University of Huddersfield Repository

Bills, Paul J., Underwood, R.J., Cann, P., Hart, A, Jiang, Xiangqian and Blunt, Liam

What is required to measure the wear of explanted metal-on-metal hips?

Original Citation


This version is available at http://eprints.hud.ac.uk/11896/

The University Repository is a digital collection of the research output of the University, available on Open Access. Copyright and Moral Rights for the items on this site are retained by the individual author and/or other copyright owners. Users may access full items free of charge; copies of full text items generally can be reproduced, displayed or performed and given to third parties in any format or medium for personal research or study, educational or not-for-profit purposes without prior permission or charge, provided:

• The authors, title and full bibliographic details is credited in any copy;
• A hyperlink and/or URL is included for the original metadata page; and
• The content is not changed in any way.

For more information, including our policy and submission procedure, please contact the Repository Team at: E.mailbox@hud.ac.uk.

http://eprints.hud.ac.uk/
WHAT IS REQUIRED TO MEASURE THE WEAR OF EXPLANTED METAL-ON-METAL HIPS?

P Bills1, R J Underwood2, P M Cann2, A Hart3, X Jiang1, L Blunt1

1Centre for Precision Technologies, University of Huddersfield, 2Tribology Group, Imperial College London, 3Department of Musculoskeletal Surgery, Imperial College London

Presented at BORS Annual Meeting
Cardiff
12 – 13 July, 2010

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

Background

• Worldwide interest in failure of Metal-on-Metal (MoM) hips
• 150,000 large diameter MoM hips implanted in UK
• Failure rate of resurfacings is 7.6%, compared to 3% for cemented hips
• Three designs of MoM hips have been removed from the market in past 4 years
• NJR data suggests 43% of hip failures are unexplained
• Wear analysis is vital tool in understanding failure mechanisms
• Edge loaded cups have linear wear rate 7 times greater than non-edge loaded

Our aims:
To assess two of the most commonly used techniques namely roundness measurement and co-ordinate measurement and consider the advantages and disadvantages of both in detail.

Measurement Requirements

• No British Standard to measure wear of explanted hip joints
• No validated measurement protocol in the literature
• Typical linear wear rates for explanted hips are:
  - Cup: 0 – 180 μm/year
  - Head: 0 – 750 μm/year
• Accuracy required ~ 1 μm

Wear and Form

• Hip joints are not perfectly spherical as manufactured – the deviations are referred to as “Form”
• The manufactured shape of the components is unknown
• Form errors can be up to 30 μm
• Wear may be smaller than form errors
• Need to be able to separate wear and worn when analysing data

Talyrond

The Talyrond 365 is a stylus based roundness machine.

Hip located on a rotating table and the stylus measures the deviation from a perfect circle.

Single profile measured to an accuracy of 30 nm and up to 72,000 data points per rev.

Accuracy:
- Gauge > 12 nm
- Spindle < 0.02 μm

Individual roundness profiles can be stitched together to build up 3D maps

Comparison of Talyrond & CMM

The Zeiss PRISMO is a co-ordinate measuring machine.

• Hip located in a chuck, probe measures grid of points, scanning whole surface to determine extent of ‘unworn area’.
• Unworn area scanned to create a reverse engineered 3D CAD surface which represents the component ‘pre-wear’ surface.
• Whole surface scanned and deviation is mapped.
• The maximum linear wear and wear volume are then calculated directly.

Wear and Form

• Hip joints are not perfectly spherical as manufactured – the deviations are referred to as “Form”
• No British Standard to measure wear of explanted hip joints
• No validated measurement protocol in the literature
• Typical linear wear rates for explanted hips are:
  - Cup: 0 – 180 μm/year
  - Head: 0 – 750 μm/year
• Accuracy required ~ 1 μm

Conclusion

• The CMM and Talyrond are both instruments suited to measuring wear of explanted hips.
• Development of robust measurement protocol and standard required including:
  - Comprehensive study of good practice.
  - Verifiable uncertainty statements.


http://www1.imperial.ac.uk/medicine/hipcentre
x.jiang@hud.ac.uk
a.hart@imperial.ac.uk

p.j.bills@hud.ac.uk
richard.underwood@ic.ac.uk