# WHAT IS REQUIRED TO MEASURE THE WEAR OF EXPLANTED METAL ON METAL HIPS?

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## Abstract

**INTRODUCTION** There is increasing worldwide interest in the assessment of wear in explanted hip components. This is due is part to high profile failures of orthopaedic components in the US, whilst in the UK hip resurfacings have been experiencing a higher than expected failure rate. The reasons for these failures are not well understood, with data from the NJR suggesting the 43% of MoM resurfacing failures are unexplained.

Wear analysis is a vital tool in determining failure mechanisms and ultimately improving the longevity of joint replacements through improved design and manufacturing control. There are currently no relevant measurement standards for the evaluation of retrieved orthopaedic components. This paper will assess two of the most commonly used techniques namely roundness measurement and co-ordinate measurement. The advantages and disadvantages of both techniques are considered in this paper.

**ROUNDNESS MACHINE** The Talyrond 365 is a stylus based roundness machine. The component is located on a rotating table and the stylus measures the deviation from a perfect circle as the component is slowly rotated. The Talyrond measures a single profile to an accuracy of 30 nm and up to 72,000 data points per revolution. The air

spindle has a radial accuracy of <0.02 μm and the Talymin gauge a minimum resolution of 12 nm. Individual roundness profiles can be stitched together to build up 3D cylinder maps, allowing 3D pictures of sections of explanted hip components to be generated.

**COORDINATE MEASURING MACHINE** Co-ordinate measuring machines (CMMs) have been widely used in manufacturing quality and research departments for a number of years and the CMM is recognised as a powerful and important tool capable of ascertaining geometric data from a component. The CMM used in this study was a Zeiss Prismo CMM (Carl Zeiss Ltd., Rugby, UK) with a probing error of 0.7 μm. Components are securely held in a chuck fixture arrangement and the dimensions of the component in the portion of the bearing that is unworn is ascertained through measurement. The initial measurements are used to produce a reverse engineered 3D CAD surface which represents the component 'pre-wear' surface. The surface of the component is then scanned and the deviation from this pre-wear surface is mapped. The maximum linear wear and wear volume are then calculated directly.

**DISCUSSION** The main advantage of CMM and Talyrond is that they are available in most metrology and measurement rooms. The CMM is a particularly versatile machine and can be used to measure any orthopaedic components. There is a need to develop a suitable Standard for both machines detailing a protocol to measure explanted hip and quantify the wear. A study is underway to measure a set of explanted hip components to allow a detailed comparison between of measurements between the Talyrond and CMM. The result of this study will be included in the paper.

**CONCLUSIONS** The CMM and Talyrond are both instruments suited to measuring wear of explanted hips. A full evaluation of the systems and the development of robust measurement protocol and standard would be advantageous to the orthopaedic industry.