Revision of Failed Osteochondral Autologous Transplantation Procedure for Chronic Talus Osteochondral Lesion With Iliac Crest Graft and Autologous Matrix-Induced Chondrogenesis: A Case Report

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Foot Ankle Spec published online 31 January 2012
DOI: 10.1177/1938640011434046

Clinical Research

Revision of Failed Osteochondral Autologous Transplantation Procedure for Chronic Talus Osteochondral Lesion With Iliac Crest Graft and Autologous Matrix-Induced Chondrogenesis

A Case Report

Martin Wiewiorski, MD, Matthias Miska, MD, Guillaume Nicolas, MD, and Victor Valderrabano, MD, PhD

Abstract: *This article describes a novel technique for treatment of recurrent large osteochondral lesions of the talus using autologous matrix-induced chondrogenesis with a collagen I/III matrix.*

Keywords: *osteochondral lesion; collagen matrix; AMIC; ankle joint*

Level of evidence: *Therapeutic level IV*

Osteochondral autologous transplantation (OATS) from the knee joint is commonly performed for reconstruction of substantial osteochondral lesions (OCLs) of the talus. Failure of such operative treatment is frustrating for both patients and surgeons.[1] Further operative treatment options are limited. Joint preserving procedures include revision with another osteochondral autograft or, if available, osteochondral allograft (mosaicplasty or bulk).[2] The goal is to reconstruct not only the chondral but also the distinct underlying symptomatic osseous component of the lesion. To avoid further sacrificing of articular joint cartilage, we developed a new method using cancellous bone from the iliac crest combined with the implantation of a collagen I/III matrix. With this case, we report the successful use of this new technique.

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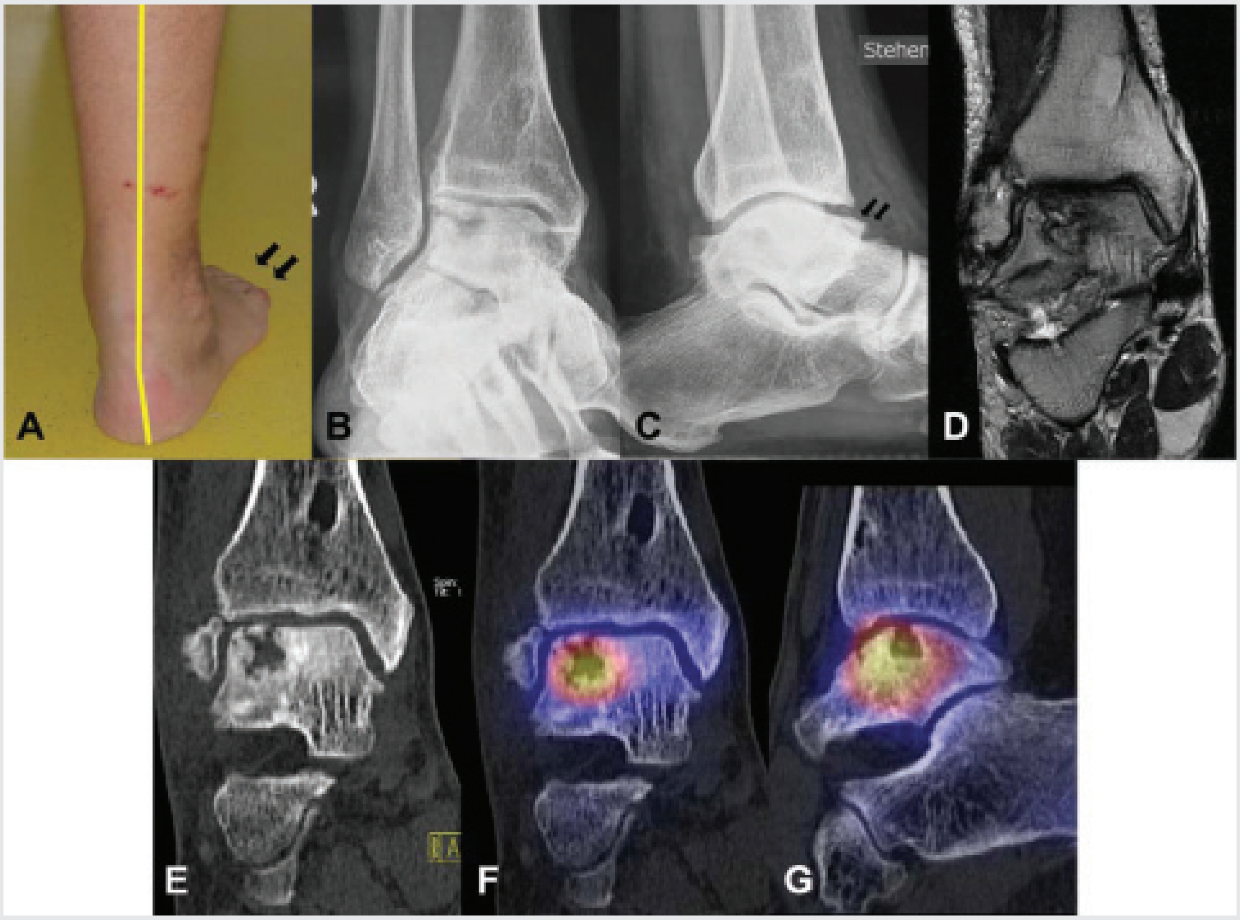
Figure 1.

Preoperative management. Clinical examination reveals a distinct valgus of the hindfoot with a positive too-many-toes-sign (®; A). Anteroposterior radiograph of the ankle shows increased translucency of the lateral talar edge (B). Lateral view (C) shows a large anterior osteophyte (®). Magnetic resonance image shows degeneration of cartilage over the lesion (D). Single photon emission computed tomography–computed tomography (SPECT-CT) demonstrates failed osseous integration of the plug with increased surrounding remodeling activity (E, F, G).



Preoperative Management

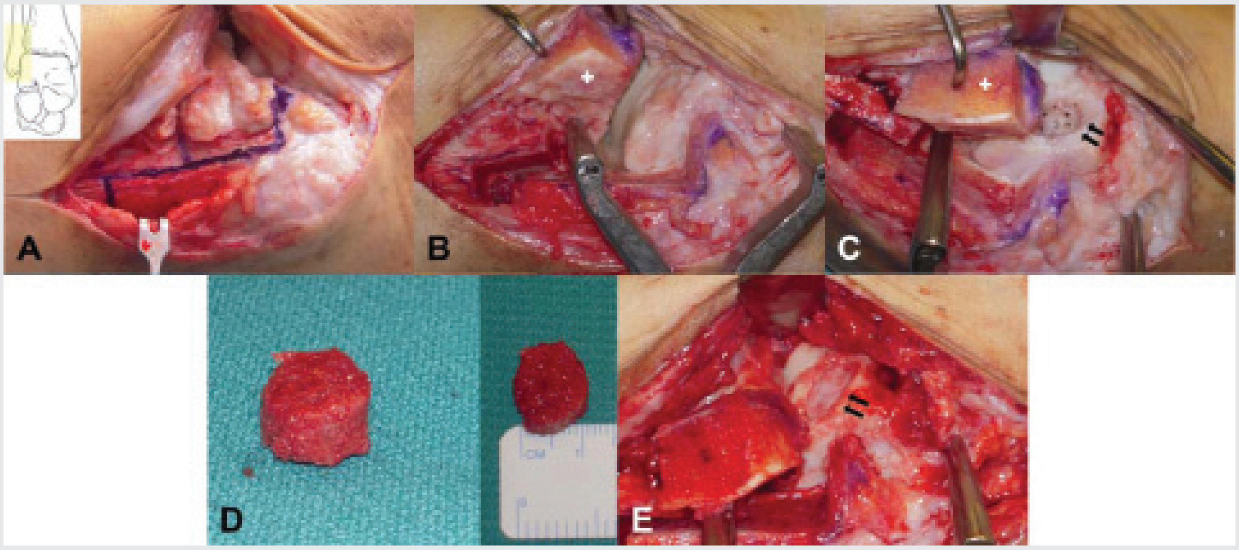
A 39-year-old male patient seen in our outpatient clinic complained about recurrent ankle swelling and load-dependent pain 2 years after OATS from the knee joint to the talus. Sport activity was reduced to swimming. Walking on uneven surfaces was reported to be difficult. Clinical examination showed distinct swelling of the right ankle and pressure pain at the anterolateral ankle joint line. Compared with the contralateral side, the range of motion (ROM) was reduced with dorsiflexion of 10° and plantar flexion of 20° (total ROM, 30°; left ankle 30° plantar flexion and 20° dorsal extension totaling 50°). The painful ankle presented a distinct anteroposterior shift and pronounced inversion (comparison with contralateral side),[3] while the deltoid showed stable situation. Standing alignment of the right lower leg demonstrated a flexible hindfoot valgus and forefoot abduction consistent with a flatfoot deformity (grade 2 tibialis posterior insufficiency according to Johnson and Strom[4]; Figure 1A).

Pain measured by the Visual Analogue Scale (VAS; 0 points, no pain; 10 points, maximal pain; during normal walking) was 6.[5] The American Orthopaedic Foot and Ankle Society (AOFAS) Ankle–Hindfoot Scale (score composed of pain, function, and alignment; minimum score, 0 points; maximum score, 100 points) was poor with 68 points.[6]

Initial conventional radiographs revealed increased subchondral translucency at the lateral talar edge (Figure 1B) and anterior ankle joint impingement due to a large osteophyte, explaining reduced dorsal extension (Figure 1C). Magnetic resonance imaging presented a disrupted cartilage layer over the recurrent lesion

Figure 2.

Surgical course. The fibular osteotomy is outlined (A). The osteotomy (+) reveals an impressive chondral defect at the lateral talar edge (B). The osteochondral lesion (→) was debrided followed by anterograde drilling (C). A spongiosa plug harvested from the iliac crest was impacted into the defect (D). The cut-to-shape collagen membrane is placed and glued on the defect (→; E).



(Figure 1D). Single photon emission computed tomography–computed tomography (SPECT-CT) revealed failed osseous integration of the plug with increased surrounding remodelling activity and subchondral cyst recurrence with disruption of the subchondral bone plate (Figures 1E-G). Integrated hybrid systems such as the SPECT-CT are a new approach allowing acquisition of functional SPECT and anatomical CT images in a single diagnostic procedure.[7] Because of the young age and high functional demand of the patient, a joint preserving operative treatment attempt was chosen.

The patient was informed that data concerning the case will be submitted for publication and written consent was obtained.

Operative Course

The patient was positioned supine. An initial ankle arthroscopy revealed a lateral instability with the lateral ankle ligament complex detached from the fibula tip. Next, a medial closing wedge supramalleolar osteotomy was performed to unload the lateral talar shoulder.[8,9] An anterolateral incision was then used to expose the lateral malleolus. To gain access to the lateral talar edge, a modified Z-shape fibular osteotomy was performed. Here, a cut within the distal fibula is performed to avoid detachment of the anterior and posterior syndesmosis (Figure 2A). The osteotomy revealed a large unstable talus osteochondral defect (Figure 2B). Cartilage and underlying necrotic bone were debrided followed by anterograde drilling/microfracturing of the underlying sclerotic bone. After debridement, the lesion had a depth of 1.5 cm totaling a volume of 3375 mm^3 (3.375 cm^3; Figure 2C). A cancellous bone plug was harvested from the ipsilateral iliac crest through a small incision and impacted into the defect (Figure 2D). A collagen matrix (Chondro-Gide, Geistlich Pharma AG, Wolhusen, Switzerland) was cut to match the chondral defect. The scaffold was moistened and placed on the defect with the porous layer facing the bone. Fibrin glue was applied at the boundary between the matrix and intact cartilage to close the interface (Figure 2E). The ankle was then moved several times throughout the whole ROM to control membrane stability. The anterior ankle joint osteophyte causing impingement was debrided (Figures 1C and 3C). The lateral ankle ligament complex was repaired directly anatomically as described by Karlsson et al[10] and Brostrom.[11] Finally, a calcaneus lengthening osteotomy was performed through the sinus tarsi, to correct the hindfoot valgus and accompanying forefoot abduction.[12]

Postoperative Care

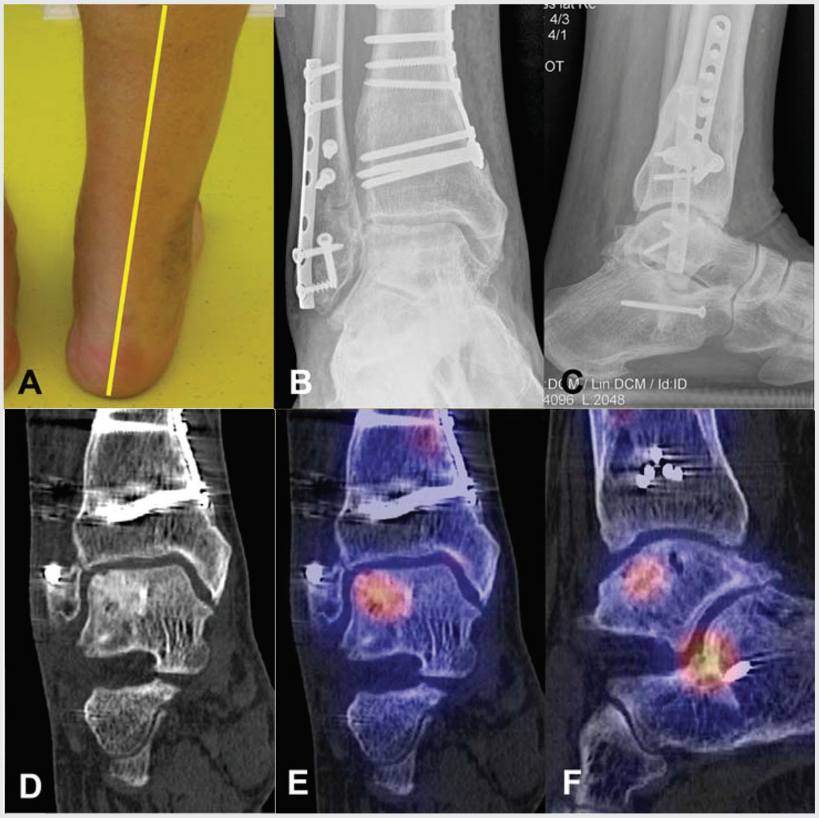
Postoperative care consisted of immobilization using a functional orthosis (Aircast Walker, Aircast-DJO-Ormed, Vista, CA) with maximum ROM of 30° and partial weight-bearing for 6 weeks (maximum 15 kg), followed by progression to full weight-bearing under intense physical therapy focusing on strengthening the ankle joint stabilizing lower leg muscles and ROM.

Follow-up

The patient was available for follow-up at 6 weeks, 3 months, and 12 months postoperatively. After 6 weeks, the patient had a VAS of 0 points and returned to a full time job. Clinical examination at 1 year revealed a physiological hindfoot

Figure 3.

Follow-up at 1 year. The hindfoot valgus and forefoot abduction deformity were successfully corrected (A, B). The lateral view shows removal of the anterior osteophyte (C). SPECT-CT (D, E, F) and conventional radiographs (B) showed successful osseus integration of the plug, full osseous consolidation of the tibial, fibular, and calcanear ostotomy and a nearly anatomic shape of the lateral talar edge.



alignment (Figure 3A) and a marginally elevated anteroposterior and inversion instability (+) compared with the contralateral ankle. VAS was 0 points. Total ankle ROM increased from a total of 30° preoperatively to 45° (plantarflexion 25°, dorsal extension 20°) postoperatively. AOFAS hindfoot score increased to 91 points (compared with 68 points preoperatively). No feeling of instability and no new ankle sprains occurred. Conventional radiographs (Figures 3B and C) and SPECT-CT (Figures 3D-F) and at 1 year showed osseous consolidation of the tibial, fibular, and calcaneal osteotomy, successful osseous integration of the plug, and a nearly anatomic shape of the lateral talar edge.

Discussion

This case reports a novel reconstruction technique with application of autologous iliac crest bone grafting in combination with a collagen type I/III matrix for treatment of a severe recurrent osteochondral lesion of the talus after failure of previous OATS. An excellent result at 1 year follow-up was shown.

To the knowledge of the authors, this is the second published case of treating talar OCL with the autologous matrix-induced chondrogenesis (AMIC) technique.[13] For the AMIC-aided treatment of chondral lesions of the knee joint,[14] good clinical outcome results after treating full-thickness lesions using the aforementioned collagen membrane combined with autologous chondrocyte transplantation (ACT) at 3-year follow-up have been reported.[15-17]

Recurrent large osteochondral lesions of the talus after failed previous operative treatment remain a challenge to orthopaedic surgeons. The predominantly young patients demand to return to sport, leisure activities, and hard work. If arthrodesis of the ankle joint is not indicated or not desired, only few operative joint preserving treatment options remain. The goal is to reconstruct the large osseous gap underlying the chondral lesion and induce cartilage regeneration. Sparse data exist for treatment of failed OATS procedure. A possible option is to retry the OATS procedure.[18] However, one has to keep in mind that this method requires sacrificing articular cartilage again. Additionally, the size of the OCL that has to be reconstructed will be probably larger than in the initial surgery. Also, the patient has to be willing to accept an operative method that failed at the first attempt.

Giannini and Vannini[19] propose ACT for young patients with large OCL (>3.0 cm^2, >0.5 cm depth) and failure of previous surgery. Good clinical results have been reported for this technique.[20-22]

We modified this technique by adding cancellous bone from the iliac crest to reconstruct the osseous lesion and covering it with a collagen membrane. The rationale behind this procedure is to allow cartilage regeneration on the base of healthy bony tissue. The process is called autologous matrix-induced chondrogenesis (AMIC). Here, the collagen I/III matrix of porcine origin attracts mesenchymal stem cells from the bone marrow of cancellous bone and provides a suitable environment for formation of cartilaginous repair tissue.[23,24]

Cancellous bone grafting for OCL of the talus has been previously described only in combination with arthroscopically guided retrograde drilling.[25,26] No reports are available for open antegrade debridement combined with cancellous bone grafting. The authors believe this can be only successfully achieved with an adequate covering of the graft tissue, as described in our technique. The lesion that has been surgically addressed in this case report had a large volume of 3375 mm^3. The question whether lesions larger than the one presented or large unconfined lesions can be successfully treated with the described technique cannot be answered at this point.

Another treatment option for large cystic OCL is fresh bulk osteochondral allograft.[27] Allografts are obtained from a bone bank and are matched for side and size. Good results are reported for this technique. In a recent study with 15 patients with an OCL >3000 mm^3, Raikin[2] reported an 87% survival rate and a high level of patient satisfaction at a minimum follow-up of 2 years. However, the authors have no experience with allograft transplantation for the talus. This technique is not available in Europe because of forensic issues.

Clar et al[28] described the cost-effectiveness of open ACT compared with microfracturing in treatment of cartilage lesions of the knee. Costs of open ACT surgery totaled £8617 (£5446 procedure plus £3200 for in vitro cell expansion) compared with £2348 for microfracturing.[28] Bulk talar allografts are reported to cost about $6500.[29] The costs of AMIC-aided treatment are comparable to microfracturing adding the costs for the collagen membrane ($815).

In this case, the AMIC procedure was combined with a corrective supramalleollar osteotomy, a calcaneus osteotomy, and lateral ligament repair. Supramalleolar osteotomies proved their usefulness for surgical treatment of varus and valgus ankle osteoarthritis.[8,9,30-32] The rationale behind this procedure is to unload the partially degenerated part of the ankle joint by shifting the load from the affected to the healthy part. In analogy to this, the authors perform supramalleolar osteotomies in cases of OCL revision surgery, to unload the reconstructed talus edge. The authors believe that alignment correction and joint stabilization are crucial for successful cartilage repair, especially in cases with a previously failed procedure. If a misaligned or unstable ankle joint is left untreated, the pathomechanisms that initially lead to failure of the previous surgery remain. Pathological stress on the repair tissue might eventually lead to recurrent graft failure.

Conclusion

This case proposes AMIC-aided reconstruction of large recurrent osteochondral talar lesions after failed previous surgery to be a promising treatment method. It is a readily available, one-step, low-cost operative procedure without the need for harvesting of vital cartilage or cartilage culturing. Optimizing the biomechanics of the ankle joint by correcting osseous malalignment and joint instability helps protect the reconstructed osteochondral defect. Future research needs to compare this new technique with conventional treatment methods in terms of radiological, clinical, and histological outcomes. FAS

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