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Retrospective analysis of the results of surgical management of osteochondral lesions of the talar dome

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Abstract

Introduction Differences in the reported results lead to the lack of comprehension of whether the size of osteochondral lesion of talar dome is too big for successful usage of arthroscopic microfracturing and osteochondral autologous transplantation would be more preferrable. **Aim** To elicit the rate and causes of poor results after using two most common methods of operative treatment of patients with osteochondral lesions of the talus (OCLT) for elaboration of indications for surgical method of choice for this category of patients. **Materials and methods** This was a retrospective study that included analysis of archive data and subsequent examination of 80 patients (80 ankle joints), who underwent treatment for symptomatic OCL of the talus from 2014 to 2020. Mean time from the operation to examination was 20.5 ± 19.8 months. **Results** A significant increase in the results of FAOS, AOFAS and VAS scales after operative treatment were observed, as well as a significant decrease in lesion sizes ($p < 0.05$). Overall patient satisfaction and intensity of preoperative pain syndrome showed strong positive correlation with the sizes of lesions on preoperative CT scans, especially with relative sizes. The data analysis revealed the borderline values of relative OCLT sizes, thus allowing us to divide the results of treatment into predictably poor and predictably good. **Discussion** The elicited borderline values of relative OCLT sizes as well as elicited correlations can be used to specify indications for choosing the method of operative treatment for this group of patients, but further prospective evaluation should be carried out. **Conclusion** The borderline values of the relative OCLT sizes were found that allow for division into predictably good and poor treatment outcomes.

Keywords: osteochondral lesion, talar bone, mosaic osteochondroplasty, drilling, arthroscopy

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INTRODUCTION

Arthroscopic repair of a cartilage defect and mosaic autologous osteochondroplasty have become widespread techniques in the world practice for treating osteochondral lesions of the talus (OCLT) [1–3]. Drilling microfracture of the damaged area refers to conditionally restorative operations and is used as a primary intervention for relatively small cartilage surface defects [3–6]. The literary sources report a high rate of positive clinical results of the application of the technique at different periods of postoperative follow-up [7–12]. However, a number of publications show lower rates of good results and there are studies evaluating the outcomes of revision surgery after failures of arthroscopic repair of the OCLT area [13-18]. The results were obtained on subgroups of patients with minor lesions that feature heterogeneity.

Mosaic autologous osteochondroplasty refers to replacement interventions and involves the use of a graft(s). This technique is used for more extensive osteochondral lesions, cystic changes in the subchondral bone tissue, as well as for patients with both lateral and medial OCLT [6, 19–21]. Autologous osteochondroplasty is characterized by a predominance of good clinical outcomes, including in the long term [22, 23].

To determine the indications for damaged area drilling, the absolute dimensions of OCLT are most often used. In the current literature, one can find the two most common size indicators: the diameter (mm) and the area (mm^2) of the defect. These indicators are used in the course of preoperative planning and in statistical processing and evaluation of treatment outcomes. An example is the study by Chuckpaiwong B. et al., which showed deterioration in the results drilling for a defect diameter of more than 15 mm [24]. A study by Ramponi L. et al. obtained the best results with drilling of cartilage defects with an area of less than 107.4 mm^2 and/or a diameter of less than 10.2 mm [25]. It should be noted that the authors of some current studies failed to find a statistically significant correlation between the size of the defect and the clinical result of the repair [26, 27].

Diverse data lead to a lack of understanding of which OCLT sizes are too big for successful arthroscopically guided drilling and in which a more invasive mosaic autologous osteochondroplasty should be preferred. This study is devoted to clarifying the indications for performing such interventions.

The **purpose** of our study was to identify the rates of poor results of the two most common methods of surgical treatment of patients with OCLT and their causes in order to clarify the indications for choosing methods of surgical treatment for this group of patients.

MATERIALS AND METHODS

The study was retrospective and included analysis of archival data and subsequent face-to-face examination of 80 patients (80 ankles) treated for symptomatic OCLT from 2014 to 2020.

Indications for different types of surgical interventions were determined in accordance with the data of the international consensus on the restoration of the cartilage of the ankle joint (2017): for an OCLT diameter of ≤ 10 mm, according to CT data, patients underwent drilling of the OCLT area using anterior arthroscopy of the ankle joint. OCLT diameter > 10 mm, cystic changes in the talus served as indications for performing mosaic autologous osteochondroplasty with the graft harvested from the knee joint [4, 20].

According to these indications, 50 patients (50 ankle joints) underwent arthroscopically guided drilling of the talar cartilage defect, and 30 patients (30 ankle joints) underwent mosaic autologous osteochondroplasty with grafts taken from the lateral condyle of the femur of the ipsilateral knee joint.

According to the design of the study, the analysis of preoperative parameters was carried out on the basis of archival data study that included radiographs, CT and MRT findings, results on the AOFAS, FAOS, SF-36, VAS scales, clinical examination results available in the medical records of inpatients. In the postoperative period, patients underwent a face-to-face examination, radiography of the ankle joints, computed tomography and magnetic resonance imaging, evaluation with the above scales, as well as an assessment of overall satisfaction with the use of a five-point scale.

The choice of the evaluation systems included in the study correlates with the data from the literature, indicating the predominant use of these questionnaires in assessing the results of treatment of patients with OCLT [28]. The average time elapsed from the moment of surgery to the examination was 20.5 ± 19.8 months. The subgroups were comparable in all preoperative characteristics except for the size and location of the OCLT.

The initial data obtained were entered into tables using the Microsoft Excel computer program, what enabled to edit and process the data. The Statistica software (version 10) and Past software (version 4.03) were used for statistical data processing, followed by comparison of the obtained results.

The study used non-parametric methods of statistical analysis due to the abnormal distribution of all assessed quantitative indicators (age, radiological parameters, assessment of the results with the evaluation systems, intensity of pain syndrome according to VAS, etc.). The normality of the distribution was tested using the Kolmogorov-Smirnov, Shapiro-Wilk, Liliefors tests.

RESULTS

The gender and age distribution of patients (Table 1) correlated with the literature data (the prevalence of young male patients) [29, 30].

A history of the injury was reported by 50 % of the patients of the entire group: 44% (22) of the subgroup after arthroscopic drilling, 60% (18) of the subgroup after mosaic autologous osteochondroplasty, which corresponded to the literature data indicating a predominantly traumatic etiology of OCLT [29, 31].

The subgroups were comparable in all preoperative characteristics except for the size and location of the OCLT, which will be described further.

In both subgroups, a significant reduction in the severity of pain syndrome was observed ($p < 0.05$). VAS score in the preoperative period in the arthroscopic treatment subgroup averaged 6.46 ± 0.2 points, and in the postoperative period it was 1.7 ± 0.3 points (improvement by 6 points). In the subgroup of mosaic autologous osteochondroplasty in the preoperative period, the mean VAS value was 7.2 ± 0.3 points, and in the postoperative period it was 2.2 ± 0.4 points (improvement by 5.5 points). There was also a significant improvement in the FAOS and AOFAS scales after surgery in both subgroups at $p < 0.05$ (Fig. 1).

Postoperative results of AOFAS, AOFAS, and VAS scores are given in Table 2.

Table 1

Age and gender distribution of patients

Group/subgroup	Number of patients	Age of symptoms manifestation, years	Age at surgery, years	Gender			
				Male		Female	
				N	%	N	%
Entire group	80	32.0 ± 1.3	35.2 ± 1.3	55	68.7	25	31.3
Arthroscopic drilling	50	31.8 ± 1.5	34.8 ± 1.5	35	70	15	30
Osteochondroplasty	30	32.4 ± 2.4	35.8 ± 2.3	20	66.7	10	33.3

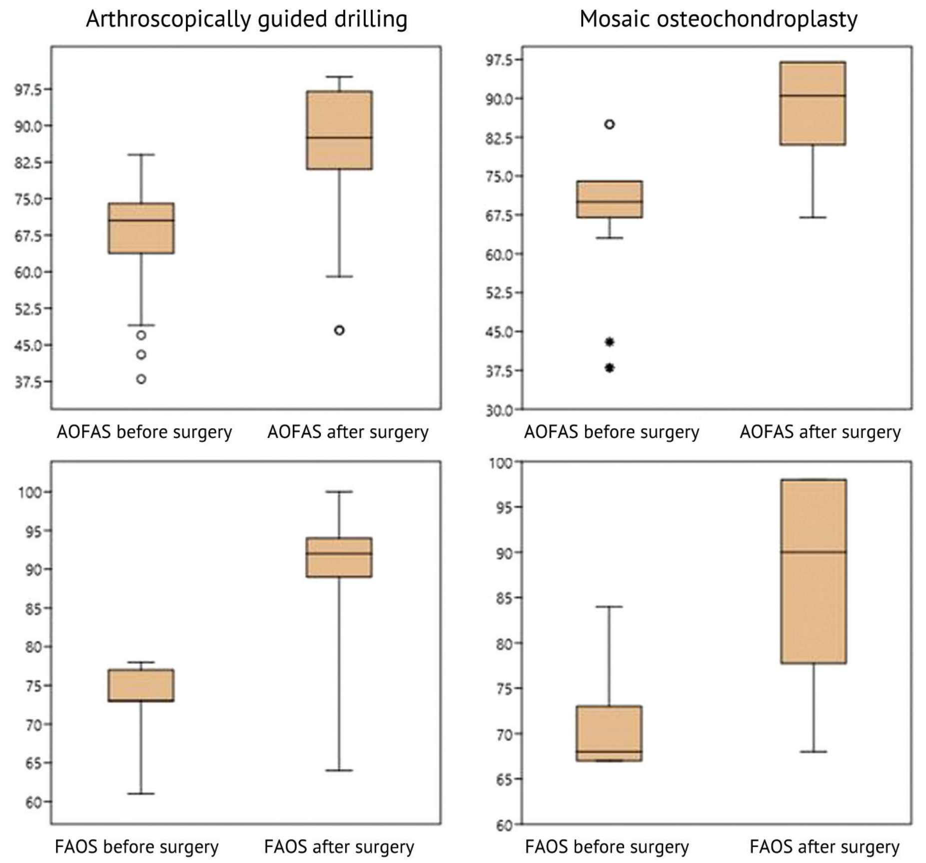

Fig. 1 Dynamics of results on the AOFAS and FAOS scales after surgery in comparison with preoperative data

Table 2

Postoperative outcomes assessed with AOFAS, FAOS and VAS systems

Subgroups	AOFAS, баллы	FAOS (mormalized score,%)	VAS, points
Arthroscopic drilling	86.4 ± 1.8	89.1 ± 1.3	1.7 ± 0.3
Osteochondroplasty	88.3 ± 1.8	86.7 ± 2.1	2.2 ± 0.4

In the subgroup after arthroscopic drilling, according to the AOFAS, the rate of poor results was 4 % (2), confidence interval 0-11.13% (using the Fisher angle transform). In the subgroup of patients after mosaic osteochondroplasty, there were no poor results, according to the standard interpretation of the AOFAS scale.

The analysis of the results according to the non-specific questionnaire SF-36 was carried out regarding two parameters: the psychological and physical components of health before and after surgery. The evaluation results are presented in Table 3.

It is noteworthy that there was a significant improvement in the results of the assessment in terms of the “physical component of health” in both subgroups (at $p < 0.05$). In particular, in the subgroup of patients after arthroscopic drilling, there was an improvement in the "physical component of health" parameter by an average of 17.4 points, and in the subgroup after mosaic autologous osteochondroplasty, by an average of 18.3 points. The parameter "psychological component of health" showed a significant improvement only in the subgroup after mosaic autologous osteochondroplasty ($p < 0.05$). In the subgroup after arthroscopic drilling, postoperative and preoperative values for this parameter were comparable (at $p > 0.05$). At the same time, the increase in the results for the “psychological component of health” parameter in the subgroup after mosaic osteochondroplasty was 3.2 points. This may indirectly indicate a greater impact of the severity of pain on the psychological state of patients in the subgroup after osteochondroplasty.

Table 3

SF-36 evaluation results in preoperative and postoperative periods

Subgroup	SF-36 physical health		SF-36 psychological health	
	Before surgery	After surgery	Before surgery	After surgery
Arthroscopic drilling	32.3 ± 0.5	48.5 ± 1.0	53.7 ± 0.5	54.2 ± 0.3
Osteochondroplasty	32.0 ± 0.6	44.8 ± 1.6	53.0 ± 0.5	55.8 ± 0.4

The overall satisfaction in the postoperative period in the subgroup of patients after arthroscopic drilling averaged 4.2 ± 0.2 points, with a minimum value of 0 points and a maximum of 5 points. In the mosaic autologous osteochondroplasty subgroup, the mean overall satisfaction score was 4.3 ± 0.2 points, with a minimum value of 2 points and a maximum of 5 points. The rate of poor results (≤ 3 points) in the subgroup after arthroscopic drilling was 16 % (8), and in the subgroup after mosaic autologous osteochondroplasty it was 13.3 % (4).

OCLT is characterized by the absence of objective changes in physical examination, and the main symptom is pain in the ankle joint. For this reason, a small number of poor results were observed in the standard interpretation of the AOFAS scores, which included a large number of questions aimed at identifying deviations in objective indicators. For the same reason, when evaluating the results on the FAOS scale, the greatest "loss of points" was noted in the "pain" section in both subgroups (Fig. 2), and the results of the assessment using the nonspecific SF-36 questionnaire had the greatest positive dynamics and significant improvement in both subgroups of patients in the "physical component of health".

Due to the prevalence of pain over objective changes and difficulties in the standard interpretation of the AOFAS scale, the following criteria for poor treatment outcomes were introduced during this study:

• retention, increase in pain or its decrease by 1 point according to VAS;

• subjective satisfaction of 3 points or lower;

• decrease, no change, or increase by ≤ 10 points on the AOFAS scale;

• decrease, no change, or increase by ≤ 10 % on the FAOS scale.

The SF-36 form was not included in the criteria for unsatisfactory treatment outcomes due to the ambiguous reliability of the dynamics of the results of the "psychological health" parameter within the subgroups.

The rate of poor results of treatment, according to the introduced parameters, was 16 % (8) in the subgroup after arthroscopic drilling and 13.3 % (4) in the subgroup after mosaic autologous osteochondroplasty, which coincided with the data obtained in the analysis of subjective overall satisfaction.

No complications were found in the subgroup of patients after arthroscopic drilling; in the subgroup after mosaic autologous osteochondroplasty, a complication was pain in the donor area and patellofemoral arthrosis of the 2nd stage was observed in 2 patients (6.7 %).

This may indicate the worst clinical outcomes of OCLT drilling in the absence of complications and the best clinical outcomes of autologous osteochondroplasty with the risk of complications in the knee joint using the standard tactics of choosing a surgical treatment method.

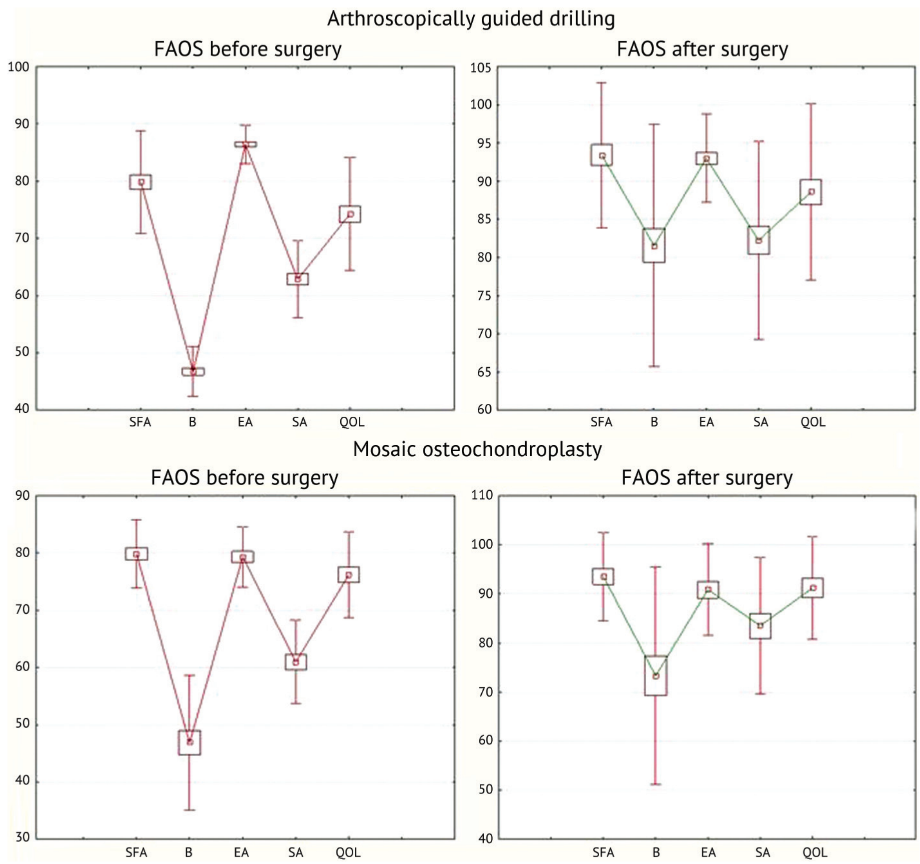

Fig. 2 Results of the FAOS questionnaire before and after surgery: SFA – symptoms of functional abnormalities; B – pain; EA – daily living; SA – sports activity; QOL – quality of life

The analysis of the radiographs in the preoperative period showed the initial signs of arthrosis of the ankle joint in 6.25 % of patients (5); four of them reported a history of ankle fractures. None of the patients showed progression of arthrotic changes in the ankle joint when postoperative radiographs (taken during the study) were compared with the preoperative ones. In the subgroup of mosaic autologous osteochondroplasty, the accuracy of reduction after osteotomy of the medial malleolus was assessed. Evaluation of postoperative radiographs (taken the next day after surgery and during the study) showed that this subgroup of patients did not have any disorders of the relationship in the ankle joint.

Relative indicators of OCLT sizes were evaluated in CT scans: the ratio of the OCLT diameter to the width of the talus some in the frontal projection at the level of the largest diameter of the OCLT; the ratio of the OCLT area to the area of the talus dome in the axial projection at the level of the largest OCLT diameter in % (Table 5).

At the same time, as in the assessment of absolute indicators of OCLT sizes, there was a significant decrease in the relative OCLT sizes in the subgroups. Preoperative and postoperative relative indices of OCLT sizes within the subgroups differed significantly ($p < 0.05$).

Also, during the study, an analysis was made of magnetic resonance images of the ankle joints of patients in the preoperative and postoperative (at the time of the study) period. In the postoperative period (at the time of the study), the MOCART scale was used to assess the rate of defect filling and restoration of cartilage tissue according to MRI data. The average value according to this scale in the subgroup of patients after arthroscopic drilling was 80.7 ± 1.7 points, and in the subgroup after mosaic autologous osteochondroplasty it was 72.3 ± 3.1 points.

It is noteworthy that the overall satisfaction of patients and the severity of pain before surgery in both subgroups had a strong positive correlation with the initial dimensions of OCLT according to CT, mostly relative. This means that the preoperative OCLT size can be used to form an algorithm for choosing the surgical treatment of patients.

However, there was a strong negative correlation of overall satisfaction with postoperative OCLT dimensions, but a strong positive correlation with MOCART scores (R = 0.89 in the subgroup after arthroscopic drilling, R = 0.91 in the subgroup after autologous mosaic osteochondroplasty). This indicates the influence of the OCLT size and the grade of cartilage tissue replacement on the severity of the pain syndrome. Overall satisfaction was higher in patients with large OCLTs (within subgroups) and, accordingly, with more severe pain in the preoperative period. This is confirmed by the revealed strong positive correlation between postoperative scale values and preoperative OCLT sizes.

The results of the AOFAS, SF-36 scales in the preoperative period did not have a strong correlation with the initial OCLT sizes, which can be explained by the features of the evaluation systemsa and indicate the absence of a significant limitation of functional indicators. However, preoperative FAOS scores (mainly "pain" block) had a strong negative correlation with baseline relative OCLT sizes (R = -0.91 and R = -0.92 in the subgroup after arthroscopic drilling, R = -0.93 and R = -0.9 in the subgroup after mosaic autologous osteochondroplasty).

The scales used reflect the dynamics of the patients' condition, while low values on the rating scales before surgery are not associated with worse postoperative results of the scales. The revealed strong negative correlation of overall satisfaction with preoperative values on the FAOS scale (R = -0.92 in the subgroup after arthroscopic drilling, R = -0.90 in the subgroup after mosaic autologous osteochondroplasty) may be explained by the peculiarities of the questionnaire and the studied pathology.

It is noteworthy that the severity of pain after surgery had a strong correlation with sports activity (R = 0.92 in the subgroup after arthroscopic drilling, R = 0.89 in the subgroup after mosaic autologous osteochondroplasty), which should be taken into account when informing patients preoperatively. Also, the previous surgical intervention was associated with a greater severity of pain after surgery.

Table 4

Mean values of absolute OCLT sizes studied with CT

	Biggest diameter, mm		Biggest depth, mm	
	Before surgery	After surgery	Before surgery	After surgery
Arthroscopic drilling	7.1 ± 0.2	0.7± 0.2	5.4 ± 0.3	0.5 ± 0.2
Osteochondroplasty	13.9 ± 0.4	3.1 ± 0.9	9.9 ± 0.7	2.3 ± 0.6

Table 5

Mean values of relative OCLT sizes studied with CT

	OCLT diameter /width of the talus dome		OCLT area / area of talar dome, %	
	Before surgery	After surgery	Before surgery	After surgery
Arthroscopic drilling	0.3 ± 0.0	0.0 ± 0.0	7.9 ± 0.3	0.6 ± 0.2
Osteochondroplasty	0.4 ± 0.0	0.1 ± 0.0	23.6 ± 1.4	2.7 ± 0.8

The analysis of poor treatment outcomes in both subgroups showed that correlations were related with the data obtained within the subgroups. Moreover, poor results of treatment in the subgroup after drilling were related to the female sex.

Also, in the course of data analysis, threshold values of the relative indicators of OCLT sizes were identified, that enable to divide the treatment results into predictably poor and predictably good.

In the subgroup of patients after arthroscopic drilling, the threshold value of the ratio of the OCLT diameter to the width of the talus dome was 0.33 (Fig. 3, A); and the borderline value of the ratio of the OCLT area to the area of the talus dome was 9.9 % (Fig. 3, B).

In the subgroup of patients after autologous mosaic osteochondroplasty, the borderline value of the ratio of the OCLT area to the area of the talus dome was 17.9%; with lower values, worsening of treatment results was noted (Fig. 4).

Patients with predictably good and predictably poor treatment outcomes according to the parameters discussed above comprised groups that were comparable in all indicators included in the study. However, no threshold values of absolute indicators of OCLT sizes that would allow dividing patients into groups with predictable results were revealed. This confirms the hypothesis of a predominant effect of relative rather than absolute indicators of OCLT sizes on the treatment outcome.

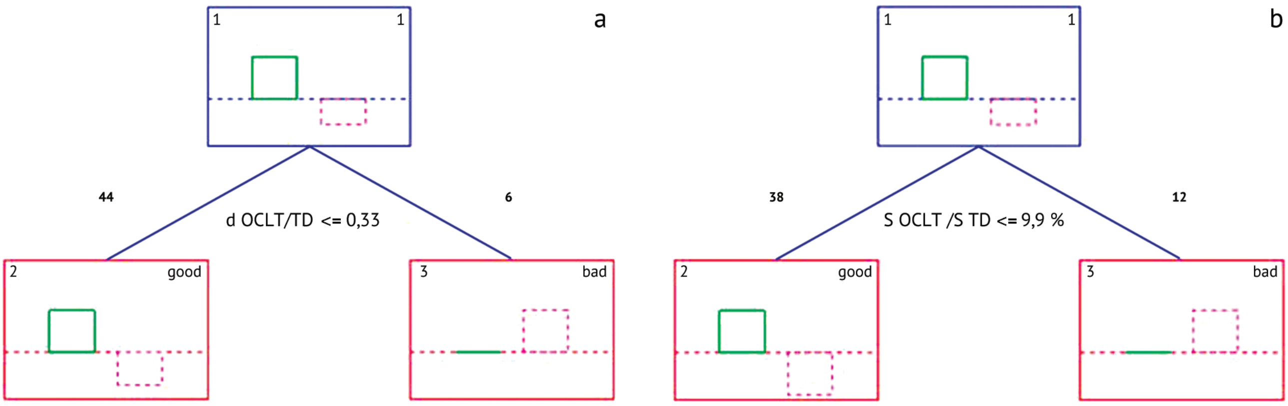

Fig. 3 Distribution according to the result of treatment in the subgroup of drilling, depending on the relative indicators of the OCLT size: a – depending on the ratio of the OCLT diameter to the width of the talus dome; b – depending on the ratio of the OCLT area to the area of the talus dome

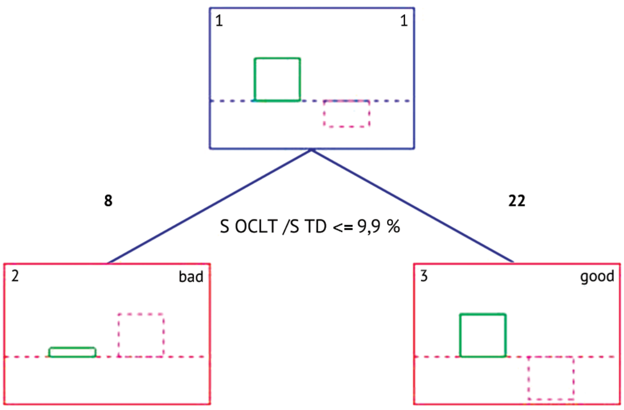

Fig. 4 Distribution according to the result of treatment in a subgroup of autologous osteochondroplasty, depending on the ratio of the OCLT area to the area of the talar dome

DISCUSSION

The term "osteochondral lesions of the talus" is used to describe defects in the articular cartilage and subchondral bone layer of a post-traumatic and degenerative nature, the symptoms of which are dominated by pain in the ankle joint [29, 32–34]. Difficulties in the OCLT treatment are associated with the anatomical features in this area (poor mosaic vascularization of the talus, extensive coverage of articular cartilage, its limited regenerative capacity, etc.) [29, 35–37].

Symptomatic OCLT is managed surgically with cartilage defect drilling under arthroscopic control and mosaic autologous osteochondroplasty [1–3].

Drilling of the OCLT area refers to interventions aimed at stimulating the bone marrow, the result of which is the formation of coarse fibrous cartilage tissue at the site of the defect due to the proliferation and differentiation of pluripotent cells [4, 5, 38]. The newly formed tissue is able to withstand the mechanical load in the ankle joint up to certain limits. In particular, its mechanical failure occurs in drilling the defects that have a diameter of more than 10 mm [39].

Therefore, arthroscopic drilling is used for small defects in the cartilage surface [3–6]. The results of using this technique, highlighted in the literature, are heterogeneous. Even in the groups of patients with small OCLT sizes, the rate of good clinical results ranges from 61 to 85% [7, 16].

Mosaic autologous osteochondroplasty involves the use of a graft(s) and is used for more extensive osteochondral lesions. It can also be used for failed arthroscopic repair [6, 17–20]. However, the use of the "lowest to highest" principle, where all patients undergo drilling first and then mosaic osteochondroplasty if the former fails has not been currently recommended due to indications of worse clinical outcomes compared with primary osteochondroplasty for the indications that persist, including the long-term ones [7, 22, 23, 40, 41].

In the majority of publications, to determine the indications for the above-described surgical techniques, absolute values of the size of the lesion are used: diameter (mm), area (mm^2), depth (mm). Moreover, the threshold limit currently remains undetermined; the largest OCLT diameter with a limit value of 15 mm is most often mentioned. But the lack of studies comparing the long-term results of these surgical techniques casts doubt on this principle [4, 25, 34, 42].

In particular, the 2017 Ankle Cartilage Restoration Consensus called it "historically determined" and formulated the following OCLT sizes, recommended for drilling: diameter < 10 mm, area < 100 mm^2, and depth < 5 mm [4]. Similar indications were also found in several studies, for example, a study by Ramponi L.et al., according to which the best results were obtained with arthroscopic repair of cartilage defects with an area of less than 107.4 mm^2 and/or a diameter of less than 10.2 mm [25].

It should be noted that the authors of some current publications failed to find a statistically significant correlation between the size of the defect and the clinical result of arthroscopic drilling [26, 27]. The ambiguity of the data suggests that the indications for drilling in terms of the OCLT size should be reconsidered.

In the course of the study, we identified certain patterns. In particular, a strong correlation of treatment outcomes with initial OCLT measurements based on CT data, mostly relative, was found, which may be used to determine indications.

During the study, the OCLT sizes were recorded according to MRI data; however, the analysis of the data, found no significant relationships with them. This may indirectly indicate the preference for using CT in assessing the size of lesions. Also, the data obtained indicate the influence of the OCLT size and the rate of cartilage tissue replacement on the severity of the pain syndrome.

The identified poor results of treatment (according to the introduced criteria) and complications may indicate poorer clinical outcomes of OCLT drilling in the absence of complications and better clinical outcomes of autologous osteochondroplasty if there is a risk of complications in the knee joint when using the standard tactics of choosing a method of surgical treatment.

In both cases of complications such as pain in the donor area, the patients showed signs of trochlear dysplasia, which should be taken into account when informing patients preoperatively.

Also, threshold values of relative indicators of OCLT sizes were identified, allowing the division of the results of treatment into predictably poor and predictably good. This is confirmed by the association of poor results of arthroscopic drilling with the female gender: according to the literature data, the size of their talus is smaller compared to males, respectively, the relative size of the OCLT is larger with the same absolute ones [43, 44].

The borderline values of relative OCLT sizes and relationships that were revealed can be used to clarify the indications for choosing surgical treatment methods for these lesions. However, this requires further prospective evaluation.

CONCLUSION

Based on the analysis of clinical examination and radiological data, as well as on the analysis of poor results of treatment of patients with OCLTs, a number of threshold indicators of the relative sizes of OPBT were found that allow for the division of treatment results into predictably poor and predictably good. The data obtained can be used in choosing the method of surgical treatment in this group of patients. Further studies are necessary.

Limitations It should be noted that the limitations of this study are the relatively small number of patients and the relatively short period of postoperative follow-up. It should also be pointed out that although the AOFAS scale is one of the most widely used in the world, it is not validated. Further prospective studies are required to develop an algorithm for choosing a surgical method for OCLT management, taking into account the data obtained and evaluating its effectiveness.

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