Case Report

Osteochondral Lesions of the Ankle Joint in Professional Soccer Players

Treatment With Autologous Matrix-induced Chondrogenesis

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Abstract: *Acute and recurrent ankle sprains and other trauma to the ankle joint are common injuries in soccer and can be accompanied by or result in osteochondral lesions of the ankle joint, majorly of the talus. Conservative treatment frequently fails. Several operative treatment techniques exist; however, the choice of the right procedure is difficult due to lack of literature with a high level of evidence. We present our treatment method for acute and chronic ankle osteochondral lesions with cystic formation approached by a new surgical technique combining bone plasty and a collagen matrix (autologous matrix-induced chondrogenesis).*

Levels of Evidence: *Therapeutic, Level IV, Case series*

Keywords: osteochondral lesion, talus, AMIC, soccer

Introduction

Soccer is one of the most frequently played sports worldwide. Its complex demand on the musculoskeletal system and frequent body contacts make players prone to injuries of the lower extremities. Whereas acute ankle sprains are known to cause acute osteochondral lesions of the talus (OCLTs),[1] chronic instability resulting from recurrent sprains is suspected to be the major cause of chronic OCLTs.[2] Conservative treatment fails frequently. Common operative treatment methods include bone marrow stimulation (microfracturing/microdrilling),[3] osteochondral autograft transfer system (OATS, mosaicplasty),[4-6] matrix-induced autologous chondrocyte transplantation (MACI),[7] autologous chondrocyte implantation (ACI),[8] or bulk allograft transplantation.[9] Although good results have been reported for those techniques,[7,10,11] the evidence regarding outcome in terms of sport rehabilitation is scarce. The following 2 cases demonstrate the use of a novel treatment approach for OCLT following the principle of autologous matrix-induced chondrogenesis (AMIC) in high-demand professional soccer players. AMIC-aided osteochondral repair for OCLT has previously shown excellent clinical results.[12] The first patient described in this report suffered a severe in-game ankle trauma that resulted in an acute shear of talar cartilage and was treated in analogy to the technique known from the knee joint.[13] The second patient suffered from a chronic OCLT caused by rotational ankle joint instability due to recurrent ankle sprains. This patient was

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treated with a modified AMIC technique with additional autologous bone plasty.[14]

Case 1

Preoperative Management

A 29-year-old male top-division soccer player suffered a severe pronation-external rotation injury of his left ankle during a premier league match (Figure 1A). The patient presented in our clinic 1 week after injury for further treatment. Conventional radiographs showed a supra-syndesmotic high fibular fracture (type C according to Weber[15]; Maissoneuve fracture) with suspected syndesmotic injury (Figure 1B). The patient consented to arthro-magnetic resonance imaging (Figure 1C) and diagnostic arthroscopy and additional subsequent procedures depending on intraoperative findings.

Surgical Course

The patient was positioned supine. A centromedial arthroscopic portal was installed. Arthroscopy revealed a syndesmotic rupture with lateral bony flakes, a complete deltoid ligament rupture, and chondral lesions of the talus and tibial plafond (Figure 1D). The decision for 1-stage reconstructive surgery was made. A medial approach to the ankle joint was performed. The deltoid showed a complete rupture of the deep and superficial portions, as well as the spring ligament. Arthrotomy revealed several chondral fragments detached from the medial talus edge, a superficial cartilage lesion of the central talus dome, and a contrecoup lesion of the posteromedial tibial plafond. The chondral fragments of the medial talar edge were severely disrupted and not fixable and were therefore debrided. Microfracturing using a sharp awl was performed (Figure 1E). Next, a commercially available acellular collagen I/III matrix (Chondro-Gide; Geistlich Pharma AG, Wolhusen, Switzerland) was cut to size and glued onto the defect with a commercially available fibrin glue (Tissucol; Baxter, Deerfield, Illinois, USA) (Figure 1F). The distal tibial surface was microfractured without defect covering.

A lateral approach to address the anterior syndesmotic area and the fibular fracture was performed. The anterior tibiofibular ligament was disrupted and the fibula was unstable in the fibular notch. The bone flakes from the syndesmotic area were removed. After ensuring the correct length and rotation of the fibula within the fibular notch, 2 stabilizing syndesmotic screws were inserted followed by suturing the anterior tibiofibular syndesmotic ligament (modified Brostrom-Gould procedure[16]). Finally, direct anatomic reconstruction of the medial ligaments—deep deltoid ligaments, superficial deltoid ligaments, and spring ligament—with resorbable sutures and transosseous fixation was performed.

Postoperative Rehabilitation

Immediate postoperative care consisted of immobilization using a walker (Aircast Walker; DJO Global, Vista, California, USA) and functional physiotherapy with 15 kg partial weight bearing starting on the second postoperative day for 8 weeks. The range of motion was restricted to 20 degrees with use of a continuous passive motion machine and lymphatic drainage massage for the first 8 weeks. Syndesmotic screws were removed after 8 weeks. For complete rehabilitation algorithm, please see Table 1.

Follow-up Examination

The patient was seen by us and the team doctor 6 weeks, 3 months, 6 months, and 1 year after surgery. Six months postoperatively, he resumed competitive soccer. Pain was reported to be 1 on the visual analog scale (VAS; with use of a 10-cm graded line, with 0 indicating no pain and 10, the worst pain imaginable).[17] The American Orthopaedic Foot & Ankle Society (AOFAS) ankle score[18] was 90 points. Conventional radiographs showed a consolidated fracture. Magnetic resonance imaging (MRI) showed slightly hypertrophic repair of the medial talus shoulder with nearly normal signal intensity compared to surrounding cartilage. On 3-year follow-up, he continues to play competitive soccer with AOFAS scale of 100.

Case 2

A 21-year-old male goal keeper of a top-division team presented with recurrent ankle swelling and load-dependent pain of his left ankle for 1 year. History revealed recurring ankle sprains. Clinical examination showed discreet swelling of the left ankle and pressure pain at the anteromedial joint line. The painful ankle presented a maximal anteroposterior and inversion instability, whereas the deltoid was stable. Standing alignment of the left lower leg demonstrated a flexible hindfoot valgus and forefoot abduction consistent with a flatfoot deformity (grade 2 tibialis posterior insufficiency according to Johnson/Strom[19]). Visual analog scale was 7 points. The AOFAS was poor with 72 points. Initial conventional radiography revealed an increased translucency of the medial talar edge (Figure 2A). Magnetic resonance imaging presented a detached but undisplaced osteochondral fragment (type 3 according to Hepple[10]) (Figure 2B).

Surgical Course

The patient was positioned supine for anterior approach to the ankle. An initial arthroscopy confirmed the radiologic findings of a large posteromedial lesion and mediolateral instability. An anteromedial incision was used and the medial malleolus exposed. To gain access to the posteromedial talar edge, an oblique 1-plane medial malleolar osteotomy was performed. This revealed an unstable chondral defect (1.5 cm²) (Figure 2C). The osteochondral fragment was removed followed by debridement and microfracturing of the underlying sclerotic bone (Figure 2D). Cancellous bone was harvested from the distal (medial malleolus osteotomy surface) medial tibia and impacted into the defect (Figure 2E). The cut-to-size collagen I/III matrix was glued onto the autologous bone graft with fibrin glue. The ankle was then moved several times throughout

Figure 1.

Case 1—Acute osteochondral lesion of the talus. Chronological sequence of injury from left to right. An opposing player attempted to kick the ball at full force and hit the patient's lower leg (blue shoe) at full force, resulting in a massive pronation-external rotation of the foot and ankle joint (A). Preoperative radiographs showed a wide tibiofibular syndesmosis with small bone fragments and a high supra-syndesmotic fibular fracture (B). Magnetic resonance imaging shows disruption of the cartilage layer (→, C). Arthrotomy revealed fractured talar cartilage (D). The fragments were debrided and the subchondral bone was microfractured (E). Finally, the defect was covered with a collagen matrix as schematically shown in (F).

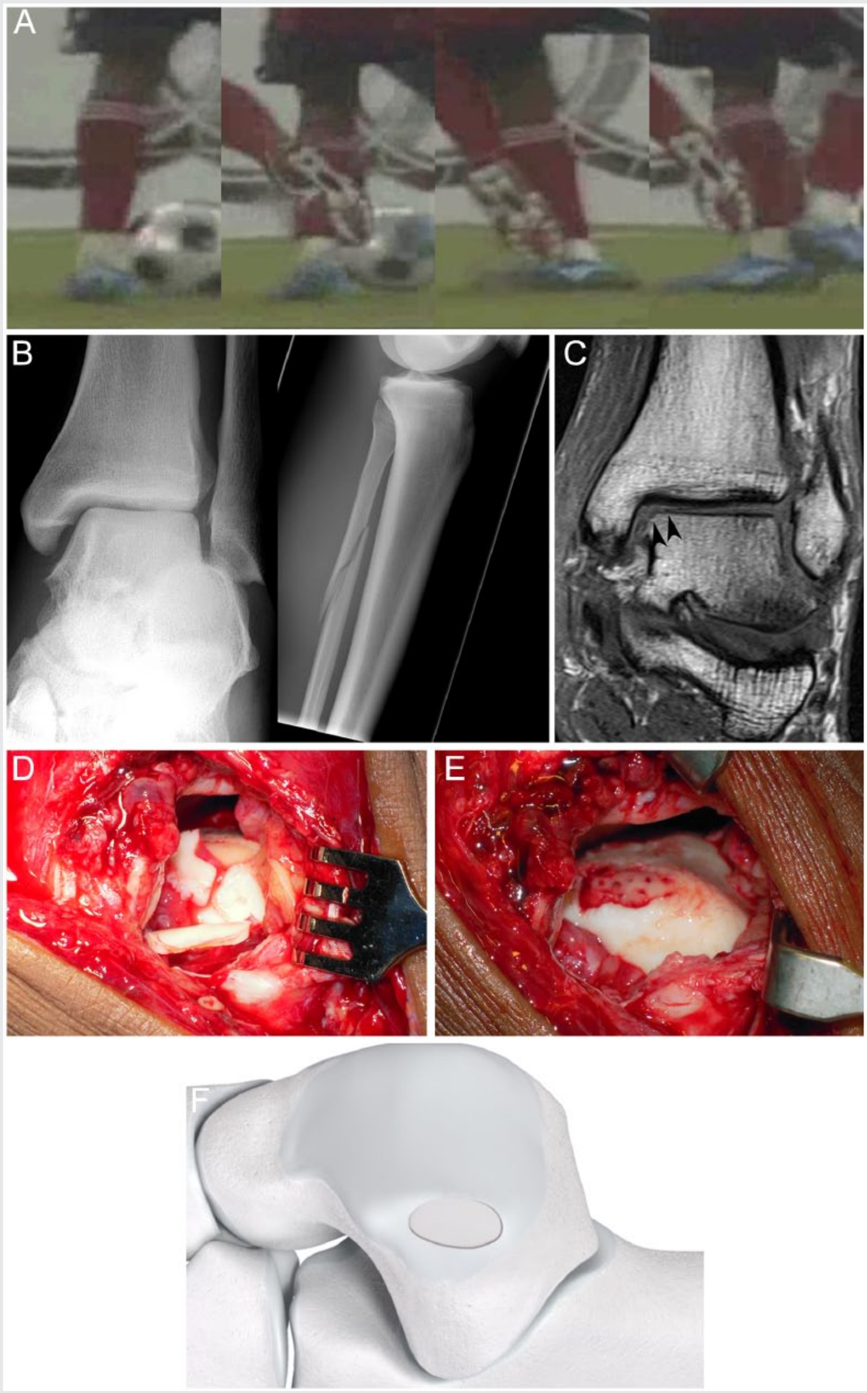


Table 1.

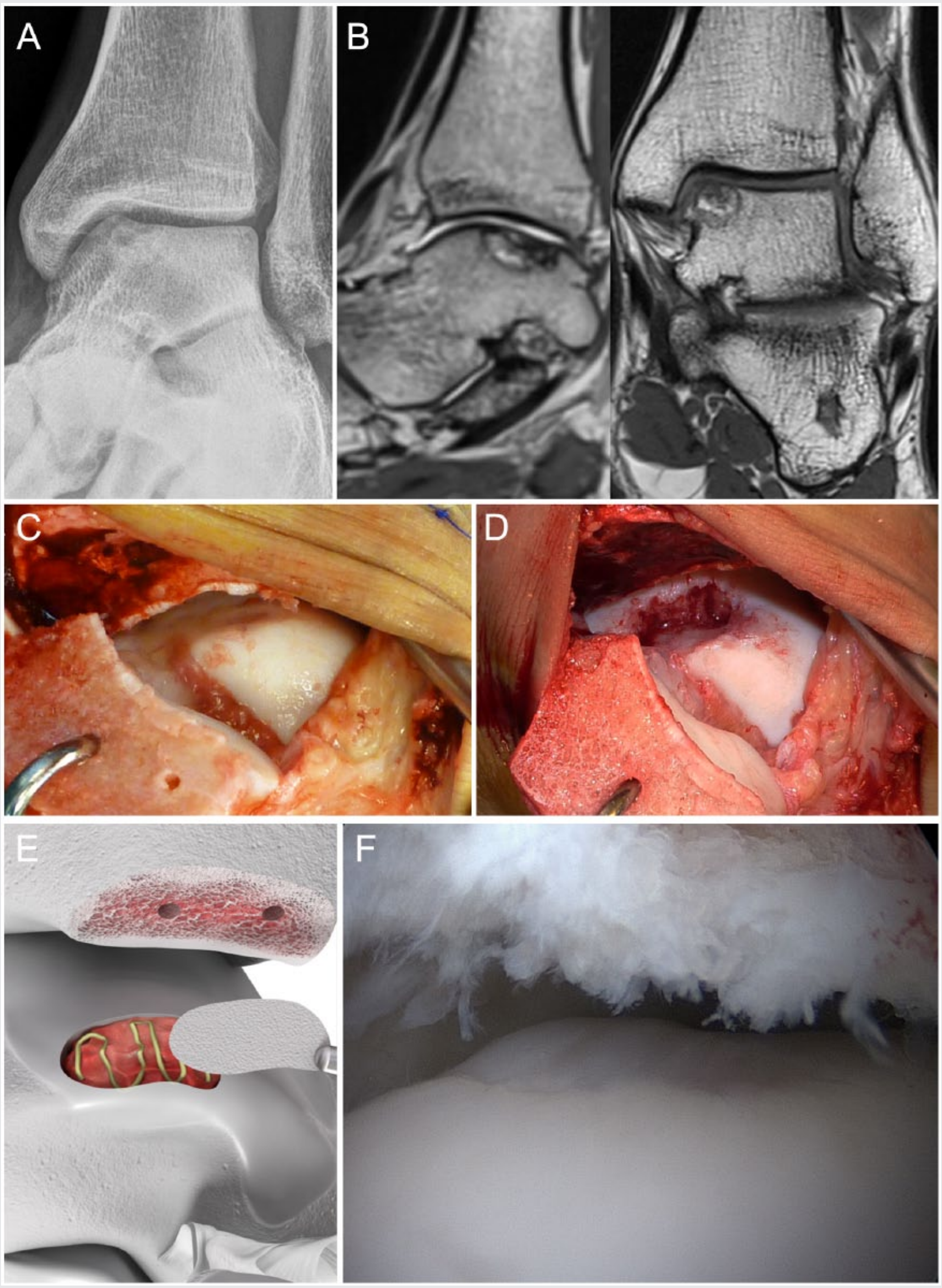
Postoperative Rehabilitation Algorithm.[a]

0	1-8	9-10	11-12	13-16	17-20	21-25	26
Surgery	**Partial Weight Bearing 15 kg in Aircast Walker**	**Achievement of Full Weight Bearing**	**Ankle Muscles Strength/Force Training**	**See Week 11-12**	**See Week 13-16**	**See Week 17-20**	**First Competition Match**
	Ankle always in neutral, ie, 0° PF/DF	Achievement of full ankle ROM	Proprioceptive training	Start soccer-specific training including plyometric drills	Start of soccer training with team	Consider hardware removal	
	CPM 2 × 30 min/d with ROM: DF 10°, PF 10°	Insoles for arch protection	Aqua jogging	Isokinetic training	Isokinetic training		
	Upper body ergometer for cardio training	Start of proprioceptive training	Treadmill jogging with controlled set-up				
	Upper body/hip/knee muscles strength training	Core stability training	Core stability training				
	Cryotherapy in elevation	Stationary bike for cardio training	Maintain cardiac fitness				
	Lymphatic drainage	Aquatic training					

Abbreviations: CPM, continuous passive motion; DF, dorsiflexion; PF, plantarflexion; ROM, range of motion.
Postoperative rehabilitation algorithm in the first 25 postoperative weeks (see timeline).

Figure 2.

Case 2—Chronic osteochondral lesion. Conventional radiographs show increased translucency at the medial talar shoulder (A). Proton density-weighted sagittal and T1-weighted coronal views on magnetic resonance imaging confirm a large detached but undisplaced osteochondral fragment (B). To expose the lesion, a medial malleolar osteotomy was performed (C). The lesion was fully debrided and microfractured (D). Cancellous bone was impacted into the defect and covered with a collagen matrix fixated with fibrin glue (E). Six months after surgery, an arthroscopy showed intact, slightly hypertrophic repair cartilage at the lesion site (F).



the whole range of motion to control stability of the matrix. Direct anatomical repair of the medial and lateral ankle ligaments was performed (modified Brostrom-Gould procedure[15]). Finally, a calcaneus lengthening osteotomy was performed through the sinus tarsi, to correct the hindfoot valgus and accompanying forefoot abduction.[12]

Postoperative Rehabilitation

The same postoperative algorithm as in case 1 was applied (Table 1).

Follow-up Examination

The patient was seen in our outpatient clinic 3 and 6 months after surgery. Due to discomfort at the medial malleolus, the screws were removed. The patient agreed to an additional ankle arthroscopy to assess the repair tissue and debride the anteromedial scarring. The defect site showed complete defect coverage with slight cartilage hypertrophy (Figure 2F). At 12 months after surgery, the patient was pain free (VAS of 0 points) and in intense preparation for the next season. The AOFAS scale increased significantly to 96 points. The ankle showed minimally less stability when compared to the contralateral side. Magnetic resonance imaging showed slightly hypertrophic repair tissue in the defect side with nearly normal signal intensity compared to surrounding cartilage. On 2-year follow-up, he continues to play competitive soccer with AOFAS score of 96 and without any pain.

Discussion

We presented 2 typical cases of professional soccer players undergoing successful cartilage repair using the AMIC technique—1 in an acute and 1 in a chronic osteochondral lesion of the talus. Both athletes returned to professional sport.

In the athletic population, OCLTs usually lead to reduced activity and even discontinuation of sports.[5] A great number of reports on the outcome after surgical treatment of OCLTs exist. However, the outcome in terms of sport activity is rarely documented. In addition, a consistent scoring system is not used, which would allow adequate comparability of the outcomes.

Giannini et al[8] examined 46 patients 12 months after arthroscopically guided MACI. In this case series, 29 patients were sport active before the onset of symptoms (25 at recreational level, 4 professionals). Of those, 16 played contact sports (soccer, basketball) and 13 noncontact sports (volleyball, tennis, swimming, and other). At follow-up, 20 out of 29 continued sport activities at the primary level, and 3 out of 29 at a lower level. All professional athletes continued their career. Aurich et al[20] reported that 81% of patients undergoing MACI returned to the same level of sports as before the onset of symptoms after surgery. In a case series published by Ferkel et al,[21] all 60 patients treated arthroscopically (debridement, microdrilling) indicated that they could return to their previous sport of choice.

Gautier et al[22] described 3 cases of soccer players who underwent OATS from the knee joint. All of them returned to sports at follow-up after 29 to 47 months.

The use of the AMIC technique for chronic OCLT has been previously reported.[12,14,23,24] Valderrabano et al assessed sport activity in 26 patients undergoing AMIC repair of OCLT. Of those 26 patients, only 12% participated in any sports activities at the time of the surgery, compared to 62% at the time of follow-up (mean = 31 months; range, 24-54 months).

To our knowledge, those are the first reported cases where AMIC-aided repair was used for treatment of OCLT in professional soccer players. Bark et al[25] reported AMIC-aided repair of a chondral lesion of the femoral condyle in a professional soccer player. The player returned to competition after 10 months.

The management of injured athletes cannot solely focus on the therapy of the chondral/osteochondral defect itself. To restore the integrity of the whole joint organ, concomitant pathological conditions of bone (fractures, alignment) and soft tissues (ligament and tendon pathologies) need to be addressed to ensure successful rehabilitation.[26] Failure to do so results in continuing pathobiomechanical stress on the ankle joint. This will eventually lead to failure of any reconstructive chondral therapy.

The currently used operative techniques have certain drawbacks: sacrificing healthy cartilage (OATS, mosaicplasty), multiple-stage operative procedures (MACI, ACI), high costs (ACI, allograft), and limited availability (allograft). The AMIC procedure provides 2 major advantages; on one hand, it is a 1-step procedure with no need for cartilage harvesting potentially leading to donor site morbidity, and on the other hand, it is cost-effective with no need for in vitro cell expansion.

Conclusion

Good clinical outcome and full return to professional soccer have been shown for a case with an acute chondral lesion and a case with a chronic osteochondral lesion of the talus after AMIC-aided repair. Further studies are necessary to assess long-term outcome. FAS

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