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Vascularized Bone Autograft for the Treatment of Chondroblastoma of the Talus at Imminent Risk of Joint Breakdown: Three Case Reports

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ABSTRACT

Surgical treatment options in a chondroblastoma of the talus breaching the subchondral layer with imminent risk of talar collapse in the weightbearing area are limited. A joint-preserving surgery should be advocated. Because current treatment options such as curettage, cryosurgery, or radiofrequency ablation may not be able to prevent a talar dome breakdown in large defects, nonvascularized bone grafting has been advocated to fill the void. To overcome the lack of vitality, a vascularized bone autograft might be an attractive alternative. We present 3 cases where a large talar defect owing to a chondroblastoma was treated with a vascularized bone autograft. In 1 of the cases, a free microvascular iliac crest bone graft was used, whereas in the other 2 cases, a vascularized graft was harvested from the medial femoral condyle. Computed tomographic scans demonstrated a stable incorporation of the graft in all cases. All patients were highly satisfied with the obtained results and showed a clinical functional outcome similar to the contralateral foot after 36, 60, and 72 months. At the latest radiographic follow-up, no evidence of recurrence was observed. In conclusion, a free vascularized bone autograft can be used to treat a large talar defect owing to chondroblastoma in young patients.

Chondroblastoma is a rare, benign bone tumor with a prevalence of 1% to 3% of all primary bone tumors and was originally described by Codman (1) in 1931 as “epiphyseal chondromatous giant cell tumor of the proximal humerus.” As many as 20% of all chondroblastomas are found to be in the bones of the foot, where the talus is affected in almost one half of the cases. Although it is described as a clinically nonaggressive tumor, rarely becoming metastatic (2–4), major concerns for foot and ankle surgeons remains the outcome of these lesions, especially with regard to osteoarthritis (5–7).

The literature focuses mainly on recurrence rates after treatment. Treatment options include intralesional curettage with or without grafting (8–11), high-speed burring and packing (12) with polymethylmetacrylate, cryosurgery, or radiofrequency ablation (13, 14). Even talectomy has been advocated for a massive chondroblastoma of the talus with good results, but a stiff hindfoot (15). Unfortunately, no consensus exists with regard to the operative treatment of large talar defects caused by chondroblastomas. In these cases, the most important challenge the surgeon may be faced with is the substantial hazard of articular collapse.

Fink et al (8) observed that subchondral fractures were present in 45% of the lesions involving the talus. Thus, pathologic subchondral fractures of the foot in association with chondroblastomas are, in contrast with other areas of the body, more frequent. Early surgery is advised to preserve the ankle and subtalar joint in these cases. Because current treatment options may not be able to prevent a talar dome breakdown of large defects, bone grafts have been used to fill the void. However, grafts lack strength and vitality; thus, they may not ensure sufficient support to prevent a breakdown of the joint and may not allow for the incorporation of the remaining subchondral bone with its cartilage layer. Alternatively, a vascularized graft might overcome this potential risk, while acting as a structural support that enhances local vitality and thus ensures articular surface salvage (16). To our knowledge only 1 case of a chondroblastoma of the foot treated with a vascularized bone graft is reported in the literature (17).

We present 3 cases treated between May 2009 and August 2012 with a vascularized autologous bone graft to salvage the ankle and subtalar joints in an extensive defect of more than one third of the talar body or neck caused by a chondroblastoma.

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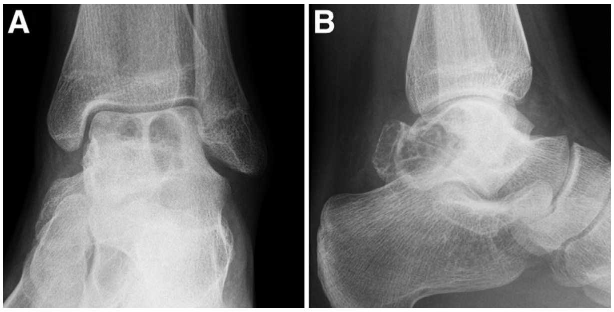

Fig. 1. Preoperative radiographs. Anteroposterior view (*A*) and lateral view (*B*).

Case Reports

Case 1

A male, age 15 years, was referred to our institution with a 3-month history of left ankle pain. The pain was described as sharp and localized on the posteromedial aspect of his ankle joint. The patient reported intermittent pain after playing soccer for several months without a history of an acute trauma. Immobilization and physical therapy were not successful. On physical examination, tenderness on compression of the deep posterior heel was revealed and forced plantarflexion of his ankle caused discomfort. The hindfoot was clinically and radiologically well-aligned and no ligamentous laxity was found in the sagittal and coronal plane of the ankle joint. He showed unrestricted range of motion, no edema, no crepitus, and no neurovascular deficits. The radiographs and computed tomographic (CT) scan revealed a defect of the talus involving two thirds of the talar body (Figs. 1 and 2). There was thinning but no disruption of the posterior facet of the subtalar joint and the remaining cortices of the talus were intact. No evidence for a pathologic fracture was seen. After presentation of this case at our tumor board, we decided to use a free microvascular iliac crest bone graft for talar reconstruction to prevent an imminent breakdown of the talar dome.

Through a dorsomedial approach to the ankle and subtalar joint, the tarsal tunnel was opened and the neurovascular bundle identified. The posterior aspect of the talus showed a bony prominence measuring 30×30 mm and protruding 20 mm into the tarsal tunnel. The protruding bone was removed. During a meticulous debridement of the talar body, care was taken not to disrupt the talar articular surface. The defect size measured 40 mm in length and 35 mm in width.

From an incision at the ipsilateral iliac crest, the deep circumflex iliac artery and vein were exposed and a vascularized bone block harvested, preserving the spina ilica anterior superior. The extracted bone block was trimmed according to the defect size and implanted into the talar dome in a press-fit manner. Gaps between the bone block and the talus were filled with autologous cancellous bone graft and demineralized bone matrix. The vascular pedicle was routed around the medial malleolus. The anastomoses were performed end-to-side to the posterior tibial artery and end-to-end to the posterior tibial vein.

Postoperative care included continuous passive motion for dorsiflexion and plantarflexion 2 hours a day for 3 months. The patient used a walking boot (Vacoped; OPED AG, Cham, Switzerland) for 8 to 10 weeks postoperatively. Only partial weightbearing of approximately 15 to 20 kg was permitted during the first 8 weeks. Then, weightbearing was gradually increased. This postoperative treatment protocol was used in all 3 cases.

The healing was uneventful and the patient was pain free. No donor site pain was reported. Owing to a dorsomedial bony prominence of the autograft, the plantarflexion was decreased to 15° as the prominence impinged to the distal dorsal tibia. A CT scan (Fig. 3) revealed the prominence and showed a full bony ingrowth for the implant. The resection of the prominence after 24 months was uneventful and resulted in a plantarflexion of 30°. CT scan and magnetic resonance imaging demonstrated a stable bony structure of the reconstructed talar bone. No recurrence of a chondroblastoma was identified 60 months after surgery. The patient is very satisfied with the result and is playing soccer again.

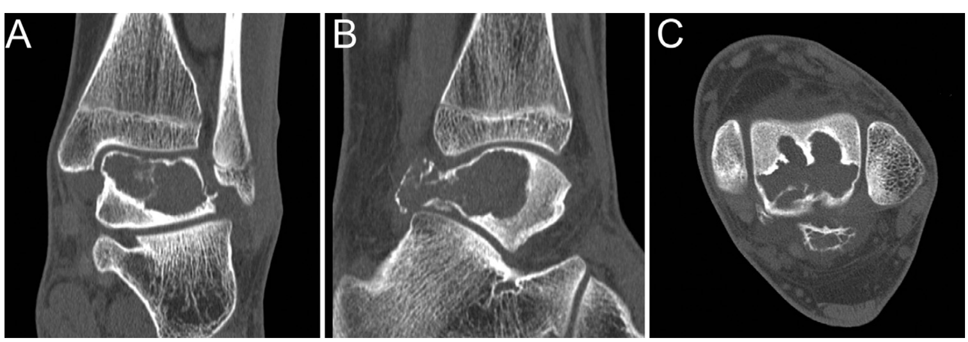

Fig. 2. Preoperative weightbearing computed tomographic scan in the coronal (*A*), sagittal (*B*), and transverse (*C*) planes.

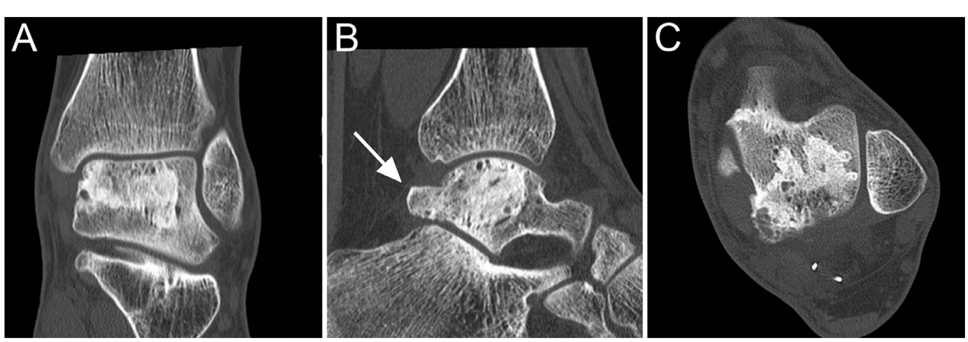

Fig. 3. Weightbearing computed tomographic scan 12 months postoperatively in the coronal (*A*), sagittal (*B*), and transverse (*C*) planes. The bony prominence of the autograft is indicated with a white arrow.

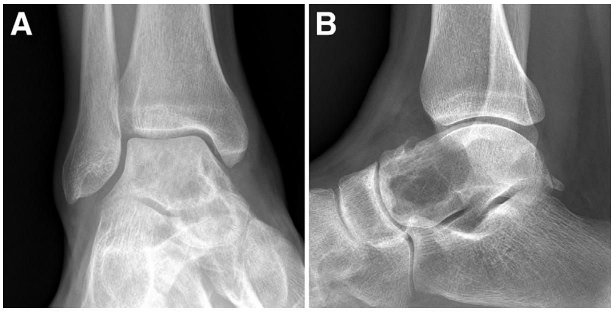

Fig. 4. Preoperative radiographs. Anteroposterior view (*A*) and lateral view (*B*).

Case 2

A male, aged 20 years, presented in our outpatient clinic with increasing ankle pain for 4 months. The pain was present under load and could be provoked with palpation of the talus. The patient reported no previous trauma.

The hindfoot was well aligned, the ankle joint showed normal range of motion, and no ligamentous laxity was found in the sagittal or coronal plane. The radiographs showed a pronounced cystic lesion of the talar neck reaching into the talar head (Fig. 4). The defect raised suspicion for a chondroblastoma, but only final histopathology after biopsy confirmed this finding. The osseous dimensions of the defect were determined with a single-photon emission CT scan (25 × 34 × 23 mm) (Fig. 5). The cortex was very thin and well preserved but with suspicion of breakdown of the dorsal talar neck.

The decision was made to reconstruct the talus with a vascularized bone graft from the medial femoral condyle because the plastic surgeon wanted to have a long pedicle to allow end-to-side suture from the graft to the anterior tibial artery. Furthermore, because the lesion was in the talar neck, we believed that no tricortical bone was necessary.

Through a dorsal approach, the talar neck was exposed. The cyst was debrided to stable articular cartilage and bleeding cancellous bone. The corners were cut in a rectangular manner with a fine chisel to allow correct fitting of the graft. The size of the defect was measured in 3 planes (anteroposterior, mediolateral, and depth) with a ruler.

The medial femoral condyle was approached through a 12- to 15-cm-long incision. The descending genicular artery was identified and exposed as far as its origin on the superficial femoral artery. The size and shape of the graft was then carefully determined and marked with 4 Kirschner wires (20 × 30 × 20 mm). A fine saw and chisel were used to harvest the graft taking care not to damage its periosteal cover and the afferent vessels. After having tied off the descending genicular artery as proximal as possible, the arterial branch was divided. The bony void of the medial femoral condyle was filled with allograft (Tutobone®; Tutogen Medical GmbH, Neunkirchen am Brand, Germany).

The corticoperiosteal graft was then press-fitted into the defect zone. No screw fixation was necessary because the graft was clinically stable when tested manually. The vascular pedicle of the graft was anastomosed to the tibial artery and included the accompanying veins where possible. Postoperatively, the standard treatment protocol was applied.

Radiographic analysis after 4 months showed good consolidation of the graft (Fig. 6). The ankle motion was free without ventral impingement. A slightly restricted range of motion, compared with the contralateral side, was clinically apparent. The patient was satisfied and was able to resume his physically demanding work at 4 months postoperative. At 72 months after surgery, the patient reported having no pain and no limitation in daily life activities, was highly satisfied, and underwent no additional surgeries.

Case 3

A male, aged 33 years, presented in our outpatient clinic with increasing subfibular pain for 1 year. The pain was mostly present after loading the foot and sometimes at rest. No trauma was known.

The physical examination of the foot showed normal range of motion and good hindfoot alignment. Subfibular pain was present on palpation. A CT scan showed a bony resorption including the subchondral bone (Fig. 7). As in case 2, the decision was to reconstruct the talar lesion with a vascularized bone graft from the medial femoral condyle. The decision was based on our growing understanding of this vascularized graft, a fulfilled learning curve from the plastic surgeon, and, therefore, a safer and more predictable surgery.

An approach from the distal fibula to sinus tarsi was performed. The cyst of the lateral talus was debrided while still maintaining the subchondral layer to the subtalar joint. The dimension of the defect was 20 × 15 × 10 mm. The corners were cut in a rectangular manner with a fine chisel to allow correct fitting of the graft. The vascularized graft of the size of the talar defect was taken from the medial femoral condyle according to the operative technique of case 2 (Fig. 9). After having radiographically verified the correct position of the graft, internal fixation was applied. Postoperatively, the standard treatment protocol was applied.

At 4 months postoperatively, the patient complained about pain after loading for longer periods of time. Nevertheless, he was able to return to his full-time work as a teacher. A slightly restricted pronation and supination compared with the contralateral side was documented. A CT scan showed no degenerative changes of the subtalar joint.

At review 8 months after surgery, the patient reported a considerable reduction of symptoms but still did not start with sports by then. A CT scan confirmed good incorporation of the graft with no sign of recurrence or cystic changes (Fig. 8). The patient was allowed to return sports play without restrictions. At 36 months after reconstruction (Fig. 10), a

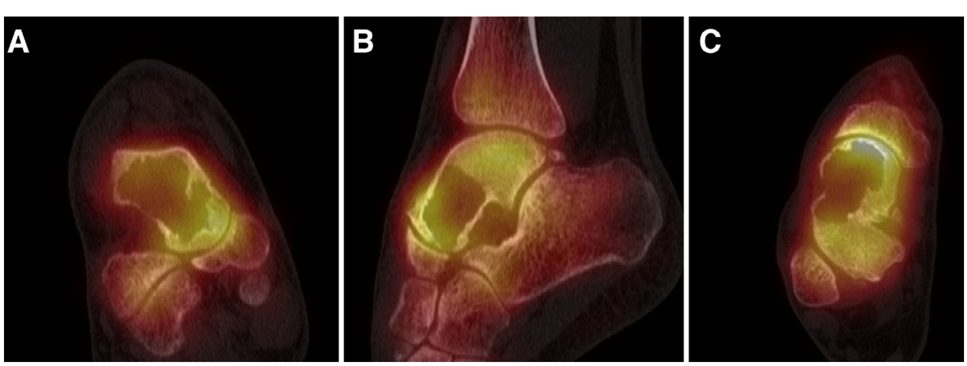

Fig. 5. Preoperative single photon emission computed tomographic scan in the coronal (*A*), sagittal (*B*), and transverse (*C*) planes.

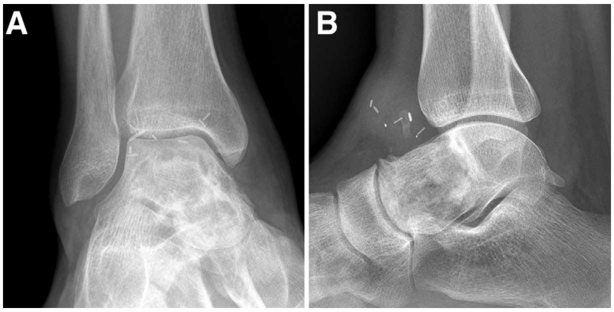

Fig. 6. Anteroposterior (*A*) and lateral (*B*) radiographs 4 months after treatment with a vascularized bone graft.

screw was removed as the patient had some residual pain over the sinus tarsi that resolved after the surgery.

Discussion

Owing to the rare prevalence of chondroblastomas, most published studies report on tumors localized in various anatomic sites. Therefore, such nonhomogenous study groups only leave a few numbers of cases at 1 specific site for analysis (5,7,18). Few cases of chondroblastoma of the talus are reported in the literature, with most of them treated with nonvascularized bone grafts (10,19–21). Only 1 case is described in the literature, where a vascularized iliac crest bone graft was used (17).

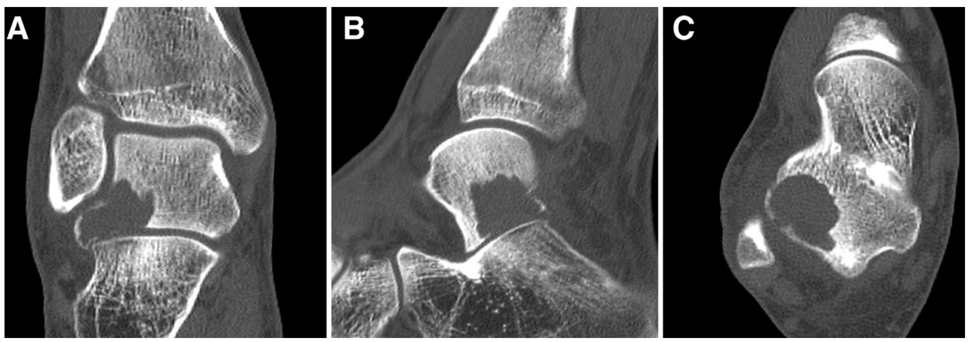

Fig. 7. Preoperative weightbearing computed tomographic scan in the coronal (*A*), sagittal (*B*), and transverse (*C*) planes.

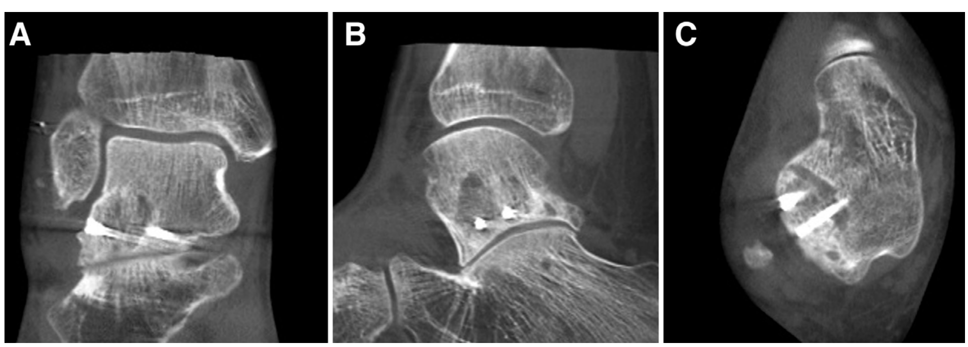

Fig. 8. Weightbearing computed tomographic scans at 6 months postoperatively in the coronal (*A*), sagittal (*B*), and transverse (*C*) planes.

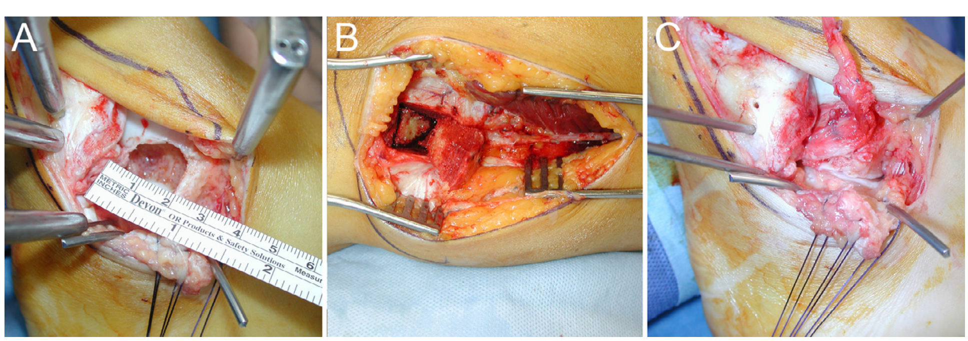

Fig. 9. Photographs showing the lateral talar defect of case 3 (*A*), the exposure of the medial femoral condyle and harvesting of the graft (*B*), and insertion of the graft into the defect in a press-fit manner (*C*).

Fig. 10. Anteroposterior (*A*) and lateral (*B*) radiographs 36 months after treatment with a vascularized bone graft.

The operative treatment of a patient with a chondroblastoma of the talus is highly challenging, because the tumor must be excised completely without harming the joint surfaces and without risking a breakdown of the talus. However, preventing a collapse of the talus to spare the peritalar joints is crucial for a good functional outcome in bony defects of the talus. Because the potential for revascularization of the talus is low, different treatment options in large defects have to be considered carefully. Shears et al (9) concluded in a series of 8 patients that bone grafting is not a necessary adjunct to the curettage of talar lesions and they described no collapse of the talar articular surface and no fracture. The mean defect size was reported to be 16.5 cm^3; however, the authors provided no details as to whether the subchondral area was at risk for breakdown or not. We believe that treatment without bone grafting is a viable option for minor defects or for those cases that are not at risk for mechanical failure. Because our 3 cases with large defects of the talus were at imminent risk of a talar collapse, we opted for a reconstructive approach with a free vascularized bone autograft.

The defect zone in chondroblastomas consists of numerous cavities with strong walls, in between which should not be harmed. Hence, there is the need for an autograft that can be matched in size according the talar defect. An autograft from the medial femoral condyle has these properties because the surgeon can tailor intraoperatively the spongiosa parts of this graft. The tricortical autograft from the iliac crest is the more stable option. This finding was presented in our first case, where the posterior facet of the subtalar joint was at risk for breakdown. However, harvesting a vascularized bone graft from the iliac crest is a much more invasive surgery than harvesting it from the medial femoral condyle (16). To enhance the fit of the inserted graft, additional cancellous graft and/or demineralized bone matrix can be used.

In the presented cases, the cartilage of the talar dome was found to be intraoperatively intact; however, the remaining subchondral layer was extremely thin. An advantage of a bony reconstruction is a primary stable situation, allowing early motion of the peritalar joint using the continuous passive motion device. As proposed for treatment of osteochondral lesions, we believe in the advantages of moving the synovial fluid to stimulate diffusion of nutrients into the damaged cartilage and diffusion of other materials out, such as blood and metabolic waste products. Furthermore continuous passive motion prevents fibrous scar tissue formation in the joint (22). This conception of early rehabilitation may be the key to the good results presented herein.

Because the graft should not be inserted too deep into the talus to prevent compression of the afferent artery, there is the tendency for bone formation along the periosteum at the site of the vascular pedicle. In this case, an additional revision surgery might be necessary to remove the bony formation and to reshape the articular surface. However, once the graft is fully incorporated, there is no reason for concern regarding a secondary avascular necrosis.

The presented 3 cases were referrals to our center for a second opinion after being told that a fusion of the ankle joint (cases 1 and 2) or of the subtalar joint (case 3) would be necessary to resolve their problems. We believe in joint-preserving techniques and hope these case reports provide a thought-provoking report for our colleagues to consider for future cases.

In conclusion, the results of our cases have shown that a free vascularized bone autograft can be used to compensate for talar bone loss in young patients with chondroblastoma of the talus. We propose this valuable joint-preserving treatment option for large defects of the talus where the chondral surface is at risk for breakdown and the articular layer remains intact.

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