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Retrospective Analysis of Ankle Osteoarthritis: Evaluation of Clinical and Epidemiologic Data at the Kazakh National Scientific Center of Traumatology and Orthopedics

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Abstract

Introduction: Ankle osteoarthritis is a prevalent condition that significantly impacts patient mobility and quality of life. Surgical interventions, such as arthroscopic debridement and arthrodesis, are commonly employed to alleviate symptoms and restore function. However, the optimal choice between these procedures remains a subject of debate.

Objective: This retrospective study aims to evaluate the clinical and epidemiologic data of patients with ankle osteoarthritis treated at the hospital. We compared the outcomes of arthroscopic debridement and arthrodesis, focusing on pain relief and functional improvements based on the severity of osteoarthritis.

Design: Cross-sectional, retrospective case series.

Results: Group I had a significantly younger median age (41 years) compared to Group II (59 years, p = 0.0021). Group II also presented a higher mean BMI (26.2 vs. 23.9; p = 0.0391). Preoperatively, Group I demonstrated a mean VAS score of 4.63, improving to 1.52 postoperatively (p = 0.0000) and 3.63 after 12 months (p = 0.0003). In Group II, the VAS score improved from 6.92 to 3.85 postoperatively (p = 0.0000), but increased to 5.08 after 12 months (p = 0.0001). Functional outcomes as measured by the AOFAS score significantly improved in both groups, although Group I showed better long-term functional outcomes.

Conclusion: Arthroscopic debridement provided better short-term functional improvement and pain relief, particularly in younger patients with early-stage osteoarthritis. Arthrodesis, while effective for advanced disease, was associated with a higher risk of recurrent pain and reduced functionality over time. The choice of treatment should be individualized, considering patient age, BMI, arthritis severity, and comorbidities.

Keywords: Ankle Joint, Retrospective Studies, Osteoarthritis, Arthrodesis, Arthroscopy.

Introduction

Arthritis is one of the most common chronic diseases and takes a leading role as a cause of disability among adults [1]. Globally, around 15% of people experience joint pain and disability due to osteoarthritis, with approximately 1-4% specifically suffering from ankle osteoarthritis [2]. Ankle joint problems are quite common but still have received lack of attention. Post-traumatic arthritis (PTA) of the ankle joint is the most frequent, accounting for 80% of cases, compared to other

major joints of the lower extremities, such as the knee (10%) and hip (2%) [3]. PTA occurs at a younger age (about 10 years earlier than primary osteoarthritis), which leads to increased disability of the able-bodied population and creates additional difficulties for the choice of treatment method for patients [4]. Moreover, it is also important to consider the substantial financial burden associated with the necessary of therapy. Nowadays, the existing methods of treatment are symptomatic and do not provide restoration of the joint. The applied surgical treatment methods are aimed only at debridement of the joint without restoration of cartilage tissue. For the treatment of osteochondral defects of the ankle joint, methods aimed at stimulating cartilage regeneration in the damaged joint such as multiple microperforations of the articular surface, mosaic chondroplasty, abrasion and microfracturing are used. One example is microfracturing, which involves drilling through bone to release fat and blood while simultaneously releasing resident reparative bone marrow cells to create cartilage. Other alternatives include autologous bone and cartilage transplantation (AOT) or methods involving joint distraction. Each of these treatments is based on the use of endogenous cells to remodel the surrounding area. However, clinical practice has shown that they cannot provide complete and sustained restoration of articular hyaline cartilage and often result in fibrotic cartilage formation, ultimately leading to treatment ineffectiveness [5]. The current treatment with the best clinical outcome is ankle arthrodesis, which is usually provided at age 68 years, approximately 16 years after disease onset. But at the same time there are some disadvantages of this method: loss of joint mobility, change in gait, increased stress on adjacent joints, failure to fuse or delayed fusion, risk of infection, hardware complications, long recovery period, poor pain relief. Total endoprosthetics (total joint replacement) is another surgical treatment option that provides a higher degree of patient satisfaction. Ankle endoprosthetics can be complicated by the development of infection, instability, or periprosthetic fractures. Due to the high wear rate of the prosthesis, revision endoprosthetics is necessary every 7 years [6]. In addition, this operation is expensive and the number of endoprostheses in Kazakhstan is limited. In view of the above, the development of etiotropic, safe and long-term regenerative method of treatment of osteoarthritis of the ankle joint is in demand.

The aim of the study was to evaluate the differential treatment of patients with degenerative ankle joint disease depending on the stage of osteoarthritis.

Materials and methods

This study was conducted with patients' informed consent and according to a protocol approved by the local institutional review board, adhering to the ethical standards outlined in the 1964 Declaration of Helsinki. We collected 40 patients who underwent surgical treatment regarding pain of ankle joint in National scientific center of traumatology and orthopedics named after academician N. D. Batpenov (Astana, Kazakhstan). Surgical procedures were determined based on the severity of ankle joint osteoarthritis, patient complaints, age, and concurrent medical conditions. Exclusion criteria: acute trauma, lower limb axial deformities, limb shortening, and patients with psychiatric disorders.

Radiography was performed for all patients to assess joint space narrowing, presence of osteophytes, and subchondral bone sclerosis and to determine the stage of osteoarthritis (Figures 1). MRI was utilized to detect subchondral cysts, tissue inflammation and edema around the joint, and evaluate blood supply (Figures 2).

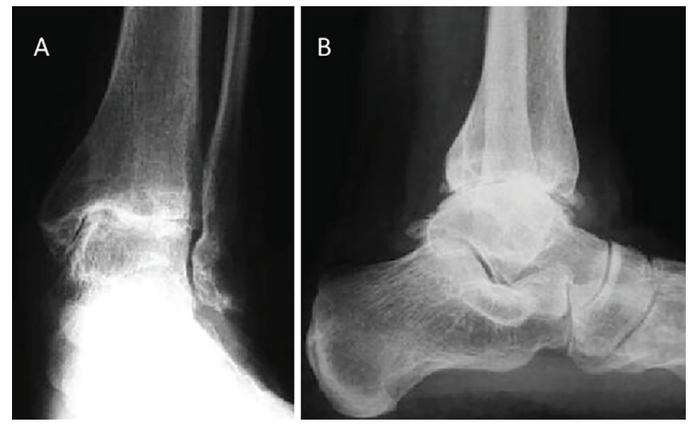

Figure 1 – X-Ray Scan of the patient's 2 left ankle joint with grade IV osteoarthritis in frontal (A) and sagital (B) side

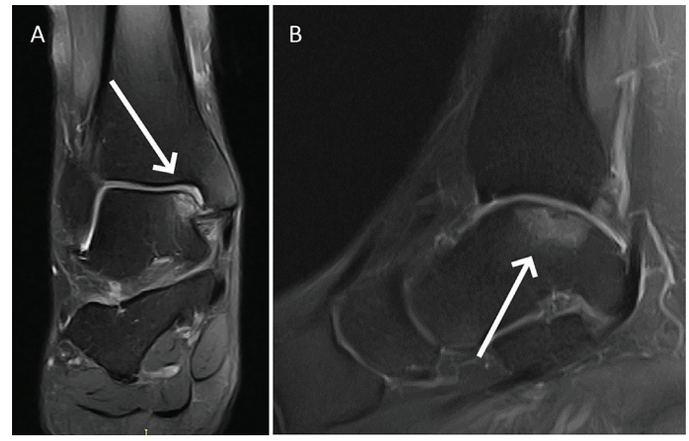

Figure 2 – MRI of the patient's 4 right ankle with osteochondral defect of the talus bone (white arrow), frontal (A) and sagital (B) side

All 40 patients were divided into two groups based on the type of surgical treatment they received. Group I, consisting of 27 patients, underwent arthroscopic debridement, while Group II, comprising 13 patients, underwent ankle arthrodesis using screws and plates. Arthroscopic vaporization of the capsule-ligamentous structures of the ankle joint was the most frequently performed operation in these cases. In addition to vaporization of capsule-ligamentous structures, arthroscopic decompression and debridement were also performed for anterior and posterior impingement of the ankle joint. This method of surgical intervention in the treatment of degenerative joint disease reflects the trend toward minimally invasive surgical treatment methods in the early stages of osteoarthritis, which can prevent the progression of cruzarthrosis. Ankle arthrodesis is a method of tibial and talus fusion that has been most commonly performed in patients with 3-4 stage of osteoarthritis. Athrodesis completely blocks movements in the ankle joint, but at the same time it releave pain syndrome.

The clinical efficacy of surgical treatment was evaluated by the regression of pain syndrome and improvement of ankle joint function. Ankle joint function was assessed using the American Orthopaedic Foot and Ankle Society (AOFAS) scale, and pain syndrome was assessed using the VAS pain rating scale.

Statistical analysis

All statistical analyses were conducted using Stata software (version 18), StataCorp, College Station, TX, USA). Statistical significance was set at $p < 0.05$ for all tests. Quantitative measures were assessed for conformity to a normal distribution using the Shapiro-Wilk criterion. Continuous variables, including the

Visual Analog Scale (VAS), the American Orthopaedic Foot and Ankle Society (AOFAS) score, gait abnormality, and range of motion, were expressed as mean ± standard deviation (SD)with the corresponding range.

Paired t-tests were employed to compare preoperative and postoperative values within each treatment group (arthroscopic debridement or arthrodesis) at different time points (preoperative, postoperative, 6 months, and 12 months). Statistical significance between these time points was determined by calculating p-values, with significance set at $p < 0.05$. For comparing the outcomes between the two independent treatment groups (arthroscopic debridement and arthrodesis), independent t-tests were used. In cases where the normality assumption was not met, the Mann-Whitney U-test was applied as a non-parametric alternative to assess differences between groups.

Results

A total of 40 patients were included in the study, divided into two groups based on the surgical treatment they received. Evaluation criteria included age, gender, weight, BMI, side of lesion, stage of osteoarthritis, and presence of comorbidities. The demographic and clinical characteristics of the patients were compared between the groups (Table 1).

Patients in Group II were significantly older, with a median age of 59 years (range 46–64), compared to 41 years (range 31–47) in Group I (p = 0.0021). There were no statistically significant differences in gender distribution, with males representing 67% in Group I and 46% in Group II (p = 0.3704). Group II had a significantly higher mean BMI (26.2 vs. 23.9; p = 0.0391). In terms of arthritis staging, the majority of Group I patients had early-stage arthritis (I and II), while Group II predominantly consisted of patients with more advanced arthritis (IIIb and IV). Comorbidities were present more frequently in Group II, including diabetes mellitus, rheumatoid arthritis, and cardiovascular conditions.

Table 1 Demographic and clinical data of patients

Indicator	Group I Arthroscopic debridement	Group II Arthrodesis	p-value
Total	n = 27	n = 13	
Age	41 (31,5-47,5)	59 (46-64)	p = 0.0021
Gender Male Female	 18 (66,7 %) 9 (33,6 %)	 6 (46,2 %) 7 (53,8 %)	p = 0.3704
Weight	70 (61,5-75,5)	75 (70-84)	p = 0.0773
Body mass index (BMI)	23,9 (22,6-25,15)	26.2 (24,6-27,6)	p = 0.0391
Side Right Left	 13 (48,1 %) 14 (51,9 %)	 9 (69,2 %) 4 (30,8 %)	
Stage of arthritis I II IIIa IIIb IV	 19 (70,4 %) 8 (29,6 %)	 - - 1 (7,7 %) 5 (38,5 %) 7 (53,8 %)	
Comorbidities No Diabetes mellitus Rheumatoid arthritis Cardiovascular Other More than 2	 19 - - 4 3 1	 5 2 3 1 - 2	

Functional Outcomes

Pre-operatively, In Group I the mean VAS score was 4.63 ± 0.63, which improved to 1.52 ± 0.51 post-operatively (p = 0.0000) (Table2, Figure 3). After 6 months, the VAS score was maintained at 1.70 ± 0.47, and after 12 months, a slight increase to 3.63 ± 0.56 was noted, though this still represented a significant improvement from baseline (p = 0.0003).

Table 2 Pre- and post-operative functional scores

	Group I		Group II	
	VAS (Mean ± SD, Range)	AOFAS (Mean ± SD, Range)	VAS (Mean ± SD, Range)	AOFAS (Mean ± SD, Range)
Pre-operative	4.63 ± 0.63 (4-6)	84.1 ± 1.58 (83-85)	6.92 ± 0.76 (6-8)	43.2 ± 8.88 (25-56)
Post-operative	1.52 ± 0.51 (1-2)	93.4 ± 3.00 (92-95)	3.85 ± 0.69 (3-5)	56.16 ± 7.47 (38-65)
p-value	0.0000	0.0000	0.0000	0.0000
After 6 months	1.70 ± 0.47 (1-2)	81.3 ± 4.78 (79-83)	4.15 ± 1.07 (2-6)	58 ± 8.82 (42-73)
p-value	0.0000	0.0018	0.0000	0.0000
After 12 months	3.63 ± 0.56 (3-4)	79.6 ± 4.72 (77-81)	5.08 ± 1.19 (3-7)	52.38 ± 7.15 (40-60)
p-value	0.0003	0.0000	0.0001	0.0000

The AOFAS score improved from a pre-operative mean of 84.1 ± 1.58 (range: 83-85) to 93.4 ± 3.00 post-operatively (p = 0.0000) (Figure 4). At the 6-month follow-up, the AOFAS score decreased slightly to 81.3 ± 4.78 but remained significantly better than the pre-operative score (p = 0.0018). After 12 months, the score further declined to 79.6 ± 4.72 (p = 0.0000).

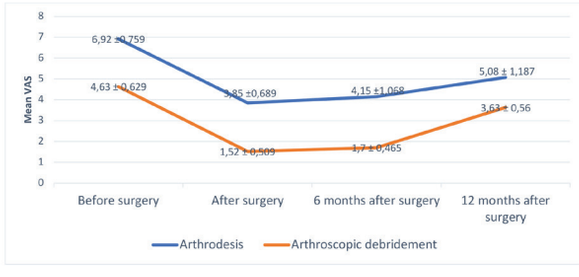

Figure 3 – Comparative analysis of pain level changes in patients of both groups

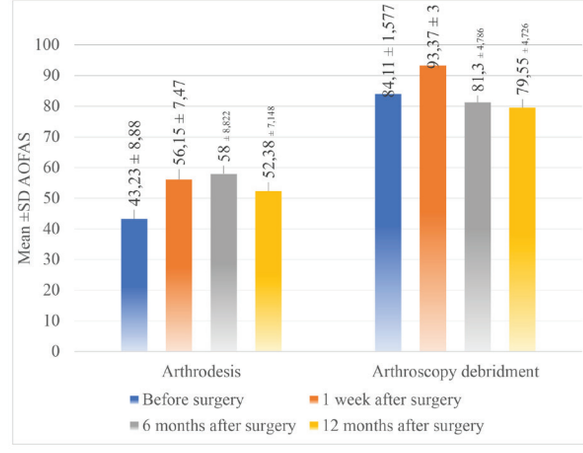

Figure 4 – Comparative analysis of ankle joint function changes in patients of both groups

In Group II, the mean pre-operative VAS score was 6.92 ± 0.76, which decreased to 3.85 ± 0.69 post-operatively (p = 0.0000). However, after 6 months, the VAS score increased to 4.15 ± 1.07, and by 12 months, it reached 5.08 ± 1.19 (p = 0.0001).

The AOFAS score in Group II also demonstrated improvement, from a pre-operative mean of 43.2 ± 8.88 to 56.16 ± 7.47 post-operatively (p = 0.0000). At the 6-month mark, the score increased to 58 ± 8.82 and remained stable at 52.38 ± 7.15 after 12 months (p = 0.0000).

Discussion

The literature provides a rather large list of indications for ankle arthroscopy [7]. In addition to free intraarticular bodies, osteochondral fractures, rheumatoid polyarthritis, and anterior impingement syndrome, arthroscopic interventions on the ankle joint are often used for ligamentous apparatus pathology and infectious arthritis as sanitizing measures. The list of indications is still expanding, and the number of ankle arthroscopies performed is increasing due to development of surgical techniques. The data obtained from other sources indicate that treatment of patients with osteochondropathy of the talus, anterior impingement syndrome, synovitis allow us to recommend ankle arthroscopy as the operation of choice for this pathology, thanks to which minimally invasive and highly effective treatment of this category of patients can be performed [8]. In patients with ankle osteoarthritis, the prognosis depends on such factors as the degree and size of cartilage damage and the presence of adjacent joint pathologies. According to the data of our study, the majority of patients in the early postoperative period showed pain reduction and improvement of joint mobility. However, within 12 months, almost all patients experienced a recurrence of pain and a decrease in ankle joint function to the preoperative level. Data on complications vary widely in the literature, with neurologic, vascular, and infectious complications reported. Researchers have noted a higher risk of neurologic complications with ankle arthroscopy compared with knee and shoulder procedures. For example, Sprague N.F. reports 24% complications [9], while Small N.C. reports only 0.7% [10]. These data, as well as our own experience, emphasize the need for careful surgical preparation, careful handling during procedures, and careful patient education about the potential risks and complications associated with arthroscopic interventions.

Ankle arthrodesis remains the "gold standard" in the treatment of late-stage osteoarthritis [11]. However, the patient's ankle joint function is limited, which causes a compensatory increase in the range of motion of the adjacent joints of the foot, leads to overloading and possible degenerative changes in joints such as the subtalar and talus and calcaneo-cuboid joints later on [12]. In addition, there are observations that the movement of the small joints of the healthy foot mimics the affected side so that the patient develops a symmetrical altered gait on both sides. As a result, a number of patients develop symmetrical limb pathology after arthrodesis [13]. Some patients require repeat arthrodesis after intervention [14], moreover stress fractures of the tibia and fibula may occur [15]. In avascular necrosis of the talus, there is insufficient blood supply, and long-term use of various medications and systemic disorders in patients with rheumatoid arthritis increase the risk of arthrodesis failure [16]. Adequate compression is a prerequisite for successful arthrodesis [17, 18]. The clinical results with endoprosthesis, arthrodesis and arthroscopy were similar. However, patients with endoprosthesis were significantly more likely to have reoperations [19]. According to other data, endoprosthesis and arthrodesis were equally effective in osteoarthritis [20].

Retrospective analysis of data on surgical treatment of ankle osteoarthritis revealed differences in outcomes between the two main methods of intervention: arthroscopic debridement and ankle arthrodesis. Of the 40 patients included in the study, 67.5% underwent arthroscopic debridement, while 32.5% underwent arthrodesis. The arthroscopic debridement group was predominantly male (66.7%) and the age of the patients was younger. The cause of osteoarthritis in this group was most often trauma. In the arthrodesis group, women accounted for 53.8%. These patients tended to present with a later degree of osteoarthritis, often having comorbidities, and their age was significantly older. Arthroscopic debridement has shown good results in the short term, especially in patients with early stages of osteoarthritis. This method is characterized by less invasiveness and faster recovery. The arthrodesis group, which had more advanced disease, demonstrated significant post-operative benefits. The increase in pain syndrome in the arthrodesis group is evidently associated with the increased load on the adjacent joints of the foot.

A key finding of our study is the significant difference in patient demographics between the two groups. Patients in the arthrodesis group were older and had a higher body mass index (BMI), which could have influenced the clinical outcomes. Additionally, the prevalence of comorbidities was higher in the arthrodesis group, particularly cardiovascular diseases and diabetes mellitus, which may have impacted their recovery and rehabilitation. These factors underscore the importance of individualized treatment plans based on patient characteristics, comorbidities, and disease severity.

The differences in outcomes between the two groups are consistent with previous studies that have shown that arthroscopic debridement is more suitable for patients with early-stage osteoarthritis, while arthrodesis is more appropriate for patients with severe joint destruction. However, it is important to note that the retrospective nature of our study and the relatively small sample size limit the generalizability of our findings. Future prospective studies with larger sample sizes and longer follow-up periods are needed to confirm these results and to further refine treatment criteria.

Our study also highlights the need for a multidisciplinary approach in the management of ankle osteoarthritis. In addition to surgical interventions, conservative measures such as weight management, physical therapy, and pharmacological treatments should be considered, especially for patients with multiple comorbidities. Moreover, the development of innovative surgical techniques and biologic treatments aimed at cartilage restoration may offer promising alternatives to traditional procedures in the future.

Conclusion

It is important to emphasize that early intervention to prevent the progression of osteoarthritis is the most important aspect of the treatment of this disease. This implies a deep understanding of the mechanisms of osteoarthritis development and the development of new, more effective methods of prevention and treatment. Further prospective studies with a large number of participants are needed to confirm our findings and to determine the optimal criteria for selecting treatment approaches.

The introduction of preventive measures and innovative strategies can significantly improve the prognosis and quality of life of patients with ankle osteoarthritis. These findings emphasize the importance of early intervention and the use of innovative methods in the treatment of osteoarthritis, which may stimulate additional research in this area.

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