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Research Article

Comparison of autologous matrix-induced chondrogenesis and mosaicplasty in the treatment of osteochondral defects of the talus

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ABSTRACT

Objective: This study aimed to compare the medium- to long-term results of mosaicplasty and autologous matrix-induced chondrogenesis (AMIC) in treating osteochondral defects of the talus (OCD).

Methods: Fifty patients treated for talus OCD were evaluated between 2010 and 2020. Patients were divided into 2 groups: patients who underwent mosaicplasty (Group I) and those who underwent AMIC (Group II). The OCD was graded according to the Berndt-Hardy and Hepple classification systems. The size of the OCD area, the number of osteochondral plugs, and the size of the collagen matrix were determined from the surgical data. The effects of patients aged below and above 45, defect areas smaller or larger than 1.5 cm^2, and gender on functional outcomes were analyzed in both groups. Range of motion (ROM), The American Orthopaedic Foot & Ankle Society score (AOFAS), the Freiburg ankle Index score (FAI), the Tegner activity scale, and the visual analog scale (VAS) were used for the functional evaluations.

Results: Group I included 28 patients, and group II included 22 patients. The mean age was 41.6 years; the mean follow-up period was 69.9 months. In the final examination of the patients, both methods could provide significant improvement in all functional scores ($P < .001$). Although it was not statistically significant, group II had better functional values. The size of the defect area independently negatively affected the preoperative AOFAS ($P = .001$ and $P = .011$, respectively) and FAI ($P = .001$ and $P = .008$, respectively) scores. Besides that, age and gender did not affect the results ($P > .05$).

Conclusion: Both methods can provide successful results; however, the AMIC method can achieve better results than mosaicplasty in similarly sized defects without causing additional morbidity.

Introduction

Osteochondritis dissecans (OCD) is a degenerative process that begins with edema in the subchondral bone and can lead to detachment of articular cartilage from the subchondral bone in the injured area. Lesions involving the articular cartilage and underlying subchondral bone often occur after trauma and may result in complete or partial dehiscence in the damaged area.[1] In addition to trauma, degenerative joint disease, metabolic disorders, alcohol consumption, and genetic predisposition may also lead to the development of OCD.[2,3] Avascular necrosis in the subchondral bone triggers remodeling with sclerosis in the surrounding tissue. After sclerosis develops, blood flow in the defect area decreases and bone healing does not occur.[4,5] After cartilage breakdown, patients admit to orthopedic clinics with severe ankle pain, difficulty bearing weight, decreased range of motion, functional limitations, and locking.[1] When all joints are examined, OCD lesions occur most frequently in the knee, followed by the ankle or elbow joint.[6]

There is no widely used treatment algorithm for osteochondral defects in the talus.[7] In the treatment of these defects, rest and immobilization with plaster are conservative treatment methods, whereas excision, curettage, microfracture, autogenous bone graft, osteochondral autotransfer system (OATS), autologous chondrocyte implantation (ACI), and autologous matrix-induced chondrogenesis (AMIC) are used.

Some publications have examined mosaicplasty and the AMIC method separately, reporting successful results with both methods. However, no publications have compared these 2 methods in the treatment of talus OCD.

This study aims to compare the outcomes of patients who underwent mosaicplasty and AMIC for the treatment of talus OCD. Our study hypothesizes that the use of AMIC in the treatment of talus OCD will achieve similar results compared to mosaicplasty without causing additional morbidity.

Material and methods

A pre-study power analysis based on previous data determined a sample size of at least 12 patients for each group to reach the desired power of >0.8.

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Postoperative AOFAS score was the primary outcome for 2 means T-test power analysis.[8]

Before the start of the study, approval was obtained from the Tokat Gaziosmanpasa University School of Medicine Ethics Committee (decision number 22-KAEK-020, date: 17.03.2022). Informed consent was obtained from patients who agreed to participate in the study. This retrospective study examined patients who underwent surgery for talus OCD between 2010 and 2020. The operations were performed in a single center by 2 different surgeons with 15 years (T.G.) and 5 years (M.A.) of experience in cartilage injuries and ankle surgery. When deciding on the surgical technique, 2 techniques were used in sequence in order to achieve a homogeneous distribution. The preoperative and final follow-up evaluations of the patients participating in the study were performed by 2 orthopedic and traumatology surgeons who did not participate in the operations or the study (Ö.C.Ç, Y.B.).

Patients aged 18 to 75 years were enrolled in the study. The inclusion criteria were as follows: (i) symptomatic ankle pain or dysfunction, (ii) talar cartilage lesion with a diameter of >5 mm with both cartilage surface involvement and subchondral bone cyst formation, (iii) grade III or severe talus OCD according to Berndt and Hardy's classification system, (iv) failure of conservative treatment for at least 3 months, (v) no significant limitation of the affected ankle joint's range of motion (<10 degrees difference from the contralateral ankle joint), and (vi) an osteochondral defect located only in the medial dome of the talus.

Patients were excluded from the study if they had involvement of the lateral or bilateral dome of the talus, metabolic bone disease, a history of ankle infection, osteoarthritis, fracture and surgery history in the same ankle, lower than Berndt and Hardy grade III OCD, and a follow-up period of <1 year (Figure 1).

Patients who met the study inclusion criteria were divided into 2 groups: patients who underwent mosaicplasty (Group I) and those who underwent AMIC (Group II). Functional evaluations of the patients with a follow-up period >1 year were performed in the final examination.

The patients' preoperative data were retrieved from their medical records (mechanism of injury, history of physical therapy, time from onset of symptoms or trauma to surgery).

Radiographic analysis was based on magnetic resonance imaging for preoperative defect size, and the lesion's diameter was measured at the largest point in the coronal and sagittal planes (Figure 2). The defect area was calculated according to the method described by Choi et al (sagittal length × coronal length × 0.79).[8]

The effects of age, gender, and defect area size on functional outcomes were investigated. Cuttica et al[9] reported in their study that defects larger than 1.5 cm^2 are a predictor of poor outcome. In our study, we therefore set the cutoff value at 1.5 cm^2 when examining the effects of defect area size on functional outcomes within groups.

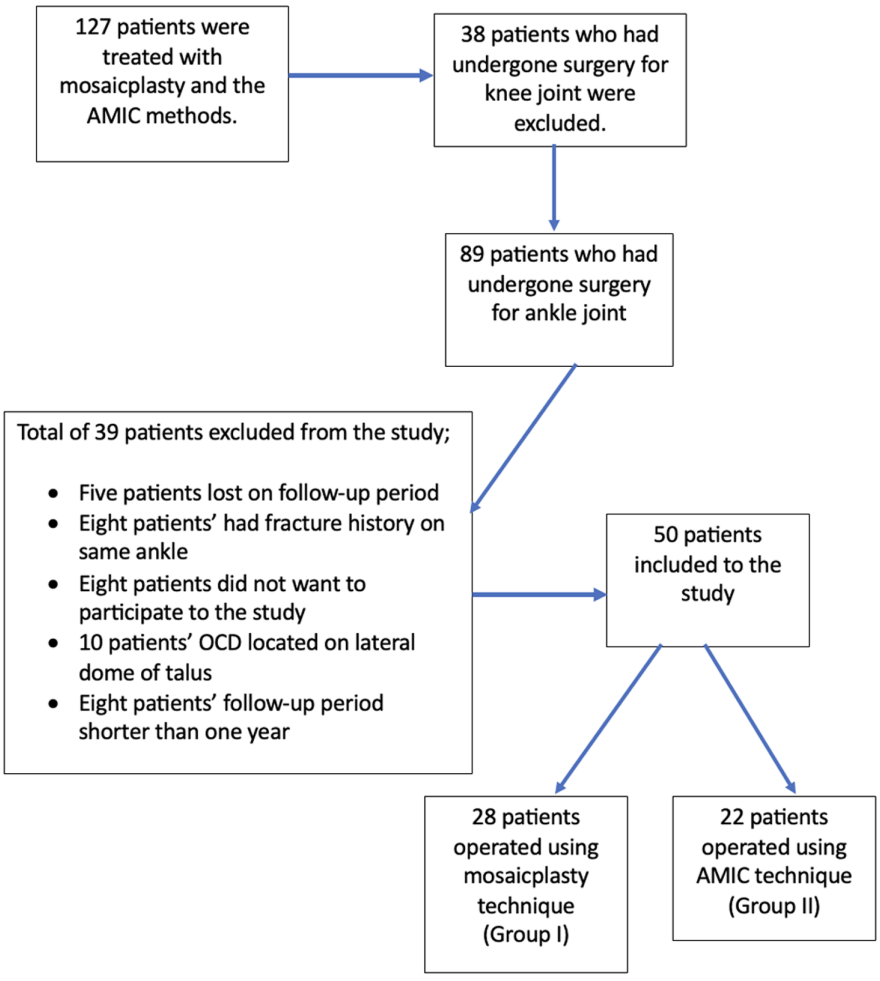

Figure 1. Presentation of the patients participating in our study in the form of a flow chart according to the inclusion and exclusion criteria.

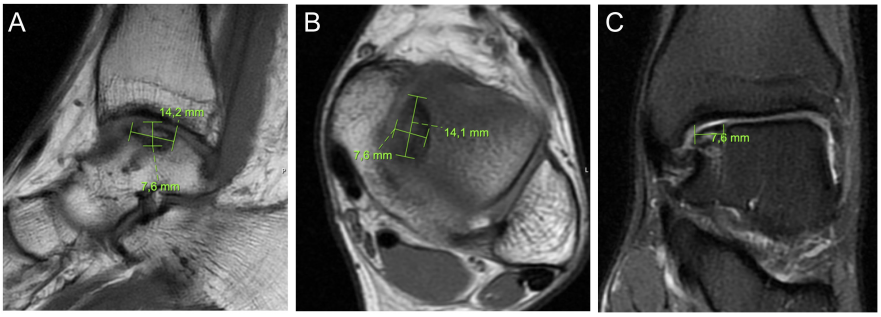

Figure 2. A-C: Measurement of the talus OCD area using magnetic resonance imaging. Sagittal (A), axial (B), and coronal (C) T1- and T2-weighted MR images show the measurement method of the OCD defect area.

ROM, The American Orthopaedic Foot & Ankle Society score (AOFAS), Freiburg ankle score, Tegner activity scale, and visual analogue scale (VAS) were used for the pre- and postoperative functional evaluations.[10-13] The OCD was graded according to the method defined by Berndt and Hardy[14] and the Hepple[15] classification system based on the preoperative ankle radiographs and magnetic resonance images. In addition, the size of the OCD area, the number of osteochondral plugs used, and the size of the collagen matrix were determined from the surgical data.

Surgical technique and rehabilitation

In both surgical methods, the patients were prepared in the supine position. In both methods, a chevron-type osteotomy of the medial malleolus was performed. Two cannulated screws with a diameter of 4.5 mm were used for osteosynthesis of the osteotomy line in all patients.

In Group I, the lesion area was debrided, and the necrotic sequestrum and sclerotic tissues were removed and curetted until bleeding was observed from the surrounding bone. After preparation of the OCD area, the width was measured in the axial plane to clearly determine the diameter of the graft recipient. The ipsilateral knee joint was then accessed in all patients via a superolateral mini-arthrotomy. Autologous osteochondral grafts were harvested from the non-weight-bearing superolateral articular surface of the femur. Grafts with a depth of 15 mm were harvested with graft recipients (Johnson&Johnson) with diameters of 8 and 10 mm, corresponding to the previously measured width. All cylinder grafts were implanted perpendicularly using the press-fit technique to avoid causing further injuries to the defect (Figure 3).

In patients in group II, after osteotomy, the defect area was debrided to the intact cartilage margin and then curetted so that no sequestrum or sclerotic tissue remained. After debridement of the cyst and access to living cancellous bone, the cavity was grafted with an autologous cancellous bone graft from the tibial side of the osteotomy line. After preparation and grafting, a bio-derived collagen membrane Chondro-Gide (Geistlich Pharma AG Wolhusen/Switzerland) was prepared depending on the measured defect area and fixed to the intact cartilage surface with 6/0 Prolene sutures. Chondro-Gide exerts its action by stabilizing the clot that allows chondrogenesis in response to the shear forces that occur during joint movement.[16]

Patients who underwent AMIC were discharged the day after surgery. In our patients who underwent mosaicplasty, the drain placed in the knee joint was removed on the first postoperative day, and they were discharged on the second postoperative day after verifying that no hematomas had formed in the surgical areas. Postoperatively, all patients were placed in a short-leg cast in a neutral position for the first 4 weeks. Active range-of-motion (ROM) and strengthening exercises commenced four weeks after surgery. Gradual weight-bearing was started 6 weeks after surgery. After the osteotomy line was fused, all patients were allowed to walk with full weight-bearing.

Statistical methods

The data were analyzed using SPSS software version 23.0 (IBM SPSS Corp.; Armonk, NY, USA). The distribution of the data was evaluated with the Shapiro–Wilk test. The categorical data were assessed with Pearson's chi-square and Fisher's exact tests. The parametric and non-parametric data were evaluated with the Student's *t*-test and the Mann–Whitney *U* test, respectively. Quantitative data with normal distribution (age, follow-up period, duration of symptoms) were

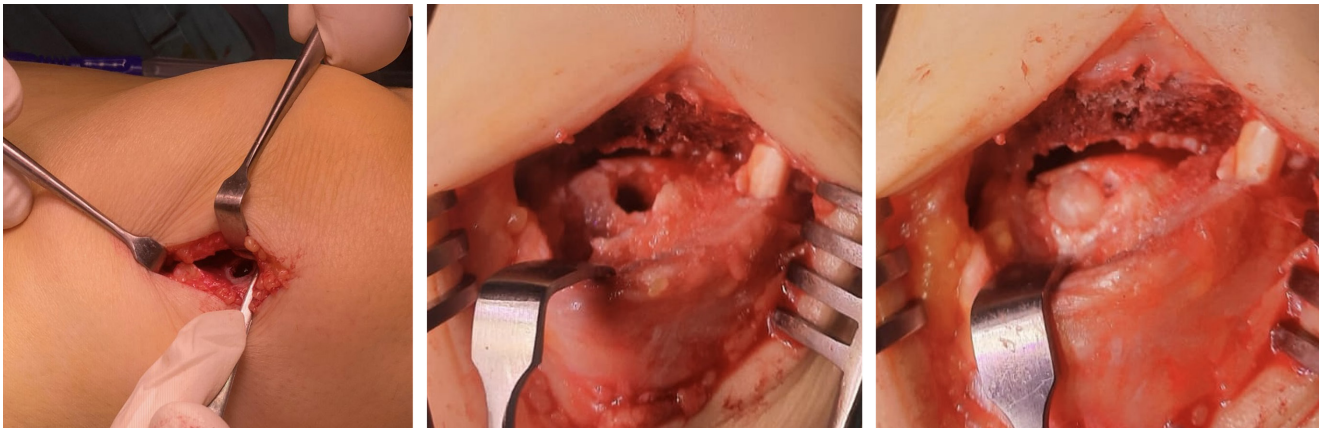

Figure 3. A-C: Intraoperative images of our patients who underwent mosaicplasty. Harvesting of the osteochondral graft from the superolateral incision of the knee joint (A), preparation of the OCD area (B), and insertion of the osteochondral graft into the defective area (C).

evaluated with the Student *t*-test and the rest were evaluated with the Mann–Whitney *U* test. The dependent groups for non-parametric data were evaluated with the Wilcoxon test. A *P*-value of <.05 was considered significant in all tests.

Results

We identified 57 patients who underwent surgery for talus OCD during the study period. Seven patients did not want to participate; therefore, 50 patients were included in this study. The patients' mean age was 41.6 ± 13.1 years (range, 18-72 years), and the mean follow-up period was 69.9 ± 30.5 months (range, 12-127 months). A summary of the patient characteristics can be found in Table 1.

Both groups showed a statistically significant improvement in the postoperative period for all scoring methods used for evaluation (*P*=.000). Group I patients were found to have statistically significantly lower AOFAS (*P*=.013) and Freiburg ankle scores in the preoperative period but were comparable to Group II postoperatively. The Tegner activity scores and VAS scores were similar between in Group I and Group II (Table 2).

In both groups, patients with defect areas larger than 1.5 cm² had worse functional results than patients with smaller defect areas. When functional outcomes were examined in the postoperative period, it was found that AOFAS and FAI scores were statistically significantly lower in patients with a defect area greater than 1.5 cm² (*P* < .05) (Table 3).

Regarding the effect of patient age on outcomes, the average defect areas of our patients who were over 45 years old at the time of surgery were evenly distributed in both groups. Patients' clinical outcomes before and after surgery did not depend on age (Table 4).

When examining the influence of gender on the results, it was found that the defect areas of the female patients in Group I were larger (F=1.83 ± 0.79, M=1.32 ± 0.53), but this did not influence the functional results. No statistically significant differences were found based on gender in patients' defect sizes or functional outcomes in Group II (Table 5).

Table 1. Demographic and OCD characteristics of the study groups

	Group I (n=28)	Group II (n=22)	*P*
Age, y	39.7 ± 13.5	43.95 ± 12.5	.267
Sex, female/male	17/11	10/12	.283
OCD area range	1.6 ± 0.73	1.29 ± 0.5	.075
Follow-up period, mo	68.1 ± 36.9	72.2 ± 20.4	.643
Side affected, right/left	12/16	12/10	.412
History of trauma (yes/no)	17/11	14/8	.412
High energy trauma	8	5	
Falling from walking level	5	5	
Sport injury	4	4	
Duration of symptoms, mo	8.4 ± 3.4	7.6 ± 3.4	.364
Berndt and Hardy classification			
Type III	21	17	.852
Type IV	7	5	
Hepple classification			
Type III	12	12	.769
Type IV	7	5	
Type V	9	5	

indicate aData are presented as mean ± SD or No. of patients and median (IQR). Student's *t*-test was performed, and Mann–Whitney *U*-test was performed.

Table 2. The patients' change with AOFAS, Freiburg Ankle score and Tegner Activity scores before and after the operation

	AOFAS Score			
	Overall	Group I	Group II	*P*
Preoperative	50.2 ± 9.8	47.7 ± 9.3	53.3 ± 9.7	.677
Postoperative	90.3 ± 4.3	90.1 ± 4.1	90.4 ± 4.8	.348
		<0.001	<0.001	
		Freiburg ankle index		
Preoperative	50.2 ± 9.4	46.3 ± 9.7	55.2 ± 6.2	.919
Postoperative	88.1 ± 6.6	87.2 ± 6	89.2 ± 7.3	.090
		<0.001	<0.001	
		Tegner activity score		
Preoperative	2.4 ± 0.7	2.3 ± 0.6	2.5 ± 0.8	.235
Postoperative	5.5 ± 0.8	5.4 ± 0.7	5.7 ± 0.9	.184
		<0.001	<0.001	
		Visual analog scale		
Preoperative	7.4 ± 0.9	7.4 ± 0.9	7.5 ± 0.9	.653
Postoperative	3.1 ± 1	3.1 ± 1.0	3.0 ± 1.1	.838
		<0.001	<0.001	

Student's *t*-test was performed, and Mann–Whitney *U*-test was performed.

Complications were observed in 14 (28%) of our patients, 10 in Group I and 4 in Group II. These complications included superficial wound infection, donor site pain, and implant removal because of irritation. One patient in group I and 1 patient in group II developed superficial wound infections; they were treated with antibiotherapy. Cannulated screws used to fix the osteotomy were removed because of implant irritation in 1 patient from group I and in 2 patients from group II. Knee pain persisted in 4 patients in group I, and ankle pain and functional limitations persisted in 4 patients at final follow-up. In group II, pain and functional limitations persisted in only 1 patient. Complete union of the osteotomy line was achieved in all patients in our study, complete osteointegration of the osteochondral and cancellous bone grafts was observed. At the end of the follow-up period, no arthritis in the ankle joint was observed in our patients (Figure 4).

Diagnostic arthroscopy of the ankle joint was performed in a total of 3 patients, 2 of whom were in the group II and 1 of whom was in the group I (Figure 5a). All of these patients who underwent second-look arthroscopy were patients who underwent implant removal. The aim of this operation was to observe the healing in the defect area and to determine the histological characteristics of the cartilage tissue

Table 3. Investigation of the influence of defect size on the AOFAS, the Freiburg ankle score and the Tegner activity score before and after surgery

	AOFAS score					
	Group I			Group II		
	<1.5 cm²	>1.5 cm²	*P*	<1.5 cm²	>1.5 cm²	*P*
Preoperative	61.2 ± 6.3	45.0 ± 9.2	.001	58.0 ± 6.2	46.6 ± 10.3	.011
Postoperative	90.2 ± 3.5	88 ± 4.2	.098	92.6 ± 4.7	87.3 ± 2.7	.008
	Freiburg ankle index					
	<1.5 cm²	>1.5 cm²	*P*	<1.5 cm²	>1.5 cm²	*P*
Preoperative	59.4 ± 2.4	51.0 ± 4.6	.001	57.9 ± 5.2	51.3 ± 5.7	.008
Postoperative	89.7 ± 4.5	85.0 ± 6.4	.036	89.6 ± 9.1	88.5 ± 3.8	.144
	Tegner activity score					
	<1.5 cm²	>1.5 cm²	*P*	<1.5 cm²	>1.5 cm²	*P*
Preoperative	2.5 ± 06	2.2 ± 0.6	.217	2.8 ± 0.6	2.2 ± 0.9	.209
Postoperative	5.6 ± 0.6	5.2 ± 0.7	.088	5.9 ± 0.9	5.4 ± 1	.324

Student's *t*-test was performed, and Mann–Whitney *U*-test was performed.

Table 4. Investigation of the influence of age on the AOFAS, the Freiburg ankle score and the Tegner activity score before and after surgery

	AOFAS Score					
	Group I			Group II		
	Age < 45	Age > 45	*P*	Age < 45	Age > 45	*P*
Preoperative	50.8 ± 11.9	55.1 ± 10.4	.430	52.7 ± 7.4	54.1 ± 12.3	.497
Postoperative	54.2 ± 6.3	56 ± 4.4	.066	90 ± 4.7	90 ± 5.1	.702
	Freiburg ankle index					
	Age < 45	Age > 45	*P*	Age < 45	Age > 45	*P*
Preoperative	54.2 ± 6.3	56 ± 4.4	.611	53.7 ± 6.5	57 ± 5.6	.314
Postoperative	85.8 ± 5.4	89.3 ± 6.4	.138	90.2 ± 4.6	88 ± 9.8	.771
	Tegner activity score					
	Age < 45	Age > 45	*P*	Age < 45	Age > 45	*P*
Preoperative	2.4 ± 0.7	2.2 ± 0.6	.516	2.8 ± 0.7	2.3 ± 0.9	.159
Postoperative	5.4 ± 0.7	5.3 ± 0.8	.677	5.6 ± 0.8	5.8 ± 1.1	.674

Student's *t*-test was performed, and Mann–Whitney *U*-test was performed.

formed in patients treated with the AMIC method. Specimens from the repair area were sent for pathological examination. Degenerative cartilage rich in hyaline was found in all patients (Figure 5b).

Discussion

Our study showed that the treatment of talus OCD had successful ROM and functional score results in both groups. Postoperative Freiburg ankle scores ($P < .001$) were significantly improved in Group II.

Mosaicplasty/OATS can be safely used for large, medially located OCD with underlying cysts; hyaline articular cartilage can be restored while maintaining its mechanical and biochemical properties.[17] Good and excellent results can be achieved in about 90%-94% of patients with osteochondral defect grafts.[1,17] While Scranton et al obtained 90% satisfactory results in 50 patients with a follow-up of 36 months, Hangody et al obtained good and excellent results in 94% of 36 patients with a follow-up of 4.2 years.[13,14] Paul et al reported that a significant proportion of patients in their study were able to return to athletic activities.[20] Literature reports that donor knee pain, which is one of the most important complications of the OATS method, occurs in an average of 12% (0%-37%) of patients.[21-24] The satisfaction rates of our patients in group I, the increase in Tegner activity scales, and donor site pain were consistent with the literature.

The AMIC technique is a method that increases the effectiveness of chondrogenesis by protecting the fibrin clot containing the stem cells obtained by bone marrow stimulation from the shearing effect of joint movement.[25-28] Valderrabano et al found in their study, in which

Table 5. Investigation of the Influence of Gender on the AOFAS, the Freiburg Ankle Score, and the Tegner Activity Score Before and After Surgery

	AOFAS Score					
	Group I			Group II		
	Female	Male	*P*	Female	Male	*P*
Preoperative	50.5 ± 10.4	55.6 ± 12.5	.134	54.6 ± 9.5	52.3 ± 10.2	.722
Postoperative	88.7 ± 4.3	89.5 ± 3.6	.404	91.8 ± 4	89.3 ± 5.2	.240
	Freiburg ankle index					
	Female	Male	*P*	Female	Male	*P*
Preoperative	54.5 ± 3.8	55.5 ± 7.8	.244	56 ± 4.7	54.5 ± 7.4	.582
Postoperative	86.3 ± 6.7	88.6 ± 4.5	.336	91.2 ± 3	87.5 ± 9.4	.418
	Tegner activity score					
	Female	Male	*P*	Female	Male	*P*
Preoperative	2.1 ± 0.7	2.6 ± 0.5	.134	2.8 ± 0.7	2.4 ± 0.9	.314
Postoperative	5.3 ± 0.7	5.5 ± 0.6	.611	5.9 ± 0.7	5.5 ± 1.1	.628

The Student *t*-test was performed and Mann–Whitney *U*-test was performed.

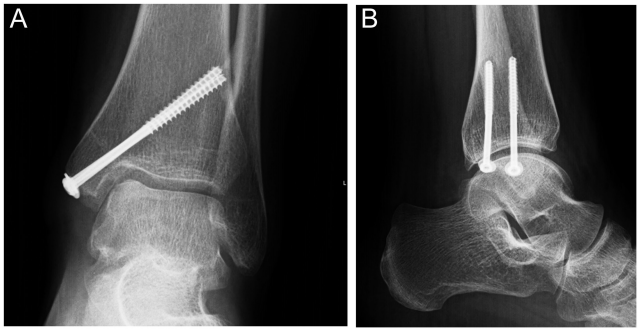

Figure 4. A, B: Anterior (A) and lateral (B) ankle X-ray show complete union of the osteotomy line and no arthrosis in the 2nd year of our patient who underwent surgery with the AMIC method.

they examined 26 patients, that the cartilage surface recovered completely in 85% of patients and the AOFAS and VAS scores improved significantly.[28] Ackermann et al showed a significant improvement in AOFAS and Tegner scores using the AMIC method after an average follow-up period of 4 years.[29] Ayyaswamy et al found a significant improvement in AOFAS and VAS scores in their study of 25 patients with an average defect area of 1.75 cm^2.[30] In a study published in 2020, which analyzed the long-term results of 15 patients treated with the AMIC technique, it was found that the average AOFAS scores of the patients increased from 60 to 84 and only 1 patient required a second operation due to persistent discomfort in the ankle joint.[31] In our study, we observed a significant improvement in the values of all patients treated with AMIC.

Many studies have been conducted on the effects of defect area size on outcomes. Cuttica et al showed in their series of 130 patients that patients with a defect area of less than 1.5 cm^2 achieved better results.[9] In studies examining the results of patients operated on using the AMIC technique, it has been shown that AOFAS and VAS results are worse in cases where the defect area is larger than 2 cm^2.[33-35] However, in a recent study, no negative correlation was found between the size of the lesion and the results.[30] In view of this result, it was stated that the AMIC technique also useful for large lesions.[30] Studies examining the outcomes of patients operated on using the mosaicplasty technique also concluded that "smaller defects and grafts lead to better results."[9,36,37] In our study, we found that the results were better in our patients with smaller defect areas, which is consistent with the literature.

Patients with a defect area greater than 2 cm^2 had lower AOFAS scores at follow-up than patients with a smaller defect area. In a study examining patients who underwent osteotomy of the medial malleolus AMIC, it was found that the defect was completely healed

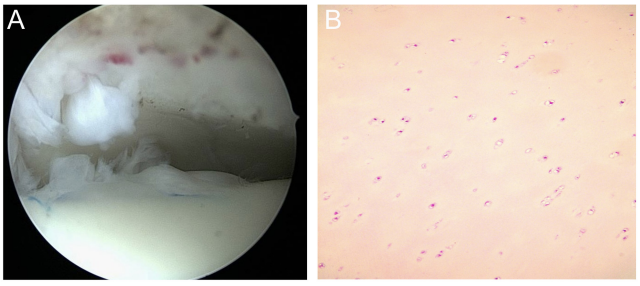

Figure 5. A, B: Intraoperative second-look arthroscopy image (A) and pathological examination image (B) showing complete healing and hyaline cartilage formation in the articular cartilage after AMIC.

in 88% of patients in whom the scaffold was placed after grafting, similar to our technique, and the patients returned to sports within 2 years.[37] Numerous studies have been performed on the efficacy of bone marrow stimulation techniques and AMIC methods, and it has been shown that even in grade III and IV lesions in OCD areas smaller than 1.5 cm^2, successful results are obtained, and the defect areas become grade I and II at the end of treatment.[1,8,38-40] Zhang et al examined the short-term results of patients they treated with the AMIC method and showed that hyaline-like cartilage tissue formed in the defect areas as a result of the second-look arthroscopy that they performed.[41] In our study, regeneration was observed in second-look arthroscopy performed on 3 patients studied; hyaline-like cartilage was obtained in the biopsies taken.

Many previous studies have examined the relationship between age and clinical outcomes. While some publications have found no association between age and clinical outcomes,[31,43-45] others report that older age is associated with poorer clinical outcomes.[37,45-47] A recent study by Waltenspül et al investigating the risk factors for the need for revision surgery after talus OCD treatment showed that age, gender, and size of the defect area were not independent risk factors.[48] When we examined our results, we found that age was not associated with worse outcomes. Besides that, although not statistically significant, we think that the higher functional scores before surgery may be due to patients expecting less physical activity as they get older.

Studies investigating the influence of gender on the results of talus OCD treatment have produced varying results. When reviewing the literature, no significant correlation between gender and AOFAS scores was found in studies conducted in recent years in which large patient series were examined in the medium and long term.[10,45,50,51] On the other hand, Lenz et al recently observed that preoperative AOFAS scores were significantly lower in male patients, while gender made no significant difference at the end of the 12-year follow-up period.[31] In our study, we found that gender had no effect on functional scores before and after surgery in either group, which is consistent with the literature.

No publication in the literature compares these 2 methods in the treatment of talus OCD. Our results show that although it is possible to reconstruct more areas with mosaicplasty, there is a risk of additional morbidity such as donor site pain. By using a collagen matrix, successful results can be achieved in lesions larger than 1 cm^2 without causing additional morbidity. Although greater improvement was observed with mosaicplasty in terms of clinical outcomes, satisfactory results were obtained with both techniques. Although greater improvement in clinical outcomes was observed with mosaicplasty in terms of clinical outcomes, satisfactory results were obtained with both techniques When comparing the surgical techniques, the additional morbidity in the knee joint in patients who underwent mosaicplasty is a disadvantage, whereas the ease of use can be considered an advantage. However, in patients undergoing AMIC, it may be difficult to suture the matrix with intact cartilage or fix it with tissue glue. On the other hand, biological reconstruction without additional morbidity and reconstruction of large areas can be considered an advantage.

Although successful results are achieved in patients following talus OCD treatment, complications can occur in 5%-58% of patients, and the most common secondary surgical requirement is the removal of the implant due to screw irritation.[30,37,48,51] In a study conducted by Waltenspül et al, it was reported that 65 of 130 patients required secondary surgery, 18 of which were performed for reasons related to AMIC. Deep fissuring in the regenerative cartilage tissue was observed in 83 of these patients, and AMIC graft thinning was observed in 17 patients.[48] In their study examining the 10-year outcomes of 24 football players who underwent mosaicplasty, Keszég et al reported that 13% of patients had donor site morbidity, 2 patients had ankle pain, and 2 patients were restricted in their movement.[52] In a multicenter study by L'Escalopier et al, 56 patients who had undergone mosaicplasty were examined and it was found that 39% of patients developed the first signs of osteoarthritis and 20% had knee pain.[53] Compared to the literature, our complication rates were similar to previous studies, but our patients had no arthritic changes. The purely arthroscopic method is currently recommended to reduce implant- and osteotomy-related complications, especially after AMIC, but the long learning curve is mentioned as a disadvantage.[48,54]

Limitations

The retrospective design of our study and the fact that the operations were performed by different surgeons may influence the results. Despite the homogeneous demographic distribution between groups, the study's retrospective nature and the collection of descriptive data from records may not have clearly documented nonoperative treatment modalities, systemic diseases, body mass index, and smoking status, except for physical therapy performed in patients before surgery, which increased the risk of bias. Although the number of our AMIC patients is higher than in some other studies in the literature, the low number of patients in our study is among our limitations. In addition to the limiting factors mentioned here, the strengths of our study are the first publication comparing these 2 methods, the narrow inclusion criteria, the long follow-up period, the patients who underwent second-look arthroscopy and histopathological examination, the evaluation of patients with more than 1 clinical scoring method, and the evaluation of pain status before and after surgery.

Our study showed that successful results can be achieved with both methods in the treatment of talus OCD. Also, the study findings showed that the AMIC method is a more advantageous method compared with mosaicplasty because it has a lower morbidity and complication rate, fewer functional limitations, and a similar improvement in functional scores in the postoperative period.

In our study, it was observed that patients treated with both methods improved significantly, with a better outcome in patients operated on using the AMIC technique. We recommend that future studies involve multi-center, randomized controlled trials with larger sample sizes.

Data availability statement: The data that support the findings of this study are available on request from the corresponding author.

Ethics committee approval: This study was approved by the Ethics Committee of Tokat Gaziosmanpasa University School of Medicine (Approval No: 22-KAEK-020, Date: 17.03.2022).

Informed consent: Informed consent was obtained from the patients who agreed to take part in the study.

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