

Journal Club: 26 February 2009  
Organiser: Mr G. J. Stranks  
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## Introduction

The focus of the evening was twofold. Firstly we reviewed recent papers concerning the natural history and treatment of hip impingement. Secondly we presented a case of a patient who had undergone a total hip replacement with a ceramic bearing and was now troubled by intrusive squeaking. A video and sound recording of the patient was examined followed by a review of a recent paper from the journal which set out to investigate this problem. That paper is the focus of this review.

### Squeaking hips.

Walter WL, Waters TS, Gillies M, et al.  
J Bone Joint Surg [Am] 2008; 90-A:102–111.

## Review

### Introduction

The introduction is concise and clearly states the aims of the paper. It familiarises the reader with the problem of squeaking in ceramic-on-ceramic total hip replacement bearings and discusses the current knowledge base regarding this previously unanticipated failure mode.

A literature search revealed that although there have been many case reports relating to squeaking hips, we were unable to find a paper replicating such an in depth investigation into the mechanisms and causes of squeaking. For this reason, we felt it was an original, interesting and worthwhile piece of work.

### Methods and Results

This paper is an amalgam of a series of studies undertaken by the investigating group. As a result, the paper can appear disjointed however the results are brought together in the discussion section to provide a theory on the cause of squeaking.

### Demographic and Radiographic Analysis

A case-controlled series of squeaking hips is presented. The data suggests that taller, heavier and younger patients and those whose acetabular component fell outside an acceptable range (15°-35° anteversion and 35°-55° inclination) were more like to experience squeaking. The retrospective, non-randomized nature of the data limits the conclusions that can be drawn.

### Retrieval Analysis

Twelve hips removed for squeaking were analyzed; the wear length and width were measured using digital callipers and the depth with a Roundtest machine. Despite the heterogenous nature of component types and head diameters a constant finding was that all revealed evidence of edge loading wear. An unspecified number showed findings suggestive of movement between the shell and insert in the form of titanium metal transfer between the two.

### Finite Element Analysis of Edge Loading

A computer generated model of a pelvis with a 54mm titanium cup and 28mm ceramic liner was studied, incorporating the material properties for the bony and prosthetic components. The model was then edge loaded (stress) and analysed to observe its response (strain) in two different cup orientations. Significantly increased tilting of the liner (40µm vs 4µm) was seen with an anteversion of 42° when compared to 24°.

### Acoustic Analysis

Three studies are combined to determine which part of the hip replacement causes the squeak. An in vivo study involved recording squeaks and performing sound analysis; this revealed a harmonic series suggesting resonance. Resonance of hip components was further analysed by computer modal analysis showing that only the acetabular shell resonated at a frequency within the audible range and this was confirmed by a provocative in vitro study where the component parts were vibrated with an impulse stimulator. The assumption is therefore made that origin of the squeak is the titanium shell.

## Conclusions and Discussion

The assorted findings from the various studies have allowed the authors to propose a theory as to the cause and source of squeaking in ceramic-on-ceramic hip replacements.

**The Theory:** *Squeaking is produced by a forced vibration with a frictional driving force and a dynamic response. Certain conditions, involving to patient demographics and cup orientation, cause edge loading which in turn has two effects. There is loss of normal fluid film lubrication, causing increased friction and also there is separation of the ceramic liner from the titanium shell. These combined factors allow the titanium shell to resonate, producing a squeak.*

The authors have given an insight into the mechanism of squeaking, they put forward an approach to investigation and treatment of the problem and they also discuss further research that is needed. In

doing so, they have fulfilled the stated aims of the paper. It is questionable as to whether the conclusions that they reach are wholly justified as there is a presumption that the computer studies and in vitro studies are replicable in vivo. The authors have shown insight into this shortcoming by stating that more in depth clinical analysis is required. The results are highly relevant because of the current increasing use of ceramic-on-ceramic bearings.

In general, the reviewer and those present at the journal club found this to be an interesting and well composed paper. The authors have combined elements of clinical and scientific research to produce a detailed piece of research.