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ORIGINAL ARTICLE

Treatment of talar osteochondral defect with peroneus longus tendon autograft

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Abstract

Background: Tendon autograft has been used in Freiberg's disease, capitellar osteochondritis dissecans, and osteochondral defect in the knee joint. The aim of this study was to evaluate the clinical and radiological results of patients treated with tendon autografts in the treatment of talus osteochondral defect (TOD), and to compare the results of this treatment with other treatment modalities in light of the literature.

Methods: The study was carried out with patients who were treated for TOD with peroneus longus tendon otograft between 2009-2017. 17 ankles of 15 patients were included in the study. The patients who were operated had osteochondral lesions that were Berndt and Harty stage III-IV on radiographs, and Hepple stage III-IV-V on magnetic resonance imaging (MRI). American Orthopedic Foot and Ankle Score (AOFAS) was used for clinical evaluation. Magnetic Resonance Observation of Cartilage Repair Tissue (MOCART) classification was used for postoperative radiological evaluation.

Results: The mean age of the patients was 31.9±14.1 (min 17-max 64) years. The mean follow-up period was 23.9±28.7 (min 6-max 120) months. The mean defect size was 1.7±0.7 (min 0.9-max 3.3) cm². The mean AOFAS score was 50.1±15.7 (min 24-max 77) preoperatively and 90.8±7.7 (min 70-max 100) postoperatively. The mean MOCART score was calculated as 87.1±3.1 (min 80-max 90). Postoperative osteoarthritis was not detected in any of the direct radiographs of the patients.

Conclusions: Tendon autograft was considered to be a reliable, easy, cheap and one-step method that can be used in TOD treatment.

Keywords: Ankle Joint, Osteochondral Defect, Scaffold, Tendon Autograft.

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INTRODUCTION

Talus osteochondral defect (TOD) is a pathological, acquired lesion in which the articular cartilage and subchondral bone are damaged (1). After the knee, the most common joint for cartilage lesion treatment is the ankle. TOD occurs in a significant proportion of ankle sprains or trauma (2). The avascular nature of the articular cartilage causes a limited ability to self-repair and regenerate (3). As a result, the probability of degeneration and subsequent osteoarthritis after the damage is quite high (4).

If the complaints cannot be resolved with conservative treatment applied for 6 months, it should be evaluated in terms of surgical treatment (5,6). The superiority of any treatment method over the other has not been conclusively proven so far. If the appropriate surgical method is not preferred in the treatment, an increase in the lesion stage, chronic ankle pain, and secondary osteoarthritis may develop (7,8).

Surgical treatment of TOD includes marrow stimulation techniques such as microfracture, anterograde-retrograde drilling and arthroscopic debridement, osteochondral autograft transplantation system (OATS), osteochondral allograft transplantation, autologous chondrocyte implantation (ACI), matrix induced autologous chondrocyte implantation (MACI), autologous matrix induced chondrogenesis (AMIC), and the use of auxiliary biological materials (9).

Tendon autograft has been used in restoration of the metatarsal head in Freiberg's disease, capitellar osteochondritis dissecans in the elbow, and osteochondral defect (OCD) in the knee joint (10-12). In an experimental study, tendon autograft has been used in OCD in the medial femoral condyle of the dog's knee (13).

The present study aimed to evaluate the clinical and radiological effectiveness of autologous tendon transplantation in selected TODs and to explore its potential as an alternative treatment for TODs.

MATERIALS AND METHODS

Study was carried out with 17 ankles of 15 patients who underwent TOD treatment with tendon autograft between 2009 and 2017. This study was approved by the Etics Commitee of the Karadeniz Technical University (Ref No: 2017/170). Berndt and Harty classification was used for preoperative radiographical evaluation of all patients and Hepple classification was used for magnetic resonance imaging (MRI) evaluation.

Patients who were followed-up for at least 6 months postoperatively in our clinic were included in this study. Adult patients not responding to conservative treatment, with active ankle pain or mechanical symptoms, no advanced osteoarthritis or other ankle diseases, no ankle instability, Berndt and Harty stage III-IV on radiographs, and Hepple stage III-IV-V lesions on MRI were operated.

Those who did not attend adequate follow-up, refused to participate in the study, did not sign the consent form, did not attend their appointments and did not come to the final controls, did not have regular follow-ups in our clinic, were treated in other clinics, did not have the first radiograph and had insufficient information in the file, and had another surgical procedure related to the operated ankle were not included in the study.

The American Orthopedic Foot and Ankle Score (AOFAS) was used in the preoperative and postoperative clinical evaluation of the patients. For the evaluation of osteochondral repair, patients underwent MRI before surgery and at the earliest 6 months after surgery. The status of cartilage repair in the MRI was evaluated using the Magnetic Resonance Observation of Cartilage Repair Tissue (MOCART) score. Mocart score includes parameters such as degree of defect repair and filling, integration with neighboring zones, repair tissue surface quality, repair tissue structure, repair tissue signal intensity, subchondral lamina, subchondral bone, adhesion, and effusion.

The subchondral bone parameter in the the original MOCART score could not be calculated on the postoperative MRI evaluation since the defect area was restored with an autologous tendon in the treatment procedure. In this regard, the patient's MOCART score was not 100 points. The highest score was 90 because all subchondral bone parameters were scored 0.

SPSS 23.0 statistical package program was used in the analysis of the data. Descriptive statistics of the evaluation results; numbers and percentages for categorical variables, mean, standard deviation, minimum and maximum for numerical variables. Kolmogorov-Smirnov test was used to evaluate the conformity of the data with normal distribution. Comparison of two dependent groups was evaluated with the Significance of Difference Between Two Spouses Test (paired t-test). Statistical significance level was accepted as p<0.01.

SURGICAL TECHNIQUE AND POSTOPERATIVE CARE

In the preoperative period, medial malleolar osteotomy was planned for centralmedial and posteromedial lesions, which were located behind the anterior of the ankle joint in computed tomography (CT) scans taken while the ankle was in full plantar flexion, for which surgical treatment was considered. After the ankle anteromedial skin incision, the defect was reached by arthrotomy. The defect was debrided until intact cartilage was reached at the defect margins. The sclerotic subchondral tissue was curetted until the healthy subchondral tissue appeared. The subchondral bone was drilled at intervals of 2–4 mm using a 1 mm sized Kirschner wire to the mesenchymal stem cells to come to the defected area. Defect sizes were reevaluated and remeasured.

With the lateral incision of the same extremity, the peroneus longus tendon was removed as half of its thickness. The tendon graft was made into a ball by making a knot on itself and placed in the defect (Figure 1). The ankle was flexed and extended to allow the defect to take its full shape. It was checked whether the tendon graft overflows from the defect and whether it is stable (Figure 2). Insufficient or overflowing tendon grafts were reshaped to completely fill the defect.

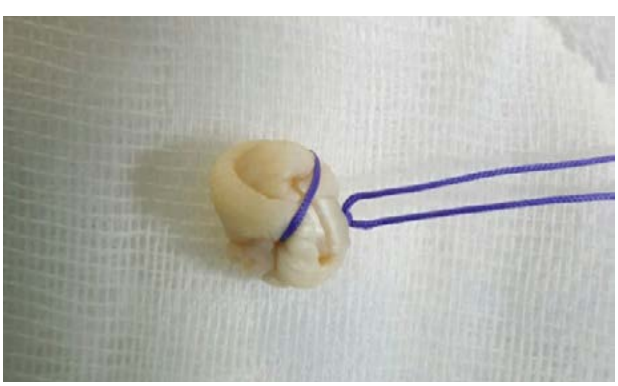

Figure 1: The tendon graft was made into a ball by making a knot on itself and ready to be transferred to the defect area.

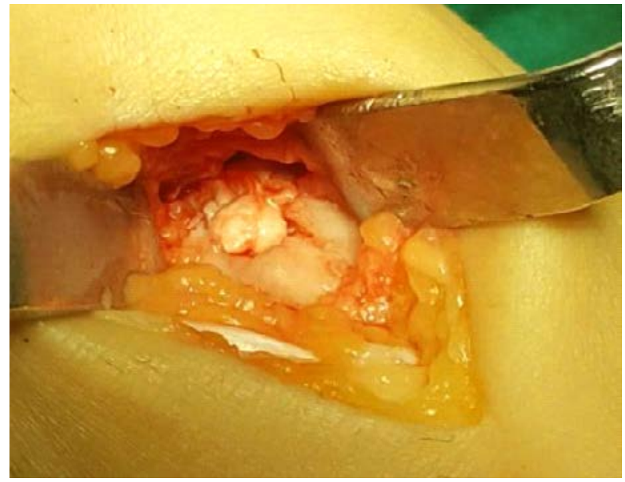

Figure 2. The left talus central medial defect was treated without the need for medial malleolus osteotomy. It can be seen that the tendon fits perfectly into the defect area.

In patients who underwent medial malleolus osteotomy (Figure 3), the osteotomy line was reduced and fixed with a 3.5 mm cannulated partially threaded cancellous screw. After the sugery, a short leg cast with a neutral ankle of 90 degrees was applied.

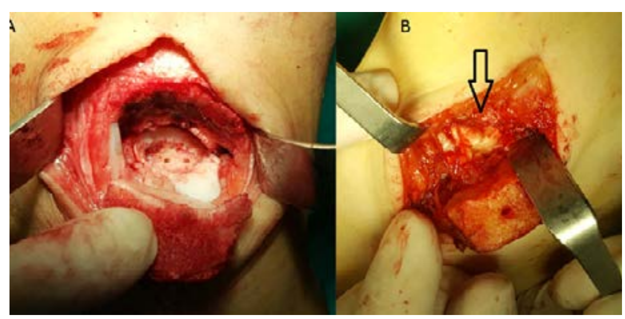

Figure 3. A: Since the right talus was located posteromedially behind the tibia anterior cortex, the defect was treated by performing a medial malleolus osteotomy. B: It can be seen that the tendon fits perfectly into the defect area.

The wound site was followed by opening the cover over the plaster. The sutures were removed on the 15th day after surgery. Walking plaster was applied to the patients who did not undergo osteotomy and were mobilized with a full load. Patients who underwent osteotomy were mobilized for 6 weeks without weight bearing. At the end of 6 weeks, the cast was removed and ankle exercises were started. After the cast was terminated, partial weight bearing was started in patients who had union on the osteotomy side on radiograph.

RESULTS

17 ankles of 15 patients who met our criteria and completed at least 6 months of follow-up were evaluated. 8 of the 15 patients were operated on the right, 5 on the left and 2 on bilateral ankles. 8 of the patients were male and 7 were female. The mean age of the patients was 31.9±14.1 (min 17-max 64) years. 1 patient was 17 years old and consent form was obtained from his parents. Others were over 18 years old and consent forms were obtained from them.

The mean follow-up period of the patients was 23.9±28.7 (min 6-max 120) months. 9 of the lesions were Berndt and Harty stage III and 8 were stage IV. 5 of the lesions were Hepple stage III, 3 were stage IV, and 9 were stage V. 8 of the lesions were in the posteromedial of the talus dome and 9 were in the mediocentral.

The mean size of lesions was 1.7±0.7 (min 0.9-max 3.3) cm^2. All 15 patients were adults. Preoperative and postoperative osteoarthritis was not detected in any of the direct radiographs of the patients (Figure 4).

Figure 4. 12th month anterior posterior radiograph of a patient with right talus posteromedial defect who underwent medial malleolus osteotomy. No degeneration is seen in the joint.

Autologous peroneus longus tendon graft was used in all patients who underwent TOD treatment with a tendon graft. None of the patients developed complications related to the donor area.

In the clinical evaluation using AOFAS, the mean preoperative AOFAS score of the patients was 50.1±15.7 (min 24-max 77). In the postoperative period, the mean AOFAS score was 90.8±7.7 (min 70-max 100). The difference between preoperative and postoperative scores was statistically significant ($p<0.001$).

MRIs taken at the earliest 6 months after surgery were evaluated. The mean MOCART score was calculated as 87.1±3.1 (min 80-max 90). No complications developed in any of the patients after the operation. Any ankle disease requiring reoperation did not develop. The graft survival rate of the patients participating in the study was 100% (Figure 5 and 6).

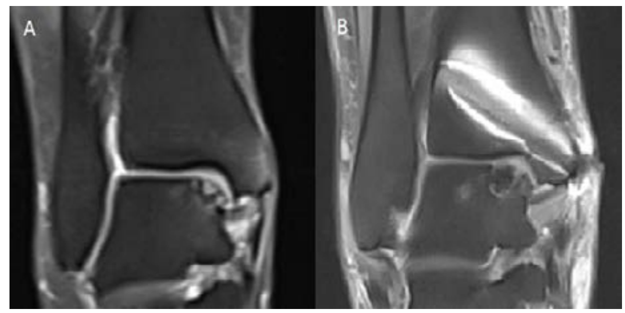

Figure 5. A: Coronal T2 section magnetic resonance images (MRI) of a grade 3 posteromedially located osteochondral defect of right talus (1 cm2 size) in 47-year old female; B: 6 months follow-up coronal T2 section MRI showing complete filling of the defect and establishment of smooth articular surface

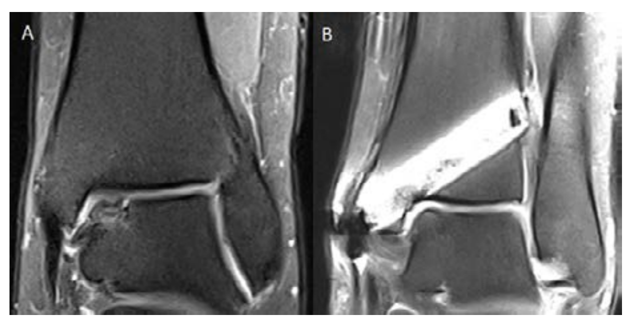

Figure 6. A: Coronal T2 section magnetic resonance images (MRI) of a grade 3 posteromedially located osteochondral defect of left talus (1.35 cm2 size) in 17-year old female; B: 1-year follow-up coronal T2 section MRI showing complete filling of the defect and establishment of smooth articular surface

All of the patients returned to their active working lives and daily activities without restriction, were satisfied with the surgery and stated that they could recommend it to other patients, stated that their ankle pain was relieved. Detailed patient demographics are shown in Table 1.

Table 1. Demographics Data of the Patients and Results

Variable	Value
Total number of patients	15 (17 osteochondral defects of the talus)
Age (year), mean ± SD (range)	31.9 ± 14.1 (range, 17–64)
Sex (female/male)	7/8
Follow-up time (months), mean ± SD (range)	23.9 ± 28.7 (range, 6–120)
Lesion area (cm²), mean ± SD (range)	1.7 ± 0.7 (range, 0.9–3.3)
AOFAS, mean ± SD (range)	Preoperative 50.1 ± 15.7 (range, 24–77). Postoperative 90.8±7.7 (range, 70–100)
MOCART, mean ± SD (range)	Postoperative 87.1 ± 3.1 (range, 80–90)
Complication	No

Note. SD, Standard deviation. AOFAS, American Orthopedic Foot and Ankle Score. MOCART, Magnetic Resonance Observation of Cartilage Repair Tissue.

DISCUSSION

In this study, there was improvement in ankle scores. The mean AOFAS score was 50.1±15 preoperatively, and 90.8±7.7 postoperatively. The difference between preoperative and postoperative scores was statistically significant ($p<0.001$). We believe that this situation was caused by the viscoelastic and anisotrophic structure of the tendon autograft. The mean MOCART score was calculated as 87.1±3.1 (min 80-max 90). No complications developed in any of the patients after the operation and no patient required revision. The graft survival rate of the patients participating in the study was %100.

Peroneal tendon autografts have been used in the treatment of OCDs because the tendon has a solid structure, can resist mechanical loads, is composed of collagen fibers due to its structure, and can act as a scaffold. The tendon graft is a monophasic (monoblock) graft. It repairs the tissues in the defect by replacing both chondral and subchondral tissues together (10).

Tendons were traditionally known to contain only tenocytes (14-16). However, human and mouse tendons have also been shown to contain tendon stem cells (Tendon Stem Cells, TSC) (17). TSCs have the potential for multidifferentiation, including differentiation into adipocytes, chondrocytes, and osteocytes. In addition, Mos et al. showed that tendon-derived fibroblasts (Tendon Derived Fibroblasts, TDFs) from adolescent non-degenerative human hamstring tendons can differentiate into adipocytes, chondrocytes, and osteocytes (18). It has also been found that TSCs can differentiate into adipocytes, chondrocytes, and osteocytes in vitro, and form tendon-like, cartilage-like, and bone-like tissues in vivo (19). With these features, the tendon autograft we used supports that it can be used in the treatment of OCDs.

The main issue in the treatment of an OCD should be primarily to fill the defect with an autograft close to the mechanical properties of the tissues in the region. As a result, the geometry of the joint should be restored and this area should be included in load bearing, pain should be eliminated, joint functions should be preserved, and degeneration should be stopped (10).

Tendon autograft has been used and good results have been obtained in the restoration of the metatarsal head in Freiberg's disease and capitellar osteochondritis dissecans in the elbow (11,12). In addition, it has been used in an OCD in the medial femoral condyle of a dog's knee and the results have been found to be satisfactory in macroscopic and microscopic terms (13).

A previous study reported satisfactory results in a case where an autologous tendon has been used in the restoration of an OCD in the knee joint. As the results of the knee OCD treatment with tendon autograft were positive, we preferred its application in TOD treatment as well. As we treated TOD with peroneus longus tendon autograft, also Turhan et al. treated 20 patients (22 knees) with OCD of the femoral medial condyle with peroneus longus tendon autograft. The mean age of patients was 25.5± 6.8 years. The average defect size was 4.2 ± 2.1 cm^2. Total Knee Injury and Osteoarthritis Outcome Score (KOOS) was 29.4 ± 5.5 preoperatively, and 81.5 ± 5.9 postoperatively. The mean follow-up period was 68.7 ± 37.7 months. The mean MOCART score was 56.2 ± 10.7. 80% of the patients showed no radiological progress of osteoarthritis (10).

Radiological improvement was detected in all patients, and MOCART scores in MRI evaluation had satisfying results. In our study, the subchondral bone parameter in the original MOCART score could not be calculated in the postoperative MRI evaluation because monoblock repair is performed by replacing the tendon graft cartilage and subchondral bone together. In other words, it replaces both cartilage and subchondral tissue function. Tendon grafts do the job of both tissues. In this regard, no patient's MOCART score was 100 points in our study. All subchondral bone parameters were scored 0. We attribute the absence of radiological degeneration to the repair of the defect, its participation in weight bearing and the improvement of joint functions. It is very important that tendon autografts are seen on MRI even after 1-8 years postoperatively and degeneration does not develop on radiographs.

The limited number of patients, short follow-up periods, the absence of a comparison group, and the lack of arthroscopic and histological evaluation are the limitations of this study.

The most important result of this study is that patients do not have pain, improvement of ankle functions are observed, and they return to work. Tendon autograft can be used in both primary and revision cases. Depending on the size of the defect, the diameter of the tendon node can be adjusted. Since the tendon tissue is flexible, it can adapt to any surface and joint geometry. While none of the patients in our study developed degeneration and arthrosis in the ankle, the tendon graft was in the place where it was placed in the control MRIs of all patients, any lysis, any resorption, and any insufficiency were not observed. No patient required a secondary operation. These results showed us that the defect was repaired with a tendon graft, the tendon adapted to the geometry of the joint, began to carry loads in the joint, and facilitated the movements.

CONCLUSIONS

It was concluded that our method is a single-session, easy, reliable, inexpensive method, which does not cause any loss for the patient, has a high level of patient satisfaction, and can be used for revision surgery in cases where other methods cannot be successful.

Declarations

The authors received no financial support for the research and/or authorship of this article. There is no conflict of interest.

This study was approved by the Ethics Committee of the Karadeniz Technical University (Date: 02.10.2017, Ref No: 2017/170).

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