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

E. Carlos Rodriguez-Merchan¹, Inmaculada Moracia-Ochagavia¹

Introduction

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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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

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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 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 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 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.

LONG-TERM SURVIVAL

In a systematic review, the comprehensive survivorship at ten years was 89% with a yearly failure rate of 1.2%[54]. In the Swedish Ankle Arthroplasty Register, the overall survival rate at 5 years is 78%[55]. In the Finnish Arthroplasty Register the yearly prevalence of TAA is 1.5 per 10^5 inhabitants[56]. 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 survivorship.

In the Swedish Ankle Register the comprehensive survival rate

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

<table>
<thead>
<tr>
<th>Authors</th>
<th>Year</th>
<th>Design</th>
<th>5-year survival</th>
<th>10-year survival</th>
<th>15-year survival</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kitaoka et al [12]</td>
<td>1994</td>
<td>Mayo</td>
<td>79%</td>
<td>65%</td>
<td>61%</td>
<td>The authors did not recommend the use of the Mayo prosthesis.</td>
</tr>
<tr>
<td>Kofoed et al [13]</td>
<td>1995</td>
<td>Cylindrical</td>
<td>NA</td>
<td>70% (*)</td>
<td>NA</td>
<td>(*) At 12 years</td>
</tr>
<tr>
<td>Schill et al [14]</td>
<td>1998</td>
<td>Thompson-Richards</td>
<td>NA</td>
<td>87% (*)</td>
<td>NA</td>
<td>(*) At 12 years</td>
</tr>
<tr>
<td>Schill et al [14]</td>
<td>1998</td>
<td>STAR</td>
<td>94.3% (*)</td>
<td>NA</td>
<td>NA</td>
<td>(*) At 6 years</td>
</tr>
<tr>
<td>Anderson et al [15]</td>
<td>2003</td>
<td>STAR</td>
<td>70%</td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Wood et al [16]</td>
<td>2008</td>
<td>STAR</td>
<td>93.30%</td>
<td>80.30%</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Karantana et al [17]</td>
<td>2010</td>
<td>STAR</td>
<td>90%</td>
<td>84% (*)</td>
<td>NA</td>
<td>(*) At 18 years</td>
</tr>
<tr>
<td>Morgan et al [18]</td>
<td>2010</td>
<td>AES</td>
<td>94.7% (*)</td>
<td>NA</td>
<td>NA</td>
<td>(*) At 6 years</td>
</tr>
<tr>
<td>Henrikson et al [19]</td>
<td>2010</td>
<td>AES</td>
<td>90%</td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Wood et al [20]</td>
<td>2010</td>
<td>MOBILITY</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>The three-year survival was 97%. The four-year survival was 93.6%</td>
</tr>
<tr>
<td>Bonnin et al [21]</td>
<td>2011</td>
<td>SALTO</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Mann et al [22]</td>
<td>2011</td>
<td>STAR</td>
<td>96%</td>
<td>90%</td>
<td>NA</td>
<td>(*) At 9 years</td>
</tr>
<tr>
<td>Hintermann et al [23]</td>
<td>2013</td>
<td>HINTEGRA</td>
<td>NA</td>
<td>83% (*)</td>
<td>NA</td>
<td>(*) At 14 years</td>
</tr>
<tr>
<td>Bang et al [24]</td>
<td>2013</td>
<td>HINTEGRA</td>
<td>94%</td>
<td>84%</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Brunner et al [25]</td>
<td>2013</td>
<td>STAR</td>
<td>NA</td>
<td>70.70%</td>
<td>45.6% (*)</td>
<td>(*) At 14 years</td>
</tr>
<tr>
<td>Adams et al [26]</td>
<td>2014</td>
<td>INBONE</td>
<td>89% (*)</td>
<td>NA</td>
<td>NA</td>
<td>(*) At 3.7 years</td>
</tr>
<tr>
<td>Henrikson and Carlson [27]</td>
<td>2015</td>
<td>STAR (single-coated)</td>
<td>NA</td>
<td>47% (*)</td>
<td>(*) At 14 years</td>
<td></td>
</tr>
<tr>
<td>Henrikson and Carlson [27]</td>
<td>2015</td>
<td>STAR (double-coated)</td>
<td>NA</td>
<td>64% (*)</td>
<td>(*) At 12 years</td>
<td></td>
</tr>
<tr>
<td>Hofmann et al [28]</td>
<td>2016</td>
<td>SALTO TALARIS</td>
<td>97.50%</td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Kerkhoff et al [29]</td>
<td>2016</td>
<td>MOBILITY</td>
<td>95%</td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Kerkhoff et al [30]</td>
<td>2016</td>
<td>STAR</td>
<td>NA</td>
<td>78%</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Koivu et al [31]</td>
<td>2017</td>
<td>AES</td>
<td>87.30%</td>
<td>74.80%</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Koivu et al [32]</td>
<td>2017</td>
<td>STAR</td>
<td>93.90%</td>
<td>86.70%</td>
<td>63.60%</td>
<td>(*) 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).</td>
</tr>
<tr>
<td>Frigg et al [33]</td>
<td>2017</td>
<td>STAR</td>
<td>(def. 1) 94%, (def. 2) 90%, and (def. 3) 78%</td>
<td>(def. 1) 91%, (def. 2) 75%, and (def. 3) 55%</td>
<td>(*) At 9 years. (**) At 14 years</td>
<td></td>
</tr>
<tr>
<td>Raikin et al [34]</td>
<td>2017</td>
<td>AGILITY</td>
<td>NA</td>
<td>80% (*)</td>
<td>70.4% (*)</td>
<td>(*) At 9 years. (**) At 14 years</td>
</tr>
<tr>
<td>Giannini et al [35]</td>
<td>2017</td>
<td>LIGAMENTS-COMPATIBLE</td>
<td>97.30%</td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Palanca et al [36]</td>
<td>2018</td>
<td>STAR</td>
<td>NA</td>
<td>73% (*)</td>
<td>NA</td>
<td>(*) At 12 years</td>
</tr>
<tr>
<td>Koo et al [37]</td>
<td>2018</td>
<td>SALTO</td>
<td>93.30%</td>
<td>NA</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Penner et al [38]</td>
<td>2018</td>
<td>INFINITY</td>
<td>97% (*)</td>
<td>NA</td>
<td>NA</td>
<td>(*) At 2.9 years</td>
</tr>
<tr>
<td>Clough et al [39]</td>
<td>2019</td>
<td>STAR</td>
<td>NA</td>
<td>76.16% (*)</td>
<td>(*) At 15.8 years</td>
<td></td>
</tr>
</tbody>
</table>

NA = Non-available; STAR = Scandinavian Total Ankle Replacement; AES = Ankle Evolution System.
declined from 81% at 5 years to 69% at 10 years[10]. 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 design[11-30]. The reported 5-year survival rate in United Sytes 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 anesthesia time were related to greater rates of complications following TAA[4].

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 Anesthesiologists 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[40]. 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[40].

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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