

Trends in osteochondral lesions of talus in twenty years and most cited twenty-five articles: a web-based bibliometric analysis

Talusun osteokondral lezyonlarında son yirmi yıllık eğilimler ve en çok atıf alan 25 makale: web tabanlı bibliyometrik bir analiz

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Abstract

Purpose: This study analyzes published research on osteochondral lesions of the talus (OLT) to identify surgical trends and highlight key findings. The focus is evaluating publication types, themes, and citation impact from 2003 to 2023.

Material and methods: To identify surgical trends and research focus, this study analyzed 553 publications from the Thomson Reuters Web of Knowledge database on OLT, indexed between 2003 and 2023. These publications were categorized by themes such as general topics, surgical strategies, autograft and allograft techniques, microfracture, pediatrics, sports, stem cell therapies, cartilage/chondrocyte implantation, AMIC, outcomes, complications, radiology, grafts, and scaffolds. The study also identified the top 25 cited articles over the period.

Results: The analysis revealed that 427 were original articles, and 56 were reviews. General topics (94 articles) and microfracture (73) were the most frequently covered themes. Findings indicate a significant increase in publications over the past five years, with microfracture and OATS being prevalent topics. The number of publications peaked in 2021, with the Hospital for Special Surgery contributing the most. Most articles were published in "Foot and Ankle International" and the "American Journal of Sports Medicine." The USA led in the number of publications, followed by South Korea. The most cited article was "Treatment of osteochondral lesions of the talus: a systematic review" by Zengerink Maartje et al., with 370 citations.

Conclusion: The study highlights a growing interest in OLT, particularly among orthopedic surgeons, with increased publications over recent years. There is a preference for autograft techniques, and AMIC has emerged as a promising treatment. This study highlights evolving trends in OLT management, emphasizing the need for continued research to optimize patient outcomes.

Keywords: Talus, osteochondral, bibliometric, web.

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Öz

Amaç: Bu çalışma, talusun osteokondral lezyonları (TOL) üzerine yayımlanmış araştırmaları analiz ederek cerrahi eğilimleri belirlemeyi ve önemli bulguları vurgulamayı amaçlamaktadır. Çalışmanın odak noktası, 2003-2023 yılları arasında yayın türlerini, temalarını ve atıf etkilerini değerlendirmektir.

Gereç ve yöntem: Bu çalışma kapsamında, 2003-2023 yılları arasında Thomson Reuters Web of Knowledge veri tabanından indekslenmiş olan talusun osteokondral lezyonları ile ilgili 553 yayın analiz edilmiştir. Bu yayınlar genel konular, cerrahi stratejiler, otogreft ve allogreft teknikleri, mikrofraktür, pediatri, spor, kök hücre tedavileri, kırık/kondrosit implantasyonu, AMIC tekniği, sonuçlar, komplikasyonlar, radyoloji, greftler ve iskele sistemleri gibi temalara göre kategorize edilmiştir. Ayrıca belirtilen dönemde en fazla atıf alan 25 makale belirlenmiştir.

Bulgular: Yapılan analizde, 427 yayının orijinal makale, 56 yayının ise derleme olduğu tespit edilmiştir. Genel konular (94 makale) ve mikrofraktür (73 makale) en sık işlenen temalardır. Bulgular son beş yılda yayın sayısında önemli bir artış olduğunu ve mikrofraktür ile OATS tekniklerinin sıkça ele alınan konular olduğunu göstermektedir. Yayın sayısı 2021 yılında zirve yapmış olup, Hospital for Special Surgery en çok katkı sağlayan kurum olarak öne çıkmıştır. Makalelerin çoğu "Foot and Ankle International" ve "American Journal of Sports Medicine" dergilerinde yayımlanmıştır. Ülke bazında en fazla yayın Amerika Birleşik Devletleri'nden yapılırken, Güney Kore ikinci sırada yer almıştır. En çok atıf alan makale, 370 atıfı Zengerink Maartje ve arkadaşları tarafından yazılan "Treatment of osteochondral lesions of the talus: a systematic review" başlıklı makedir.

Sonuç: Bu çalışma, TOL konusundaki ilginin özellikle ortopedi cerrahları arasında giderek arttığını ve son yıllarda yayın sayısının yükseldiğini ortaya koymaktadır. Otogreft tekniklerinin tercih edildiği, AMIC tekniğinin ise umut verici bir tedavi yöntemi olarak öne çıktığı görülmektedir. Çalışma, TOL tedavisindeki gelişen eğilimleri vurgulayarak hasta sonuçlarını optimize etmek adına sürekli araştırmaya ihtiyaç duyulduğunu belirtmektedir.

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Anahtar kelimeler: Talus, osteokondral, bibliometrik, web.

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Introduction

Osteochondral lesions of the talus (OLT) represent a challenging subset of ankle injuries, encompassing a spectrum of pathological changes involving both articular cartilage and subchondral bone [1]. These lesions can result from acute trauma, such as ankle sprains or fractures, or from chronic overuse, leading to degenerative changes over time [2]. Clinical presentation varies widely, from mild discomfort and swelling to severe pain and joint instability, depending on the lesion's size, location, and chronicity [3]. Recent improvements in imaging—most notably high-resolution MRI—have markedly enhanced our capacity to detect and characterize these lesions, thereby enabling more tailored treatment planning [4]. Despite these advances, the optimal management of talar osteochondral lesions remains controversial, with various surgical and non-surgical options available. Beyond symptom relief, these treatments focus on restoring the biomechanical stability of the ankle joint and minimizing the risk of long-term complications, particularly osteoarthritis [5].

Various surgical options are employed, tailored to each lesion's specific size, location, and severity. Arthroscopic debridement and microfracture: Successful for small to moderate lesions ($<1.5 \text{ cm}^2$), typically in the talar dome. A minimally invasive approach in which the surgeon uses an arthroscope to access the ankle joint. The damaged cartilage and underlying bone are debrided [cleaned] to remove loose fragments and damaged tissue. Microfracture involves making small holes in the subchondral bone to stimulate the formation of fibrocartilage to replace the damaged cartilage [6]. Osteochondral Autograft Transfer (OATS): This is suitable for larger lesions ($>1.5 \text{ cm}^2$) or for lesions that have not responded to conservative treatment. A cylindrical segment of intact cartilage and underlying bone is collected from a minimally loaded portion of the patient's knee joint. This plug is then transferred to the lesion site on the talus and fixed in place, restoring the articular surface [7]. Recently, studies

have used periosteal bone as a graft instead of knee cartilage [8]. Autologous chondrocyte implantation (ACI): Reserved for larger lesions or when other techniques have failed. In the first stage, healthy cartilage cells are collected from a low-stress zone within the patient's knee. These cells are then cultured in a laboratory. This increases their number. To encourage proper integration and cartilage formation, the cultured chondrocytes are implanted into the talus defect under a periosteal patch [9]. Osteochondral allograft transplantation: Used for large lesions where autografting is not feasible. It involves the transplantation of donor osteochondral tissue [usually from a cadaveric source] to replace the damaged area of the talus. The procedure aims to restore the joint surface and functionality [10]. Autologous Matrix Induced Chondrogenesis (AMIC) is a minimally invasive surgical technique designed to promote articular cartilage regeneration in osteochondral lesions of the talus. Suitable for small to medium-sized lesions, typically less than 2 cm^2 , it combines the benefits of microfracture with a collagen matrix to enhance the healing process. Ankle arthroscopy visualizes the osteochondral lesion and assesses the surrounding cartilage and bone. Microfracture is applied, and a collagen-based graft is positioned over the microfractured area. The collagen matrix is secured with fibrin glue or sutures [11]. Mesenchymal stem cells (MSCs), with their intrinsic regenerative abilities, make stem cell therapy an up-and-coming method for addressing cartilage and bone injuries associated with osteochondral lesions of the talus. MSCs are multipotent cells capable of differentiating into different cell types, including chondrocytes [cartilage cells] and osteoblasts [bone-forming cells], making them ideal candidates for tissue repair [12].

Bone marrow mesenchymal stem cells (BM-MSCs) are derived from the patient's bone marrow, usually from the iliac crest. Adipose-derived stem cells (ADSCs) are derived from the patient's adipose tissue through minimally invasive liposuction, peripheral blood-derived stem cells, obtained from peripheral blood

through specialised techniques such as apheresis [13]. Stem cell therapy holds great promise as a regenerative treatment option for talar osteochondral lesions, offering potential benefits in cartilage repair, joint preservation, and functional restoration [14].

This research identifies shifts and patterns in the surgical treatment of OLT by systematically analyzing studies from the past two decades. The study seeks to categorize the types of publications, focus areas, and citation impacts within OLT research, providing insights into the evolving preferences and techniques in treatment strategies and highlighting key findings that contribute to optimizing patient outcomes.

Materials and methods

553 OLT research articles, letters, case reports, reviews, and meeting abstracts published between January 2003 and December 2023 and indexed by title and abstract in Thomson Reuters Web of Knowledge were analysed. The publications reviewed were those with osteochondral lesions of the talus, osteochondritis dissecans of the talus, chondral defects of the talus, and chondrocyte implantation of the talus in the title. Articles with an English abstract and title were included in the study. They were categorised according to the type of publication. The top 25 most-cited articles were also documented between 2000 and 2023.

The topic was the question of publications on OLT. Surgical strategies were the main topic, followed by general topics: OATS, Allograft Osteochondral Transplantation (AOT), microfracture, paediatrics, sports, technique, stem cells, adjuvant therapies, additional injury, cartilage/chondrocytes, AMIC, outcome, complications, radiology, graft, and scaffold were the titles of the most relevant articles, which were examined by title and abstract where published documents on the same study were available.

This article did not require ethics committee approval as there was no animal model or human tissue evaluation. The title Osteochondral lesions of the talus was analysed as the main topic of the papers. General topics include

ethology, anatomical localisation, biomechanical or kinematic analysis. OATS encompasses studies investigating the application of osteochondral and osteoperiosteal autografts in managing talar osteochondral lesions. AOT includes papers on osteochondral allografts and osteoperiosteal allografts. Microfracture includes documents on the treatment of OLT as a method of subchondral stimulation with microfracture. Paediatric groups include skeletally immature patients. Sports include all sporting activities such as athletics, football, and basketball. Stem cells include stem cell derivatives. Adjuvant therapies include platelet-rich plasma and hyaluronic acid injections. Additional injury describes injuries such as lateral ligament injuries. Cartilage/chondrocytes includes articles on cartilage autograft transfer, chondrocyte implantation, EMCA, and allograft transplantation. AMIC includes articles about autologous matrix-induced chondrogenesis. The outcome includes articles written as a result of medium- and long-term follow-up. Complications include articles written about complications and their therapies, subchondral cysts, and their complications. Radiology includes articles on radiological imaging techniques such as MRI, CT scans, X-rays, and scintigraphy. Grafting includes articles using bone grafts other than AMIC. Scaffolds include articles using scaffolds, such as hyaluronic acid.

Results

A total of 553 articles on OLT were reviewed. Four hundred twenty-seven were original articles, and 56 were review articles. The distribution of the articles according to the titles chosen by the majority of topics is shown in Table 1. The most popular titles are "general topics" with 94 articles and "microfracture" with 73 articles. Publication years and citations are shown in Figure 1. The year with the most published articles is 2021, with 59 articles, followed by 2020 with 52 articles. The centre with the most published articles is the Hospital for Special Surgery, which has 41 articles, followed by the University of Amsterdam, which has 27 articles. The distribution of centres is shown in Figure 2. Most [$n=56$, 11%] articles were published in the Foot and Ankle International, followed by the American Journal of Sports Medicine [$n=48$, 9.5%] (Figure 3).

Table 1. Quantitative distributions of Publications

	2023	2022	2021	2020	2019	2018	2017	2016	2015	2014	2013	2012	2011	2010	2009	2008	2007- 2006	2005-2004- 2003	Total
General topics	5	10	12	6	2	6	7	3	2	3	9	9	5	6	4	3	2	-	94
OATS	2	7	6	7	2	5	1	6	5	4	6	2	3	-	3	1	4	2	66
AOT	-	3	3	-	4	3	3	-	1	2	1	1	1	3	-	-	-	-	25
Microfracture	7	6	12	6	7	3	5	4	6	2	3	4	1	2	1	1	1	2	73
Pediatric	5	4	5	4	-	3	2	1	1	1	2	1	-	-	-	-	2	1	32
Sports	1	2	2	2	2	-	2	2	1	1	-	-	-	-	-	-	-	-	15
Technics	5	4	9	5	4	-	2	4	2	3	3	1	1	3	1	4	2	1	54
Stem cell	2	5	-	2	2	2	4	4	2	4	2	-	3	1	-	-	-	-	33
Adjuvant therapies	2	1	1	4	4	1	2	4	3	-	-	4	1	-	-	-	-	-	27
Additional injury	2	4	4	5	1	1	-	2	1	1	-	-	-	-	1	-	-	-	22
Cartilage / chondrocyte	2	1	6	6	1	-	2	-	-	5	3	3	3	3	2	1	-	3	41
AMIC	1	5	5	4	5	2	6	2	3	-	4	1	2	-	-	-	-	-	40
Outcome	4	2	8	3	9	4	2	4	3	2	6	1	1	2	3	1	1	1	57
Complication	4	3	4	1	-	-	-	-	-	-	-	-	1	-	-	-	-	-	13
Radiology	6	3	5	7	6	5	3	5	2	2	1	5	5	2	-	2	2	1	62
Graft	7	4	2	2	-	1	2	-	1	-	1	-	1	-	-	-	1	-	22
Scaffold	4	2	2	1	1	-	6	2	-	-	-	-	1	-	-	-	1	-	20

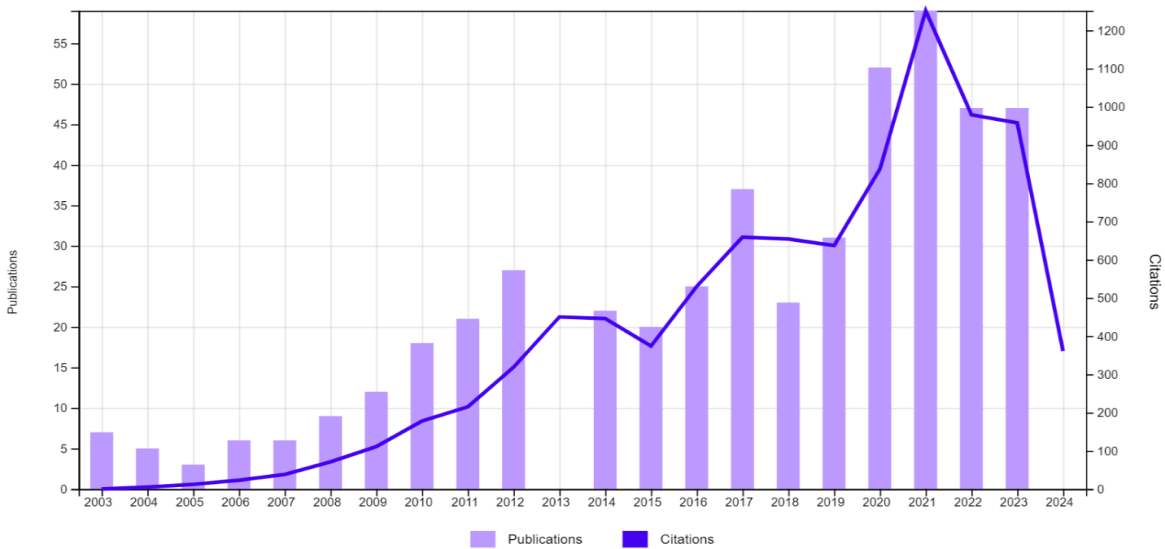


Figure 1. Publication years and citations



Figure 2. Centers with the most articles published



Figure 3. Journals with the most articles published

The most prolific author was Kennedy JG, who had 94 publications, followed by Dahmen J. and Kerkhoffs GMMJ, who had 20 publications (Figure 4). Only 24 published articles had a primary author who was not an orthopaedic or podiatric surgeon. The United States published the most papers, 166, followed by South Korea with 55 (Figure 5). The 25 most cited articles,

years of publication, journals, total citations, and average citations per year are shown in Table 2. The most cited article was "Treatment of osteochondral lesions of the talus: a systematic review" by Zengerink et al. [5] in 2010 with 370 citations. The mean number of citations per year is shown in Table 3.



Figure 4. Authors who published the most articles

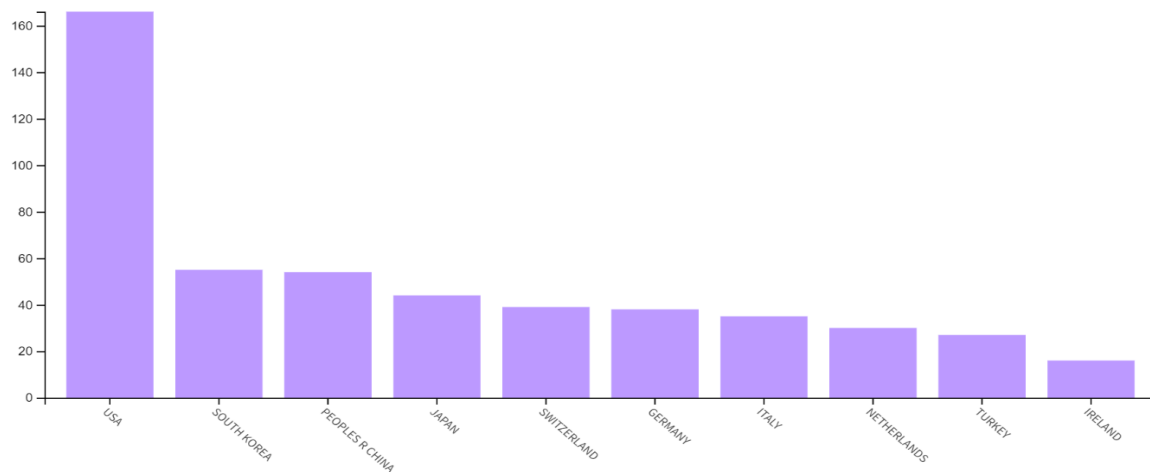


Figure 5. Countries with the most articles published

Table 2. Most cited 25 articles between 2003-2023

	Title	Authors	Source Title	Year	Total Citations	Average Per Year
1	Treatment of osteochondral lesions of the talus: a systematic review	Zengerink, Maartje et al.	Knee Surgery Sports Traumatology Arthroscopy	2010	370	24.67
2	Osteochondral Lesion of the Talus Is There a Critical Defect Size for Poor Outcome?	Choi, Woo Jin et al.	American Journal of Sports Medicine	2009	275	17.19
3	Arthroscopic treatment of chronic osteochondral lesions of the talus - Long-term results	Ferkel, Richard D et al.	American Journal of Sports Medicine	2008	273	16.06
4	Osteochondral lesions of the talus: Localization and morphologic data from 424 patients using a novel anatomical grid scheme	Raikin, Steven M. et al.	Foot & Ankle International	2007	267	14.83
5	Osteochondral lesions of the talus: Randomized controlled trial comparing chondroplasty, microfracture, and osteochondral autograft transplantation	Gobbi, Alberto et al.	Arthroscopy-The Journal of Arthroscopic and Related Surgery	2006	217	11.42
6	The morbidity associated with osteochondral harvest from asymptomatic knees for the treatment of osteochondral lesions of the Talus	Reddy, Sudheer et al.	American Journal of Sports Medicine	2007	181	10.06
7	Platelet-Rich Plasma or Hyaluronate in the Management of Osteochondral Lesions of the Talus	Mei-Dan, Omer et al.	American Journal of Sports Medicine	2012	162	12.46
8	Lesion Size Is a Predictor of Clinical Outcomes After Bone Marrow Stimulation for Osteochondral Lesions of the Talus: A Systematic Review	Ramponi, Laura et al.	American Journal of Sports Medicine	2017	147	18.38
9	Outcome of osteochondral autograft transplantation for type-V cystic osteochondral lesions of the talus	Scranton, PF et al.	Journal of Bone and Joint Surgery-British Volume	2006	145	7.63
10	Arthroscopic autologous chondrocyte implantation in osteochondral lesions of the talus - Surgical technique and results	Giannini, Sandro et al.	American Journal of Sports Medicine	2008	142	8.35
11	Prospective study on diagnostic strategies in osteochondral lesions of the talus - Is MRI superior to helical CT?	Verhagen, RAW et al.	Journal of Bone and Joint Surgery-British Volume	2005	142	7.1
12	Arthroscopic treatment of osteochondral lesions of the talus	Robinson, DE et al.	Journal of Bone and Joint Surgery-British Volume	2003	138	6.27
13	Osteochondral lesions of the talus: A new magnetic resonance grading system with arthroscopic correlation	Mintz, DN et al.	Arthroscopy-The Journal of Arthroscopic and Related Surgery	2003	131	5.95
14	Cartilage repair evolution in post-traumatic osteochondral lesions of the talus: From open field autologous chondrocyte to bone-marrow-derived cells transplantation	Giannini, Sandro et al.	Injury-International Journal of the Care of the Injured	2010	122	8.13

Table 2. Most cited 25 articles between 2003-2023 (continued)

	Title	Authors	Source Title	Year	Total Citations	Average Per Year
15	Donor-Site Morbidity After Osteochondral Autologous Transplantation for Lesions of the Talus	Paul, J. et al.	Journal of Bone and Joint Surgery-American Volume	2009	117	7.31
16	The Treatment of Osteochondral Lesions of the Talus with Autologous Osteochondral Transplantation and Bone Marrow Aspirate Concentrate: Surgical Technique	Kennedy, John G. et al.	Cartilage	2011	104	7.43
17	Intermediate Outcomes of Fresh Talar Osteochondral Allografts for Treatment of Large Osteochondral Lesions of the Talus	Haene, Roger et al.	Journal of Bone and Joint Surgery-American Volume	2012	102	7.85
18	Osteochondral lesions of the talus aspects of current management	Hannon, C. P. et al.	Bone & Joint Journal	2014	99	9
19	Second-Look Arthroscopic Findings and Clinical Outcomes After Microfracture for Osteochondral Lesions of the Talus	Lee, Keun-Bae et al.	American Journal of Sports Medicine	2009	99	6.19
20	Surgical Treatment of Osteochondral Lesions of the Talus by Open-Field Autologous Chondrocyte Implantation A 10-Year Follow-up Clinical and Magnetic Resonance Imaging T2-Mapping Evaluation	Giannini, Sandro et al.	American Journal of Sports Medicine	2009	96	6
21	Mosaicplasty with autogenous talar autograft for osteochondral lesions of the talus after failed primary arthroscopic management - A prospective study with a 4-year follow-up	Kreuz, PC et al.	American Journal of Sports Medicine	2006	94	4.95
22	Current Concept Review: Osteochondral Lesions of the Talus	McGahan, Patrick et al.	Foot & Ankle International	2010	85	5.67
23	Arthroscopic microfracture for osteochondral lesions of the talus	Lee, Keun-Bae et al.	Knee Surgery Sports Traumatology Arthroscopy	2010	81	5.4
24	Evaluation and Management of Osteochondral Lesions of the Talus	Looze, Christopher A. et al.	Cartilage	2017	80	10
25	Clinical outcomes of platelet rich plasma (PRP) as an adjunct to microfracture surgery in osteochondral lesions of the talus	Guney, Ahmet et al.	Knee Surgery Sports Traumatology Arthroscopy	2015	76	7.6

Table 3. Citation reports among years

Year	Citation Per Article	Total Citation	Total Article	Citation Per Year
2023	0.71	33	46	0.71
2022	2.77	133	48	1.38
2021	5.93	374	63	1.97
2020	8.48	416	49	2.12
2019	12.78	409	32	2.55
2018	16.68	417	25	2.78
2017	19.19	691	36	2.74
2016	24.03	625	26	3
2015	20.43	470	23	2.27
2014	15.66	376	24	1.5
2013	30.25	968	32	2.75
2012	29.22	906	31	2.43
2011	22.14	465	21	1.7
2010	57.47	1207	21	4.1
2009	61.5	738	12	4.07
2008	54.4	544	10	3.4
2007/06	93.25	1119	12	5.32
2005/04/03	48.5	970	20	2.42

Discussion

The number of publications on OLT has increased in recent years. The year with the most articles published is 2021, with 59, and approximately 50% of the articles were published in the last five years. This result shows that there is a trend towards OLT, especially among orthopaedic surgeons. As mentioned in the results section, only 24 first authors were not orthopaedic surgeons in publications on OLT.

The most commonly written titles are general topics. For example, the etiology, anatomy, lesion size, depth, and location, additional injury, type of injury, and predisposing factors of OLT have been described in many articles [15, 16]. Microfracture is still one of the less invasive treatment methods that has been used for many years in the surgical treatment of OLT, with published long-term results [6]. This is supported by the fact that microfracture is the second most widely written topic in this study, with 77 articles. Most of the articles on

microfracture were published in 2021, with 12 articles. Surgical strategies may be modified depending on the size, depth, and localisation of the lesion [17]. The use of osteochondral grafts is one of these options [18]. Studies have shown that reconstructions with autograft in talar osteochondral lesions are more successful in the medium and long term than reconstructions with allograft [19]. This study found 66 articles on autograft and 25 articles on allograft. This could be an indication that the use of autograft is more practical and convenient. According to the results of this study, OATS is the most common surgical approach after microfracture in OLT treatment. Recently, AMIC treatment has been an increasing treatment protocol in OLT surgery. The first articles described this method with medial malleolus osteotomy, but nowadays, newer articles use AMIC procedures without malleolus osteotomy, direct visualisation of the ankle [20]. Almost all articles on AMIC have been published in the last decade. There seems to be a trend towards this procedure.

Cartilage/chondrocyte articles were concentrated in 2009-2015, decreased significantly in the next five years, and peaked in 2020-2021. Treatments based on chondrocytes usually require two-stage surgical procedures [21]. Sometimes it wasn't cost-effective. Articles on stem cell and adjuvant therapies show a relatively homogeneous distribution after 2011. They are used in the literature to accelerate postoperative recovery or as an adjunct to conservative treatment [22, 23]. A certain number of radiological studies were published in all years. However, as expected for outcome studies, there has been an increase in the last decade [24-27]. Although the 25 most cited articles cover almost all topics, more outcome studies exist.

In 2017, a systematic review study, "Lesion Size Is a Predictor of Clinical Outcomes After Bone Marrow Stimulation for Osteochondral Lesions of the Talus", had an average citation per year of 18.38. It should be considered a remarkable and promising study [3]. The study by Looze et al. [28] has an average of 10 citations per year, more than the articles further up the list. This study showed that articles on complications were published mainly in the last 5 years. This finding can be interpreted as understanding the importance of medium- and long-term outcomes and unsuccessful surgical management [29].

Analysis of the literature on OLT from 2003 to 2023 reveals significant trends and insights into the evolving surgical management of these complex ankle injuries. The study highlights a marked increase in research publications in recent years, reflecting growing interest and advances in treatment options, particularly among orthopaedic surgeons. General topics and microfracture remain prominent areas of focus, highlighting their continued relevance in the management of OLT. There is a clear preference for autograft techniques over allografts, with autografts demonstrating superior mid- and long-term results. In addition, the emergence of AMIC as a treatment strategy signals a shift towards innovative and minimally invasive approaches. With the increasing adoption of AMIC, it is anticipated that the use of mosaicplasty may decline in the coming years. Despite these advances, continued research is essential to understand further and improve

long-term surgical efficacy, outcomes, and complications. This study highlights the need for ongoing investigation and evaluation of treatment strategies to improve patient care and optimise outcomes in the management of OLT.

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Authors' contributions: M.Y. developed the study's main idea and hypothesis. A.N.A. formulated the theory and structured the materials and methods section. M.Y. conducted the data analysis in the results section. M.Y. wrote the discussion section, which was later reviewed, revised, and approved by A.N.A. Additionally, all authors actively contributed to discussions throughout the study and approved the final version of the manuscript.

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