Revision Total Ankle Replacement: Success & Survivorship

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Statement of Purpose

The purpose of this study was to evaluate the success, implant survivorship, and complications associated with revision total ankle replacement (TAR).

Methodology

Institutional review board approval was obtained for this study. A retrospective review was conducted on consecutive patients who underwent revision TAR with the same surgeon between 2005-2016. Patients were included if they had a failed TAR and subsequently underwent revision of either tibial, talar or both metal components[1] and had a minimum two-year follow-up[2].

Medical records and radiographs were independently reviewed by an investigator not directly involved in patient care (FCG). The demographic data collected included patient age at primary TAR, age at revision, gender, BMI, and medical comorbidities. Clinical documentation, operative reports, and radiographs were reviewed to determine the indication for primary TAR, original prosthesis, mode of failure, post-operative complications, revision components and adjunct procedures.

Success of the revision was defined by no clinical/radiographic deformity and no need for bracing. Subjective scores for pain and activity were not measured.

Procedures

The primary surgeon determined the mode of revision, components, and necessary bone or soft tissue procedures to balance the ankle. The cement and rebar technique as previously described by Schuberth[3] was used in certain cases of significant talar subsidence or bone loss. Figures 1-3 depict a revision example for massive bone loss.

Figures 1 A & B - Preoperative ankle radiographs

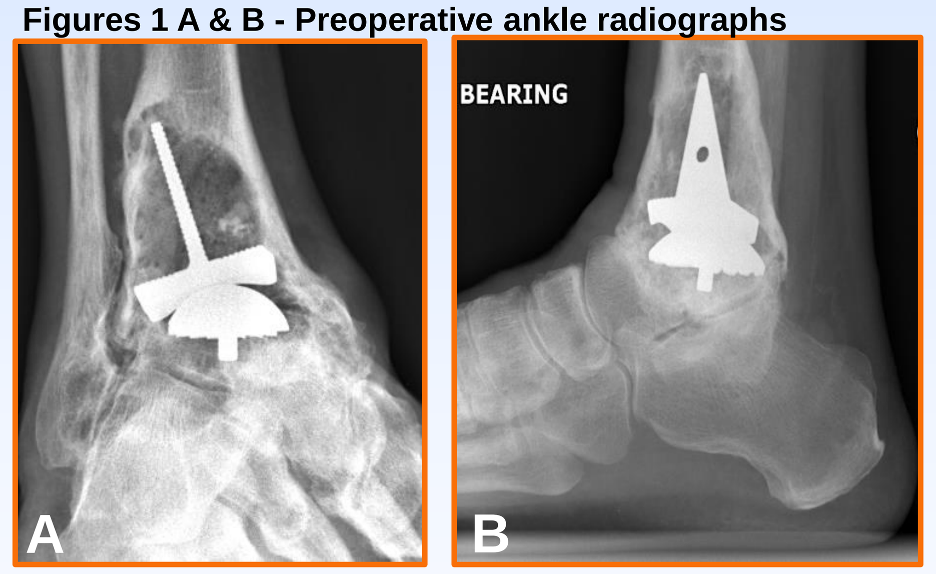
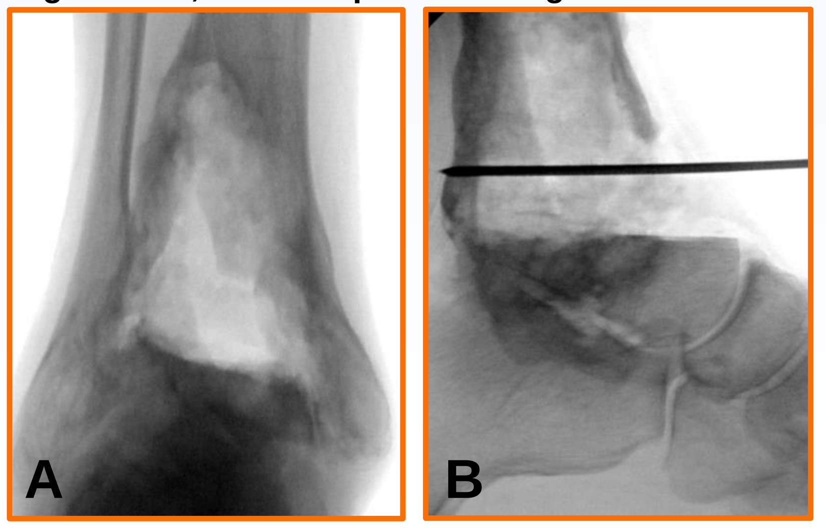
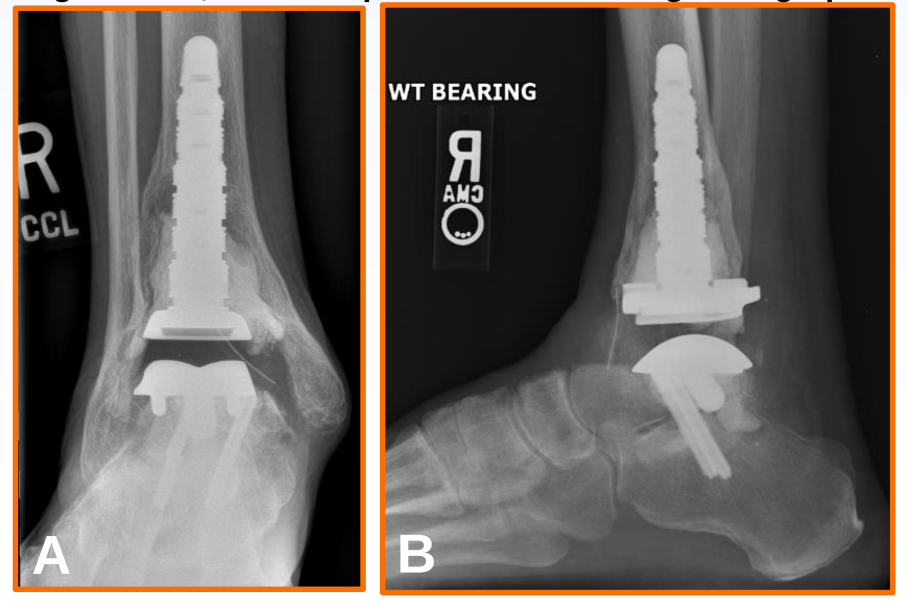


Figure 1 C – Preoperative CT

Figures 2 A,B – Intraoperative images



Figures 3 A,B – Postoperative loadbearing radiographs



Literature Review

Over the past 10-15 years TAR has become increasingly common for management of end-stage ankle arthritis. Implant design evolution has produced 80-95% survivorship at 8-12 years with high patient satisfaction scores[4] compared to failure rates of greater than 50% in the 1970's. In spite of improved survivorship, premature failure often necessitates revision.

Literature on revision TAR is limited and indications are not well established.

Glazebrook[5] performed a systematic review analyzing 20 studies including 2400 ankle replacements. Types and rates of complications in TAR were identified. The most common complication was subsidence (11%), followed by aseptic loosening (9%). The likelihood of each complication leading to a failure of the prosthesis was also evaluated. Low grade complications such as intra-operative fracture and wound healing problems were unlikely to cause failure. Technical error, subsidence, and post-operative fractures were medium grade, leading to failure less than 50% of the time. High grade complications such as deep infection, aseptic loosening and component failure lead to failure greater than 50% of the time.

Sadoghi[6] performed a complications-based analysis of total ankle, total hip, and total knee arthroplasties using worldwide arthroplasty registries. Aseptic loosening was the primary cause leading to revision in all prostheses.

Cody[7] analyzed independent risk factors for TAR failure with minimum 5 year follow-up. They found a 6.4% revision rate and independent risk factors for failure were the Inbone I prosthesis and ipsilateral hindfoot fusion. Age, BMI, and pre-operative deformity were not associated with increased failure rates.

Hintermann's study[8] evaluated 117 patients with a failed TAR at a mean of 4 years, all of whom underwent revision. Fifteen percent of the revisions failed: 11 secondary revisions were performed secondary to aseptic loosening (81% success) and 6 failures led to fusions in the setting of coronal plane instability, deep infection and continued pain. The authors found significant improvements in AOFAS hindfoot scores and an 83% survival rate at 9 years.

Table 1. Demographics

DEMOGRAPHIC INFORMATION
GENDER Male – 49 Female – 44
OPERATIVE SIDE Right – 49 Left – 44
COMORBIDITIES Diabetes – 8 CMT – 1 CP – 1 Polio – 2 Rheumatologic – 11
AVERAGE AGE (years) Primary TAR – 56.5 Revision TAR – 61.6
BMI AT REVISION (kg/m^2) 29.65
INDICATION FOR PRIMARY TAR Post-traumatic – 34 (37%) Primary – 25 (27%) Secondary – 11 (12%) Unknown – 23 (24%)

Table 2. Primary implant and longevity

ORIGINAL IMPLANT	NUMBER	LONGEVITY (avg years)
AGILITY	45	6.48
STAR	18	4.18
INBONE	15	4.55
SALTO	12	4.06
INFINITY	1	1.75
NEWTON	1	36
BUECHEL-PAPPAS	1	11

Results

A total of 114 consecutive patients underwent revision TAR from 2005-2016; 93 met inclusion criteria. Demographic data is reported in Table 1. The original prosthesis and average longevity is summarized in Table 2. The predominant indications for revision included osteolysis, aseptic loosening, subsidence, malposition, infection, and avascular necrosis (Table 3). Seventeen patients had multiple indications for revision. The revision prosthesis is listed in Table 4. Of note, 63% of patients had their components exchanged with a different system. Twenty-eight patients (30%) were revised with metal reinforced cement augmentation technique and 51 patients underwent additional procedures during their revision (Table 5).

Figure 4 illustrates the revision implant success and failures. Seventy-three patients (79%) had no major complication with their revision. The average survivorship was approximately 4 years (range 2-13.25 years). The metal reinforced cement augmentation technique met with an 86% success rate. There were 20 failures (21%). Four revision failures went on to fusion and two have braceable deformities, all 6 of which were secondary to frontal plane instability. One patient failed due to talar subsidence and expired prior to a second revision. Thirteen patients underwent a second revision in the setting of subsidence, osteolysis or aseptic loosening (Table 6). There was a 69% success rate of the secondary revision at approximately 3.8 years.

Figure 4. Revision implant success and failures

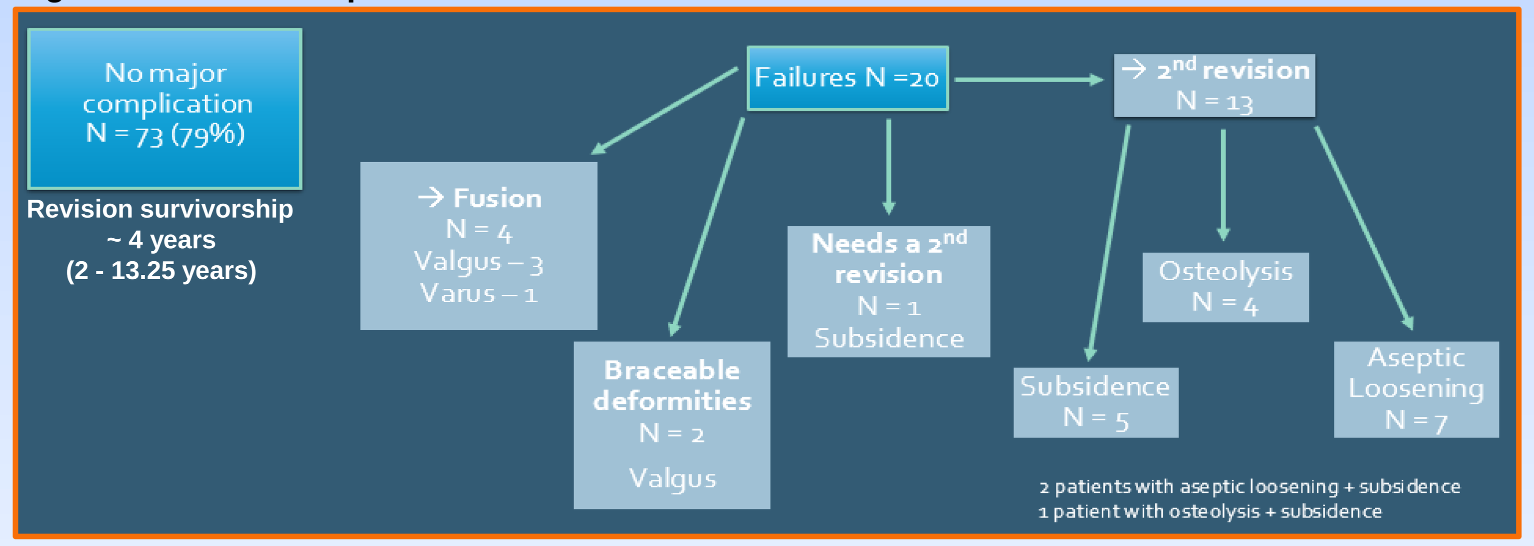


Table 3. Indications for revision

INDICATION	N =	%
Osteolysis	34	31
Aseptic loosening Varus Valgus	32 6 5	29
Subsidence	25	23
Malposition Equinus Varus	15 8 7	13
Infection	3	3
AVN	1	1

Table 4. Revision implant

REVISION IMPLANT	N =	%
INBONE	59	63%
SALTO	13	14%
AGILITY	9	10%
INFINITY (tibia) / INBONE (talus)	8	9%
STAR	2	2%
INFINITY	1	1%
FEMORAL HEMI	1	1%

Table 5. Additional procedures

ADDITIONAL PROCEDURES DURING REVISION	N =
None	42
Subtalar joint fusion	27
Lateral ankle stabilization	8
pTAL / gastroc recession	7
Dwyer type calcaneal osteotomy	5
Talonavicular joint fusion	4
Deltoid release	3
Deltoid reconstruction	2
Posterior tibial tendon transfer	2
Subtalar joint fusion revision	2
Medial malleolus ORIF	2
Fibula malunion revision	1
Syndesmosis fusion	1
Midfoot derotational osteotomy	1
Anterior tibial tendon transfer	1
Peroneal repair	1

Table 6. Secondary revision outcomes

Patient	Primary TAR	Failure mode	Years	Revision TAR	Failure mode	Years	2nd revision	Years	Fate
1	Agility	Polywear	4	Agility	Polywear	3	Agility long stem talus	10	Success
2	Agility	Talar subsidence	2	Agility	Osteolysis	5	Inbone + fusion rods	4	Success
3	Agility	Polywear, osteolysis	4.5	Inbone	Aseptic loosening (talus)	1	Inbone I → II talus	7	Success
4	Agility	Polywear, talar subsidence	7	Agility (talus)	Polywear, tibial loosening	4	Inbone	7	Success
5	Agility	Varus	1.25	Agility (talus)	Talar subsidence	6	Inbone + fusion rods	< 1	Success
6	Agility	Talar subsidence	2	Agility	Valgus	10	Inbone + fusion rods	1	Success
7	Inbone	Talar subsidence	9mo	Inbone (talus)	Varus	9	Envision	< 1	Success
8	Salto	Talar loosening	9mo	Inbone + fusion rods	Talar loosening	5	Inbone (talus)	2.5	Success
9	STAR	Talar subsidence	3	Infinity / Inbone	Tibial loosening	1	Inbone	1	Success
10	Salto	Tibial loosening	2.5	Salto	Tibial loosening	1	Inbone	1	Talar loosening → revision + fusion rods 3rd revision = success
11	Agility	Valgus, aseptic loosening	6.5mo	Agility #2	Valgus, subsidence	11	Inbone + fusion rods		Valgus Failure → bracing
12	Agility	Talar subsidence	3	Inbone	Talar subsidence	1.5	Inbone + fusion rods		Osteolysis, loosening Failure → bracing
13	Agility	Polywear, osteolysis	5	Agility	Talar loosening	1.25	Agility (talus)		Osteolysis Failure → fusion

Analysis & Discussion

The results of this study show encouraging mid-term outcomes for revision TAR. The success rate of the primary revision was 79% with an average four-year survivorship. In combination with the second revision outcomes, there is an overall success of 89%. These results are similar to a previous study that utilized one revision system[8].

Current primary and revision TAR systems, as well as metal reinforced cement augmentation, offer viable options for revision of the failed TAR. Long-term follow up is necessary to determine the efficacy of each mode of revision.

Osteolysis and aseptic loosening are primary modes of failure for both primary and revision TAR. Frontal plane instability is a major factor in success versus failure of revision TAR. In the current study, 45% of the revision TAR failures were in the setting of frontal plane instability.

The major limitation of the current study is the absence of a subjective scoring system. Success was defined only by clinical / radiographic analysis.

Based on the results of this study – one of the largest series to date utilizing various TAR systems – surgeons may consider revision TAR to be a viable treatment option for failure of the primary prosthesis.

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