

Total Ankle Arthroplasty: Long-term Survival and Factors that Influence it

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Conflict-of-interest statement: The author(s) declare(s) that there is no conflict of interest regarding the publication of this paper.

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Received: June 26, 2019

Revised: July 15, 2019

Accepted: July 18 2019

Published online: August 28, 2019

ABSTRACT

Total ankle arthroplasty (TAA) and ankle arthrodesis are efficacious treatments of end-stage ankle osteoarthritis but the selection must be specially fit to individual patients. TAA offers a judicious option to ankle arthrodesis in prudently selected patients. Reoperation rates are greater in TAA compared with ankle arthrodesis. The primary diagnosis for TAA is 37% osteoarthritis, 34% traumatic arthritis, 15% rheumatoid arthritis, 14% other. Patients experiencing TAA tend to be older, female, and have rheumatoid arthritis compared with those being subjected to ankle arthrodesis. Aseptic loosening and infection are the most frequent complications of TAA needing revision. The 15-year survival of primary TAA ranges from 45% to 91%. A comparison between the HINTEGRA implant, the AGILITY implant, the MOBILITY implant, and the Scandinavian Total Ankle Replacement (STAR) implant exhibited reasonable

results of four modern TAA designs. TAA is a demanding surgical technique and the survival is not similar to that following hip or knee arthroplasty. Revision TAA has a 10-year survival of 55%, which is lower than the 10-year survival of 74% for primary TAA.

Key words: Total ankle arthroplasty; Long-term survival; Risks factors of failure

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Rodriguez-Merchan EC, Moracia-Ochagavia I. Total Ankle Arthroplasty: Long-term Survival and Factors that Influence it. *International Journal of Orthopaedics* 2019; 6(4): 1124-1128 Available from: URL: <http://www.ghrnet.org/index.php/ijo/article/view/2620>

INTRODUCTION

Total ankle arthroplasty (TAA) has become more and more popular worldwide as an option to ankle arthrodesis for surgical management of end-stage ankle osteoarthritis^[1]. In fact, the usage of TAA in the United States has augmented close to 50% over the past 14 years^[2].

It has been reported that patients experiencing TAA tended to be older, female, and have rheumatoid arthritis compared with those going through ankle arthrodesis. Patients experiencing TAA had shorter length of stay, greater hospitalization costs, and more blood transfusions compared with those going through ankle arthrodesis. Moreover, lower hospital volume and shorter anaesthesia time were related to higher rates of complications following TAA^[1].

The rate of TAA is augmenting in the United States as its reputation and indications increase^[3]. In a study the primary diagnosis for TAA was 37.4% osteoarthritis, 34.3% traumatic arthritis, and 15.5% rheumatoid arthritis^[3]. TAA has demonstrated a positive correlation with time, significantly augmenting from 2.4 cases per 100,000 admissions from 1997 to 2003 to 3.5 cases per 100,000 from 2004 to 2010^[2].

It has been recently published that reoperation rates are greater in TAA compared with ankle arthrodesis and TAA and ankle arthrodesis are efficacious treatments of end-stage ankle osteoarthritis but the election must be tailored to individual patients^[4].

Table 1 Survivorship of different designs of total ankle arthroplasty (TAA) in the literature[11-39].

Authors	Year	Design	5-year survival	10-year survival	15-year survival	Comments
Buechel and Pappas [11]	1992	Buechel-Pappas	NA	94.75%	NA	
Kitaoka et al [12]	1994	Mayo	79%	65%	61%	The authors did not recommend the use of the Mayo TAA
Kofoed et al [13]	1995	Cylindrical cemented	NA	70% (*)	NA	(*) At 12 years
Schill et al [14]	1998	Thompson-Richards	NA	87% (*)	NA	(*) At 12 years
Schill et al [14]	1998	STAR	94.3% (*)	NA	NA	(*) At 6 years
Anderson et al [15]	2003	STAR	70%	NA	NA	
Wood et al [16]	2008	STAR	93.30%	80.30%	NA	
Karantana et al [17]	2010	STAR	90%	84% (*)	NA	(*) At 8 years
Morgan et al [18]	2010	AES	94.7% (*)	NA	NA	(*) At 6 years
Henricson et al [19]	2010	AES	90%	NA	NA	
Wood et al [20]	2010	MOBILITY	NA	NA	NA	The three-year survival was 97%. The four-year survival was 93.6%
Bonnin et al [21]	2011	SALTO	NA	NA	NA	Survivorship at 7 to 11 years: The survival rate was 65% with any reoperation of the ankle and 85% with revision of a component as the end points.
Mann et al [22]	2011	STAR	96%	90%	NA	
Hintermann et al [23]	2013	HINTEGRA	NA	83% (*)	NA	(*) At 9 years
Barg et al [24]	2013	HINTEGRA	94%	84%	NA	
Brunner et al [25]	2013	STAR	NA	70.70%	45.6% (*)	(*) At 14 years
Adams et al [26]	2014	INBONE	89% (*)	NA	NA	(*) At 3.7 years
Henricson and Carlsson [27]	2015	STAR (single-coated)	NA	NA	47% (*)	(*) At 14 years
Henricson and Carlsson [27]	2015	STAR (double-coated)	NA	64% (*)	NA	(*) At 12 years
Hofmann et al [28]	2016	SALTO TALARIS	97.50%	NA	NA	
Kerkhoff et al [29]	2016	MOBILITY	95%	NA	NA	
Kerkhoff et al [30]	2016	STAR	NA	78%	NA	
Koivu et al [31]	2017	AES	87.30%	74.80%	NA	
Koivu et al [32]	2017	STAR	93.90%	86.70%	63.60%	
Frigg et al [33]	2017	STAR	NA	(def. 1) 94%, (def. 2) 90%, and (def. 3) 78%	(def. 1) 91%, (def. 2) 75%, and (def. 3) 55%	(*) At 19 years. The primary endpoint was defined as exchange of the whole prosthesis or conversion to ankle arthrodesis (def. 1), exchange of at least one metallic component (def. 2), or exchange of any component including the inlay (due to breakage or wear) (def. 3).
Raijin et al [34]	2017	AGILITY	NA	80% (*)	70.4% (**)	(*) At 9 years. (**) At 14 years
Giannini et al [35]	2017	LIGAMENTS-COMPATIBLE	97.30%	NA	NA	
Palanca et al [36]	2018	STAR	NA	NA	73% (*)	(*) Metal implant survival was 73% at 15 years
Koo et al [37]	2018	SALTO	93.30%	NA	NA	
Penner et al [38]	2018	INFINITY	97% (*)	NA	NA	(*) At 2.9 years
Clough et al [39]	2019	STAR	NA	NA	76.16% (*)	(*) At 15.8 years

NA = Non-available; STAR = Scandinavian Total Ankle Replacement; AES = Ankle Evolution System.

TAA offers a rational option to ankle arthrodesis in meticulously selected patients. Aseptic loosening and infection are the most frequent complications needing revision^[5]. The uncemented mobile or fixed bearing designs had better results compared with their older counterparts. There was no evidence to insinuate supremacy of one design over another among the accessible implants.

However, we believe that the long-term survival of the different TAA designs and the factors that influence it must be defined more precisely. The purpose of this article has been to determine the long-term survival of the different types of existing TAA and also to know whether some risk factors can influence it. All this in order to help decide which TAA design has greater long-term survival and what risk factors we must control, so that said survival is not diminished.

LONG-TERM SURVIVAL

In a systematic review, the comprehensive survivorship at ten years was 89% with a yearly failure rate of 1.2%^[6]. In the Swedish Ankle Arthroplasty Register, the overall survival rate at 5 years is 78%^[7]. In the Finnish Arthroplasty Register the yearly prevalence of TAA is 1.5 per 10⁵ inhabitants^[8]. The 5-year overall survivorship for the whole TAA group is 83%. The most common reasons for revision are aseptic loosening of one or both of the prosthesis components (39%) and instability (39%). Moreover, no difference was found in survival rate between the STAR and Ankle Evolution System (AES) prostheses. Age, sex, diagnosis, and hospital volume did not influence the TAA survival.

In the Swedish Ankle Register the comprehensive survival rate

declined from 81% at 5 years to 69% at 10 years^[9]. Women below the age of 60 with osteoarthritis were at a greater risk of revision, but age did not affect the result in men or women with rheumatoid arthritis. In a study, implant survival for several national joint registries was 94% at 2-years, 87% at 5-years and 81% at 10-years^[10].

Different TAA designs: 5, 10 and 15 year survivals

Table 1 summarizes the 5, 10 and 15 year survivals of different existing TAA designs^[11-39]. The reported 5-year survival rate in United States was 90.1%^[40]. Kamrad et al found that revision TAA has a 10-year survival of 55%, which is lower than the 10-year survival of 74% for primary TAA published from the same registry^[41].

Failure risk factors of TAA

A study demonstrated significant racial disparities with lower TAA usage and suboptimal results in Blacks compared to Whites^[42]. It has been reported that patients who are male, have a history of community-acquired pneumonia, and have a larger number of preoperative comorbidities had a significant augmented risk of suffering one complication within 30 days of surgery^[43].

Patients experiencing TAA had shorter length of stay, greater hospitalization costs, and more blood transfusions compared with those experiencing ankle arthrodesis. Lower hospital volume and shorter anaesthesia time were related to greater rates of complications following TAA^[1].

It has been observed that patients with rheumatoid arthritis or who were readmitted within 90 days of TAA had significantly augmented risk of failure. Risk factors for readmission were Charlson-Deyo Score ≥ 2 and increased length of stay during TAA^[40].

It has been observed that the 30-day complication rate was 2.4% with 0.5% mortality and 0.2% infection rate. Length of hospital stay, both as an end point at >5 days and as a continuous variable, was related to overall adverse events. Patient characteristics that anticipated perioperative morbidity included presence of three or comorbidities, American Society of Anaesthesiologists class III, and history of preceding cardiac surgery^[44].

It has been reported that patients who experience staged bilateral TAA benefit as much as patients who go through unilateral TAA, in spite of having a worse preoperative health status^[45]. It has been found that survival rates of TAA in patients under age of 55 years are similar to those in patients older than 55 years in the intermediate-term follow-up^[46].

COMPARATIVE STUDIES

A comparison between two 3-component total ankle implants (HINTEGRA versus MOBILITY systems) showed favourable clinical result without significant differences. However, in terms of adverse events, ankle impingement syndrome was more common in the HINTEGRA group, while intraoperative malleolar fracture was found only in the MOBILITY group^[47]. A study demonstrated similar results between HINTEGRA, STAR, and AGILITY implants^[48].

Conversion of ankle arthrodesis to total ankle arthroplasty

In 2015 Pellegrini et al analysed 23 TAAs in patients who had experienced a prior or an attempted ankle arthrodesis^[49]. They performed concurrent surgical procedures in eighteen ankles (78%), with the most frequent procedure being prophylactic malleolar fixation (70%). Short-term follow-up following conversion of ankle arthrodesis to TAA showed pain relief and ameliorated function in a most patients.

CONCLUSIONS

Total ankle arthroplasty (TAA) offers a ratiocinative alternative to ankle arthrodesis in prudently selected patients. The primary diagnosis for TAA is 37% osteoarthritis, 34% traumatic arthritis, 15% rheumatoid arthritis, 14% other. Patients receiving TAA tend to be older, female, and have rheumatoid arthritis compared with those receiving ankle arthrodesis. Aseptic loosening and infection are the most prevalent complications of TAA needing revision. The 15-year survival of primary TAA ranges from 45% to 91%. A comparison between the HINTEGRA implant, the AGILITY implant, the MOBILITY implant, and the Scandinavian Total Ankle Replacement (STAR) implant showed acceptable results of four modern TAA prostheses. TAA is a demanding surgical procedure and the survival is not comparable to that after hip or knee arthroplasty. Revision TAA has a 10-year survival of 55%, which is lower than the 10-year survival of 74% for primary TAA published.

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