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ANKLE

Concomitant ankle instability has a negative impact on the quality of life in patients with osteochondral lesions of the talus: data from the German Cartilage Registry (KnorpelRegister DGOU)

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Abstract

Purpose The purpose of this study was to compare patients with osteochondral lesions of the talus (OCLT) with and without concomitant chronic ankle instability (CAI).

Methods Data from the German Cartilage Registry (KnorpelRegister DGOU) for 63 patients with a solitary OCLT were used. All patients received autologous matrix-induced chondrogenesis (AMIC) for OCLT treatment. Patients in group A received an additional ankle stabilisation, while patients in group B received AMIC alone. Both groups were compared according to demographic, lesion-related, and therapy-related factors as well as baseline clinical outcome scores at the time of surgery. The Foot and Ankle Ability Measure (FAAM), the Foot and Ankle Outcome Score (FAOS), and the Numeric Rating Scale for Pain (NRS) were used.

Results Patients in group A were older compared to group B [median 34 years (range 20–65 years) vs. 28.5 years (range 18–72 years)]; the rate of trauma-associated OCLTs was higher (89.7% vs. 38.3%); more patients in group A had a previous non-surgical treatment (74.1% vs. 41.4%); and their OCLT lesion size was smaller [median 100 mm^2 (range 15–600 mm^2) vs. 150 mm^2 (range 25–448 mm^2)]. Most OCLTs were located medially in the coronary plane and centrally in the sagittal plane in both groups. Patients in group A had worse scores on the FAOS quality-of-life subscale compared to patients in group B.

Conclusion Patients with OCLT with concomitant CAI differ from those without concomitant CAI according to demographic and lesion-related factors. The additional presence of CAI worsens the quality of life of patients with OCLT. Patients with OCLT should be examined for concomitant CAI, so that if CAI is present, it can be integrated into the treatment concept.

Level of evidence IV.

Keywords Osteochondral lesion · Ankle · Talus · Ankle instabilty · Cartilage · Cartilage registry · Knorpelregister

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Abbreviations

AMIC	Autologous matrix-induced chondrogenesis
AOFAS	American Orthopedic Foot and Ankle Society
BHL	Berndt–Harty–Loomer
CAI	Chronic ankle instability
FAAM	Foot and Ankle Ability Measure
FAOS	Foot and Ankle Outcome Score
ICRS	International Cartilage Repair Society
IRB	Institutional Review Board
NRS	Numeric Rating Scale for Pain
OCLA	Osteochondral lesion of the ankle
OCLT	Osteochondral lesion of the talus

Introduction

Osteochondral lesions of the ankle (OCLA) and chronic ankle instability (CAI) are often coincident. Several authors have described OCLA as an associated pathology in acute and chronically unstable ankles [2, 7, 10, 11, 18, 21]. In CAI, reported rates of chondral and osteochondral lesions of the tibia or talus have ranged from approximately 16% [10] to 95% [21].

Ankle sprains may be associated with ligamentous injuries of the ankle joint, especially the lateral ligaments, and inadequate healing after non-surgical treatment may lead to CAI in 10–30% of cases [11, 19]. It remains unclear whether subsequent OCLA is a result of the initial trauma from the sprain or from repeated microtraumas due to CAI.

Van Dijk et al. conducted a study involving a group of 30 patients who underwent operative repair of acute lateral ankle ligament ruptures and found cartilage lesions of the ankle in 20 patients [27]. Nineteen lesions were located at the tip and/or anterior distal part of the medial malleolus as well as on the opposite medial facet of the talus. The authors concluded that, during an inversion ankle sprain, an impingement occurs between the medial malleolus and the medial facet of the talus, which results in cartilage damage.

Only a few case series have analysed the combined operative treatment of OCLA and CAI, and the study designs differ among these publications. Lee et al. compared the outcomes of patients with osteochondral lesions of the talus (OCLT) alone with the outcomes of patients with both OCLT and CAI after surgical treatment [12]. The treatment of OCLT consisted of bone marrow stimulation. Patients with CAI also received lateral ligament reconstruction. The authors reported an increased proportion of larger cartilage lesions and additional lesions at the tip of the medial malleolus and the tibial plafond for the patients who underwent combined OCLT and CAI treatment. Furthermore, the authors detected an increased clinical failure rate after surgery according to American Orthopedic Foot and Ankle Society (AOFAS) scores as well as inferior outcomes according to the Foot and Ankle Outcome Score (FAOS) sports/recreational activities subscale for the patients with OCLT and CAI compared to the patients with only OCLT [12].

Both Li et al. and Jiang et al. compared the results of combined operative OCLA + CAI treatment to those of CAI treatment alone and reported comparable outcomes in both groups, respectively [8, 13]. Gregush et al. also analysed the results of concomitant operative OCLA + CAI treatment in 31 patients [5]. The authors concluded that the presence of an OCLA had a negative effect on the overall result when compared to the results of patients who underwent lateral ankle stabilisation as an isolated procedure. Yasui et al. evaluated the clinical outcome of 16 patients after simultaneous surgery involving stabilisation of CAI combined with retrograde drilling for subchondral bone lesions of the talus [29]. The authors reported a significant postoperative improvement in AOFAS scores as well as pain measured via Visual Analog Scale scores [29]. Furthermore, Yasui et al. observed a reduction of the lesion size on magnetic resonance imaging when comparing pre- and postoperative scans.

To the best of our knowledge, no study has yet focused on the combined treatment of OCLA and CAI with autologous matrix-induced chondrogenesis (AMIC) plus ankle stabilisation. AMIC is a collagen type I/III scaffold that is inserted into the cartilage defect. A collagen matrix is applied after microfracture, nanofracture or drilling of the subchondral bone, or after autologous bone grafting [3, 22–24, 28]. The role of AMIC in the treatment of OCLA is the subject of current research [1, 4, 20].

The purpose of this study was to compare patients with one OCLT with and without concomitant CAI according to demographic, lesion-related, and therapy-related factors as well as baseline clinical outcome scores at the time of surgery. All OCLTs were treated with AMIC. The aim was to investigate whether the presence of CAI has an influence on the demographic and lesion characteristics as well as the baseline clinical outcome scores. Knowledge of such an influence could change patient counselling and therapy decisions. If CAI has an influence, all OCLA patients would have to be examined for CAI and CAI would have to be integrated into the treatment concept.

It was hypothesised that there is a difference according to demographic and lesion-related factors as well as baseline clinical outcome scores between patients with OCLT and CAI compared to patients with OCLT without CAI.

Materials and methods

The data used in this study were obtained from the German Cartilage Registry (KnorpelRegister DGOU). Approval was given by every institutional review board (IRB) at every participating clinical centre. The identification number of the IRB of the study coordination centre at the University Hospital of Freiburg, Germany is 520/14. The study was performed according to the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments. All individual participants gave their informed consent prior to inclusion. The German Cartilage Registry is financially supported by the Deutsche Arthrose-Hilfe e.V. and the Stiftung Oskar-Helene-Heim.

This registry included data of 633 patients with OCLA who underwent operations between 2014 and 2018 in 49 clinical centres. The data were prospectively collected using a web-based remote data entry system. All patients whose data were in the registry by December 2018 were included in the analysis. The following exclusion criteria were used: missing basic data set (patient age and gender), more than one treated OCLA, osteochondral lesion of the distal tibia, any OCLA treatment other than AMIC, any previous surgery on the ankle, and distal tibial osteotomy as concomitant surgery. As a result, a total of 63 patients with a solitary OCLT (38 men and 25 women, median age 31 years [range 18–72 years]) who were treated in 13 different centres were included in the study.

Demographic variables including age, gender (male vs. female) and body mass index were assessed. Information on the aetiology of the OCLT (traumatic, posttraumatic, degenerative, or other), the duration of symptoms, and the location of the OCLT at the talus in the frontal plane (medial vs. lateral) as well as the sagittal plane (anterior vs. central vs. posterior) were also included. The OCLTs were classified according to the Berndt-Harty-Loomer classification [14] and International Cartilage Repair Society (ICRS) classification. The approximate lesion size was calculated by multiplying the lesion length by the width. The cartilage condition at the corresponding joint surface (intact vs. ICRS 1–2 vs. ICRS 3–4) was also assessed. Whether the patients had any previous non-surgical treatment and the reason for the non-surgical treatment if it had occurred was also recorded.

OCLTs were categorised as traumatic when there was evidence of trauma to the ankle within 12 months prior to the current operation, and as post-traumatic when there was evidence of trauma more than 12 months before the operation. OCLTs were categorised as degenerative if there was no evidence of trauma to the ankle in the patient's history.

The following variables related to the operation were captured: the type of approach to the ankle, whether AMIC was combined with autologous bone grafting, whether an additional debridement of impingement was performed, whether a concomitant ankle stabilisation was performed and, if so, which kind of stabilisation was used.

The study population was divided into two groups. Patients in group A ($n = 29$) had both OCLT and CAI. They received AMIC for OCLT treatment and an additional ankle stabilisation. Patients in group B ($n = 34$) had only OCLA. They received AMIC alone. Both groups were compared according to demographic, lesion-related, and therapy-related factors.

The surgical stabilisation techniques that were performed in group A are presented in Table 1.

The clinical condition of the patients was measured at the time of the operation according to the German versions of the Foot and Ankle Ability Measure (FAAM) [16], the FAOS [25], and the Numeric Rating Scale for Pain (NRS) [6]. The NRS score consists of values ranging from 0 (no pain) to 10 (pain as bad as you can imagine). Group A and B were also compared according to FAAM, FAOS, and NRS scores at the time of the operation.

Table 1 Surgical techniques used for ankle stabilisation in group A ($n = 29$) according to anatomical localisation

Localisation	Technique	*n*
Lateral ($n = 22$)		
	Broström	17
	Broström-Gould	5
Lateral and medial ($n = 6$)		
	Medial and lateral suture anchor	3
	Broström lateral + medial stabilisation	3
Medial ($n = 1$)		
	Medial stabilisation	1

Statistical analysis

The Shapiro–Wilk *W* test was applied to screen the data for normality of distribution. Mean and standard deviation for normally distributed data, and median and range for non-normally distributed data were reported.

To compare groups A and B according to demographic, lesion-related and therapy-related factors, the Wilcoxon test was used for continuous data and the Chi-square test for categorical data. The Wilcoxon test was also used to compare the FAAM and FAOS subscale scores for groups A and B at the time of the operation, respectively.

The level of significance was set at $p = 0.05$ for all statistical tests.

Results

Table 2 shows the demographic, lesion-related and therapy-related factors within groups A and B. The patients within group A were older, with a median age of 34 years (range 20–65 years) compared to 28.5 years (range 18–72 years) for group B. However, the difference was not statistically significant.

The aetiology of the OCLT was significantly different between group A and B. In Group A, traumatic and post-traumatic OCLTs were more frequent than degenerative OCLTs (89.7% versus 10.3%), whereas in Group B, the distribution of the aetiology was reversed (61.7% degenerative versus 38.3% traumatic/post-traumatic, $p = 0.001$).

In both groups, OCLTs were more frequently located at the medial than at the lateral talus in the coronary plane, and

Table 2 Comparison of demographic, lesion-related and therapy-related factors within groups A (OCLT + CAI treatment) and B (OCLT treatment alone)

	Group A ($n=29$)	Group B ($n=34$)	p value
Age (median, range)	34 years (20–65 years)	28.5 years (18–72 years)	n.s.*
Gender (*n*/%)			
Male	16/55.2	22/64.7	
Female	13/44.8	12/35.3	n.s.†
Body mass index (median, range)	25.7 kg/m^2 (20.9–32.5 kg/m^2)	25.2 kg/m^2 (19.8–49.6 kg/m^2)	n.s.*
Aetiology of OCLT (*n*/%)			
Traumatic	10/34.5	4/11.8	
Posttraumatic	16/55.2	9/26.5	
Degenerative	3/10.3	21/61.7	0.001†
Duration of symptoms (median, range)	12 months (1–120 months)	12 months (3–120 months)	n.s.*
Location, frontal plane (*n*/%)			
Missing data $n=3$			
Medial	16/57.1	23/71.9	
Lateral	12/42.9	9/28.1	n.s.†
Location, sagittal plane (*n*/%)			n.s.†
Missing data $n=6$			
Anterior	1/3.6	2/6.9	
Central	18/64.3	20/69.0	
Posterior	9/32.1	7/24.1	
Lesion size (median, range)	100 mm^2 (15–600 mm^2)	150 mm^2 (25–448 mm^2)	n.s.*
Stage BHL (*n*/%)			
1	2/6.9	1/2.9	
2	4/13.8	5/14.7	
3	10/34.5	14/41.2	
4	8/27.6	4/11.8	
5	5/17.2	10/29.4	n.s.†
Stage ICRS (*n*/%)			
1	0	0	
2	2/6.9	2/5.9	
3	10/34.5	9/26.5	
4	17/58.6	23/67.6	n.s.†
Corresponding joint surface (*n*/%)			n.s.†
Intact	24/82.8	32/94.1	
ICRS 1–2	3/10.3	2/5.9	
ICRS 3–4	2/6.9	0	
Previous non-surgical treatment (*n*/%)			
Missing data $n=7$			
Yes	20/74.1	12/41.4	0.013†
No	7/25.9	17/58.6	
Reason non-surgical treatment (*n*/%)			
Missing data $n=2$			
Ligamentous injury	18/90.0	9/100.0	n.s.†
Fracture	2/10.0	0	
Approach (*n*)			
Arthroscopy			
Anterior	12	21	
Posterior	0	2	
Arthrotomy			
Antero-medial	5	5	

Table 2 (continued)

	Group A ($n=29$)	Group B ($n=34$)	p value
Antero-lateral	7	3	
Antero-central	13	6	
Postero-lateral	1	2	
Osteotomy			
Medial tibia	0	9	
Combined autologous bone grafting (n/%)			n.s.†
Yes	13/44.8	11/32.4	
No	16/55.2	23/67.6	
Combined debridement of impingement (n/%)			n.s.†
Yes	16/55.2	15/44.1	
No	13/44.8	19/55.9	

When comparing the different approaches between groups A and B, only frequencies were given due to the sometimes small group size

OCLT osteochondral lesion of the talus, *BHL* Berndt–Harty–Loomer, *ICRS* International Cartilage Repair Society, *n.s.* not statistically significan

*Wilcoxon test

†Chi-square test *t*

Table 3 Comparison of FAAM subscale baseline values between groups A (OCLT + CAI treatment) and B (OCLT treatment alone)

FAAM subscale	Group	Median (range)	p value
Activities of daily living (%)	A ($n=23$)	68.8 (4.8–98.8)	n.s*
	B ($n=27$)	64.3 (10.0–100.0)	
Sports (%)	A ($n=21$)	21.9 (0–87.5)	n.s.*
	B ($n=25$)	34.4 (0–100.0)	
Function, activities of daily living (%)	A ($n=19$)	65.0 (5.0–100.0)	n.s.*
	B ($n=21$)	50.0 (10.0–90.0)	
Function, sports (%)	A ($n=24$)	27.5 (0–100.0)	n.s*
	B ($n=26$)	35.0 (0–100.0)	

FAAM Foot and Ankle Ability Measure, *n.s.* not statistically significant

*Wilcoxon test

at the central talus than the anterior or posterior talus in the sagittal plane. There were no statistically significant differences between groups A and B regarding the localisation of the OCLTs. The OCLTs in group A were smaller, with a median lesion size of 100 mm^2 (range 15–600 mm^2) compared to 150 mm^2 (range 25–448 mm^2) in group B; however, the difference was not statistically significant.

The majority of patients in both groups presented with OCLTs in advanced stages according to the Berndt-Harty-Loomer classification (stage 3–5: group A, 79.3%; group B, 82.4%), as well as the ICRS classification (ICRS stage 3–4: Group A, 93.1%; group B, 94.1%). The corresponding joint surface at the distal tibia was intact in the majority of patients in both groups (group A, 82.8%; group B, 94.1%).

A previous non-surgical treatment of the ankle was significantly more frequent in patients in group A ($p=0.013$). The reason for the non-surgical treatment was a ligamentous injury in 90.0% of patients in group A and in all patients in group B.

Table 4 Comparison of the FAAM function overall subscale between groups A (OCLT + CAI treatment) and B (OCLT treatment alone)

FAAM function overall subscale $n=50$ (n/%)	Group A	Group B	p value
Normal	2/8.3	0	n.s.†
Nearly normal	6/25.0	7/26.9	
Abnormal	12/50.0	16/61.5	
Severely abnormal	4/16.7	3/11.6	

FAAM Foot and Ankle Ability Measure, *n.s.* not statistically significant

†Chi-square test

The frequencies of combined autologous bone grafting or debridement of a bony or soft tissue impingement were not different between group A and B.

FAAM baseline scores at the time of surgery were not significantly different between Groups A and B (Tables 3 and 4). Patients in group A had worse scores on the quality of life subscale of the FAOS compared to patients in group B ($p = 0.017$). The remaining FAOS subscales were not significantly different between groups A and B (Table 5). The median NRS scores at the time of surgery were not significantly different between groups A and B (median 3 [range 0–8] versus median 3.5 [range 1–9]; missing data, $n = 14$).

Discussion

The most important finding of this study was that patients with OCLT and concomitant CAI have a decreased quality of life compared to patients with only OCLT. Further, patients with OCLT differ according to demographic and lesion-related factors depending on whether a concomitant CAI is present. Patients with concomitant CAI were older, although the difference in age between Groups A and B was not statistically significant. Furthermore, the rate of trauma-associated OCLTs was significantly higher when concomitant CAI was present, and patients in Group A had also more frequently undergone previous non-surgical treatment of the ankle than patients in Group B.

The aetiology and pathophysiology of OCLA are still unknown [17]. Ankle instability is the result of trauma. Therefore, OCLA can occur as either the result of initial trauma or repeated microtrauma in the context of instability. The rate of arthroscopic detection of OCLAs in operations performed for CAI reported in the literature ranges from 25 to 95% [10, 11, 18, 21].

Lee et al. compared patients with OCLT with and without concomitant CAI and evaluated baseline characteristics before and after propensity score matching [12]. Before matching, the mean age in the OCLT + CAI Group was higher, although this was not statistically significant. Similar results were observed in this study. After matching, the mean age was approximately the same in both groups. An explanation for the somewhat higher age in the OCLT + CAI population could be that the OCLT only developed after a prolonged presence of CAI, for example by repeated microtraumas. Furthermore, Lee et al. found more men than women in both groups, both before and after propensity score matching [12]. In this study, no significant difference was observed according to the gender distribution between Groups A and B.

Table 5 Comparison of FAOS subscale baseline values between groups A (OCLT + CAI treatment) and B (OCLT treatment alone)

FAOS subscale	Group	Median (range)	*p* value
Pain (%)	A (*n* = 22)	68.1 (30.1–100.0)	n.s.*
	B (*n* = 25)	61.1 (8.3–88.9)	
Symptoms (%)	A (*n* = 23)	60.7 (35.7–96.4)	n.s.*
	B (*n* = 26)	58.9 (17.9–96.4)	
Activities of daily living (%)	A (*n* = 22)	80.1 (25.0–100.0)	n.s.*
	B (*n* = 23)	77.9 (23.5–95.6)	
Sport/recreational activities (%)	A (*n* = 22)	30.0 (0–100.0)	n.s.*
	B (*n* = 23)	20.0 (0–65.0)	
Quality of life (%)	A (*n* = 22)	25.0 (0–100.0)	0.017*
	B (*n* = 26)	37.5 (12.5–56.3)	

FAOS Foot and Ankle Outcome Score, *n.s.* not statistically significant

*Wilcoxon test

Lee et al. found a higher rate of trauma-associated OCLTs in the group with concomitant CAI before propensity score matching [12]. However, there was no difference after matching. Also in this study, more patients with a history of trauma were observed in group A. In this study, OCLT was evaluated as degenerative in only three patients in group A. These patients had no trauma in their medical history. However, it is possible that, in these cases, an unremarkable trauma occurred to the ankle, which subsequently led to the development of CAI.

Furthermore, Lee et al. found a higher rate of laterally located lesions and larger lesions in unstable ankles compared to patients with OCLT without CAI [12]. However, the majority of OCLTs in their study were located medially within both groups (OCLT + CAI, 64% vs. OCLT without CAI, 79%). Similar findings regarding the higher rate of lateral lesions were observed in this study, whereby the majority of lesions were located medially in group A (57.1%) as well as in group B (71.9%). In addition, in this study population, the lesions were larger within group B.

In this study, it is not surprising that the rate of previous non-surgical therapies for ligament injuries in Group A was higher than in Group B. It is suspected that inadequate therapy of ligament injury led to CAI, which in turn led to the development of OCLT through repeated microtrauma.

Jiang et al. performed ankle arthroscopy and anatomic lateral ankle ligament repair with suture anchors for CAI in 70 patients [8]. Thirty-four of the patients had additional OCLAs, which were treated with arthroscopic abrasion, curettage, drilling, or microfracture. The authors did not observe a difference in patients' demographic characteristics between the CAI + OCLA and the CAI groups. Li et al. performed a repair of the lateral ligament complex for chronic ankle instability in 104 patients and found concomitant OCLA in 33 of these patients. The authors addressed this by debridement, microfracture, or osteochondral implantation [13] and did not find any difference in age and gender distribution between the two groups.

Reduced clinical status according to the FAOS and FAAM baseline scores was evaluated in all patients in this study, especially with regard to sports and recreational activities. The joint function of the majority of patients in both groups was classified as abnormal or severely abnormal according to FAAM scores. Quality of life based on the FAOS score was also poor in both groups, with patients in group A having a worse quality of life than patients in group B.

In a recent study, Kim et al. showed that patients with CAI with accompanied osteoarthritis of the medial compartment and long symptom duration benefit from ankle stabilisation according to joint function and symptoms [9]. This underlines the relevance of ankle instability in patients with ankle chondropathy.

This study has several limitations. It is a cross-sectional cohort study with data collection from a national multicentre registry. Patients from 13 different centres were included in the study, which leads to a certain heterogeneity of the data. However, this is a feature of registry studies. Patient data such as lesion size or ICRS scores were provided by the surgeon, which may lead to variability regarding the evaluation of the participating surgeons [15]. However, previous literature reported good inter-observer reliability for ICRS [26], excellent inter-observer reliability for the FAAM [16], and excellent test–retest reliability for the FAOS [25]. In this study, a relatively large number of AMIC patients were included. The homogeneity of the data was improved by including only patients with a solitary talus lesion and without prior surgery on the affected ankle joint. One limitation of this study is that CAI was not uniformly diagnosed in all centres. The respective surgeon was responsible for the diagnosis. In addition, since different stabilisation techniques were used, a comparative statement about different techniques can't be made.

The performance of combined debridement of a bony or soft tissue impingement as well as autologous bone grafting in combination with AMIC each represents a possible confounder. However, both interventions occurred with similar frequencies in both groups.

This study does not yet assess any clinical follow-up data. Future evaluations of the German Cartilage Registry will show whether the long-term clinical outcome of OCLT patients with and without concomitant CAI differ. Patients with OCLT should be examined for concomitant CAI so that if CAI is present it can be integrated into the treatment concept.

Conclusions

OCLT patients with concomitant CAI differ from OCLT patients without CAI according to demographic and lesion-related factors. The presence of CAI also worsens the quality of life of OCLT patients.

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Author contributions DK: study design, data acquisition, statistical data analysis and interpretation, drafting and writing the manuscript. AA, MA, SS and CB: study design, revision of the manuscript. MW, OG, YB, SE and CP data acquisition, revision of the manuscript. MDA: study design, statistical data analysis and interpretation, drafting and writing the manuscript. All authors read and approved the final manuscript.

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Compliance with ethical standards

Conflict of interest CP is a consultant of Medartis AG. CP has received or will receive research grants not related to this paper from Plasmaconcept, Medartis, Stryker, DePuysSynthes, NewDeal, and OPED. The other authors declare that they have no potential conflict of interest.

Ethical approval The study was performed according to the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments.

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