Total Ankle Arthroplasty Reasons for Failure

Ara Francis IMRCS, Yasser Aljabi IMRCS, Khalid Mohammed FRCS, Robert Flavin MD

St. Vincent’s University Hospital, Dublin, Ireland
Disclosure

NO CONFLICT TO DISCLOSE

Total Ankle Arthroplasty - Reasons for Failure

Ara Francis IMRCS
Yasser Aljabi IMRCS
Khalid Mohammed FRCS
Prof. Robert Flavin MD

The authors have no conflicts with this presentation
Total Ankle Arthroplasty – Reasons for Failure

• Total Ankle Arthroplasty was initially developed in 1970’s as a two component design. Catastrophic failure of early implants led to widespread abandonment of TAA in favor of joint arthrodesis.

• Popularity of TAA has increased since development of 2\textsuperscript{nd} generation, three component implants

• Unlike Total Hip Arthroplasty (THA) and Total Knee Arthroplasty (TKA) – long term outcomes and survivorship remain equal or inferior to ankle arthrodesis.

• We aim to shed light on mechanisms of failure
Lateral and Anteroposterior views of a failed STAR TAA
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Methods

• Specially designed ankle simulator used to test 3 commercially available TAAs, the STAR (Stryker), Hintegra (Integra) and Mobility(De Puy)* – which replicates plantar/dorsiflexion, inversion and eversion movements

• The following were performed before, during and after testing
  – Visual inspection of bearings
  – Measurement of weight of the bearings
  – Optical Profile Projector – geometries of bearing
  – Scanning Electron Microscopy to analyze bearing surface

• Minimum load of 1.2kN (ground reaction forces), also assessed under 2.5kN load with particular reference to medial and lateral wear patterns

• Tests run for 50,000 cycles at a rate of 1.4Hz, then bearings were removed for inspection

* not commercially available, included due to its polymer geometric design
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Results

• The radius of the STAR and Hintegra bearings increased significantly after testing (7% and 10% respectively) leading to flattening of the bearing surface

• Scanned Electron Microscopy imaging showed increased wear of the bearing surfaces in the STAR and Hintegra TAA with a distinct change in the pattern of polymer fibres. The Mobility bearing maintained its linear pattern

• There was minimal visible deformation seen in the STAR and Hintegra polymer bearings after each stage of testing. There was no deformation seen in the Mobility shape polymer at any stage of testing.

• The percentage weight changes of the polymer bearings were minimal across all implants
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Fig. 1 demonstrating the % change in critical dimensions of the bearings after 100,000 cycles (h1 = front height, h2 = rear height, r = radius)
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The surfaces of the bearings were examined before and after testing with Scanning Electron Microscopy (x 20 magnification). A clear change in polymer fibre pattern is seen in both bearings. The Mobility preserved its linear pattern.
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Fig. 6 and 7 showing % Change in critical dimensions of the bearings after max load of 1.2kN and 2.5 kN and 50,000 cycles respectively.

The Mobility bearing out-performed the other implant designs during assessment of medial and lateral loading patterns.
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Discussion

• The gold standard for treatment of ankle arthritis remains the ankle arthrodesis
• Next generation implants have renewed interest in Total Ankle Arthroplasty
• Survivorship and outcomes still do not match those of Joint Arthrodesis
• Potential design flaws in the Hintegra lead to rim loading and loss of congruency during the peak phase of joint reaction force during gait cycle, seen with excessive coronal loading i.e. deltoid ligament deficiency, pes cavus
• Failure of the STAR design was due to keel loading experienced as a result of coronal imbalance (leads to excessive loading on the lateral side of the implant and eventual stressing of the ankle and Chopart joint)
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Conclusion

- Our biomechanical analysis and literature review supports the senior author's clinical experience that the main reason for failure is medial insufficiency which causes excessive loading and therefore failure of the implant.

- The optimum implant design includes a central keel with bilateral ellipsoidal facets on the Talar – Polymer mobile bearing interface, such as that seen with the Mobility.
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References

- Wood P.L.R., Karski M.T., Watmough P. Total Ankle Replacement: The Results of 100 Mobility Total Ankle Replacements. JBJS(Br). 2010;92B.7:958-962.