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USE OF AN INLAY-INTERPOSITIONAL PEDICLED FIBULAR GRAFT FOR THE TREATMENT OF NON-UNION OF ALLOGRAFT FRACTURE OF THE TIBIA

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Nonunion of tibial fractures is a challenging problem that often necessitates the use of bone grafts. Cancellous, orticocancellous, vascularized, and nonvascularized pedicled and free grafts and flaps have been described. Cadaveric allografts have made it possible to bridge bony defects and to salvage extremities in patients in whom tumors have been resected, but the fracture rate is high (15 to 45 percent), and the graft is prone to nonunion because of antigenicity, resorption, and impaired healing. Allograft exchange, fracture reduction and closed fixation, amputation, and vascularized bone grafts have been also used for the treatment of allograft fractures.
In this report, we describe the successful use of an interpositional vascularized fibular graft for the treatment of tibial fracture nonunion after a failed allograft in a patient with a history of osteosarcoma of the left tibia.

Key words: *fibular flap / graft, allograft nonunion and fracture.*

Tibia allograft kırığı sonucu gelişen non-union (kaynamama) tedavisinde interpozisyonel pediküllü fibula flebinin her iki kırık ucu içerisine yerleştirilerek kullanılması

Tibia kırıkları sonrası gelişen nonunion (kırık kaynamaması) önemli bir problem olup sıklıkla kemik greftlerinin kullanılmasını gerektirir. Bu amaçla vaskülarize (pediküllü yada free flap olarak) ve vaskülarize olmayan kanselöz, kortikokanselöz kemik greftleri tamımlanmıştır. Tümör nedeniyle rezeksiyon yapılan hastaaaların ekstremitelerini kurtarmak ve oluşan kemik defektlerini kadavra allogreftleriyle rekonstrükte etmek mümkündür. Ancak bu durumda fraktür oranı % 15 - 45 gibi yüksek olup; ayrıca bu allogreft antijenitesi, rezorpsiyonu ve yetersiz iyileşmesi gibi nedenlerle kaynamanın oluşmamasına da eğilimlidir.
Allogreft kırıklarını tedavisinde; allogreft değişimi, kırık redüksiyonu, kapalı fiksasyon, amputasyon ve vaskülarize kemik greftleri kullanılmıştır.
Bu bildiride, sol tibiasında osteosarkom nedeniyle kadavra alloggrefti uygulaması sonrası travmaya sekonder gelişen tibial allogreft fraktürü ve non-union tedavisinde interpozisyonel vaskülarize fibular greft kullanımının başarılı olduğu sunulmuştur.

Anahtar kelimeler*: fibular flap / graft, allograft nonunion and fracture*

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Reconstruction of skeletal defects in long bones after cancer resection is a difficult and challenging task.[1-6] Since the 1970s, allograft bone transplantation has become an established technique. [7-9] Graft healing is due to the callus formation derived from a host bone and the periosteum. Remodeling at the allograft is very slow, and while the deep portions of the graft retain its architecture, soft tissues of the host surrounding the allograft become attached by deposition of a thin seam of new bone on the surface of the graft. [7-15] Allograft fracture is common, and occurs in 15 to 45 percent of cases within an average of 2 years from the time of implantation. [5,8-10] Fractures generally occur ın cases of tumor. Marginal wide resection of bone and soft tissue, irradiation, and chemotherapy contribute to this high incidence of fractures. These fractures are prone to nonunion because of the impaired healing potential of the allograft. One strategy to improve healing is to brid e the fracture with vascularized autologous bone combined with rigid fıxation. [8-17] In this case g report, we describe the successful use of an interpositional vascularized fıbular graft for the treatment of tibial fracture nonunion through allograft.

CASE REPORT

A 44- year-old woman sustained a traumatic open left tibial fracture 2.5 years following treatment for osteosarcoma by segmental resection and immediate reconstruction with a cadaveric tibial allograft (Figure.1). The fracture involved the allograft and was treated by internal fıxation and a non-weight-bearing cast in an other center. After 6 months, persistent nonunion was still present (Figure.2). It was elected to reoperate and amend to salvage the extremity. The fracture was exposed, and the reviously placed hardware and loose fragments of bone were removed. There was no evidence of ınfectıon or tumor recurrence. A fıbrous reactive capsule was present around the allograft with evidence of revascularization only at the host-graft junction. The distal medullary canal of the allograft was reamed to aproximately 10 mm, and an ipsilateral proximally based fıbular graft of about 7 cm in length was mobilized and inserted into the medullary canal with overlaps of approximately 10 mm in the host tibia and 20 mm in the

Figure 1. Traumatic open left tibial fracture in a 44 years old woman 2.5 years after treatment of osteosarcoma by segmental resection and immediate reconstruction with a cadaveric tibial of allograft is resent six months after initial debridment and internal fıxation.

Figure 2. The non-unıon site at the time of secondary debridment, and pedicled vascularized fıbular graft transfer. Bone sequestration can be seen.

allograft (Figure. 3). Iliac crest cancellous bone graft was harvested and packed around the fibula and at the distal and proximal junctions.

Durin the postoperative period, the patient was kept in a non-weight-bearing cast for 8 weeks after which a short lower-extremity cast was used. Following sufficient bone healing at 6 Months, the cast was removed, and the patient was allowed progressively weight-bearing (Figure. 4a,b) mo ', Follow up has continued for 28 months.

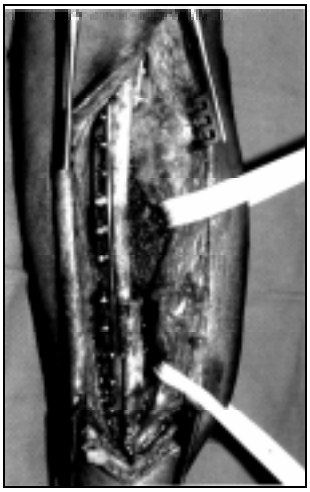

Figure 3. A proxima11y based fibular graft is used to bridge the bony defect after removal of part of the allograft. The fibulais inserted into the medullary canal with an overlap of approximately 10 mm in the host tibia and 20 mm in the allograft.

DISCUSSION

Since the 1970s, allografts have ained increasing credence as replacements for large skeletal , segments and as a means of restoring anatomy and furıctions. [9-13] Allografts have several advantages over autografts, including that they are easy to obtain and store for a long time, they can be cut to the required size to fıt the defect, and they can restore articular surfaces and resected joints. They are, however antigenic and have been associated with a high rate of complications, especially fracture and infection. [l,7,9,11-16] Compared with a conventional fracture, healing between an allograft and host bone proceeds at a slower rate and remodeling is incomplete. The diaphyseal osteosynthesis requires an average of 9 months for healing, regardless of the technique of fıxation. [l,7,9,11-14] No factor could be time indentifıed that consistently influenced or allowed prediction about the time needed for the diaphyseal ıde junctions to heal.

Because the allograft is very sensitive to stress, fractures may occur with minimal trauma, and most of the fracture lines involve one or two of the screw holes or a defect in;the allograft. [l4-17] In our case, the fracture was located through one screw hole and failed to heal after the initial treatment.

The best management of allograft fracture is not clear. Management depends on the condition

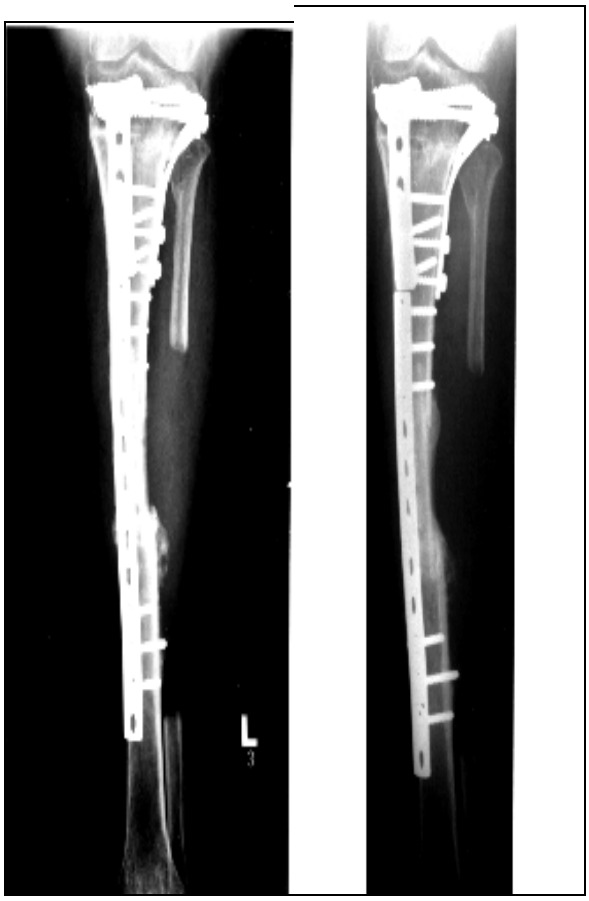

Figure 4. Postoperative radiogram showing bone healing six (a) and twenty-eighth (b) months after flap transfer.

and functional status of the allograft, the location of the fracture, the status of the underlying disease, and the wishes of the patient. These factors influence whether closed treatment, repeated internal fıxation and implantation of autogenous bone, arthrodesis, arthroplasty, or replacement of the allograft should be recommended. However, when fractures occur through the shaft of the allograft, the allograft is often must be replaced because of the limited intrinsic healing potential and the poor quality of allograft. [7,9,1l-15] Tibial nonunion is a complication of allograft implantation and fracture. It is defıned as a condition in which the fractured fragments do not heal in 6 months without additional intervention by the surgeon. [l-6] Once a surgeon

has diagnosed a nonunion, predisposing factors of the nonunion must be identified and, if possible, eliminated. Optimum treatment includes rigid fixation in a satisfactory position, bone-to-bone contact, and a well-vascularized soft tissue envelope. [1-5] Achieving as many of these goals as possible, while avoiding factors that predispose to nonunion, allows the greatest chance of successful healing.[1-6] Delay in revascularization is one of the predisposing causes of fracture and nonunion,[13-15] and if the first open reduction and internal fixation with autogenous graft fails, it is reasonable to use vascularized bone.[10,13-17] In our case, we preferred to keep the allograft remnants after exploration and debridement of bone debris and to bridge the gap with the vascularized ipsilateral fibular graft. We elected to insert both ends of the graft inside the allo raft remnants following enlargement of the medullar diameter, in order to achieve more bone to bone contact. Because technical aspects of internal fixation play a very important role in allograft operation, [1,10,13-15] we packed iliac cancellous bone around the junction and graft to promote healing.

Although we performed this operation in only one case, it shows that the vascularized fibular inla graft can successfully be used to correct the tibial nonunion through allograft fracture.

REFERENCES

1. Ward, W. G., Goldner, R. D., and Nunley, J. A. Reconstruction of tibial bone defects in tibial nonunion. Microsurgery 1 l: 63, 1990.
2. Shapiro, M. S., Endrizzi, D. P., Cannon, R. M., and Dick, H. M. Treatment af tibial defects and nonunion using ipsilateral vascularized fibular transposition. Clin. Orthop. 296: 207, 1993.
3. A1-Zahrani, S., Harding, M. G., Kremli, M. et al. Free fibular graft still has a place in the treatment of bone defects. Injury 24: 551, 1993.
4. Yajima, H., Tamai, S., Mizumoto, S., Inada, I. Vascularized fibular grafts in the treatment of osteomyelitis and infected nonunion. Clin. Othop. 293: 256, 1993.
5. Malizos, K. N., Beris, A. E., Xenakis, T. A. et al. Free vascularized fibular graft: A versatile graft. for reconstruction of large skeletal defects and revascularization of necrotic bone. Microsurgery 13. 182, 1992.
6. Taylor, G. I. The current status of free vascularized bone grafts. Clin. Plast. Surg. 10: 185, 1983.
7. Enneking, W. F., and Mindell, E. R. Observations on massive retrieved human allograft. J. Bone Joint Surg. 73-A: 1123, 1991.
8. Lord, F., Gebhart, M. C., Tomford, W. W" Mankin, H. J. Infection in bone allograft. J. Bone Joint Surg. 70-A: 369, 1988.
9. Mnaymneh, W., and Malinin, T. Massive allograft in surgery of bone tumors. Orthop. Clin. North Am. 20: 455, 1991.
10. Griffiths, H.J., Anderson, J. R., Thompson, R. C., Amudson, P., and Detlie, T. Radiographic evaluation of the complications of long bone allograft. Skeletal Radiol. 24: 283, 1995.
11. Brien, E. W., Terek, R. M., Healey, J. H., Lane, J. M. Allograft reconstruction after proximal tibial resection for bone tumors. Clin. Orthop. 323: 116, 1996.
12. Stevenson, S., Shaffer, J. W., Goldberg, V. M. The humoral response to vascular and nonvascular allograft of bone. Clin. Orthop. 323: 86, 1996.
13. Stevenson, S., Li, X. Q., and Martin, B. The fate of cancellous and ' cortical bone after transplantation of fresh and frozen tissue-antigen-matched and mismatched osteochondral allografts in dogs. J. Bone Joint Surg. 73-A: 1144, 1991 .
14. Berry, B. H., Lord, F., Gebhardt, M. C., Mankin, H. J. Fractures of allografts. J. Bone Joint Surg.72-A: 825, 1990.
15. Thompson, R. C., Pickvance, E. A., Garry, D. Fractures in large-segment allografts.J. Bone Joint Surg. 75-A: 1663, 1993.
16. Tomford, W. W., Thongphasuk, J., Mankin, H., Ferraro, M. J. Frozen musculoskeletal allografts. J. Bone Joint Surg. 72-A: 1137, 1990.
17. Minami, A., Kutsumi, K., Takeda, N., Kaneda, K. Vascularized fibular graft for bone reconstruction of the extremities after tumor resection in limb-saving procedures. Microsurgery 16:56, 1995.