftler sintigrafide osteoblastik aktivite gösterdi.

Sonuç: : Kan akımının nispeten daha iyi olduğu tarafa kansellöz tarafı çevrilerek uygulanmış kortikokansellöz kemik greftlemesi uygulaması, kemik greftinin sağlamlığı ve yaşayabilirliği açısından iyi sonuçlar vermektedir.

Anahtar Kelimeler: kemik grefti, otolog, ters çevrilmiş, yaşayabilirlik

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INTRODUCTION

Bone defects can cause both functional and cosmetic deficiencies. Neurocranial defects expose the brain tissue to potential harm and cosmetic problems occur mostly in facial bone defects. Bonedefects can be encountered frequently, especiallyin the head and neck region, due to congenital deficiencies, trauma, infection and cancer (1-3).

Cancellous bone grafts have high osteoconduction, osteoinduction and osteogenesis capacities, cortical bone grafts have less but exhibit better load-bearing capacity (4). Thus corticocancellous bone grafts can provide the relevant combination in terms of both load-bearing and osteogenetic capacity. Bone reconstructions can be performed with non-vascularized bone grafts for small defects. However,as the size of the defect to be reconstructed increases, the risk of resorption and infection increases (5). Therefore, the use of vascularized bone flaps and other alloplastic materials is recommended. In order to increase the viability of non-vascularized bone grafts it is possible to apply them in smaller multi-piece or powder form (6,7). rather than in block form. These multi-piece or powder grafts can be expanded to the surface areaby drilling holes or other similar methods (7), and stem cell applications such as growth factors and platelet rich plasma (8) can be applied.

The aim of this study was to present early and late period findings in patients who underwent reconstruction with corticocancellous bone grafts using the technique of inverting the cancellous side of the graft to the recipient tissues with betterblood supply.

MATERIAL AND METHODS

Patients who had bone defects in the head and neck region repaired with corticocancellous bone grafts originating from the iliac bone between 2018 and 2019 were retrospectively reviewed. All patients were informed before bone grafting and informed consent was obtained prior to this stage. Among these, some patients had received corticocancellous grafts with the cancellous region positioned so that it was in contact with recipient tissues with better blood supply. The etiology of the bone defects of the patients, localization of the defects, the size of the bone graft taken, the type of soft tissue covering the graft, and early and late complications were documented. The patients were followed for at least one year, and six months later, bone scintigraphy was examined and the viability of the grafts was checked.

RESULTS

A total of seven patients, including four men and three women were included in the study. The average age of patients was 42 years. When the defective areas requiring bone grafting were examined, two maxillary, three mandibular and two frontal reconstructions were needed. The smallest bone defect size was 3x1.5 cm and the largest defect size was 10x4 cm. While the largest size of the autologous bone grafts used as one piece was 4x2 cm, the total size of the grafts used in multiple pieces was a maximum of 10 x 4 cm. Soft tissue coverage over the bone was random flaps in all patients, except one. A plate was used for fixation in all patients, except one. In one patient with osteomyelitis reinfection and resorption occurred and debridement was performed for infection control while bone reconstruction was electively postponed. Apart from this, no early or late complications were encountered (Table 1). The stages and results of surgical procedures of two of the cases are summarized below.

Case2

A 79-year-old female patient was evaluated for squamous cell carcinoma in her right infraorbital region. The patient had no comorbidity. No palpable lymph node was observed on physical examination, and pathological lymphadenopathy was not reported radiologically on ultrasonographic examination. Maxillary bone invasion was not seen on computerized tomography but it was reportedthat the bone tissue was thinned in the area closeto the infraorbital region. When it was seen that the mass was adjacent to the bone and passing through the periosteum perioperatively, it was decided to resect the bone tissue at the site of tumor invasion

Table 1 : The characteristics of patients, autologous bone grafts and flaps.

Case	Age	Aetiology	Anatomic Region	Graft Size	Soft Tissue Coverage	Fixation Technique	Follow up Time (Months)	Complication
1	32	Odontogenic Cyst	Maxillar bone (lower)	2.5x3	Random	Plate	21	-
2	79	SCC	Maxillar bone (upper)	3x3	RFFF	Plate	50	-
3	43	Trauma Nonunion	Frontal bone	4x2	Random	Plate	32	-
4	26	Trauma (lost of bone)	Frontal bone	10x4 (Multi piece)	Random	Plate	15	-
5	37	Trauma Nonunion	Mandibular bone	3.5 x 2.5	Random	Plate	26	-
6	35	Intraosseoshemangioma	Nasomaxillar bone	4x2	Random	Plate	38	-
7	44	Osteomyelitis	Mandibular bone	3x1.5	Random	Screw	8	Reinfection and graft resorbtion

and resect and sacrifice the infraorbital nerve with the mass. Approximately 3x3cm of bone tissue was resected from the upper half of the maxillary bone with the infraorbital rim. Right, modified, radical supra-omohyoid neck dissection was performed prophylactically for the tumor, which was accepted as T4 due to suspicion of bone tissue invasion. The 3 x 3 cm corticocancellous bone graft, takenfrom the right iliac bone, was fixed with titanium plates and screws by inverting the compact bone face towards the sinus. The soft tissue coverage wasapplied with left radial forearm free flap, for which the right superior thyroid artery and vein were selected as recipient vessels (Figure 1).

Figure 1 : Pre-operative view of a 79-year-old female patient, Case-2, due to squamous cell carcinoma in the right infraorbital region. (Left) 3 years after the operation. (Right)

The operation lasted six hours and the patient was followed up in the Intensive Care Unit for one day postoperatively. In the early period, no circulatory disorders and signs of infection were observed in the wound areas. Histopathological examination was positive for bone invasion and negative for infraorbital nerve invasion. The histopathological examination of the supra-omohyoid neck dissection material reported all of the 24 lymph nodes as reactive. In the oncological follow-up, the patient was followed up without the need for complementary therapy, and no recurrence was encountered by the fourth year. The bone graft in the upper half of the right maxillary bone was found to be viable on bone scintigraphy in the third year. (Figure 2).

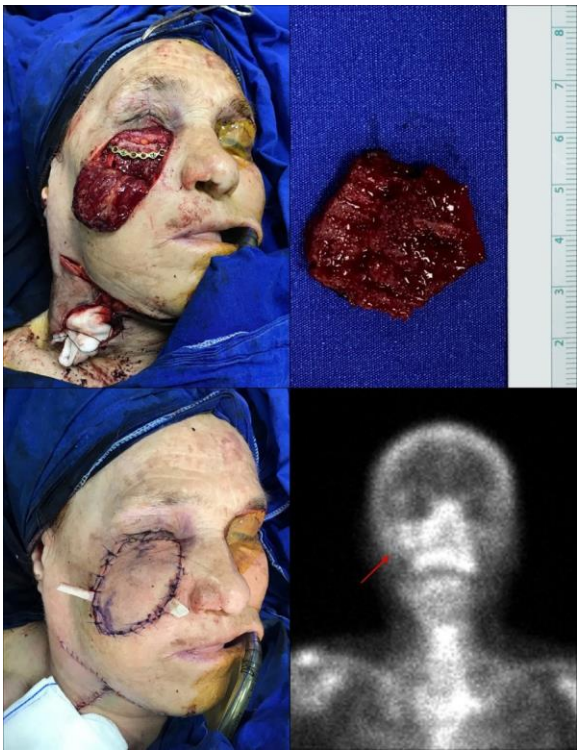

Figure 2: The view of Case 2 is seen after shaping the autologous bone graft by inverting and fixing it with plate screw and before covering with the free flap (Above left). Corticocancellous bone graft harvested with the dimensions 3x3 cm (Above right). The view after completion of the maxillary area reconstruction and neck dissection (Below left). The increase in osteoblastic activity (marked with an arrow) at the upper right maxillary level is observed on bone scintigraphy, three years after the operation (Below right).

Case 4

A 26-year-old male patient with a history of intracranial hemorrhage after a traffic accident in the past was evaluated. His left frontoparietal bone tissue was removed due to comminuted fractures and cerebral edema. On physical examination, it was observed that there was a large bone defect of 10 x 4 cm in the left frontotemporal region and that the defective area had a depth of 2 cm at the deepest compared to contralateral side. On computerized tomography, it was seen that the bone tissue in the relevant area was completely defective and there was cerebral tissue on the ground (see Figure 3).

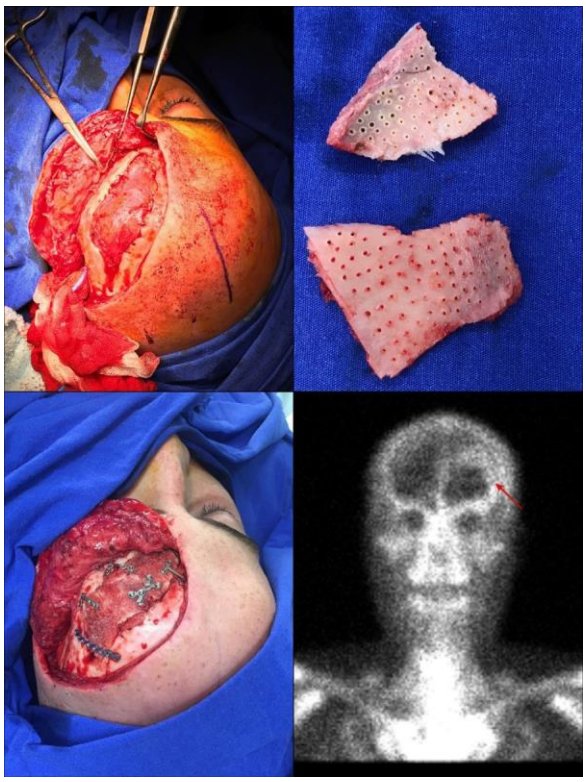

Figure 3: A 26-year-old male patient (Case-4), after a traffic accident five years previously, showing a collapse in the left frontoparietal region due to a bone tissue defect with a width of 10 x 4 cm, seen from different angles (Left). First year view after reconstruction of the bone defect seen from different angles (Right).

The cancellous parts of the corticocancellous grafts taken from bilateral iliac bones were inverted to the side of the skin flap, and the defect was repaired with two pieces of graft, and fixation was achieved with titanium plates and screws. The operation lasted three hours and the patient was followed up in the ward postoperatively. No signs of circulatory disorder or infection were observed in the early period. In the late period, it was observed that the bone remained stable and healing was fully achieved. It was reported on bone scintigraphy, performed one year after the operation, that the autologous iliac grafts were viable and gave signals suggesting osteoblastic activity (Figure 4).

Figure 4: Exploration of the defect in Case 4 during surgery (Above left). The appearance of two corticocancellous bone grafts obtained from the iliac bone is observed. Bone grafts were drilled with a motor-drill to increase the contact surface (Above right). The inversion and fixation of the cancellous parts of the bone grafts to the scalp flap side is shown (Below left). On scintigraphy one year postoperatively, osteoblastic activity in the left frontoparietal region was observed (Below right).

DISCUSSION

Autogenous bone grafting is the gold standard method in bone reconstructions (9). Other methods are titanium meshes, cadaver-derived bones, porous-polyethylene and other allografts (4). It is known that bone grafts and flaps are superior to these materials. However, their use is more rational in cases where autogenous bone grafts cannot be applied. Usually, donor sites of bone grafts are iliac bone, fibula, rib and calvarium (4,10,11). The iliac donorsite has minimal morbidity and the highest ease of application, proportional to the size of the graft taken(10).

Bone grafts are harvested as cortical bone, cancellous bone and corticocancellous bone grafts. It is recommended to have a cortical component in places that require strength. Cancellous bone, which is more dense in terms of stem cell content and is a source in bone production, can be harvested alone or used with cortical bone grafts (4). It is thought that turning the cancellous face into the area with more blood flow supply can give good results, while transferring corticocancellous bone grafts to the recipient site. The surface area of the cancellous face of the graft, which is turned in the direction of the area of high vascularity, is wider than the cortical face of the graft. In addition, the greater concentration of osteogenic factors and mesenchymal progenitor factors on the cancellous side supports the idea of graft inversion.

Autogenous bone grafts have a higher chance of success when used for defects smaller than 6 cm (12). In addition to the transferable size of the graft, good vascularity of the recipient area is importantin the long-term viability of the graft. It is thought that placing a large bone graft in a defect with poor vascularization or for which radiotherapy is foreseen in the postoperative period would have a high risk of infection and resorption. Therefore, the use of vascularized bone grafts will be more advantageous in terms of avoiding resorption and should be planned on a patient by patient basis for large defects.

Autologous bone grafts have some limitations. These are: donor site morbidity; limited harvested graft size; and suitability of the patient's donor site. Postoperative pain may occur, especially after the iliac bone originated graft removal (13). There are studies reporting conflicting findings in terms of the effectiveness of postoperative donor site analgesia applied for two days (14,15). However, after four years of follow-up, a significant increase was observed in the satisfaction of the group receiving analgesic treatment (16). In the patients included in this study, 0.5% concentration of bupivacaine was applied intermittently to the donor area with 5cc push applications every six hours for 36 hours. While the patients defined minimal donor site pain in the early period, they did not complain of any discomfort in the late period. Major complications, such as neurovascular injury, deep infection and fracture after the procedure inthe iliac bone donor site, are reported to occur at a rate of 5.8%, and minor complications such as superficial infection or seroma are around 10% (17). Smokers and high body mass index increase the risk of complications (18). Two patients in the study had a smoking habit. One of them was a patient with a diagnosis of osteomyelitis, and graft loss occurred due to infection in the recipient site. However, none of the patients had a problem in donor site recovery.

Another advantage of fixing the cortex of the grafts by turning them to the side with relatively less blood supply is thought to be the advantage that the smoothness of the bone surface can provide. For example, as in Case 2, the cortical part of the corticocancellous bone graft was turned into the maxillary sinus and the radial forearm free flap, which has a good blood supply from the facial artery, touched the cancellous part. At the same time, by protecting the mucosa of the maxillary sinus, the contact surface of the mucosa became the cortical face, which is relatively flat compared to the cancellous face. A similar situation has been applied in neurocranium reconstruction, as in Case 4, and the cancellous face was turned to the side of the random scalp flap. Osteoblastic activity was observed in bone grafts in late period scintigraphy images, although the maximum size reached around 13 cm in width.

This study is a relatively small case series and therefore the evaluation results cannot provide sufficient data, which is a limitation of this study. Therefore, larger sample sizes would be necessary to compare the success of this method with anatomically placed bone grafts in comparison studies.

Conclusion

Bone defects are both functional and cosmetic problems that can occur after trauma, tumor and infection. In autogenous bone grafting, which is the first choice in bone reconstruction, the choice of fixing the cancellous side of the corticocancellous bone graft to the side with the best blood supply appears to give good results.

Conflict of Interest

There is no conflict of interest.

Financial Support

No financial support was received.

Ethics Committee Approval

Ethical approval was obtained the Local Ethics Committee (Protocol No: 2020-2896) and the Ministry of Health for this study.

Informed Consent

This a retrospective study. Informed consent forms were obtained from all patients for this study.

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