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# Open Ankle Arthrodesis Outcome: Comparison between Anterior and Lateral Approaches

**Abstract**

**Background:** Ankle arthrodesis is one of the major surgeries for the treatment of advanced osteoarthritis of the ankle joint. There are various techniques available for ankle arthrodesis and each technique has unique advantages and disadvantages. The aim of the present study was to evaluate the results of ankle arthrodesis with two this different approaches.

**Methods:** The medical records of the patients who were admitted for ankle arthrodesis and treated by a single surgeon from January 2015 to January 2020 were reviewed. The patients were recalled for re-evaluation after a mean follow-up of 19 months. Functional outcomes were assessed using validated AOFAS Ankle-Hind foot score, Manchester-Oxford Foot Questionnaire (MOXFQ) and visual analog scale (VAS) score for pain. The collected data were recorded in a pre-designed checklist and then analyzed using SPSS software.

**Results:** A total of 32 patients, 18 men and 14 women with a mean age of 46.7 years were included in the study. 67.6% had history of ankle fractures. Anterior approach was used in 24 patients, 75%, and the rest of the patients had surgery with lateral approach (25%). The most common instrument for arthrodesis was concomitant use of plate and screws in 18 patients (56%). Union occurred in 28 patients (87.5%) within 11.1 weeks after the surgery. The AOFAS score increased significantly and MOXFQ and VAS scores decreased significantly following the surgery ($p<0.001$ for each). Advanced age and intramedullary nail were related to prolonged time to union ($p<0.05$). Surgical approaches (either anterior or lateral) had no association with AOFAS, MOXFQ, and VAS scores. Non-union was seen in 4 patients (12.5%) and deep infection in 3 patients (9.3%) after ankle arthrodesis.

**Conclusion:** The study results showed that, this surgery could improve patients' pain and function with relatively low post-operative complications.

**Keywords:** Ankle, Osteoarthritis, Arthrodesis, Outcome assessment

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## Introduction

Although osteoarthritis of the ankle is much less common than knees, hands, and hips, it still affects about one percent of the adult population [(1)]. In contrast to hip and knee arthritis, ankle osteoarthritis is mainly caused by trauma, accounting for 75 % of all ankles joint injuries [(2)]. The common causes of ankle osteoarthritis are fractures, damage to the ankle ligaments, destruction and loss of cartilage due to infection, rheumatic disorders, gout and other destructive joint diseases. These injuries cause osteoarthritis over time even after healing [(3)]. The main symptom of the disease is pain, which causes loss of range of motion and often limitation of ankle movements. The pain usually gets worse with prolonged activity and is relieved by rest. Restriction of ankle movements is more common in the morning and usually lasts less than 30 minutes after the start of daily activities, but may return after periods of inactivity. The patient may also complain of "joint locking" and joint instability. These symptoms affect daily activities due to pain and limited ankle movements [(4)]. Treatment of symptoms at early stages includes exercise, reduction of joint stress by resting or use of painkillers. However, many patients fail to maintain their ideal weight and long-term use of analgesics is not

recommended due to their risk of side effects [5]. Ankle arthrodesis continues to be the gold standard in the treatment of severe osteoarthritis [6]. This type of surgery is suitable for young and active people who have heavy physical work [7]. Depending on the ankle deformity and damage, the soft tissue condition and the surgeon's preference and experience, several surgical approaches may be considered for arthrodesis. A lateral approach is a common procedure used for ankle fusion. Other approaches include anterior, medial, posterior, or simultaneous medial and lateral, each of which may be selected depending on the patient's condition and the surgeon's experience [8].The complications of arthrodesis is reported in 9 to 60 percent of patients and limitations in daily life or work activities were reported in 33 to 50 percent of patients with ankle osteoarthritis [9, 10]. The aim of the present study is to evaluate the patients' satisfaction and functional outcomes of arthrodesis with special attention to the surgical approach and fixation technique.

## Methods

The present retrospective study was approved by ethics committee of Mashhad University of Medical sciences. The medical records of patients who were admitted to orthopaedic departments of Shahid Kamyab and Ghaem Hospitals for ankle arthrodesis and treated by a single surgeon (the first author) from January 2015 to January 2020 were reviewed. The demographic information, indication for arthrodesis, surgical techniques, fixation devices and any documentation of postoperative complications were documented. The preoperative validated AOFAS Ankle-Hindfoot score [11], Manchester-Oxford Foot Questionnaire (MOXFQ) [12] and visual analog scale (VAS) for pain (with 0 representing no pain and 10 representing the maximum possible pain) were also collected. Patients were contacted at a minimum of 12 months following primary surgery for a visit and re-examination. In the follow-up visit they were asked to complete the functional outcome questionnaires (AOFAS, MOXFQ, VAS). Satisfaction with the result of surgery were assessed using a 5-point Likert scale ("very satisfied," "satisfied," "neither satisfied nor dissatisfied," "dissatisfied," and "very dissatisfied"). Union of the arthrodesis site was assessed by the standard ankle radiographs interpreted by the orthopedic foot and ankle surgeon who performed the surgeries. Patients underwent arthrodesis through anterior (24 cases, 75%) or lateral approach (8 cases, 25%). Screws only, plate and screws and intra-medullary nail were used for fixation of the fusion site (Figure 1, 2).

Statistical analysis:

Clinical scores were represented with means ± standard deviations. Independent t-test or Mann-Whitney test used to compare pre and postoperative AOFAS, MOXFQ and VAS scores. Chi-square test was also used to compare the grouped variables. Pearson test was used to evaluate the correlation of quantitative variables. In all tests, a significance level of 0.05 was considered.

## Results

Thirty-two patients, including 14 (43.75 %) women and 18 (56.25%) men, with a mean age of 46.7 years and body mass index (BMI) of 27.7 kg/m$^2$, were included in the study with a mean follow-up of 37 (range, 12-120) months. Applied internal fixation devices were screws only, plate only, plate and screws, and intra-medullary nail (Table 1).

The indication for arthrodesis was post-traumatic osteoarthritis in 19 (59%) patients. Bimalleolar and talus fractures were the most common injuries leading to end stage ankle arthritis (Table 2). Union occurred in 28 (87.5%) patients at a mean time of 12.7 weeks after the surgery. Four patients had incomplete unions during their last follow-up. Two of them had Charcot joint, one patient had gout and one patient had systemic lupus erythematosus.


**Figure 1: Ankle arthrodesis through anterior approach using plate and screws. Union occurred after 6 weeks of the surgery**


**Figure 2: Ankle arthrodesis through lateral approach using intramedullary nail in a diabetic patient following failure of previous osteosynthesis.**

| **Table 1: Surgical approach data** | |
|---|---|
| Surgery | N (%) |
| Anterior approach | 24 (75 %) |
| Screw | 3 (12.5%) |
| Plate and screw | 16 (66.6%) |
| Intra-medullary nail | 1 (4.1%) |
| Plate | 4 (16.6%) |
| Lateral approach | 8 (25%) |
| Screw | 2 (25%) |
| Plate and screw | 2 (25%) |
| Intra-medullary nail | 2 (25%) |
| Plate | 2 (25%) |

| **Table 2: Primary Indication for Ankle Arthrodesis** | |
|---|---|
| Posttraumatic arthritis | 19(59%) |
| Primary OA | 3(10%) |
| Gout | 1(3%) |
| Systemic lupus erythematosus | 1(3%) |
| Tuberculosis | 1(3%) |
| Rheumatoid Arthritis | 2(6%) |
| Charcot joint | 3(10%) |
| Polio | 1(3%) |
| Talar Osteonecrosis | 1(3%) |

The mean AOFAS score increased from 36.61±15.31 pre-operatively to 70.23±18.46 (P < 0.001). MOXFQ score and VAS pain score significantly decreased from 81.88±9.80 and 7.26±1.14 to 50.61±21.39 and 2.38±2.07 respectively (P< 0.001). Surgical approaches (either anterior or lateral) had no association with AOFAS, MOXFQ, and VAS scores (Table 3). (11)34.3% of patients were very satisfied, (18)55.9% satisfied, and (3)9.3% partially satisfied. (P>0.05) there was no significant association between type of internal fixation devices and postoperative functional scores.

Time to union was significantly higher in patients who received ankle fusion nail (P=0.03) and also patients older than 60 years old (p=0.04). The Patients with previous history of fracture had significantly lower union time (p=0.04). 6(18%) patients experienced complications, of which 4 (12.5%) required an additional surgery. 3 patients had deep infection that underwent irrigation and debridement. Two of them developed non-union (Table 4).

| Table 3: Comparison of Pre- and Postoperative Outcomes for Patients Undergoing Ankle Arthrodesis | | | |
|---|---|---|---|
| Assessment tools | Preoperative | Postoperative | P < |
| AOFAS | 36.61 ± 15.31 | 70.23 ± 18.46 | 0.001 |
| MOXFQ | 81.88 ± 9.80 | 50.61 ±21.39 | 0.001 |
| VAS | 7.26 ± 1.14 | 2.38 ± 2.07 | 0.001 |

| Table 4: Ankle Arthrodesis Complications. | |
|---|---|
| Complication | N (%) |
| Superficial Infection | 2(6.25%) |
| Deep Infection | 3(9.37%) |
| Non-union | 4(12.5%) |
| Hardware irritation | 3(9.37%) |
| Hardware removal | 2(6.25%) |

## Discussion

The present study demonstrated that the overall incidence rate of union following arthrodesis was 87.5% and the average time to union was 12.7 weeks. While the time to union was not related to surgical technique, the patients with history of fractures required significantly less time compared to other etiologies than other patients.

Neither Surgical approach nor fixation device was associated with improved functional scores. Different studies reported union rate between 73% to 100% [9, 10] [15-17]. Kim et al. reported 92% union rate in 60 patients who underwent arthrodesis through anterior and lateral approaches. Although the union rate in their study was slightly higher than this study, functional scores in either of two approaches were not significantly different [13]. Morasiewicz et al. compared the 21 patients undergoing arthrodesis with the Ilizarov technique with 26 patients undergoing internal fixation [14]. They stated that ankle fusion was achieved in 100% of patients with Ilizarov arthrodesis and 85% of those with internal fixation. They reported lower VAS score and lower complication rate in Ilizarov group but functional scores were not significantly different among the two groups [15]. A recent systematic review by Van den Heuvel et al. evaluated the result of open ankle arthrodesis in 38 studies including 1250 patients with osteoarthritis [17]. The union rate was 98% in the anterior approach, 96% in the lateral approach, and 96% in the medial and lateral approaches which were greater than our study. Similar to the present study there was no correlation between fixation devices and the rate of union in their review (P=0.07). Also functional scores (AOFAS score) was not related to the surgical approach and fixation techniques [15]. Reported complication rate after ankle arthrodesis vary widely between different studies. Non-union rate was reported between 0 to 27%, deep infection from 1.2 to 19 percent and malalignment from 2.5 to 8.5 percent [16, 17].

Non-union was high in our study and it could be related to the presence of patients with severe charcot neuroarthropathy and patients with rheumatic disorders that use immunosuppressive and bone suppressive drugs in the study population. Deep infection occurred in 9% of the patients after the arthrodesis. History of infection in the ankle region was present in 25% of the patients before the arthrodesis and it may be the reason for the high rate of deep infection in our study.

Limitations

One of the main limitations of the present study was its retrospective nature and unequal number of patients in different treatment groups. Moreover, the study did not investigate some of the risk factors affecting the union, including addiction, smoking or alcohol consumption, as there were unreliable patient responses for these factors.

## Conclusion

The results of this study showed that in general, ankle arthrodesis significantly reduces patients' pain and improves their physical function and general health. Different techniques do not differ significantly in patients' performance and pain relief. Further studies are required to assess the predictive factors of the outcome and to study new methods of ankle arthrodesis, including arthroscopic techniques and specific fixation devices.

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