

## Evaluation of Clinical Effect of Ankle Arthrodesis and Total Ankle Arthroplasty for End-stage Ankle Arthritis

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### Abstract

**Objective:** Arthrodesis as well as total ankle arthroplasty has been recently reported as an effective therapy for end-stage ankle arthritis. In this paper, we expand both surgical technique and retrospectively review our experience with evaluation of clinical effect of arthrodesis and total replacement for end-stage ankle arthritis.

**Methods:** 14 patients after arthrodesis (A group) and 16 patients after total ankle arthroplasty (B group) for end-stage osteoarthritis of the ankle joint were followed clinically and radiologically 5 years (range: 2.1-8.6) after surgery. To evaluate the outcome, a clinical scoring system (AOFAS, Kellgren and Lawrence) and by gait analysis (Vicon 612 System) were used.

**Results:** The pre- and post-operative mean AOFAS score was  $38.5 \pm 2.3$  and  $74.3 \pm 2.1$  points in A group. The mean score was  $38.1 \pm 2.4$  and  $80.3 \pm 2.2$  points in B group, with statistical significance. Spatio-temporal parameters obtained with gait analysis showed a progressive recovery to normality. In A group, mean stride length normalized (%high) was 60.5 pre-op and exactly 70.5 both at 6 and 12 months; speed rose from 80.4 cm/s to 96.8 cm/s at 6 months and 99.1 cm/s at 12 months. In B group, mean stride length normalized (%high) was 62.6 pre-op and exactly 74.3 both at 6 and 12 months; speed rose from 81.5 cm/s to 97.9 cm/s at 6 months and 100 cm/s at 12 months. Both with statistical significance six patients in B group and three patients in A group showed radiological evidence of degeneration of the talonavicular joint and the subtalar joint. We noted only one case with degeneration of the calcaneocuboid joint in B group.

**Conclusion:** Our study revealed arthrodesis as well as total ankle arthroplasty have been recently reported as an effective surgical technique for end-stage ankle arthritis.

**Keywords:** Ankle arthritis; Arthrodesis; Total ankle arthroplasty

### Introduction

Degenerative arthritis of the ankle is a disabling problem that affects greater than 50,000 new patients in the US each year [1]. Fifty-percent of elderly patients have some form of arthrosis involving the foot or ankle [2]. The treatment of ankle arthritis remains a challenging and controversial problem. In most cases of ankle arthritis, it is critical to exhaust an extensive course of non-surgical treatments prior to offering surgical options [3]. Historically, ankle arthrodesis has been the main stay of treatment. Recently, ankle replacement has become increasingly popular. Surgically, the advantages of ankle arthroplasty over arthrodesis have been reported to include retained ankle plantar and dorsiflexion, improved gait, greater patient function and decreased stress on adjacent joints with slower progression of hind foot degenerative changes [1,4,5]. Currently, surgical options include allograft resurfacing, arthroscopic debridement and osteophyte resection, joint distraction arthroplasty, supramalleolar osteotomy, total ankle arthroplasty, and ankle arthrodesis. A substantial number of patients require treatment for debilitating ankle arthritis [6-9]. According to industry experts, approximately 4,400 total ankle arthroplastys and approximately 25,000 ankle arthrodesis were performed in the United States in 2010 [10]. Ankle arthrodesis as well as total ankle arthroplasty have been recently reported as an effective therapy for end-stage ankle arthritis. In this

paper, we expand both surgical technique and retrospectively review our experience with evaluation of clinical effect of arthrodesis and total arthroplasty for end-stage ankle arthritis [11]

### Materials and Methods

In total, 30 patients of end-stage ankle arthritis that failed conservative management in this retrospective analysis (17 females and 13 males), mean age of 64.5 years (rang: 38-78 years). Osteoarthritis in 14, post-traumatic arthritis in 11 and rheumatoid Arthritis in 5 (Table 1) 14 ankle arthrodesis (A group) and 16 total ankle arthroplastys (B group) performed By the senior author from January 2001 to December 2008 were reviewed in this study. Exclusion criteria were non-union and additional procedures in A group. In addition, three patients did not wish to participate at follow-up. In the B group exclusion criteria were revision surgery and secondary fusion. Again, one patients did not participate at follow-up. Mean follow-up was 5 years (range: 2.1-8.6 years). Pre-and post-operative AOFAS (American Orthopaedic Foot and Ankle Society) scores [12] and gait analysis (Vicon 612 System)

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Diagnosis	Arthrodesis	Arthroplasty
Osteoarthritis(n=14)	6	8
Post-traumatic arthritis(n=11)	5	6
Rheumatoid arthritis(n=5)	3	2
All patients	14	16

Table 1: Patients data.

	Pre-operation	Post-operation	p-value
Arthrodesis	38.5 ± 2.3	74.3 ± 2.7	< 0.001
arthroplasty	38.1 ± 2.4	80.3 ± 2.2	< 0.001

Table 2: AOFAS ankle score.



Figure 1: Preoperative anteroposterior and lateral ankle radiographs of a patient with ankle osteoarthritis (A and B) postoperative antero-posterior and lateral radiographs after ankle arthrodesis (C and D)



Figure 2: Preoperative anteroposterior and lateral ankle radiographs of a patient with ankle osteoarthritis. (A and B) postoperative antero-posterior and lateral radiographs after total ankle arthroplasty (C and D).

[13] were used to evaluate clinical effect. Radiological data were used to evaluate the degenerative state of adjacent foot joints. This outcome measurement assesses pain, function, hindfoot motion, and alignment. The maximum score is 100 points. Patient satisfaction was graded as 'happy' (would recommend to others), 'satisfactory' (much better, but will not recommend to others), 'unhappy' (will consider alternatives next time).

### Arthrodesis

For ankle fusion two 7.3 mm cannulated self-cutting cancellous compression screws (Synthes GmbH, Salzburg, Austria). Multiple surgical options are available including a standard open or mini-open approach, arthroscopy, and external fixation. The classic approach is trans-fibular with or without an accessory medial portal.

### Arthroplasty

Total ankle arthroplasty was performed using the uncemented Hintegra® prosthesis (Newdeal SA, Lyon, France). Performing an adequate medial and lateral gutter debridement is of paramount importance. Intra-operative malleolar fracture and deltoid ligament insufficiency should be avoided. It is important to have solid bony support. During surgery, meticulous handling of the soft tissues, hemostasis, and a multilayer closure are critical in preventing infection and wound complications. Patients should be immobilized postoperatively and instructed to elevate the extremity to assist in wound healing. Weight bearing may be initiated at approximately 6 weeks postoperatively or when bony consolidation is seen.

### Results

The pre- and post-operative mean AOFAS score was 38.5 ± 2.3 and

74.3 ± 2.1 points in A group. The mean score was 38.1 ± 2.4 and 80.3 ± 2.2 points in B group, with statistical significance (Table 2). Spatio-temporal parameters obtained with gait analysis showed a progressive recovery to normality. In A group, mean stride length normalised (%high) was 60.5 pre-op and exactly 70.5 both at 6 and 12 months; speed rose from 80.4 cm/s to 96.8 cm/s at 6 months and 99.1 cm/s at 12 months. In B group, mean stride length normalized (%high) was 62.6 pre-op and exactly 74.3 both at 6 and 12 months; speed rose from 81.5 cm/s to 97.9 cm/s at 6 months and 100 cm/s at 12 months. Both with statistical significance six patients in B group and three patients in A group showed radiological evidence of degeneration of the talonavicular joint and the subtalar joint. We noted only one case with degeneration of the calcaneocuboid joint in B group. 75% of patients were happy and satisfactory in group B, 71% of patients were happy and satisfactory in group A. Two patients had had ankle fusion on the opposite side earlier, both were happier with the replaced side (Figures 1 and 2).

### Discussion

Decision making regarding arthrodesis versus total ankle arthroplasty plays an important role for the successful treatment of end-stage ankle arthritis. Every patient's individual combination of criteria has to be assessed and balanced thoroughly before surgery [14,15]. The author's personal major and minor criteria for decision making between arthrodesis versus total ankle arthroplasty are listed in study. Major criteria have shown evidence in the literature and are considered of equal value without a ranking among each other. When still in doubt after balancing the major criteria, minor criteria should be analyzed [16]. Although they seem reasonable, solid evidence for the minor criteria from studies comparing the impact of these criteria on the outcome is lacking in the literature. Balancing the criteria for decision making is not always easy and clear. In our study, for older and less demanding end-stage ankle arthritis patients, a total ankle arthroplasty is recommended. Whereas younger with a high activity level, no adjacent joint arthritis, and posttraumatic end-stage ankle arthritis, an arthrodesis is recommended [17,18].

In a recent comparative study analyzing the impact of complications on arthrodesis and total ankle arthroplasty outcome, patients with total ankle arthroplasty were as satisfied and yielded scores as good as did the patients with arthrodesis despite having significantly more complications at a mean follow-up of 38 months [19]. This finding was thought to be associated with a better postoperative function and a selection bias. If any ankle range of motion is retained, the patient's gait after total ankle arthroplasty is less disturbed. In our study, In A group, mean stride length normalized (%high) was 60.5 pre-op and exactly 70.5 both at 6 and 12 months; speed rose from 80.4 cm/s to 96.8 cm/s at 6 months and 99.1 cm/s at 12 months. In B group, mean stride length normalized (%high) was 62.6 pre-op and exactly 74.3 both at 6 and 12 months; speed rose from 81.5 cm/s to 97.9 cm/s at 6 months and 100 cm/s at 12 months. The patient's gait is significant improvement. We found a statistically significant increase of patients who were active in sports. The AOFAS score improved from 38.5 points preoperatively to 74 points postoperatively in group A, from 38.5 points preoperatively to 76 points postoperatively in group B. The AOFAS score also improved from 38.1 points to 80 points. This represents a higher value than preoperatively function, which indicates an improvement of their activity level.

The authors also tend to involuntarily select arthrodesis for patient, when negative criteria. Predominate, although evidence in the literature that total ankle arthroplasty is more affected by these criteria than arthrodesis does not exist [20]. Total ankle arthroplasty seems

to be reserved for patients with an assumed uneventful healing and superior outcome. This selection is likely because failure of total ankle arthroplasty is more difficult and complex to reoperate or to salvage than is failure of arthrodesis [1,21]. Once fusion is achieved, the risk of failure after arthrodesis is lower compared with total ankle arthroplasty [15,22]. Compared to arthrodesis, the primary advantages of total ankle replacements are maintenance of motion of the ankle and reduced risk of developing adjacent joint arthritis. Maintenance of motion, especially in patients with relatively stiff feet, has many potential advantages over fusion [16,23]. Weight bearing gait on flat surfaces has been shown to be well-maintained and undetectable to observation. The protection of adjacent joints remains a theoretical advantage of arthroplasty [19,24]. Data on time to adjacent joint arthritis are contradictory and the prevention of it by an arthroplasty, while reasonable in theory, has no evidence yet to support it. To maintain the longest function of ankle replacements, the mechanical conditions should allow smooth and continuous interaction between the gliding surfaces. Uncorrectable deformities preclude this from happening and should not be considered for ankle replacement. Similarly, patients with active lifestyle interests that involve rapid acceleration and deceleration forces on the articulating surfaces will likely prematurely wear their ankle replacement [17,18,25]. In our study, six patients in B group and three patients in A group showed radiological evidence of degeneration of the talonavicular joint and the subtalar joint. Adjacent joint degeneration of the subtalar and talonavicular joints after total ankle arthroplasty is higher compared to ankle arthrodesis. Maybe operative indication was inappropriate, in group B, two patients were no more than 45 years, ardently love athletic activity. Our study showed arthrodesis as well as total ankle arthroplasty have been recently reported as an effective therapy for end-stage ankle arthritis. In both groups there was a tendency towards engaging in low impact sports after surgery in comparison to the activity levels before the onset of symptoms.

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