THE FAILURE OF TOTAL ANKLE REPLACEMENTS: AN EXPLANT ANALYSIS STUDY

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INTRODUCTION
Revision rates following total ankle replacement are unsatisfactory compared to other lower limb joint replacements (9% at 10 years, compared to 4% for hips and knees)
Revision surgeries are costly to the NHS, as well as adding burden and trauma to the patient
Explant analysis studies are limited, and the reasons for high failure rates of ankles are not yet fully understood

Aim: To investigate the failure mechanisms of contemporary total ankle replacements using an explant analysis approach

METHODOLOGY
A cohort of 28 explanted total ankle replacements analysed, comprised of 9 different designs (3 fixed and 6 mobile bearing)
Initial microscopic analysis to identify damage modes present
Material characterisation of metal components via X-ray fluorescence spectroscopy and embedded debris via scanning electron microscopy with energy dispersive X-ray spectroscopy
Measurement of surface roughness parameters using non-contacting 3D profilometry
Quantification of polyethylene volumetric wear for the first time, using a coordinate measuring machine

RESULTS
Pitting of metal components
Pitting on 54% of tibial components
64% of CoCr
20% of Ti
Pitting on 96% of talar components
Average surface roughness (Sa) and maximum valley depth (Sv) values significantly higher for pitted than unpitted areas, confirming the presence of pits

Volumetric wear
A relatively low mean wear volume (1.60 mm³) was measured from the polyethylene insert bearing surfaces
Range 0.08 mm³ to 6.90 mm³ (compared to 2.1 mm³ to 18.6 mm³ reported by simulator studies)
Lateral aspect wear significantly higher than medial aspect wear (1.04 mm³ vs 0.84 mm³)
Mean asymmetry ratio = 2.77

Key takeaway:
Metal particulate debris release may be an under-recognised issue in contemporary total ankle replacements that should be considered in further study of failed or painful ankle replacement

Fixed versus mobile bearing
No significant differences between the proportion of fixed and mobile bearing tibial or talar components exhibiting pitting
Fixed pitted Sa and Sv values significantly higher for fixed than mobile bearing tibial and talar components

CONCLUSIONS
This explant analysis study demonstrates the release of metal debris from both the articulating surfaces and the coatings of various contemporary total ankle replacements, including both fixed and mobile bearing designs
Relatively low volumes of polyethylene wear were measured
Proposal of a new failure mechanism:
The high rate of total ankle replacement failures is more likely due to metal release rather than linked to polyethylene wear as in other artificial joints

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References
1. National Joint Registry Annual Report 2022

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