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Ankle fusion after failed ankle replacement in rheumatic and non-rheumatic patients

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ABSTRACT

Background: With longer follow-up, survival rate of total ankle replacements (TAR) diminishes. It is therefore important to have a reliable fall-back option in case of failed TAR. Revision arthroplasty is often impossible because of loss of bonestock or infection. Conversion to ankle fusion is then indicated. We investigated the clinical, radiographic and patient reported results for fusion after failed TAR in a consecutive group of patients. We concentrated on the influence of inflammatory joint disease (IJD) on union rate.
Methods: Patient files and radiographic images of 46 consecutive patients (47 ankles) were reviewed. There were 22 patients with IJD. Fixation methods included; anterior plating, blade plate fixation, intramedullary nailing, compression screws and external fixation. Foot and Ankle Outcome Score (FAOS) and Foot and Ankle Ability Measure (FAAM) were used to determine patient related outcomes.
Results: Forty out of 47 ankles (85%) Fused. Union rate in the non-IJD group (96%) was significantly higher compared to the IJD-group (73%, p = 0.04). Revisions and complications were more frequent in the IJD group, but numbers were too small to detect a significant difference. Mean PROM scores were: FAOS-symptoms; 68.5, FAOS-pain; 70.3, FAOS-QoL; 43.7, FAOS-ADL; 68.1 and FAAM-ADL; 52.1, with no significant difference between IJD and non-IJD patients.
Conclusions: IJD-patients have a higher nonunion rate after ankle fusion for failed TAR. However, patient reported outcome is not significantly different between the two groups.
Level of evidence: IV, retrospective cohort.

1. Introduction

A recent systematic review shows a 10-year survival-rate of 89% for new generation mobile-bearing total ankle replacements (TAR) [1]. However, a register study with the longest follow-up so far reported a 10 year survival rate of 69% [2]. As survival is expected to decrease with longer follow-up, reliable salvage procedures are needed. According to the Dutch national joint replacement registry, 104 TARs have been performed in 2015, in contrast to 24.000 total knee and 30.000 total hip arthroplasties [3]. The relatively small number of TARs makes it difficult to establish large databases, suitable for significant comparisons.

In case of failure of the TAR, revision arthroplasty is often impossible due to severe loss of bonestock, soft tissue problems or infection. In these cases tibiotalar fusion is often performed. Image 1 shows an example of a patient with severe cystic boneloss around a TAR. Between 1982 and 2011, multiple authors have addressed this matter and reported union rates between 61% and 100% [4–14]. Various fixation methods were used, including compression screws, screw-plate constructs and tibiotalocalcaneal fusions with intramedullary nails. However, long term follow-up studies are not available. Destruction of the ankle joint may be caused by trauma, osteoarthritis and inflammatory joint diseases. (IJD) Rheumatoid arthritis, gouty arthritis, psoriatic arthritis, lupus arthritis are all inflammatory joint diseases, and rheumatoid arthritis is the most common. It is unknown if IJD affects union rate of ankle fusion for failed TAR. In studies on primary ankle arthrodesis and ankle fusion after failed TAR, several IJD populations were studied, but there are no studies comparing IJD and non-IJD patients [15–18].

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Image 1. Female with rheumatoid arthritis and Salto talaris total ankle replacement. Revision to arthrodesis because of bearing breakage and large cystic lesion.

The aim of this study was to determine the fusion rate of ankle fusion for failed TAR performed in our clinic. Possible differences in outcome between patients with and without IJD were assessed. Secondary aims were to evaluate ankle function and quality of life after medium to long-term follow-up.

2. Methods

Approval of the medical ethics committee was obtained on December 26, 2016. Our institutions database was searched for all patients in whom fusion for failed TAR had been performed between January 1995 and December 2015. No exclusion criteria were applied. In total, 46 patients (47 ankles) were included. Patients' files, operative records, and pre- and postoperative radiographs were reviewed to determine union, reoperation and complication rates. Local or systemic infection, delayed wound closure, nonunion and fixation material breakage within 6 months after surgery were registered as complications. There were 18 males (39%) and 28 females (61%). Mean age was 63 years (range 28–82). Mean follow-up duration was 6.6 years (range 1.3–20.5). Twenty-two patients (47%) had inflammatory joint disease (IJD) as primary diagnosis. The IJD group consisted of patients with rheumatoid arthritis (n = 21) and one patient with chronic synovitis of the ankle. Different designs of TAR had been used: Beuchel–Pappas (BP, n = 10); Cobalt Coated Implant (CCI, n = 29); Low Contact Stress (LCS, n = 4); Scandinavian Total Ankle Replacement (STAR, n = 1); Salto Talaris (n = 1); AES Biomet (n = 1) and Hintegra (n = 1). Grafting was performed in 43 out of 47 ankles. Different grafts were used: iliac spine (n = 20), autologous femoral head (n = 3), homologous femoral head (n = 3), spongious bone (n = 12), other locally harvested bone (n = 4) and artificial bone matrix (n = 1). The reasons for failure could be divided in two major groups; aseptic (n = 37) and septic loosening (n = 10) of the TAR. Subgroup analyses were performed for IJD and non-IJD patients and septic and non-septic patients. All surviving patients (n = 35), with 36 arthrodesis were sent a questionnaire to evaluate ankle function and quality of life.

2.1. Radiologic evaluation

All regular follow-up images, including sagittal and coronal images of the hindfoot and CT-scans (when performed), were evaluated. Radiological union was defined as "The presence of multiple bone trabeculae across the arthrodesis pane or total disappearance of the pseudo-joint" [5,11,19]. All radiology images were reviewed by one or two experienced foot and ankle surgeons and a musculoskeletal radiologist. A nonunion was diagnosed if cortical continuation or trabecular bridges across the pseudo joint were absent at six months after surgery.

2.2. Function and quality of life

Two patient reported outcome measures (PROMs) were utilized to evaluate ankle function and quality of life (QoL) at final follow up; The Foot and Ankle Outcome Score (FAOS) and The Foot and Ankle Ability Measure (FAAM).

The FAOS consists of five subscales: symptoms, pain, activities of daily living (ADL), sports and recreation, and QoL [20]. Each subscale consists of a number of items, rated on a five-point Likert scale. For each subscale the score ranges from 0 (worst) to 100 (best). The FAAM is a functional outcome measure which consists of a subscale for ADL and sports, likewise consisting of multiple items that are rated on a five-point Likert scale, again with each subscale ranging from 0 (worst) to 100 (best) [21]. The sports subscales of both questionnaires were not used, since we deemed these unsuitable for this population. Both questionnaires were validated in different populations, including IJD [21–26].

2.3. Surgical technique

All surgical procedures were performed by two surgeons with experience in the field of foot and ankle surgery. An anterior approach was chosen in 41 ankles, the remaining six ankles were approached laterally. Fixation methods were: Anterior plating (n = 22), blade plate fixation (n = 11), internal screws (n = 8), intramedullary nail (n = 5) and external fixation (n = 1). A bone graft was used in 43 ankles. Donor or artificial bone matrix was used in six ankles.

In case of infection, a staged procedure was performed, consisting of implant removal, debridement and insertion of a cement spacer loaded with antibiotics. Fusion was performed after three to six months of antibiotic treatment and in absence of fever, a normalized blood count (CRP <10) and at least two negative cultures. If needed, an additional imaging was performed to rule out persisting infection.

Postoperative treatment depended on fixation method, wound healing and bone quality and often consisted of non-weight bearing cast-immobilization for 6–12 weeks, depending on radiologic bone consolidation. Images 1 and 2 show two examples of patients who had ankle fusion for failed total ankle replacement.

If revision arthrodesis was needed, each case was reviewed individually to determine the most effective method, depending on the failure mechanism, previous fixation method, soft tissue status and bone stock. The failed fixation material was removed and

Image 2. Directly post-surgery, same patient as in Image 1.

debridement was performed until two vital bone surfaces were obtained. Often, there was significant bone loss and intramedullary nailing was the preferred fixation option. Image 2 shows an example of anterior plating directly post surgery.

2.4. Statistical analysis

For statistical analysis, SPSS version 24 (Armonk, NY: IBM Corp) was used. Normality of continuous data was checked by use of the Kolmogorov-Smirnov test. Data was described as means with addition of Standard Deviation (SD). Because of small sample sizes, univariate analysis was performed. Comparison between patients with and without IJD was performed using Student's T-test for continuous data. In case of ordinal data, Mann Whitney U-tests were used, and Chi-square tests (or Fisher's Exact tests when appropriate) in case of categorical data. Comparison of fusion rate between fixation methods was performed using Chi-square tests. A p-value <0.05 was considered statistically significant.

3. Results

3.1. Fusion rate, complications and revisions

Twenty-seven ankles fused after one attempt, 12 after two attempts and one ankle after three attempts. In total, 40 out of 47 ankles (85%) fused (Table 1). Of the seven ankles that did not fuse, two had a septic non-union. Six of these had IJD. Union rate was significantly higher in the non-IJD group (96%) compared to the IJD-group (73%, p = 0.04). Revision was performed seven times in the IJD-group (44%) and six times in the non-IJD group (25%). Complication and revision rate did not significantly differ between these groups (p = 0.15 and 0.31 respectively). Table 2 displays the fusion rate for each surgical method. An overview of the encountered surgical complications is displayed in Table 3. Ten patients had revision arthrodesis for septic failure of the TAR. Eight of these ultimately fused. Separate analysis of the septic group did not lead to any significant results. Table 4 provides additional info on failed cases.

Table 1
Fusion rates, complications and revision rates.

	Total (n = 47)	Non-IJD (n = 25)	IJD (n = 22)	P-value[c]
Fusion rate	40 (85%)	24 (96%)	16 (73%)	**0.04**
Complications[a]	22 (53%)	9 (36%)	13 (59%)	0.15
Revisions[b]	13 (33%)	6 (25%)	7 (44%)	0.31

[a] Nr of cases with one or more complications in follow-up.
[b] Nr of patients that needed redo-fusion before fusion was achieved in total (n = 40), non IJD (n = 24), IJD (n = 16) groups.
[c] A significant difference is present.

Table 2
Fusion rate and complication rate per fixation method.

	Fusion rate [a]
Intramedullary nail (n = 5)	2 (40%)
Blade plate fixation (n = 11)	10 (91%)
Anterior plating (n = 22)	20 (91%)
Internal screws (n = 8)	7 (88%)
External fixation (n = 1)	1 (100%)

[a] No significant differences between groups.

3.2. Quality of life & and ankle function

Twelve patients had deceased before final follow-up (all due to reasons not related to the surgery) and two did not return the questionnaire. Thirty-two out of thirty-four (94%) questionnaires were completed. Overall, subscores were moderate to good (Table 4). On the FAOS-symptoms and FAOS-QoL subscores the IJD subgroup scored higher than the non-IJD group, but numbers were too small to detect a significant difference. (p = 0.11 and 0.29 respectively) Lowest scores were reported in the FAOS-QoL subscore (43.7, SD 32.7).

4. Discussion

In this retrospective study, union rates, complication rates, QoL and ankle function were analysed in patients with and without IJD who had undergone ankle fusion because of failed TAR. Overall fusion rate was satisfactory at 85% and corresponds with the union rates reported in literature [4–14]. In our study, redo-arthrodesis was often needed to reach fusion. The two earliest studies reported a 100% fusion rate, but these numbers were never repeated [6,14].

In primary ankle fusion, union are not 100%. A review from 2008 on primary open ankle fusion reported a union rate of 91% in 195 patients [27]. A 90% fusion rate was found in a cohort with primary ankle fusions utilizing a transfibular approach in 130 IJD patients [28]. To our knowledge, there are no studies comparing IJD and non-IJD patients. The higher union rate in primary fusion is not surprising, as surgical conditions are obviously more favourable in these patients.

Table 3
Number of complications per fusion attempt.

	Attempt 1 (n = 47)	Attempt 2 (n = 17)	Attempt 3 (n = 1)
Non-union	20	5	1
Infection	3	1	
Material breakage	2		
Dehiscense	2		
Fistula	2	1	

Table 4
Questionnaire subscores.

	Total (mean, SD)
FAOS-sympt	68.5 (24.6)
FAOS-pain	70.3 (70.0)
FAOS-QoL	43.7 (32.7)
FAOS-ADL	68.1 (26.1)
FAAM-ADL	52.1 (26.6)

In our study, fusion rate in the IJD group (73%) was significantly lower compared to the non-IJD group (96%, p = 0.04). Since no other authors have compared IJD and non-IJD patients, this result cannot be placed in context of similar studies. However, three studies with a high percentage of IJD patients (83–88%) reported union rates of 61–69% [5,10,11]. With the results of our study it is not possible to determine why this fusion rate is lower, but perhaps a different bone metabolism or the use of medication might contribute to an altered bone healing process and implant ingrowth.

In case of septic failure, there are several factors that may affect union rate. These are the infection itself, loss of bone stock, the choice of fixation method, a girdlestone situation and antibiotic treatment.

In our institution, the subtalar joint was preserved if possible, to preserve hindfoot mobility. Although evidence is limited, there is no indication that union rate in tibiotalar fusion is different from the union rate in tibiotalocalcaneal fusion [29]. Therefore, we believe that whenever possible, an isolated tibiotalar fusion should be performed. Because of its retrospective nature and small sample size, the current study is not suitable to compare different fixation methods. The preferred fixation method was dictated by the mode of failure. For example, an intramedullary nail was used in cases with extensive damage to the talus bone, making these patients already susceptible to non-union. Additionally, fixation methods were variable among IJD and non-IJD patients, due to the availability of new fixation methods over time. Therefore, no statistical comparison was made between fixation methods. Comparative data on fixation methods is limited, although multiple non-comparative studies have been conducted. Anterior plating has satisfactory results and leads to higher union rates compared to internal screw fixation [30–33]. Additionally, the use of a double plating system results in a stiffer construct compared to a single plate and may lead to higher union rates [34]. However, in the design of double plating more often thinner screws are used which are more likely to break. Double plating is more bulky, potentially causing wound healing problems. In our series no difference could be found between double and single plating. Ten out of eleven (91%) ankles with blade plate fixation fused (two after revision surgery). Blade plate fixation has previously been found to be a reliable way to obtain fusion [5,35,36]. However it is now considered old fashioned as “better” materials/systems are available. Intramedullary nailing was used as a last resort in cases with a failed fusion attempt and substantial bone loss in our clinic. Two out of five ankles (40%) fused. In 2014 Deleu et al. performed a study on tibiotalocalcaneal fusion after failed TAR using intramedullary nails, with a 13 out of 17 ankles fusing after one attempt. A literature review by the same authors reports varying but overall good results in arthrodesis after failed TAR [37]. However, a more recent study reported a failure rate of 17% with compression nails, compared to 43% with non-compression nails [38]. In our series, various types of nails were used.

One might raise the suggestion that in IJD, a more rigid fixation is needed. However, this cannot be concluded from our data. Nonetheless, non-union is more frequent in IJD. We believe that poor bone quality due to a different biology could play a role.

The FAOS-QoL score was low compared to the other subscores with a mean score of 43.7. However, a study on primary ankle fusion reported a mean score of 43.2. The other FAOS subscores were also comparable, except for the FAOS-pain, where the score of 70.3 in our study was higher than the 47.9 found by Braito et al. [39].

Our results suggest that QoL after fusion for failed TAR is not optimal and may be lower than after primary fusion. Comparing our results with other studies is difficult, because most other authors have used different outcome measures. We found a mean FAAM-ADL score of 51, comparing unfavourably with scores of 69 and 72 reported after primary ankle fusion [40,41]. The FAOS-ADL score of 68 reported by us is similar to the score of 70 presented by Braito et al. [39]. An increase in FAOS-ADL score from 50 to 83 after TAR was reported by a recent retrospective study [42].

These findings show loss of ankle functionality in case of fusion for failed TAR and underline the importance of limiting the number of failures in TAR. As discussed earlier, failure rates of TAR have declined with newer implants, but there is a lack of long-term follow-up studies.

Several studies have shown that IJD does not negatively influence implant survival [2,43–45]. It has to be taken into account that IJD patients generally suffer from multi-joint disease, which makes it difficult to complete PROMs for just one joint. Charnley developed a scale to stratify patients with multi-joint involvement [46].

As a consideration, IJD patients may experience joint pain differently as opposed to patients with post-traumatic or secondary joint disease, who are not used to having joint complaints. IJD patients may even think of pain as a less important aspect of their disease and may experience function and pain as separate entities [47]. We believe that this may also affect IJD patient’s valuations of PROM items.

Several limitations to this study have to be taken into account. Due to its retrospective nature, no PROMs were scored at baseline. Also, we were forced to analyse patients in multiple subgroups for each method of fusion. Many authors in the field have used different outcome measures, such as clinician observational scores or purely clinical outcomes like union rate and infection rates. Although the American Orthopedic Foot and Ankle Score (AOFAS) is the most commonly used outcome measure in TAR its relevance, validity, reliability, responsiveness and applicability are only supported by limited evidence [48]. PROMs are being used more and more commonly and we believe that PROMs are more suitable to monitor patient functioning because they eliminate bias caused by the observing clinician. Two different PROMs were used to increase comparability.

When counselling patients for TAR the possibility of failure of the TAR should be discussed. Especially in patients with IJD the potential failure of revision surgery should be mentioned because of the higher non-union rate.

5. Conclusion

We present our results on ankle fusion for failed TAR in the largest cohort to date. Overall, a union rate of 57% was obtained, which increased to 85% after revision arthrodesis. IJD-patients had a significantly higher chance of nonunion compared to non-IJD patients. We were unable to detect a significant difference in patient reported outcomes between the two groups.

Conflict of interest

None of the authors has any financial or intellectual conflict of interest to declare.

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