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Outcome After Salvage Arthrodesis for Failed Total Ankle Replacement

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Abstract

Background: In cases with total ankle replacement (TAR) failure, a decision between revision TAR and salvage arthrodesis (SA) must be made. In a previous study, we analyzed revision TAR and found low functional outcome and satisfaction. The aims of the current study were to analyze SA concerning failure rate and patient-related outcome measures (PROMs).

Methods: Until September 2014, a total of 1110 primary TARs were recorded in the Swedish Ankle Registry. Of the 188 failures, 118 were revised with SA (and 70 with revision TAR). Patient- and implant-specific data for SA cases were analyzed as well as arthrodesis techniques. Failure of SA was defined as repeat arthrodesis or amputation. Generic and region-specific PROMs of 68 patients alive with a solid unilateral SA performed more than 1 year before were analyzed.

Results: The first-attempt solid arthrodesis rate of SA was 90%. Overall, 25 of 53 (47%) patients were very satisfied or satisfied. Mean Self-reported Foot and Ankle Score (SEFAS) was 22 (95% confidence interval 20-24), Euro Qol–5 Dimensions 0.57 (0.49-0.65), Euro Qol–Visual Analogue Scale 59 (53-64), Short Form-36 physical 34 (31-37) and mental 50 (46-54). The scores and satisfaction were similar to those after revision TAR but the reoperation rate was significantly lower in SA ($P < .05$).

Conclusion: Salvage arthrodesis after failed TAR had a solid arthrodesis rate of 90% at first attempt, but similar to revision TAR, less than 50% of the patients were satisfied and the functional scores were low. Until studies show true benefit of revision TAR over SA, we favor SA for failed TAR.

Level of Evidence: Level IV, retrospective case series.

Keywords: salvage arthrodesis, revision TAR, failed total ankle replacement, failure rate, satisfaction, outcome, PROM, ankle arthritis

Introduction

Total ankle replacement (TAR) plays an important role in the operative treatment of ankle arthritis and has become an alternative to arthrodesis. However, the increasing popularity of TAR has also lead to increasing numbers of revision procedures, and the failure rate of TAR has been reported higher than those of hip and knee replacements.[6,14] Salvage arthrodesis (SA) is the generally accepted surgical treatment for failed TAR,[2-5,7,10] but revision TAR has gained popularity especially as some studies have found similar implant survival as for primary TAR.[9,12] We previously analyzed survival and outcome of revision TAR in the Swedish Ankle Registry[11] and found a 10-year implant survival of 55% and low outcome scores, and only half of the patients were satisfied with their revision TAR.

The aims of the present study were to analyze results of salvage arthrodesis after failed primary TAR, performed in Sweden from January 1993 until September 2014, and specifically describe (1) failure rate, (2) methods of treatment for failure, and (3) patient-reported outcome measures (PROMs).

Methods

The Swedish Ankle Registry (www.swedankle.se) is a National Quality Registry[6] of all primary TARs and reoperations performed in Sweden since 1993 with patient-specific data such as age, sex, diagnosis, operative technique, and type of implant and since 2008 also PROMs including grade of satisfaction, health-related quality of life (Euro Qol–5 Dimensions [EQ-5D], Short Form–36 Questions [SF-36]), and a foot and ankle–specific score (Self-reported Foot and Ankle Score [SEFAS]).

Until September 2014, a total of 1110 primary TARs were recorded in 1026 patients (617 women). A total of 188 failures

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were registered, whereof 118 salvage arthrodeses were performed in 114 patients (71 women). The 70 patients (44 women) who underwent revision TAR with component exchange have been presented previously.[11] These 114 patients were at mean 55 (range, 21-83) years old at the time of primary TAR surgery and 61 (range, 27-90) at the time of SA. Rheumatoid arthritis was the primary diagnosis in 47 (40%) of the 118 cases, posttraumatic arthritis in 40 (34%), osteoarthritis in 26 (22%), and other diagnoses in 5 (4%). In 68 (58%) of the 118 cases, aseptic loosening was the cause of failure of the TAR; in 14 (12%) infection; and in 36 (30%) pain, technical failure, malalignment, or instability. Twelve patients had died before September 2014, all without any further ankle revisions recorded.

We evaluated the cases with SA concerning mean age at the time of primary and revision surgery, diagnosis, type of primary prosthesis, cause of failure of the TAR, and arthrodesis technique. We identified if additional operative procedures had been reported to the registry. SA was defined as a solid arthrodesis if no further major revision (repeat arthrodesis or amputation) was registered during the study period.

We asked all patients who had undergone a solid first attempt SA with a minimum follow-up time of 12 months to reply to the following PROMs: the validated SEFAS, the EQ-5D scale, the Euro Qol–Visual Analogue Scale (EQ-VAS) for health, the Short Form–36 Questions (SF-36) scale, and a separate question regarding satisfaction. SEFAS provides values between 0 and 48, where a value of 48 represents normal foot and ankle function.[1] EQ-5D index provides values between −0.594 and 1 (full health). EQ-VAS ranks the self-estimated health on a visual analog scale from 0 to 100, with full health at 100. The generic SF-36 score assesses health-related quality of life by values between 0 and 100, interpreting 100 as full health. The patients were also specifically asked if they were very satisfied, satisfied, neither satisfied nor dissatisfied, dissatisfied, or very dissatisfied with the revised ankle.[15] The 4 patients who underwent bilateral SA were excluded from the PROM evaluation. Of the 80 patients alive and with solid unilateral SA, 68 (85%) answered the PROMs at median 2 (range, 1-17) years after their salvage arthrodesis. Not all of the 68 patients responded to all questions in all questionnaires. In cases of incomplete questionnaires in the SEFAS, we used the following approach[1]: (1) questionnaires were disregarded with missing answers to 2 or more questions; (2) in cases with 1 missing question, the mean result of the remaining 11 questions was used; (3) in cases with double answers for 1 question, the worse outcome was recorded; and (4) the worse outcome was recorded in cases when the patients set their mark between 2 answers.

Statistics

Data are reported as numbers and proportions (%), medians or means with standard deviations, ranges or 95% confidence intervals. For statistical analysis of group differences, independent *t* tests were performed to compare means and chi-square tests for categorical variables. Changes within groups were tested by Wilcoxon rank-sum tests because of the small numbers in each group. To estimate the success rate of SA, a Kaplan-Meier analysis with repeat arthrodesis or amputation as endpoints was utilized. All statistical analyses were performed with Statistical Package of Social Sciences (SPSS), version 22.

Table 1. Type of Prosthesis and Mean Time From Primary TAR to Salvage Arthrodesis (SA).

Type of Prosthesis	n (%)	Mean Time to SA in Months
STAR	72 (61)	79
AES	14 (12)	44
Mobility	13 (11)	35
BP	10 (8)	42
CCI	6 (5)	27
Hintegra	3 (3)	47
Total	118	63

Ethics

The study has been approved by the Relevant Ethical Review Board and was performed according to the declaration of Helsinki.

Results

The most common type of primary TAR converted into arthrodesis was the STAR as shown in Table 1. Retrograde nailing was the most frequently used technique for SA (58/118, 49%), followed by plate fixation (15/118, 13%), metal spacer with plate or nail fixation (9/118, 8%), external fixation (7/118, 6%), and screw fixation (6/118, 5%). In 23 (19%) cases, the arthrodesis technique was not recorded.

Twelve (10%) of the 118 salvage arthrodeses did not unite at first attempt, resulting in 2 amputations and 10 repeat arthrodeses (Figure 1). Of the 10 repeat arthrodeses, 7 united whereas 3 did not. One of the latter cases led to amputation and 2 to repeat arthrodesis. The Kaplan-Meier analysis estimated 91% of the patients without further major revisions after 5 years and 83% after 10 years (Figure 2).

Failure of SA was recorded in 2 (8%) of the 26 cases with osteoarthritis, in 6 (13%) of the 47 with rheumatoid arthritis, and in 4 (10%) of the 40 with posttraumatic arthritis. Concerning arthrodesis technique, 6 (10%) of the 58 retrograde nailing SA cases failed, 1 of the 15 plate fixations, 3 of the 7 external fixations, 1 of the 9 with metal spacer, and 1 of the 23 without registered technique. Because of small subgroup sizes, statistical testing was not reasonable. Figure 3 shows reoperations registered for the failed ankles. Once SA was solid, no further reoperations could be found in the registry.

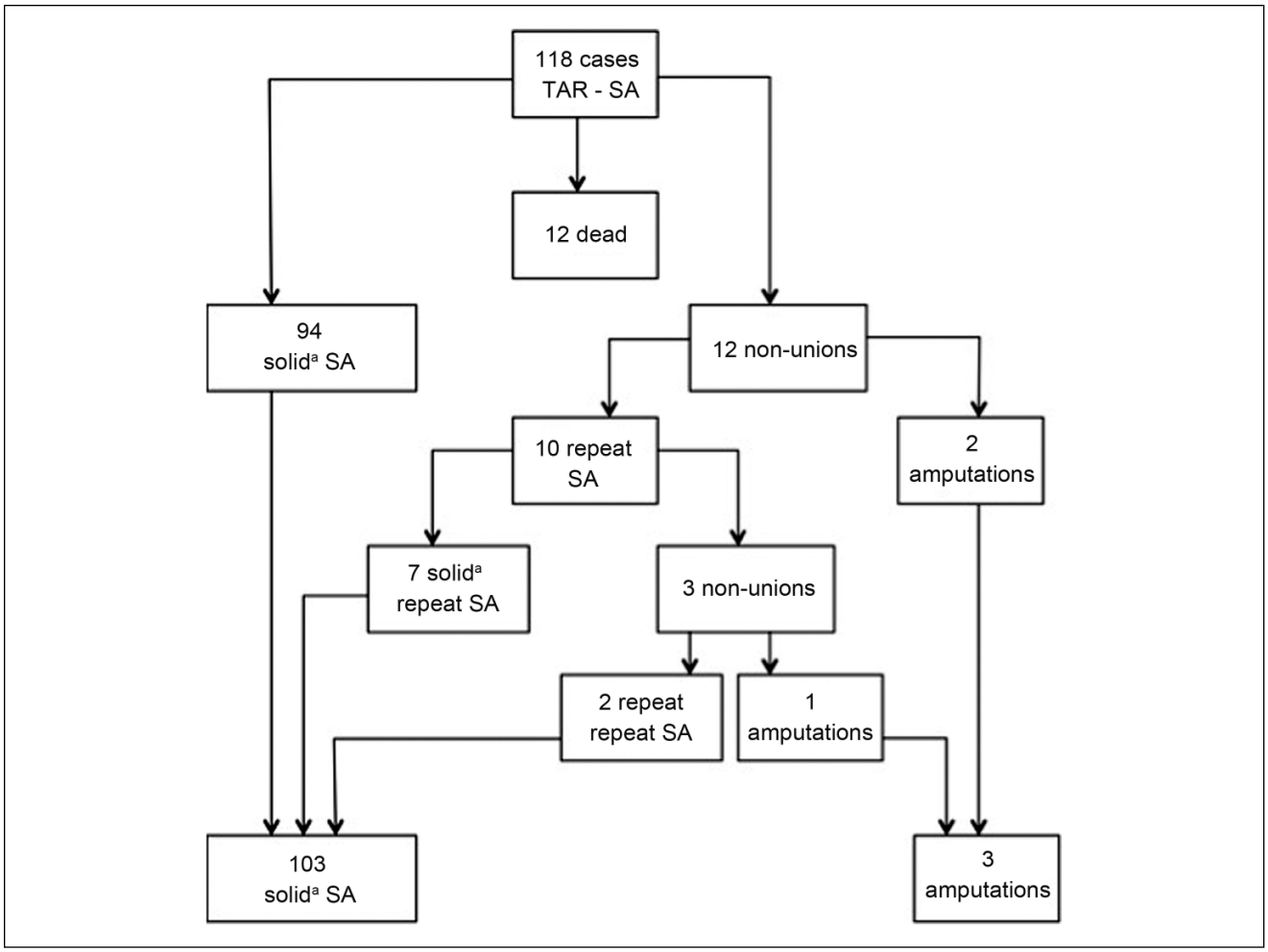

Figure 1. Flowchart cases with salvage arthrodesis (SA) after failed primary total ankle replacement (TAR).
[a]Solid: no further major revision (repeat arthrodesis or amputation) recorded.

The PROMs of 68 patients are shown in Table 2 (A). For comparison, the results of revision TAR are shown in Table 2 (B). Twenty-five (47%) of 53 patients were very satisfied or satisfied with their salvage arthrodesis, 15 (28%) neither satisfied nor dissatisfied, and 13 (25%) dissatisfied or very dissatisfied. Both pre- and postrevision scores were recorded only in 10 patients and are shown in Table 3 (A). For comparison, Table 3 (B) contains the results of pre- and postoperative scores of 7 revision TAR patients. We found no obvious association between SA technique and functional outcome or satisfaction.

Discussion

In this study, salvage arthrodesis for failed primary TAR had a first attempt solid arthrodesis rate of 90%. However, subjective outcomes showed that only half of the patients were satisfied with their ankle, and 3 patients of 114 (3%) underwent below knee amputation as a consequence of a failed salvage procedure.

The presented rate of solid salvage arthrodesis is comparable to those seen in the literature. Gross et al found in a recently published systematic review of SA an overall first attempt union rate of SA of 84%. Results depended on the arthrodesis technique with the highest union rates after blade plate use. Furthermore, isolated tibiotalar arthrodesis resulted in a higher union rate than tibiotalocalcaneal arthrodesis.[5] Deleu et al reported a first attempt success rate in 13 of 17 SA.[3] Doets and Zuercher found nonunion in 7 of 18 ankles, all failed cases performed with other techniques than blade plates.[4] In the study of Culpan et al, 15 of 16 patients united at first attempt and the authors assumed potentially higher nonunion rates of SA in patients with rheumatoid arthritis.[2] The same conclusion was reported by Hopgood et al.[10] We did not distinguish between different SA procedures in this study (tibio-talar arthrodesis vs tibio-talo-calcaneal [TTC] arthrodesis). This may however be interesting, as TTC arthrodesis includes an additional joint in addition to the originally failed one. In secondary

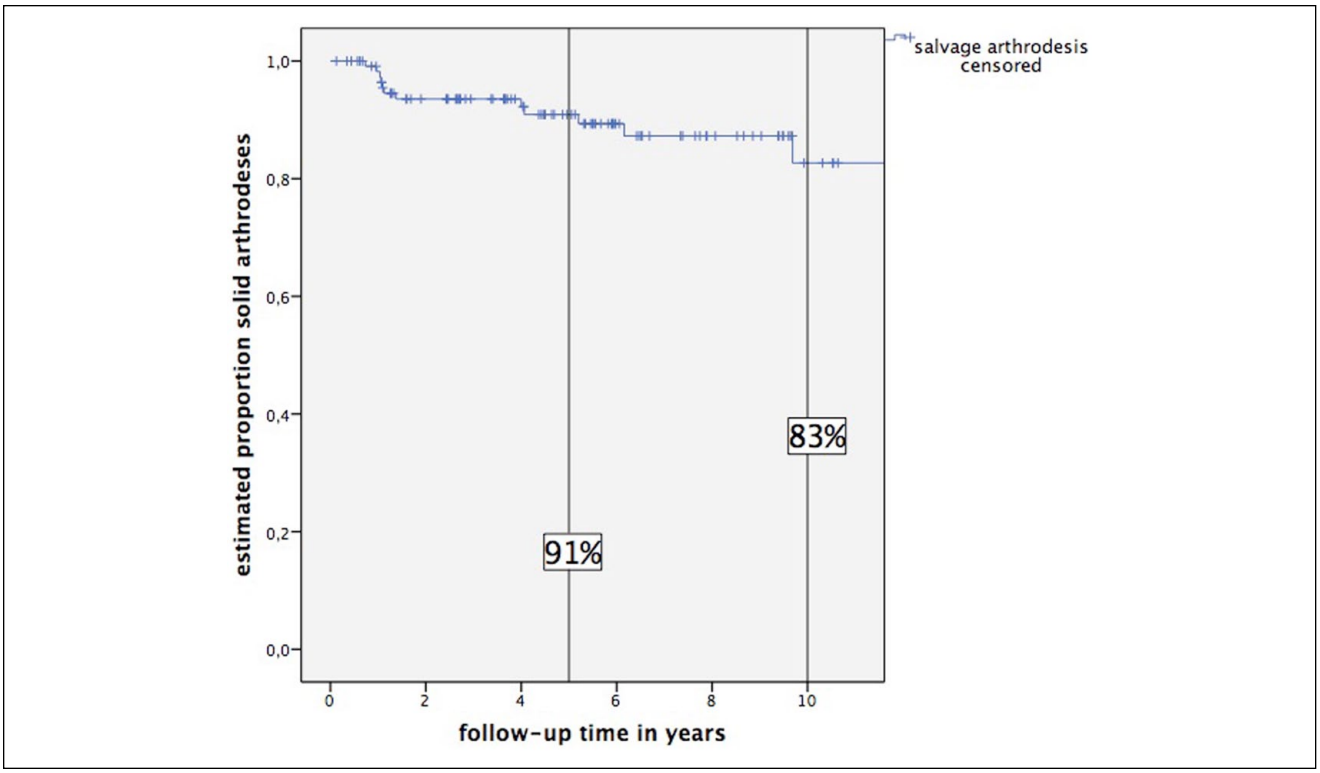

Figure 2. Kaplan-Meier analysis of salvage arthrodesis.

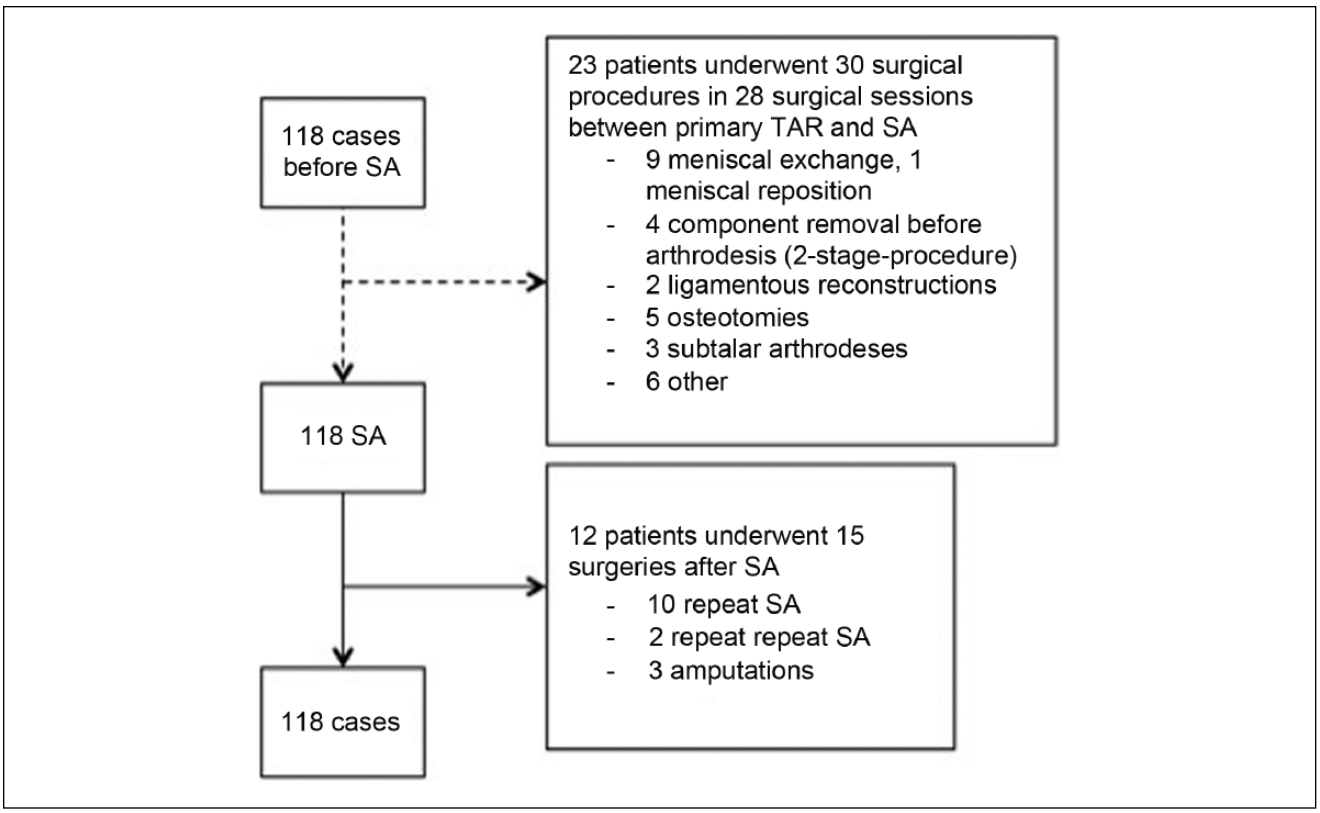

Figure 3. Flowchart reoperations.

Table 2. Mean Functional Scores of Patients With (A) Salvage Arthrodesis and (B) Revision TAR (From Kamrad et al[11]).

A. Mean Functional Scores of Patients With SA			B. Mean Scores of Patients With Revision TAR (From Kamrad et al[11])
	SA		Revision TAR
PROM	n	Mean (95% CI)	Mean (95% CI) (n = 29)
SEFAS	68	22 (20-24)	22 (19-26)
EQ-5D index	66	0.57 (0.49-0.65)	0.6 (0.5-0.7)
EQ-VAS	64	59 (53-64)	64 (58-74)
SF-36 physical function	64	40 (34-46)	52 (43-61)
SF-36 bodily pain	62	48 (41-54)	50 (40-61)
SF-36 physical	60	34 (31-37)	37 (33-41)
SF-36 mental	60	50 (46-54)	49 (43-55)

Abbreviations: CI, confidence interval; EQ-5D, Euro Qol–5 Dimensions; EQ-VAS, Euro Qol–Visual Analogue Scale; PROM, patient-related outcome measure; SA, salvage arthrodesis; SEFAS, Self-reported Foot & Ankle Score; SF, Short Form–36 Questions.

Table 3. Pre- and Postoperative PROMs in (A) Salvage Arthrodesis[a] and (B) Revision TAR (From Kamrad et al[11])[a,c].

	Salvage Arthrodesis[a,b]		Revision TAR (From Kamrad et al[11])[a,c]	
PROM	Pre (n = 10)	Post (n = 10)	Pre (n = 7)	Post (n = 7)
SEFAS	13	17 (*P* = .3)	19	22 (*P* = .2)
EQ-5D	0.4	0.5 (*P* = .6)	0.5	0.6 (*P* = .4)
EQ-VAS	43	52 (*P* = .2)	51	56 (*P* = .6)
SF-36 physical function	35	32 (*P* = .4)	46	48 (*P* = .9)
SF-36 bodily pain	33	37 (*P* = 1.0)	34	**47 (*P* = .04)**
SF-36 physical	33	29 (*P* = .4)	31	35 (*P* = .2)
SF-36 mental	45	47 (*P* = .7)	48	49 (*P* = .8)

Abbreviations: EQ-5D, Euro Qol–5 Dimensions; EQ-VAS, Euro Qol–Visual Analogue Scale; PROM, patient-related outcome measure; SA, salvage arthrodesis; SEFAS, Self-reported Foot & Ankle Score; SF, Short Form–36 Questions.
[a]*P* for differences pre to post was based on the Wilcoxon rank-sum test. Boldface indicates significance.
[b]Mean age of the 10 patients preoperation 51 and postoperation 59; mean time to revision was 98 months.
[c]Mean age of the 7 patients preoperation 48 and postoperation 52, posttraumatic arthritis in 5 of 7 cases.

analyses (data not shown), we did not find any association between arthrodesis technique and outcome (SEFAS or satisfaction). This was, however, not a primary outcome of our study, and future studies aimed at this question may provide further information regarding this matter.

In cases with nonunion of SA, repeat arthrodesis is most often utilized but in isolated cases below knee amputation may have to be considered. In our study, 3 of the 12 failed SA cases resulted in amputation. Other studies seldom reported amputations as a final consequence of failed TAR, though it is often mentioned as a possible treatment, especially in severe cases with large bone loss or infection.[5,10,13,17]

The evaluation of PROMs in our study showed that all post-SA scores including satisfaction were comparatively low. The SF-36 physical function subscale mean score of 40 points was in our study as low as in a recently published study of Rahm et al.[16] A systematic review of SA has found significant increase of the scores from pre- to postoperation.[5] We could identify only 10 patients with both pre- and postoperative scores and were unable to find any significant changes, possibly because of a type II error (Table 3, A).

The strengths of the current study include a large data set regarding SA after failed primary TAR. The unselected, nationwide patient cohort includes all or almost all cases, and the results reflect the everyday practice with the inclusion of different hospitals and different surgeons. The evaluation of validated PROMs allows comparison with other alternative operative procedures such as revision TAR and with other studies.

Weaknesses of the study include the risk of incomplete reporting to the registry. Yet, we are confident that the reporting to the Swedish Ankle Registry is complete or almost complete concerning TAR registration and secondary revision procedures.[8] Unfortunately, additional nonankle procedures such as subtalar or midfoot arthrodesis after

Table 4. Basic Differences Between Salvage Arthrodesis Patients and Revision TAR Patients.

	SA (n = 118)	Revision TAR (n = 69)	*P*
Mean (SD) age in years at time of primary TAR	55 (12)	53 (12)	.2
Mean (SD) age in years at time of revision	61 (13)	55 (11)	<.005
Diagnosis (%)			.03
Osteoarthritis (total primary TAR 24%)	22	20	
Rheumatoid arthritis (total primary TAR 34%)	40	23	
Posttraumatic arthritis (total primary TAR 35%)	34	55	
Other (total primary TAR 7%)	4	2	
Cause of failure (%)			.04
Aseptic loosening	58	54	
Infection	12	3	
Other	30	43	

Abbreviations: SA, salvage arthrodesis; SD, standard deviation; TAR, total ankle replacement.

SA were not recorded, as these procedures are not considered true revisions of the primary TAR. Some other studies do include these procedures as they may sometimes be seen as consequences of the former ones. Despite the possibility to record arthrodesis technique, this information was lacking in some cases. It would have been interesting to see if the operation technique influenced the failure rate, patient satisfaction, and PROM outcome, as described in other studies, but even in our complete nationwide data set, this was not possible. Another weakness is that failed cases were only captured through recorded revisions. Hence, cases with clinically asymptomatic nonunion were not included in our failure rate. Anyhow, our failure rate of 10% is similar to that of other studies, and nonunion without any further revision is rare.[5] A further limitation is the absence of preoperative PROM data in all cases, as this would have given more strength in the evaluation of scores, both concerning patient selection, improvement by surgery, and potential differences between salvage arthrodesis and revision TAR (Table 3, A and B). Many of the subgroups contained only small numbers, limiting statistical testing and inferences. Patients undergoing SA were diverse, and the registry did not provide enough background information to enable adjustment. This should be considered when setting up new registries but also in current registries not collecting these data. Finally, comparison of the outcome of SA with primary arthrodesis (PA) would have given valuable additional information on potential differences between primary and secondary procedures. Rahm et al found inferior clinical outcome of 23 patients with SA compared to PA in 23 matched-pair patients. After a follow-up time of 38 (SA) and 56 (PA) months, respectively, patients with SA had significantly more pain and worse function compared to PA.[16] Further comparative studies will have to be done to potentially confirm these results.

When a TAR fails, the situation requires a decision between revision TAR and salvage arthrodesis, but there is no generally accepted algorithm on how to choose. Literature supports salvage arthrodesis as a valid method for failed TAR with high union rate and few complications, though the results can depend on both primary diagnosis and fusion technique.[2-5,7,10,13]

Our data covers all or almost all cases with salvage arthrodesis after failed primary TAR in Sweden. By contrasting these results with those from the alternate procedure, component exchange, from the same registry[11] we have some opportunity to compare the 2 procedures. It should be clearly stated that the comparison must be interpreted with caution because of differences in patient selection. Patients in the SA group were older both at the time of primary and secondary surgery whereas the median follow-up time was 2 years in the SA group compared to 8 years in the revision TAR group, leading to similar ages in both groups at the time for evaluation. Table 4 illustrates differences in background factors, which may reflect some aspects of the patient selection. In our data, we found revision TAR in younger patients ($P < .005$) with posttraumatic arthritis ($P = .03$), in cases due to unspecified reasons for failure ($P = .04$) and after a time well below the expected survival of primary TARs. On the contrary, SA was found in cases with well-defined causes of failure after a significantly longer period after the primary TAR. Yet, obvious factors affecting case selection including bone quality and comorbidities, which may potentially influence the choice of treatment, were not recorded in the registry.

In both SA and revision TAR patients, the satisfaction rate was similar in that about half of the patients were satisfied or very satisfied with their ankle at the time of evaluation. Mean functional scores, both generic and specific, were mostly similar (Table 2, A and B) (*P* values for group differences ranging from .1 to .9). The only exception was the SF-36 physical function subscale with statistically significant better follow-up results in revision TAR patients ($P = .02$).

First-attempt solid arthrodesis rate of SA was 90%. After the 118 first-attempt SA, 15 additional operative procedures were performed in 12 patients. All interventions were major revisions such as repeat arthrodeses or amputations. An interesting observation was that repeat arthrodesis was performed up to 8 years after the first-attempt SA. Our previously published follow-up study of revision TARs showed a 10-year survival of revision TAR of 55%.[11] A total of 47 additional surgical procedures were registered in 28 patients after first-attempt revision TAR, of which 34 were major revisions such as repeat component exchange, arthrodesis, or repeat arthrodesis. Compared to these results, SA was in the current study associated with a statistically significant lower reoperation rate than revision TAR ($P < .05$).

In summary, based on our results, we see an advantage of salvage arthrodesis over revision TAR when primary TAR fails. Despite assumed nonsimilar patient selection, functional outcome and satisfaction were similar in both groups but the reoperation rate was significantly lower in the SA group. Until studies show true benefit of revision TAR over SA, we favor SA for failed TAR. More studies are however necessary to establish appropriate general clinical guidelines.

Supplemental Material

Supplemental material for this article is available on the *Foot & Ankle International* website at http://fai.sagepub.com/supplemental.

Declaration of Conflicting Interests

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