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A retrospective analysis in the management of osteochondral lesions of the talus: Microfracture versus mosaicplasty

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Abstract

Aim: This study compared the clinical and functional outcomes of arthroscopic microfracture treatment and open mosaicplasty for osteochondral lesions of the talus (OLT).

Materials and Methods: The study was conducted between January 2005 and December 2012. Data for patients who underwent arthroscopic microfracture treatment or open mosaicplasty for OLT were retrospectively analyzed. The American Orthopedic Foot-Ankle Association (AOFAS) scoring system was used for functional assessment and the visual analog scale (VAS) score was used to evaluate pain level.

Results: A total of 27 patients (13 microfracture, 14 mosaicplasty) were included. In the microfracture group, median AOFAS score increased from 55.8 (29–80) before surgery to 82.6 (54–100) at the last follow-up, whereas VAS score decreased from 7.9 (6–10) to 2.3 (0–8). In the mosaicplasty group, median (IQR) AOFAS score increased from 63.3 (44–77) preoperatively to 90.5 (74–100) at the last follow-up, and VAS score decreased from 7.5 (6–10) to 1.5 (0–5).

Conclusion: Arthroscopic microfracture treatment and open mosaicplasty are safe and effective treatment options for OLT. We could not see any clinical or functional difference between chondroplasty and microfracture when compared with mosaicoplasty. Microfracture can be chosen as the first treatment method in patients with cartilage lesions smaller than 2.5 cm2 because it is less invasive and can respond to rehabilitation more quickly.

Introduction

Osteochondral lesions of the talus (OLT) include the hyaline cartilage covering the joint surface and lesions extending to the subchondral bone [1,2]. These lesions generally occur in young and active patients and can result in ankle arthritis without early diagnosis and treatment [3]. Early diagnosis in these patients is very important in terms of joint functions in the future. Technological progress in imaging methods has contributed greatly to early diagnosis and planning of treatment [3]. It perhaps is the better treatment for "symptomatic" OLT that fail conservative management but not All OLT as it reads [4,5]. It is known that conservative treatments have a place in cases with knee and ankle chondral damage [6,7]. Lesion severity and location and the patients age and expectations determine the treatment method [6,7]. Joint debridement and resurrection/microfracture (bone marrow stimulation), mosaicplasty, and autologous chondrocyte implantation are the leading surgical treatments performed by arthroscopy and/or mini-arthrotomy [8,9]. The common goal of these methods is to create a stable and smooth joint surface, obtain a functional ankle, and prevent future osteoarthritis [4]. The OLT size and morphology in the first place but also surgeon and individual patient aspects are considered when it comes to surgery.

The aim of microfracture is to re-blood the defect area. Microfracture has many advantages; It has the advantage of low surgical morbidity and rapid rehabilitation-healing since it is technically easy and can be performed arthroposcopically. Full weight bearing can be started within 2 weeks after the surgery [9]. Mosaicplasty, on the other hand, is mostly applied for larger chondral lesions in the talus. Its advantage is that the damaged cartilage is replaced by healthy hyaline cartilage and it can be used in lesions up to 4 cm^2 . The disadvantages are that the curvature of the knee joint surface is different from that of the talus and the talus cartilage is attached to the knee cartilage (1.5-2.6 mm) is less thick (under 1 mm) [9].

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While the results of these two techniques are promising, it is impossible to recommend one procedure over the other due to the lack of comparative analyses. As a result, both techniques should be evaluated in terms of pros and cons and customized on a patient basism [9].

The aim of this study was to compare the functional and clinical results of arthroscopic microfracture treatment and open mosaicplasty in patients with OLT treated at our clinic. We could not see any clinical or functional difference between chondroplasty and microfracture when compared with mosaicoplasty. Microfracture can be chosen as the first treatment method in patients with cartilage lesions smaller than 2.5 cm^2 because it is less invasive and can respond to rehabilitation more quickly.

Materials and Methods

Ethics approval for the study was obtained from our institutional ethics committee (Umraniye Training and Research Hospital Clinical Researches Ethics Committee, 09/04/2021, E-54132726-000-7923). 1975 Declaration of Helsinki, which was revised in 2013.

Forty seven patients who underwent arthroscopic microfracture treatment or open mosaicplasty for OLT in the hospital between January 2005 and December 2012 were evaluated retrospectively. Detailed preoperative history and results of physical examination of each patient were recorded. OLT was diagnosed by clinical and radiologic methods. Anteroposterior, lateral, and oblique ankle radiographs and corresponding ankle (T1- and T2-weighted) magnetic resonance imaging (MRI) data were obtained. Lesions were classified according to the Bristol MRI classification as $\leq$2.5 cm^2 and stage $\geq$2 as a criterion for treatment selection. All of the lesions were located on the medial part of the talus. Patients with lesions >2.5 cm^2 (n:4), with rheumatologic diseases(n:1), arthrosis of the hindfoot(n:1), or structural malalignment(n:1) were excluded. Patients with a history of smoking(n:5), defined diabetes(n:3) and blood pressure disease(n:3), Body mass index >30 (n:2) were not included in the study. A total of 27 patients (12 males and 15 females) were included in the study after they had provided written, informed consent. Power analysis was not applied because the study was retrospective. CT was not taken to avoid extra costs.

The surgery was performed by 2 senior surgeons. Which surgical treatment will be applied is left to the surgeons' choice. MRIs were evaluated by an independent radiologist. Arthroscopic microfractures of the surgical type, five men and eight women were aged between 23 and 57 years; Open mosaicplasty, seven were male and seven were female, between the ages of 23 and 52.

Surgical technique

Diagnostic ankle arthroscopy was systematically performed using a tourniquet. After the chondral lesion in the talus was found with diagnostic arthroscopy, the location, nature, dimensions of the chondral lesion and its relationship with the surface were defined in terms of documentation and diagnosis (Figure 1).

In mosaicplasty cases, the lesion area was reached by applying oblique osteotomy to the medial malleolus. The

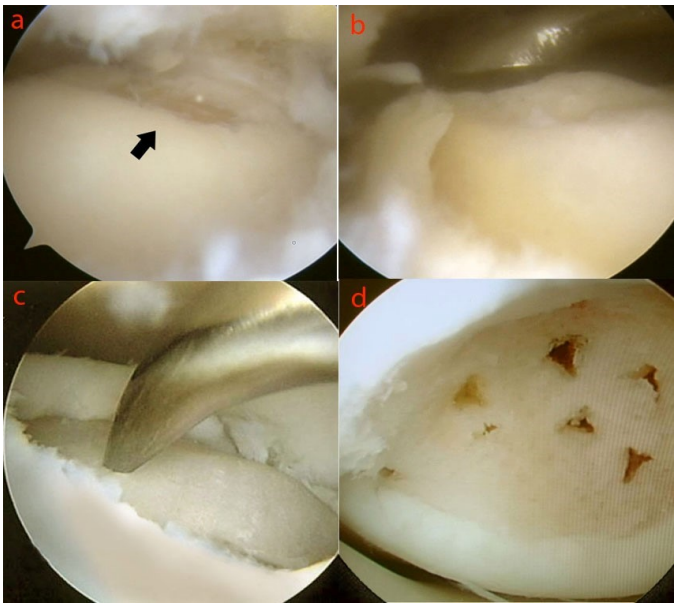

Figure 1. Microfracture case. (a) Observation of the lesion area. (b) Debridement of the lesion. (c) Microfracture application. (d) Appearance of cartilage after microfracture.

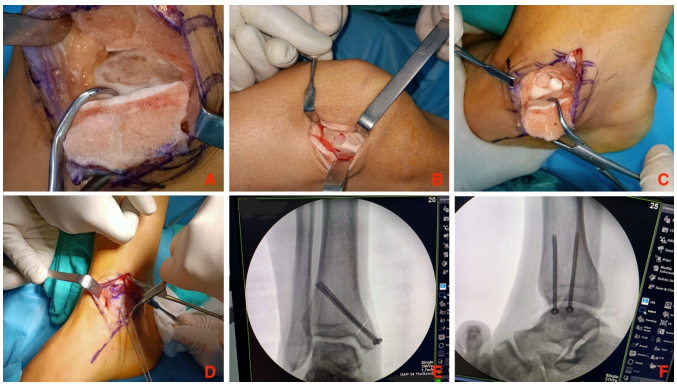

Figure 2. Mosaicplasty case. (a) Observation of the lesion area. (b) Surgical set. (c) Graft removal. (d) Graft blocks. (e) Recipient area after graft placement. (f) Post-osteosynthesis osteotomy line. (g) Postoperative radiograp.

osteochondral grafts (standard blocks 15 mm long and 6–8 mm in diameter) were taken from the ipsilateral femur distal and lateral to the superolateral region of the condyle. A disposable mosaicplasty set (Small Joint OATS Set; Arthrex®, Naples, FL, USA) was used for graft removal and application to the missing area. After obtaining the graft, no stopper was placed in the donor area. The grafts were placed perpendicular to the previously prepared slots at the level of the joint face. After completing the transfer, graft placement was verified by moving the joint through the entire opening; medial malleolus fixation was then performed. 4.0 mm titanium cannulated screws (TST®, Istanbul, Türkiye) were used for fixation of medial malleolar osteotomies (Figure 2). A below-knee plaster splint was applied after the operation.

As both chondral structure and surgical constriction, tubes and osteotomy were evaluated with MRI of the patients at the 8th and 12th weeks, CT was not performed in order to avoid extra load. In all cases, we used a double screw compatible with the literature. There was no problem in reduction fixation and union.

Postoperative evaluation

The patient intended to return to normal daily life activities with muscle strengthening and proprioceptive exercises. A splint fixing the ankle at 90° was applied. Patients were mobilized with crutches on the first postoperative day. No strain on the ankle was allowed for 3 weeks. Partial loading was allowed in the second 3-week period and full loading was permitted after the 6th week. However, partial loading was allowed in the mosaicplasty group if there was union and complete loading on the osteotomy line in the radiographic examination on day 45th. Full weight bearing was allowed after 8 weeks. The American Orthopedic Foot and Ankle Association (AOFAS) scoring system was used before and after surgery to assess patient function. Pain was evaluated by visual analog scale (VAS) score. For the assessment of functional status at medium-term after surgery, test results at the last follow-up visit were used.

Statistical analysis

The normality of distribution of quantitative variables was evaluated with the Kolmogorov–Smirnov test. Quantitative variables conforming to a normal distribution are presented as mean±SD, and non-normally distributed variables are presented as median (interquartile range). Qualitative variables are expressed as frequency (%). The 2 groups were compared with the independent samples t-test for normally distributed variables and Mann–Whitney U test for non-normally distributed variables. Dependent variables not conforming to a normal distribution were compared with the Wilcoxon t test. The relationship between qualitative variables (sex and type of intervention) was assessed with the χ^2 test. In all tests, p values <0.05 were considered statistically significant.

Results

A total of 13 patients (5 men and 8 women; age 23–57 years) underwent surgery-type arthroscopic microfracture treatment and 14 (7 men and 7 women; age 23–52 years) underwent mosaicplasty. Patient characteristics including age, time before diagnosis, follow-up period, and lesion width and size are shown in Table 1. There were no statistically significant differences in age, time before diagnosis, and lesion width and size between patients who underwent the 2 types of surgery (p>0.05). However, patients who underwent mosaicplasty had a significantly longer follow-up period than those who underwent surgery with microfracture (p=0.040) (Table 1). Since none of the patients were smokers, they were not included in the table for simplicity.

Table 1. Characteristic of the two groups.

Characteristic	Microfracture (n=13)	Mosaicplasty (n=14)	p
Age, years	41.38±9.99	37±8.58	0.231
Lesion length, cm	11 (10.5–11.5)	11.5 (10–16.25)	0.302
Lesion width, cm	7 (5–9)	10 (5.75–10)	0.220
Symptom duration, months	14 (12–33)	10 (3–24)	0.239
Duration of follow-up, months	33.31±11.08	50.5±26.6	**0.040**

Abbreviations: cm, centimeter.

Table 2. Comparison of the group with regard to pain and functional assessment score.

Assessment	Microfracture (n=13)	Mosaicplasty (n=14)	p
AOFAS			
Preoperative	55.85±11.70	63.36±10.16	0.086
Last follow-up	82.6±13.7	90.5±9.9	0.105
Change in score	26.8	27.2	**<0.001**
VAS			
Preoperative	7.9±0.9	7.5±0.9	0.259
Last follow-up	2.3±2.3	1.5±1.7	0.375
Change in score	−5.6	−6	**<0.001**

Abbreviations: AOFAS, American Orthopedic Foot-Ankle Association; VAS, visual analog scale.

The analysis findings regarding whether the AOFAS and VAS scores measured before and 1 year after the operation differ according to the type of surgery are given in Table 2. Accordingly, preoperative and postoperative AOFAS and VAS scores do not differ statistically according to the type of surgery (p>0.05). According to Table 2, there is a statistically significant difference between the AOFAS and VAS scores measured before and after the operation (p<0.001). Postoperative AOFAS and VAS scores were significantly higher than preoperative AOFAS and VAS scores.

We also examined whether sex was related to the type of surgical intervention and found that there was no statistically significant relationship between these variables (p=0.830).

Discussion

This study compared the clinical and functional outcomes of arthroscopic microfracture treatment and open mosaicplasty for osteochondral lesions of the talus (OLT). Defect size is one of the most important determinants of prognosis. The literature generally gives data on defect sizes of 1.5 cm^2 and below, and comparisons are made on this [4,10]. Although the size and depth are very important, the distinction is not clear. Considering all these parameters of OLT in the treatment algorithm, a treatment method is determined by considering the individual factors of the patient, the possibilities and the experience of the surgeon and the patient [4,10]. It is not possible to accurately calculate the size of chondral lesions in the talus clinically. MRI can cause a high rate of false positive evaluation. It cannot clearly show the softening in the chondral layer. There is no clear space here. This difference can only be

detected during surgery [10].

In the literature, it is stated that the size of the defect area is one of the most important determinants of prognosis. Bone marrow stimulation methods such as microfracture are recommended for lesions $\leq$1.5 cm^2, and mosaicplasty has been suggested when the defect area is >1.5 cm^2 [4,10].

In our study, which we performed in parallel with the study of Gobbi et al. [11], we found no significant clinical or functional differences between patients with lesions <2.5 cm^2 who underwent microfracture as compared to mosaicplasty.

Polat et al reported that clinically good and excellent results regardless of defect size in the long-term follow-up of 82 patients who underwent arthroscopic debridement and microfracture, supporting the results of our study. The authors also recommended microfracture as the first-choice treatment as it is less invasive and effective for OLT. Especially in osteochondral lesions, the desire or, more accurately, the expectation is to cover the damaged cartilage with the more durable hyaline cartilage. On the other hand, mosaicplasty is recommended especially in young patients with higher physical expectations [12].

Lee et al reported that the fibrocartilage formed in 36% of lesions treated by microfracture was less durable than natural cartilage 3.6 years after surgery, as determined by arthroscopy and confirmed by clinical and radiologic findings [13]. In our study, we did not apply second look arthroscopy to our patients, but when we compared the clinical and radiological results of the patients who underwent arthroscopic microfracture with mosaicplasty, we could not find a significant difference. Robinson et al and Schuman et al both two studies comparing cartilage repair techniques obtained similar positive results with both strategies; these authors suggested the bone marrow stimulation technique as the first-line treatment for OLT, although it leads to the formation of biomechanically weaker fibrocartilage [14,15].

The mosaicplasty method developed by Hangody involves implantation of hyaline cartilage for the repair of subchondral depression. This therapeutic strategy has had success rates varying between 80% and 94% [6,7,16,17].

Valderrabano et al reported that donor site morbidity with this technique may promote the development of patellofemoral osteoarthritis [17-19]. In our study, although our patients had no signs of patellofemoral osteoarthritis, two of our patients had persistent knee pain. These patients were older than the other members of the group, and no signs of osteoarthritis were found in their last follow-up.

We performed malleolar osteotomy on all of our patients for whom we applied mosaicplasty. Thanks to this, we were able to perform a better surgical planning and as a result, the osteochondral grafts were placed at the right angle without breaking. The surgical morbidity rate is higher in mosaicplasty compared to bone marrow stimulation techniques, but it provides the advantage of covering the defect area with hyaline cartilage.

Osteotomy of the medial malleolus and complications related to the donor area are potential morbidities [20]. Lamb et al reported that 94% of patients had no symptoms after medial malleolar osteotomy, and radiologic union occurred an average of 6 weeks after surgery [21]. In this study,none of our patients in the mosaicplasty group experienced symptoms and complications related to the osteotomy site due to fixation and union.

Short and medium-term studies have reported high success rates with mosaicplasty [6,22,23]. Lee et al reported that 88.8% of patients achieved excellent results and 11.8% achieved good results after an average follow-up of 36 months [13]. Gautier et al reported that good or excellent results were achieved by all 11 patients 24 months after surgery, with a mean AOFAS score of 92 [24]. While studies with short and medium-term results are in the majority in the literature, studies with long-term results are limited.In one of the largest and longest-followed series, 94% of patients showed excellent or good results Hangody et al. [25,26]. Andreas B.Imhoff reported that (7 year) study of 26 patients who underwent mosaicplasty for osteochondral lesions, the average AOFAS score increased from 50 before surgery to 78 postoperatively while the average VAS score decreased from 7.8 to 1.5 [27].

Most of the complications associated with mosaicplasty are related to the donor area [28]. There is no evidence of degenerative changes in the knee as a result of graft removal. Problems in the donor site are generally considered to be temporary symptoms, and heal within 6 weeks in 95% of cases and within a year in 98% [23]. There was no radiologic evidence of degeneration in the donor area after mosaicplasty application and joint functions were normal in the study by Gautier et al. [24]. Two of our patients had pain and throbbing in the donor (knee) area, especially when going up and down stairs, but no degeneration was detected and the symptoms completely resolved in the first postoperative year.

Although the cartilage defect area in the talus after mosaicplasty is covered with a more durable cartilage than the fibrocartilaginous tissue formed after microfracture, when donor site morbidity, osteotomy and post-union process are evaluated, microfracture may be the first and even permanent treatment option in patients who have been appropriately selected according to the patient and his/her expectations. Although hyaline cartilage formed after mosaicplasty can be recommended especially for athletes with a high expectation, donor site morbidity and malleolar osteotomy and subsequent fracture healing can delay the return to active sports for at least 6 weeks. . The fact that the clinical and radiological results of mosaicplasty and microfracture were not different in our study also supports this prediction.

Limitations of our study included the small number of patients and absence of demographic and clinical randomization. Additionally, we did not perform a comparative cost analysis of the 2 treatment methods. Finally, cartilage healing was not evaluated at the histologic level.

Conclusion

Arthroscopic microfracture and open mosaicplasty are safe and effective treatment options for talar osteochondral lesions. Although both surgical methods have good functional results in the mid-term, the formation of more

durable cartilage than microfracture of mosaicplasty may be superior in terms of less pain and arthritis delay in the advanced stage. However, the results of our study are minimally invasive in arthroscopic microfracture talus osteochondral lesions and cause less donor site morbidity. Because there is no difference between the two groups in terms of clinical and functional results, microfracture can be preferred as the first-line treatment. There is a need for controlled randomized studies with large samples to compare their superiority to each other in the treatment of osteochondral lesions of the talus.

Ethical approval

The study was carried out with the permission of Umraniye Training and Research Hospital Clinical Researches Ethics Committee (Date: 09/04/2021, Decision No: E-54132726-000-7923).

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