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A STUDY OF THE WEAR OF EXPLANTED METAL-ON-METAL RESURFACING HIP PROSTHESES

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ABSTRACT

One of the most recent and controversial designs of hip replacement is the metal-on-metal resurfacing prosthesis. These devices are said to be aimed at younger more active patients who would quickly wear out a traditional total hip replacement. Due to the relatively recent introduction of hip resurfacing devices there are few studies of failed and explanted devices of this type. However, from a large, independent, single-surgeon cohort a number of hip resurfacing prostheses which had failed were obtained. The majority were associated with groin pain in patients and a minority with fracture of the femur. Acetabular cup and femoral head components were analyzed using a roundness measuring machine and a co-ordinate measuring machine. Components associated with fracture of the femur showed minimal out of roundness changes compared with typical production values. In contrast, components associated with groin pain in patients showed much greater out of roundness values, which were taken to be indicative of wear. All of this data was augmented by co-ordinate measuring machine data. Therefore it is likely that the groin pain of patients was associated with an adverse reaction to excessive metal wear debris.

Keywords: metal-on-metal, cobalt chrome, hip resurfacing, explant analysis

INTRODUCTION

Although the majority of total hip replacement operations are very successful procedures there is a constant need to improve these devices for the long-term benefit of patients suffering from common musculo-skeletal diseases. One of the latest group of implants are known as hip resurfacings, and they consist of a relatively large diameter femoral head articulating within a thin acetabular cup. Both components are manufactured from cobalt chrome. Various designs of such metal-on-metal hip resurfacing prostheses are offered by several orthopedic engineering companies and many of these devices show good short to medium term clinical results [1]. However there are concerns over such implants including the higher ion levels in the blood of patients fitted with them [2]. Much valuable data can be learnt from explanted prostheses which have 'failed' and then been removed from patients. As hip resurfacing prostheses have only recently been introduced, there are relatively few such retrieval studies [3].

METHODS AND MATERIALS

Twelve femoral and acetabular components from metal-on-metal hip resurfacing prostheses were obtained at revision operations. The majority were revised due to the patient suffering groin pain. In these cases, at revision operation an effusion was always seen from the joint capsule. A minority of components were obtained following revision after the patient's femur had fractured. Each component was examined using a Zeiss TSK Rondcom60A roundness measuring machine and a Mitutoyo LEGEX co-ordinate measuring machine. Out of roundness measurements were taken on three planes for each acetabular and femoral component. The co-ordinate measuring machine was used to obtain 12 traces at 30° intervals for each acetabular and femoral component. Both machines allowed areas of localized wear to be identified and the maximum wear depth to be quantified.

RESULTS

The maximum out of roundness values for the twelve components are given in table 1. As can be seen, those components associated with fracture of the femur all showed the lowest out of roundness values. Where pain and effusion were associated with the reason for revision, the out of roundness values were much greater, up to a maximum of 91.8µm. For the cups associated with pain and effusion, the out of roundness traces indicated that wear took place towards the edge of the cup and a typical trace is shown in figure 1. A similar range of values and results were obtained from the co-ordinate measuring machine and a typical trace is given in figure 2.

Component	Patient	Head/Cup	Max out of roundness (µm)	Reason for revision
1	A	Head	91.8	Pain, effusion
2	A	Cup	64.0	Pain, effusion
3	B	Head	38.0	Pain, effusion
4	B	Cup	28.8	Pain, effusion
5	C	Head	17.7	Pain, effusion
6	C	Cup	14.8	Pain, effusion
7	D	Head	31.3	Pain, effusion
8	E	Head	2.7	Fracture of femur
9	F	Head	38.8	Pain, effusion
10	G	Head	24.7	Pain, effusion
11	H	Head	3.1	Fracture of femur
12	I	Head	2.0	Fracture of femur

Table 1: Maximum out of roundness values of the 12 explanted components.

Roundness

Data No. :1,2,3

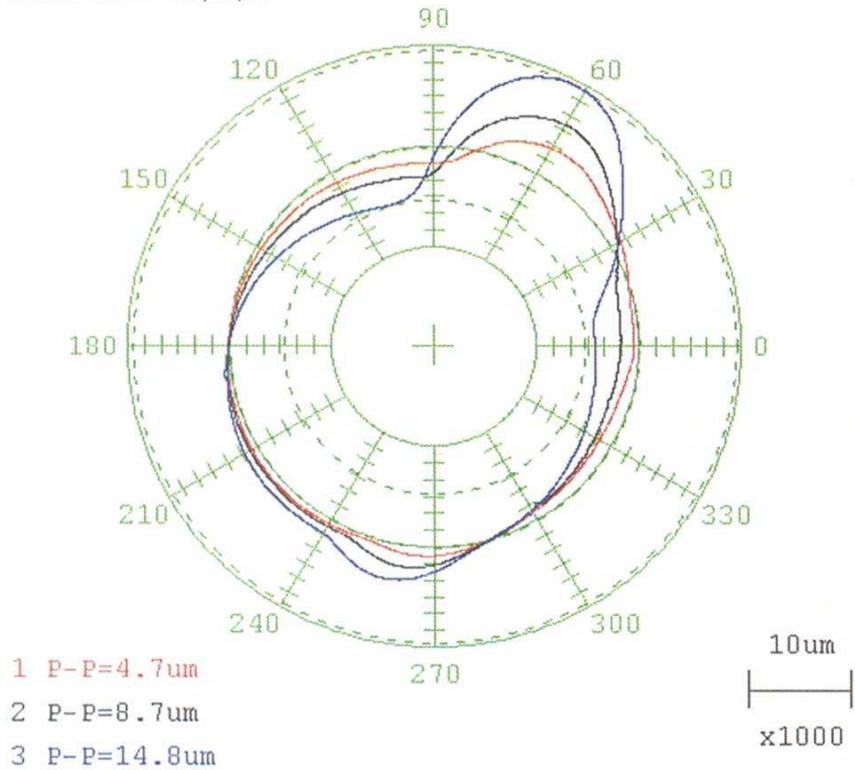


Fig. 1: Roundness trace from cup component 6 showing localized edge wear.

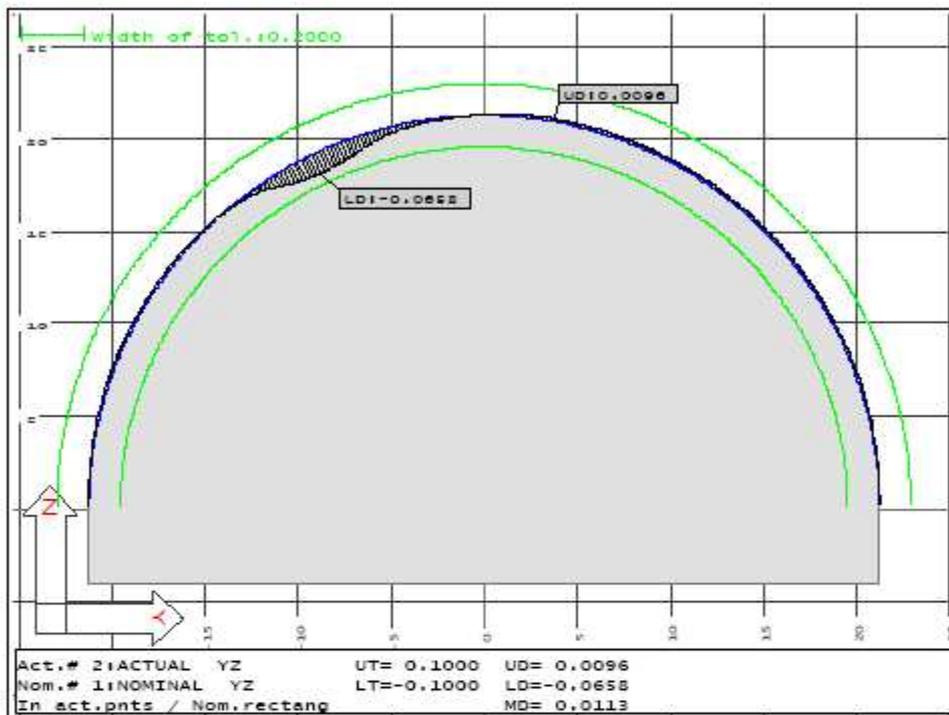


Fig.2: Typical co-ordinate measuring machine trace from the head of an explanted component showing localised wear and a maximum local wear depth of 68µm

DISCUSSION

Both the out of roundness measurements and those from the co-ordinate measuring machine provided information about the wear of the implants. For a new component, a typical out of roundness value would be of the order of less than 5 μ m. Therefore, from table 1, it can be seen that components 8, 11 and 12 (all from patients whose femurs had fractured) showed minimal distortion or wear after removal. Such data also helps to verify the accuracy of the measuring technique. To the authors' best knowledge, the dichotomy between low wear components associated with femoral fracture and high wear explants associated with groin pain and effusion has not previously been reported. For the three paired components, the out of roundness data suggested that wear was greater on the femoral components than on the acetabular components. Typical co-ordinate measuring machine scans, such as that in figure 2, helped to identify localized areas of wear and maximum wear depths. Values in the range of <2 μ m to 164 μ m have been reported previously [3] and show good agreement with the findings of this study.

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