Single-Step Arthroscopic Repair With Cell-Free Polymer-Based Scaffold in Osteochondral Lesions of the Talus: Clinical and Radiological Results

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Purpose: To report the clinical and radiological results of patients with talar osteochondral lesions who were treated by microfracture and cell-free scaffold implantation in a single-step arthroscopic surgery. **Methods:** Forty patients, treated with a single-step arthroscopic surgery, were evaluated in this single-center-based retrospective study. Patients with degenerative arthritis (n = 1), history of ankle fracture (n = 1), kissing lesions (n = 1), lower extremity deformity (n = 1), and lesions <1.5 cm^2 (n = 4) were excluded. Oversized (>10 mm depth) bone cysts were additionally treated with bone graft. Patients were evaluated clinically, using the American Orthopedic Foot and Ankle Society (AOFAS) hindfoot score. Radiological assessment was performed with magnetic resonance imaging, using the magnetic resonance observation of cartilage repair tissue (MOCART) score. **Results:** Thirty-two patients with a mean age of 38 ± 12 years were evaluated. The mean defect size was 2.5 ± 0.8 cm^2 and the mean defect volume was 2.4 ± 1.9 cm^3. The mean preoperative AOFAS score was 52.8 ± 13.9 and increased to 87.1 ± 11.1 postoperatively at the mean follow-up of 33.8 ± 14.0 months ($P = .0001$). A total of 84.4% of patients had good to excellent clinical scores. Clinical scores had no significant relation with age, lesion size, depth, or body mass index. The mean MOCART score was 64.2 ± 12.0. There was no significant correlation between the total MOCART and AOFAS scores ($P = .123$). A significant relation was found between the defect filling (the subgroup of the MOCART score) and the clinical outcomes ($P = .0001$, rho = 0.731). **Conclusions:** The arthroscopic scaffold implantation technique is a single-step, safe, and effective method for the treatment of talar osteochondral lesions with satisfactory clinical and radiological outcomes. **Level of Evidence:** Level IV, therapeutic case series.

Osteochondral lesions (OCL) of the talus, defined as lesions of the cartilage layer and underlying subchondral bone, are one of the major challenges in orthopaedic surgery. These lesions usually occur as a result of trauma, particularly inversion or eversion ankle sprain, in young patients.[1,2]

Even though cartilage tissue has excellent load absorption and distribution qualities, it has poor regeneration capacity.[3] Therefore, patients with talar OCL may have chronic symptoms such as pain, swelling, locking, limited range of motion, and degenerative arthritis due to unhealed lesions.[1,2,4]

The treatment of cartilage lesions is still controversial and no agreed guidelines are available for management. The microfracture technique is the most used single-step procedure in cartilage repair. This can be easily performed arthroscopically. Many studies have reported good to excellent results with the microfracture technique, especially for smaller OCL (<1.5 cm^2) in long-term results.[5-7] Despite these advantages, the higher failure rate in larger lesions and formation of biomechanically poor fibrocartilage repair tissue compared with native hyaline cartilage are the main concerns of the microfracture technique.[2,5,8]

Autologous osteochondral transplantation (AOT) and autologous chondrocyte implantation (ACI) techniques are reported to provide hyaline cartilage with good clinical outcomes.[9-11] ACI has disadvantages such as the requirement of 2-step surgery, high cost, and additional time needed for the cell culture process.[12] Despite the successful outcomes with ACI, up to 15% failure rate in

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5 years has been reported in a systematic review in the knee joint.[13] Recently, Knutsen et al.[14] found no significant difference between microfracture and ACI in 15 years' follow-up. Donor site morbidity, need for open surgery, including malleolar osteotomy, and the risk of joint surface incongruity are the main concerns of AOT.[1,2,15]

Disadvantages of existing procedures for cartilage regeneration have led the surgeons to investigate new techniques. In recent years, tissue-engineered porous biomaterials (scaffolds) have been used for the treatment of OCL.[16,17] These biomaterials provide 3-dimensional support and mechanical stability for mesenchymal stem cells, and their porous structure allows cell migration into the healing tissue.[18] In a 3-dimensional environment, it has been proven that better mimicking of native tissue and better chondrocyte transformation occur, and chondrocytes maintain their structure effectively compared with a 2-dimensional environment.[11,18,19] According to recent animal studies, cell-free scaffolds are also efficacious in cartilage regeneration with the achievement of well-structured subchondral trabecular bone, repair tissue rich in proteoglycans and type II collagen which are the histological characteristics of hyaline cartilage.[20,21]

Benthien and Behrens[22] described an autologous matrix-induced chondrogenesis (AMIC) technique for knee cartilage lesions with collagen I/III matrix scaffold. Satisfactory and promising results have been reported for talar OCL with the AMIC technique.[23-26] Despite the advantages of this combined procedure, only a few clinical studies of arthroscopically applied cell-free scaffolds for the treatment of talar OCL have yet been published.[27,28]

The aim of this study is to report the clinical and radiological results of patients with talar OCL who were treated by microfracture, and cell-free scaffold implantation, in a single-step arthroscopic surgery. The null hypothesis is that the cell-free scaffold implantation method is a safe and effective technique for the treatment of talar OCL.

Methods

Forty patients with talar OCL were treated with cell-free polyglycolic acid-hyaluronan (PGA-HA) scaffold (Chondrotissue, BioTissue AG, Zurich, Switzerland) implantation in a single-step arthroscopic procedure between May 2007 and October 2014. All procedures were performed by the senior author (U.K.). The study has been approved by an ethics committee (Ref no: 2012-KAEK-15/1354).

Patients aged between 18 and 60 years with a lesion size of $\geq$1.5 cm^2 were included in the study. Eight patients were excluded from the study because of accompanying kissing lesions (n = 1), lower extremity deformity (n = 1), degenerative arthritis (n = 1), history of fracture (n = 1), and <1.5 cm^2 lesion size (n = 4). All patients had persistent symptoms such as pain or limited function despite at least 6 months of nonsurgical treatment. Associated ligament injuries were treated with the ligament reconstruction technique described by Ahlgren and Larrson, in the same operation.[29,30] Oversized bone cysts (>10 mm depth) were defined with preoperative magnetic resonance imaging (MRI), and they were treated with autogenous cancellous iliac bone graft before implantation of the scaffold.[23]

Patients were evaluated using the preoperative and postoperative American Orthopedic Foot and Ankle Society (AOFAS) Hindfoot Questionnaire[31] scores recorded during their preoperative physical examination and postoperative follow-up appointments. Results were categorized as follows: excellent (90% to 100%), good (80% to 89%), fair (60% to 79%), and poor (less than 60%). All patients were evaluated by 2 surgeons (T.K.E., A.V.) in consensus.

The diagnosis was confirmed by preoperative MRI and all patients were evaluated with postoperative MRI. The postoperative AOFAS scores were recorded at the same date of MRI performed. The clinical routine MRI was performed on a 1.5 T MR system (Magnetom Aera, Siemens, Erlangen, Germany) with a dedicated 16-channel foot and ankle coil (Siemens). Defect size, depth, and volume were evaluated with preoperative MRI in Radiant Dicom Viewer (Version 3.2.3, Medixant Company, Poznań, Poland) by using ellipsoid size and volume formulas (Fig 1). Postoperative MRI results were analyzed using the magnetic resonance observation of cartilage repair tissue (MOCART) score by 2 experienced radiologists (D.E.G., A.Y.Ö.) in consensus blinded to the surgical history.[23,32,33] The defect filling was described as a subgroup of MOCART score and measured according to the level of the repair tissue compared with adjacent cartilage tissue in postoperative MRI.

Surgical Technique

The surgical technique is performed arthroscopically. The malleolar osteotomy was not performed in any of the patients. Anterolateral and anteromedial portals are used for an anterior approach, and posterolateral and posteromedial portals are used for a posterior approach. After proper identification of the OCL, the detached osteochondral fragment is removed. The border of the lesion is debrided using an arthroscopic curette to stable healthy cartilage (Fig 2A). The microfracture procedure is then performed with an awl (Fig 2B). In the case of large bone defect, with >10 mm of depth in preoperative MRI, the defect is filled with an autogenous cancellous bone graft that is harvested from the iliac crest (Fig 3A). Chondral lesion shape and size are measured using a probe. PGA-HA scaffold is prepared, inserted through the most appropriate portal using a