

CeraNews

Improve Arthroplasty

Professor Lars Lidgren, MD, is the Head of the Department of Orthopedics of Lund University in Sweden. He is Chairman of the Swedish National Knee Register and Director of the National Musculoskeletal Competence Center in Sweden. Lidgren initiated a Bone and Joint Decade Consensus Meeting in Lund in 1998, which led to the global Bone and Joint Decade campaign (BJD). He is at present Chairman of its International Steering Committee.

What has the BJD achieved?

We have managed to bring the physicians from different musculoskeletal disciplines and patients to sit at the same table. Together they have changed the health priorities in a number of countries, in terms of public health as well as in the field of medical research. Musculoskeletal science is now on the agenda of academic units world-wide. There have been some significant funding activities, and the BJD networks of many countries have initiated very impressive activities in the health care systems. I think that the BJD has considerably changed the perception of musculoskeletal health issues.¹

Why is the burden of disease one of the key issues of the BJD? We are going to see an age-quake. In Europe we will soon have around 125 million people over 65. Some of the most frequent musculoskeletal disorders, like joint diseases, spinal disorders or osteoporosis, are age related. This means that the health care systems are facing a growing burden of musculoskeletal disorders. Measures have to be taken to postpone or at best prevent osteoarthritis by weight reduction, a healthy life style etc, and we have to improve the results of primary arthroplasty in order to reduce the need for costly revisions.

Can arthroplasty registers help? You have to study a large number of clinical units spread throughout a



Lars Lidgren, MD

country to get an overall view of the results of a certain type of procedure, done by the average surgeon in the average clinic. This can give us early warnings if a technique or an implant causes problems or proves to be inferior to the average standard. When we compare official data from different countries it becomes quite clear that the national register has contributed to a lower revision rate in Sweden.^{2,3,4} Arthroplasty registers are actually a very cost effective means of improving outcome.

What are the most important weak points of arthroplasty today? In both hip and knee the most frequent failure mechanism is related to loosening and wear. These factors are often connected, as an initially unstable implant will be more severely affected by wear, which will contribute to further loosening. The wear process and loosening is quite different in the hip and the knee. But degradation of bearing surfaces and the initial stability of the implant are the key issues, especially in young patients.

What are the key issues concerning wear in hip joints? We have to look at the biological burden of the different materials and bearing couplings. Concerning metal-to-metal, it remains to be proven in further studies that this concept has such a low release of ions that there is no systemic negative effect on the human body and especially on genetic stability. Metal-on-metal may cause problems in patients with inflammatory conditions.⁵

What about crosslinked polyethylenes? It is very crucial to realize that we have only five to ten years of clinical experience although there seems to be very promising progress. Some of the first generation crosslinked polys failed because they were brittle. It is also important to consider possible outliers: What happens if you get third body wear from contamination of small metal or bone cement particles with difficulties being embedded in a relatively hard plastic material and this in a very young and active patient?

And ceramics? Comparing ceramic and metal ball heads coupled with polyethylene there is evidence that ceramic components could be of some advantage in high demand joints. As to ceramic-on-ceramic, there are no studies based on

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How Rare Are Ceramic Fractures?

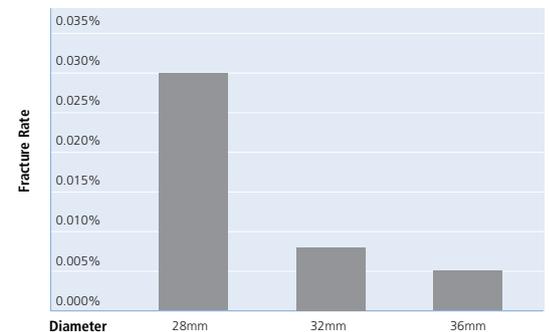
Fractures of components made of BIOLOX® ceramics are among the rarest complications in hip arthroplasty. An evaluation of the data that are available to CeramTec confirms this conclusion. In the interest of promoting optimal patient care, CeramTec began publishing its internal complication statistics a long time ago. The latest information available is presented here. All of the data used in the evaluation relate to complications that were reported to CeramTec in the period from January 2000 to March 2008. We have observed an increased tendency in recent years towards the consistent reporting of complications.



The correct position of the ceramic insert within the acetabular cup can be checked by running a finger along its rim.

CeramTec distributed approximately 2,300,000 ball heads in the period from January 2000 to March 2008 (around 2,050,000 BIOLOX®*forte* and 250,000 BIOLOX®*delta*). The in-vivo fracture rate for ball heads made of the material BIOLOX®*forte* is 0.021%, or roughly 20 per 100,000 implants. The in-vivo fracture rate for ball heads made of BIOLOX®*delta* is 0.003%, or 3 per 100,000 implants.

BIOLOX®*forte* femoral ball heads



Note:

Our new BIOLOX®*delta* material offers superior mechanical properties. These translate into a reduction in complications as shown previously. One of these complications, intraoperative chipping, still can occur even with this material if proper seating of the ceramic insert is not achieved during surgery. The next issue of CeraNews will feature an extensive discussion on the use of ceramic cup inserts. The recommended handling of BIOLOX® products is described in detail in our training DVD.

More information about the DVD is available on page 9.



Interview (continued)

national register data. There are limited studies from individual units that have used radiostereometric analysis (RSA) with promising results for ceramic-on-ceramic

up to 5 years. Ceramic-on-polyethylene is a well proven concept.

What can the industry do to improve arthroplasty?

When companies introduce new concepts to the market they should do this step by step. They should start in selected centers to make sure that good primary fixation is achieved, eventually using RSA, and also show that the initial wear of the new implant is very low. Larger studies with a close follow-up should be the next step before spreading out. The wear of an implant also depends very much on how you put it in. In order to obtain valid results for everyday use you have to collect the data from many clinical units, including the not highly specialized ones.

What can surgeons do to improve arthroplasty results? We analyzed what happened after a change in technique but with the same design of an implant.⁶ Because the change was introduced without training the surgeons the results significantly deteriorated. We need good training courses especially for cementing and implantation techniques, for minimally invasive procedures and for every new implant design which often comes with new instruments for insertion. The surgeons should attend certified training courses before they are allowed to use new implants and procedures. I think we did not have and still do not have enough systematic training.

Which trends in arthroplasty will dominate the next five to ten years? Minimally invasive procedures might be applied increasingly, however with caution and by using more precise implantation techniques. There is a great underlying trend towards bigger specialized joint replacement centers. We can already see this in Germany where fewer hospitals are performing more arthroplasties. On the implant side bone-like or biologically activated surfaces will become more important for non-cemented implants. Concerning wear couples, we are obviously moving towards technologies that will reduce wear. I am expecting developments on the ceramic and metal side as well as on the polyethylene side, with different solutions for the knee and the hip. For all new methods and technologies both outcome and long term cost efficiency have to be considered as growing numbers of older and also more and more younger patients are being operated on.

References: 1. <http://www.bjdonline.org>; 2. Robertsson O. Knee arthroplasty registers. *J Bone Joint Surg* 2007; 89-B: 1-4.; 3. <http://www.knee.se>; 4. <http://www.jru.orthop.gu.se>; 5. Lidgren L. Chronic inflammation, joint replacement and malignant lymphoma. *J Bone Joint Surg* 2008; 90-B (1): 7-10; 6. Robertsson O, Lidgren L. The short-term results of 3 common UKA implants during different periods in Sweden. *J Arthroplasty*, in press.



Heinrich Wecker, Business Manager for Central Europe at CeramTec's Medical Technology Division

Dear Reader,

Hip replacement is one of the most successful forms of routine orthopaedic surgery. But this success goes hand in hand with high expectations. Many patients take an absence of complications and optimal results for granted. But in fact, the procedure is technically very demanding and does not always proceed without a hitch.

As there is no global arthroplasty register, it is not possible to obtain the overall complication rate for total hip replacement. The literature indicates complication rates between 2 percent and as high as 30 percent. Despite the large discrepancies in the available estimates, it is safe to assume that the total number of complications is a 5- or even 6-figure number as a result of the more than one million replacements performed each year. Because of this we decided – in the spirit of an open exchange of information on behalf of optimal patient care – to devote the present issue of CeraNews to the subjects of outcome, complications and preventive measures.

Our knowledge of the important parameters responsible for total hip replacement complications is becoming more detailed and precise. In addition, the surgical techniques themselves are becoming ever more refined. Unsatisfactory clinical results and complications such as postoperative pain and the development of squeaking can be minimized or avoided altogether with the help of these advances.

It is a well-known fact that proper implant positioning and fixation play a crucial role. Aseptic loosening continues to be one of the most common of hip replacement complications. Particle disease triggered by wear debris is one of the major causes. Hypersensitive reactions to metal and bone cement components are increasingly being discussed as sources of postoperative complications. The use of ceramic components allows surgeons to minimize, or even entirely rule out, a number of these risks. This is becoming ever more important as the average age of patients at the time of initial hip replacement continues to decrease, they generally have higher activity levels and general life expectancy continues to increase. Ceramic materials introduce the possibility of achieving survival rates that are at least as long as the life expectancy of the patients themselves.

Yours sincerely,
Heinrich Wecker

The Five Million Mark

A Short BIOLOX® Success Story

High performance ceramics are generally utilized when other materials begin to show their limitations. Ceramics are harder, more resistant to wear and they exhibit greater biocompatibility than other materials. The first material-related clinical complications were already commonplace in the pioneering days of arthroplasty. As they were induced by components made of metal and polyethylene, the stage was set for ceramic components. Their use in THR has shown outstanding clinical results. To date, more than five million BIOLOX® components for total hip replacement have been produced.

The unprecedented success of arthroplasty began in the 1960s with Charnley's low-friction principle. However, as the number of patients receiving hip replacements increased, the core problem of his artificial hips became ever clearer: the smooth gliding of the metal ball head in the polyethylene cup liner came at the experience of high rates of wear that then led, over time, to aseptic loosening. In the early 1970s, Pierre Boutin in France and Heinz Mittelmeier in Germany became the first surgeons to replace the metal ball head with a ceramic head so as to reduce wear. They also experimented with the use of ceramic cup liners.



Pierre Boutin (left) and Heinz Mittelmeier introduced ceramic components to the field of arthroplasty.

There were only a handful of companies who were able to manufacture such components in the required quality. CeramTec introduced its aluminum oxide BIOLOX® to the market in 1974. This product represented the standard for ceramic ball heads for more than 20 years, until it was replaced in 1995 by a more advanced material, BIOLOX®*forte*, exhibiting smaller grain size and even better mechanical properties. In 2002, CeramTec introduced BIOLOX®*delta* to the orthopaedic surgical community. This ceramic material provides surgeons with the option of using a material that combines the advantages of aluminum oxide and zirconium oxide without the disadvantages of the latter. In addition to the usual properties of ceramic components, BIOLOX®*delta* also exhibits very high fracture strength and very high resistance to crack propagation.



Ceramic-on-ceramic articulation components from the 1970s

Today approximately 75 percent of the ceramic components used in hip arthroplasty devices implanted around the world are manufactured by CeramTec. This year the five-millionth component made of a BIOLOX® material will be implanted – a clear confirmation of excellent material properties and clinical performance. In total hip replacement they are used either in wear couples of ceramic-on-polyethylene or ceramic-on-ceramic. More than 1,000,000 components have been implanted of the latter, supporting the increased acceptance not only of ceramic ball heads but also of ceramic inserts around the world.

Complications in Hip Arthroplasty and Possible Contributing Factors

M. Azizbaig Mohajer, Ch. Tschauner, and R. Graf

Freedom from pain, enhanced mobility and improved joint function are the most important goals of modern, routine hip replacement. The figures presented in the literature on the frequency of complications following hip replacement surgery vary considerably. Depending on the particular studies, complications are seen to arise in 2.2% to 27.5% of all replacements.

General complications and specific arthroplasty-related complications may occur during hip replacement surgery. General complications such as thrombus, pulmonary embolism, wound-healing disorders and scarring can occur during or after any major surgery. Significant specific complications include injury to nerves and blood vessels, luxation, infection, bone fractures (diaphyseal fractures), aseptic loosening and periarticular heterotopical ossification.

1) The literature indicates that the frequency of **intraoperative nerve injury** lies between 0.6% and 3.7%. More than 80% of all cases involve injury to the N. ischiadicus or the N. peroneus. Injuries involving the N. femoralis are significantly less common. The authors of one study report a more than 2.3% risk of injury to the N. femoralis (10 of 440 patients). The surgical technique itself is seen as the cause of such injuries (e.g. poorly placed retractors on the acetabulum in the case of anterolateral access). Injuries to N. peroneus and N. pudendus are also described in the literature.

Intra- and postoperative ischemia, mechanical deformations (tearing and pressure injuries caused by retractors), bleeding and hematoma formation, direct trauma (cuts and incisions), nerve-cerclage wire entanglement and luxation are described in the literature as causes of postoperative nerve damage. It is important to keep in mind that the risk of nerve lesions (nerve distraction) increases significantly in the case of intraoperative leg lengthening of more than 3 to 4 cm. Nerve damage may also occur in the form of hip-extensor and knee-extensor paresis, hypoesthesia and diminished patellar reflex.

2) **Vessel lesions** are rare complications that are associated with hip replacement surgery and about which little has been reported in the literature. In the context of a retrospective study, vessel lesions were diagnosed in 0.08% of 9,581 primary hip replacements within 13 years. Reinforcing press-fit

cups with screws may pose a risk. Here, injuries to branches of the iliac vessels and obturator vessels have been reported. Vessel lesions may also occur as a result of poorly placed retractors and resected osteophytes and joint capsules. As discussed in various reports, delayed diagnosis is regarded as a risk.

3) The literature suggests that the frequency of postoperative **luxation** is between 1% and 7%, with special risk groups including patients who have undergone previous surgery, patients with femoral neck fractures, patients with congenital hip dysplasia, and patients undergoing intraoperative leg lengthening of more than 3 cm. Luxation occurs four times more often in women than men. Alcoholics represent a further risk group.

The change from a head diameter of 28 mm to a larger diameter of 32 mm or more is associated with a significant reduction in the incidence of luxation, especially in the risk groups.

The surgical technique itself warrants special attention. Higher rates of luxation are associated with dorsal access, steep cup positioning, increased cup anteversion and detachments of the greater trochanter. An intact soft-tissue mantle is an important stabilizing factor. Intraoperative attempts to shorten the leg in cases of a preoperative difference in leg length often lead to a weakening of the joint closure, and thus to an increased risk of luxation. In contrast, leg lengthening, particularly in cases of dysplasia coxarthrosis to compensate for differences, is often unproblematic. The best protection against postoperative luxation is to instruct the patient not to exceed a 90° flexion in the affected hip during the first 6 weeks after the operation.

4) **Infections**, which are one of the more feared complications following hip replacement surgery, occur at a frequency of 0.2% to 7.3%. Gram-positive bacteria such as staphylococcus aureus are detected more frequently than gram-negative bacte-



Mohammad Azizbaig Mohajer, Christian Tschauner, and Reinhard Graf of the Orthopaedics Unit at the Stolzalpe State Hospital in Austria

ria. Cephalosporins (of the first and second generation) administered preoperatively offer suitable protection against bacterial infection. Early infections are those that manifest themselves within 6 weeks of surgery. While these necessitate revision (synovectomy), they do not necessitate the removal of the implant (although it may be necessary to change the polyethylene inlay). In contrast, late infections (i.e. those manifesting themselves after 6 weeks) make the removal of the replacement hip unavoidable because of the need to combat the infection.

5) Diaphyseal fractures can largely be avoided by applying adequate surgical techniques. According to our own current statistics (made available by the Stolzalpe Hospital in Austria), the rate of femoral stem fissures occurring during hip replacement surgery during the last 4 years was less than 0.5%.

6) Aseptic loosening continues to be a problem in hip arthroplasty. Clinical and laboratory testing (including leukocyte scintigraphy) can be used to rule out infection as the cause of the usually load-dependent (and seldom load-independent) hip pain. Revision that includes the replacement of the

prosthesis is usually unavoidable. Current data made available by the Swedish Hip Replacement Register (Annual Report 2006) suggest that aseptic loosening is responsible for 74.9% of all first revisions.

7) Periarticular calcification (periarticular heterotopic ossification = PHO) represents a special type of complication. The onset of the calcification may occur in periarticular soft tissue (e.g. in muscle tissue) weeks or months after hip surgery. If it is extensive, the calcification may cause pain and limit hip mobility (see Brooker). The postoperative administration of non-steroid antirheumatics for a period of one week represents a common form of prophylaxis. This can significantly reduce the risk of PHO. The literature indicates a reduction in the risk from 80% to around 10%.

References available from the authors

According to investigations conducted by the Patient Safety Committee of the AAOS, 368,600 patients are admitted to hospital with multi-resistant Staphylococcus aureus (MRSA) infections each year in the United States alone. The infections prove fatal for 18,650 patients. Such infections raise the standard treatment costs by 30% to 100%. Our photo shows a deep infection after THA.
(Source: CeramTec AG)



The Causes of Artificial Hip Squeaking

By N. Hoffmann, C. Weiss, M. Morlock, and A. Hothan

The occasional occurrence of hip prosthesis squeaking is an uncommon, but well-known phenomenon. All standard bearing couples appear to be affected by noise development, and even Charnley reported on the problem. Squeaking is usually difficult to reproduce and often occurs only in special motion and load situations. The ability to predictably control this phenomenon will require a better understanding of the causal relationships and contributing factors involved. The following summary offers a look at current CeramTec-supported research whose aim is to further reduce the incidence of hip replacement squeaking.

Hip Prostheses and Friction-induced Vibration

Charnley observed as early as 1979 that the presence of certain conditions could lead to squeaking in hip replacement patients. The squeaking itself is seldom permanent and tends to disappear after a few days. Owing to the tendency of the phenomenon to come and go, there is a general lack of sound clinical data on the occurrence of squeaking [KKWS08, MNJS01]. Researchers have still not been able to clearly identify the causes of squeaking or specify the primary contributing factors. However, we may assume that certain causal relationships exist between the occurrence of squeaking, the design of the artificial hip and its positioning.

Research is therefore being conducted to identify the causes of squeaking and the main factors that lead to its development. The focus of the investigations is friction-induced vibration: in numerous technical and natural systems, the vibrations that cause squeaking arise in connection with sliding motions or in connection with the transition objects make from a sticking to a sliding state. Typical examples include the sound generated by stringed instruments, the squeaking of friction brakes and even the rumbling made by an avalanche. All squeaking is based on physical mechanisms that generate a certain degree of vibration beyond the desired smooth and even sliding motion [Hof06, AA06, Hof07]. The so-called self-generating vibrations produced in this manner then lead to an acoustic epiphenomenon that we perceive as squeaking.

Research

To arrive at an initial characterization of the phenomenon, airborne-sound measurements and vibration measurements were taken in a special hip simulator.

Mechanical testing, clinical data and anecdotal reports indicate that squeaking is only generated in connection with specific movement and load configurations. The squeaking itself is manifested in a sustained perceivable sound that is dominated by a certain frequency. This allows one to clearly demarcate the phenomenon of squeaking from other phenomena such as clicking sounds. The frequency associated with squeaking is directly related to the stiffness of the bodies involved. Significant differences (e.g. relating to cup stiffness) have already been ascertained.

Norbert Hoffmann, Institute for Mechanics and Sea Engineering, Hamburg-Harburg Technical University



Michael Morlock, Institute for Biomechanics, Hamburg-Harburg Technical University



Modelling and Simulation

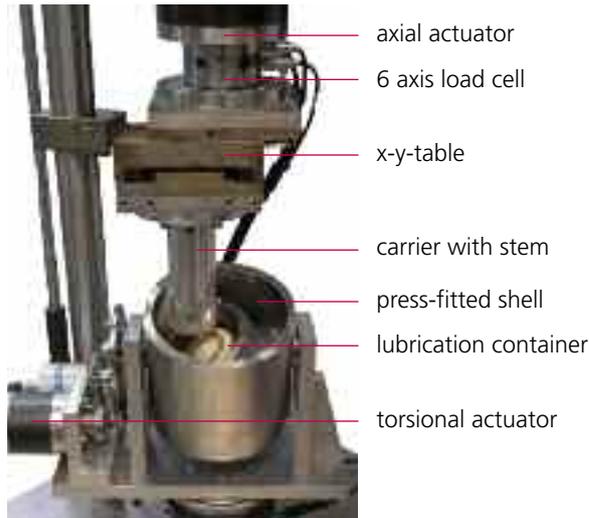
The physical mechanisms at work on the sliding surface itself are difficult to examine experimentally. A computer-assisted computing model was developed in order to gain a better look at these mechanisms, and in order to be able to vary the contributing factors independently of the experimental conditions. This enables one to examine joint components associated with specific movement and load configurations for the development or absence of squeaking.

The initial results show that an increased risk of squeaking exists whenever individual components show a certain proximity to their own frequencies. This means that individual components may then interact with one another beyond the area of the sliding surface.

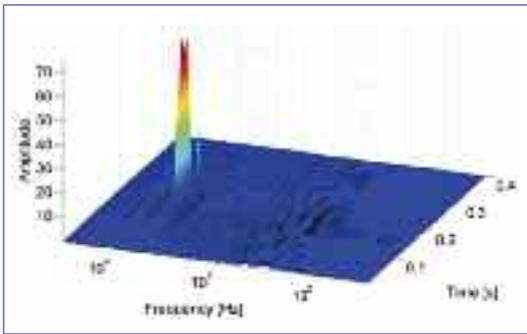
Summary and Outlook

While the experimental and simulation-supported research that has been conducted so far indicates that the occurrence of squeaking in artificial hips is a multifactorial phenomenon, numerous relationships have not yet been sufficiently explained and are in need of further investigation.

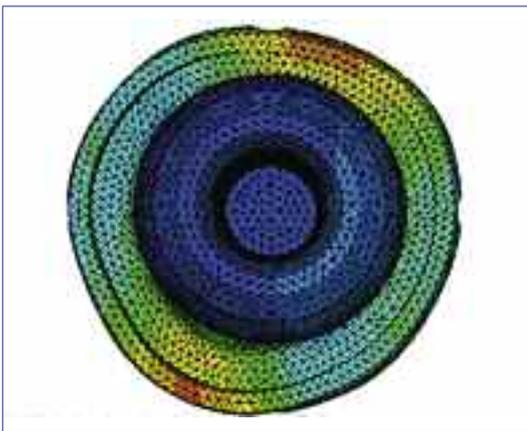
Given that squeaking only occurs in certain very specific movement and load parameters, a step-by-step approach to delimiting the critical parameter areas is being taken so as to enable an effective means of intervention for designers and clinicians. The research is being conducted in the context of a global project involving various renowned laboratories. Those participating include Richard D. Komistek (University of Tennessee), Stephen Murphy (New England Baptist Hospital), Seth Greenwald (Cleveland Clinic) and Bill Walter (Sydney).



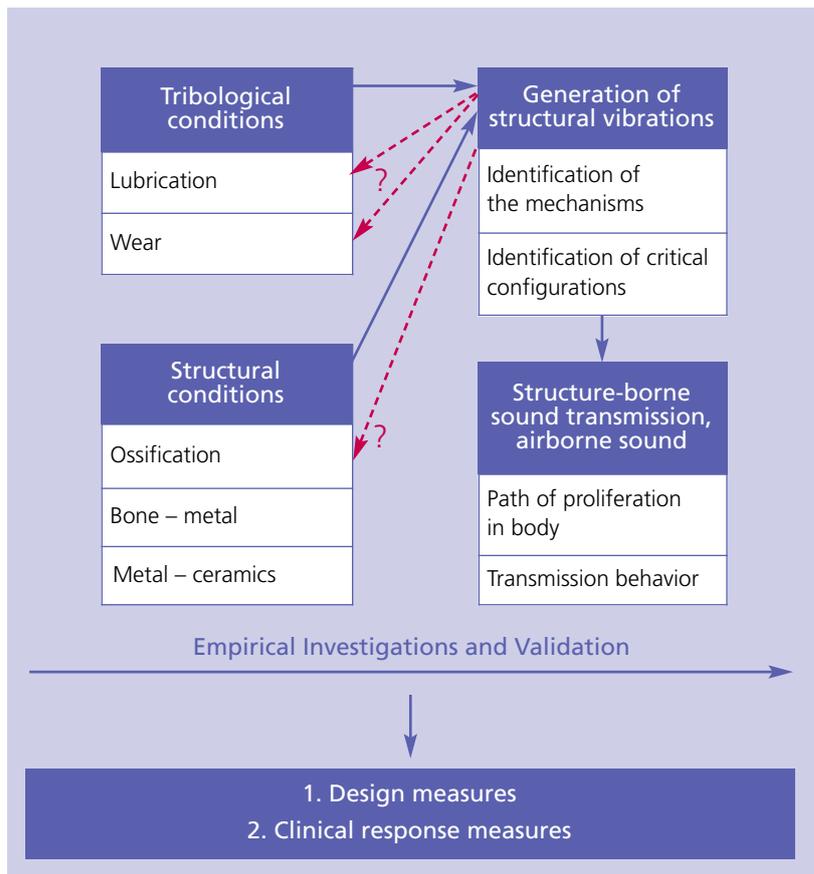
Hip simulator for acoustic measurements:
Movement and load cycles are examined for the production of vibrations and noises using laser vibrometry and the sensory analysis of airborne sound.



Time-frequency representation of a squeaking sound:
A squeaking sound arises and ceases (amplitude axis) in the course of the movement cycle (time axis).



Sample calculation result:
Maximum deformation of a cup during squeaking. The cup moves in a certain relation to the ball head which gives rise to a coherent vibration perceived as a squeaking sound.



Chains of action and investigational method:
In addition to structural dynamics and acoustics, tribological factors and ossification also influence noise development.

Literature: [AO06] A.R. AbuBakar and H. Ouyang. Complex eigenvalue analysis and dynamic transient analysis in predicting disc brake squeal. *Int. J. Vehicle Noise and Vibration*, 2:143–155, 2006. [Cha79] J. Charnley. *Low friction Arthroplasty of the Hip*. Springer, 1979. [Hof06] N. Hoffmann. Friction induced vibrations. *CADFEM Infoplaner*, 2006. [Hof07] N. Hoffmann. Linear stability of steady sliding in point contacts with velocity dependent and LuGre type friction. *J. Sound Vib.* 301:1023–34, 2007. [KKWS08] J.C. Keurentjes, R.M. Kuipers, D.J. Wever, and B.W. Schreurs. High Incidence of Squeaking in THAs with Alumina Ceramic-on-ceramic Bearings. *Clinical Orthopaedics and Related Research*, Springer New York, 2008. [MNJ+01] M. Morlock, R. Nassutt, R. Janssen, G. Willmann, and M. Honl. Mismatched wear couple zirconium oxide and aluminum oxide in total hip arthroplasty. *The Journal of Arthroplasty* Vol. 16 No. 8:1071–4, 2001. Acknowledgement: This study has been supported financially by CeramTec AG.

Tricks of the Trade: Avoiding Problems with Ceramic Components in THR

Jonathan P. Garino, MD

The use of modern, modular ceramic components has increased dramatically over the past few years. With this increased usage, there have also been refinements in the technique of constructing the devices along with engineering improvements that have resulted in enhancements which have improved the installation. But since these devices do not behave like polyethylene, the surgeon deciding to use ceramic components in a THR for a patient should keep several guidelines in mind to reduce the risk of complications.

Conservative Neck Cut

Compared with their metal counterparts, ceramic ball heads are available with a limited size range for neck length, from approximately 0 mm to 8 mm. Larger ball head sizes, such as 36 mm, have a larger range of up to 12 mm. It is advisable to use a conservative neck cut and remove more neck if necessary after initial trial reductions in order to properly restore leg length.

The Cup in a More Horizontal Position

Ceramic-on-ceramic components, although very strong, are optimized for load bearing at 45° degrees or less on the acetabular side to evenly distribute the forces over the greatest amount of surface area between the ball head and the cup. Because the greatest amounts of loading with weight bearing takes place with the hip in extension, placement of the cup at a more horizontal angle improves this load transfer. Minimizing rim overload with horizontal placement can potentially reduce any later chipping of the ceramic rim.

Increased Anteversion

With increasing horizontal orientation more of the cup is pulled from a posterior to a superior position leaving less posterior coverage as the horizontal orientation of the cup increases. This can be compensated for by increasing the anteversion of the cup. In addition ceramic liners do not have anteverted, face changing or offset options like polyethylene, increasing the importance of precise cup placement. Be aware that proper intra-operative testing for stability is the key to optimising patient function while avoiding impingement and dislo-



Left (preop): 60-year-old patient showing coxarthrosis with femoral head necrosis and caudal osteophytes on the rim of the cup (pincer impingement); right (postop): treatment with ceramic-on-ceramic bearing (BILOX®delta) after osteophyte removal (ball head size: 36 mm) Source: H. Röhrig, M.D., Bonn University Orthopaedic Clinic



Jonathan P. Garino, MD, Associate Professor of Orthopaedic Surgery at the University of Pennsylvania and Director of the Joint Reconstruction Center at the Penn Presbyterian Medical Center

cation. This is particularly applicable to the posterior approach. Proper and aggressive testing for anterior instability is critical. This is accomplished by bringing the leg into extension and external rotation.

Use of Trial Liners and Ballheads

The tapers on the cup and stem side of the articulation are to be used only once with ceramic components. Therefore it is very important that trial liners and ballheads be used at the time of trial reduction and that proper manipulation of these trials take place before the final implants are opened. This also facilitates minor cup adjustments should any changes in cup position be necessary. Once a surgeon is satisfied with the stability and range of motion with the trials, then he or she can comfortably move on toward impaction of the ceramic components.

Removal of Osteophytes, Acetabular Wall and Scar Tissue – Avoid Bone and Soft Tissue Impingement

Occasionally increased cup anteversion drops the anterior edge of the cup slightly below the top of the anterior wall or anterior osteophytes. In some instances, impingement on these anterior structures leads to a suboptimal degree of stability. In an effort to enhance the stability in this situation, careful resection of the bone responsible for impingement can be effective in further optimizing stability.

Cleaning, Drying of the Tapers and Placement of the Ball Head and Liner

The taper surfaces of both the stem and the shell are critical load transfer areas and need to be fully protected from damage and made clean and completely dry before the ceramic components are introduced. The ceramic acetabular liner can be slightly difficult to place. The relatively gentle taper



Impingement and dislocation are a frequent complication in younger and more active patients. Source: W. Mittelmeier, Orthopaedic Clinic, Rostock University, Germany

can allow for “cocking” of the liner in a malposition fashion. There are tools included in instrument sets to assist in placement of the liner, and they are quite helpful. Alternatively placement of these liners by hand is usually relatively easy. In either case, placement can be confirmed with a simple running of the finger around the rim to be sure that the component has been pressed evenly into the taper and that no area of the taper is deeper into the cup relative to any other area.

Ceramic Component Impaction

Currently, the tapers on the acetabular and femoral sides have been machined with a special grooved surface with a series of peaks and valleys designed to transfer loads in a proper manner. Meeting the proper tolerances necessary for ceramics, these grooves do it in a very efficient fashion. When the ceramic piece is inserted and subsequently impacted there is a relative flattening of the peaks and a very even distribution of the forces throughout the entire surface area circumferentially around the taper of the ceramic piece. These components should not be simply twisted on or placed without impaction because they can subsequently shake loose or not undergo the full seating required to optimize their force transfer.

Performing a Thorough Soft Tissue Repair (Including the Capsule Whenever Possible)

A thorough closure will assist in providing the desired stability required for a good long term result. Proper tissue coverage and tension will reduce the possibility of dislocation while enhancing the stability of the THR.

Summary

Modern technology, careful preoperative planning and meticulous intraoperative technique are required in order to place the components in the ideal position for the patient. These are the key elements to be kept in mind when implanting devices that give us great confidence and result in few complications in the younger, more active patient.

Ceramics in THA – A comprehensive DVD

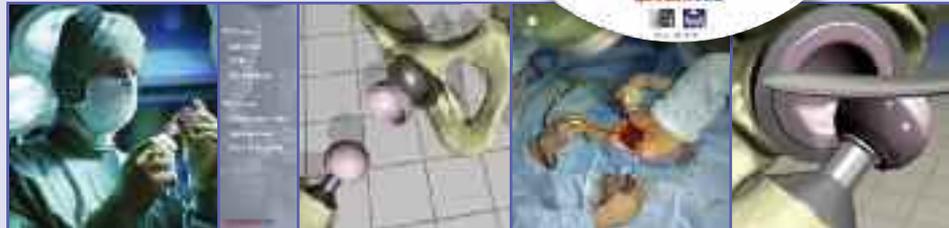
The new CeramTec DVD on the use of ceramic materials in arthroplasty is now available from the company upon request. The DVD contains comprehensive information and is primarily addressed to physicians who wish to learn more about this subject area.

The DVD includes:

- Surgery videos and instructional animation
- Tips and tricks
- Instructions on the handling of ceramic components
- A general guide to material combinations
- Facts from the field of materials science
- Reference library, including the Proceedings of the BIOLOX® Symposia, Bibliography



www.biolox.com/biolox-ceramics-dvd



“Eurotaper” Not a Standard

In response to the recent reappearance of the term “Eurotaper” on the market, we, as the market leader, would like to take the opportunity of pointing out that the term and the cone (taper) it refers to do not represent a standard of any sort. The term “Eurotaper” was first used in the market a decade ago in an attempt to classify taper types according to a common standard.

However, the goal of establishing a standard has clearly not been reached. Despite the identical sizes involved, there are numerous other technical parameters that influence the interface. It follows that there is no such thing as a “Eurotaper” technical standard. Those who come across the term “Eurotaper” today are advised to exercise a good deal of caution and healthy skepticism as it is necessary to make sure that the taper is designed and tested to match the ball head.

Zimmer Inc.: Note about Metal-on-Metal Bearings

In an interview that appeared in CeraNews 3/2007, Professor Lazennec of the La Pitié-Salpêtrière hospital in Paris describes his clinical experience with metal-on-metal bearings made of high-carbon alloys.

Given that these clinical results depart from those of other clinical studies involving such bearings, we (Zimmer GmbH Winterthur, Switzerland) regard it as appropriate to give others an opportunity to present some statements of metal-on-metal articulation involving high-carbon alloys.

These statements are available at: <http://www.zimmerorthopedics.ch/ctl?template=MP&action=1&op=global&id=560&xm=pos>

AAOS Highlights

With over 13,000 orthopaedic surgeons attending, the AAOS meeting of 2008 in San Francisco was once again the biggest event of the specialism world-wide. Among the most widely discussed clinical trends in joint reconstruction were the treatment of more active and younger patients, techniques for revision surgery, alternative bearing surfaces, resurfacing systems and less invasive surgery.

Resurfacing vs. THA

According to **David R. Marker** et al. (Baltimore, USA) early results (2–5 years) for hip resurfacing (HR) were comparable to those of standard THA. The mean HHS score was 90 points for the HR group and 91 points for the THA group. **Andrew John Shimmin** et al. (Windsor, Australia) stated the same after conducting a comparative study of function. The results of the gait analysis showed no difference between the THA and HR groups. This study did not show a significant superior functional outcome for HR when compared to THA.

HR doesn't have an advantage in the earlier return of function according to **Bernard N. Stulberg** et al. (Cleveland, USA). They compared the results from 337 unilateral HR patients to results from 266 unilateral ceramic-on-ceramic (CoC) THA patients that had similar baseline characteristics. At 6 weeks the HHS for the HR group was statistically worse than for the THA group. Resurfacing patients reported slightly more pain than CoC THA patients. At 6 and 12 months post surgery the scores were higher for the HR group, but without statistical significance. These differences disappear at 24 months after surgery.

Groin pain after HR appears to be more common than after standard THA. **Ahmad Bin Nasser** et al. (Verdun, Canada) reported that 4.3% of THA patients complain of groin pain/iliopsoas tendonitis. They evaluated 106 HR hips (102 patients) at a mean follow up of 18.8 months (range 6–60). 24% of the patients had ongoing groin pain. Surgical approach, implant positioning/design and reaction to metal wear debris seem to play a role.



Metal-on-Metal

Taek Rim Yoon (Jeonnam, Korea) compared the serum ion levels of 6 patients with metal-on-metal (MoM) THA and chronic renal failure with that of 6 patients with normal renal function after MoM THA. Patients with renal failure showed more than 100-fold higher serum cobalt concentrations than the control group.



Brant Harradine and **Thomas Parker Vail** (San Francisco, USA) presented a synopsis of the latest clinical data on MoM bearings: a study of **Alexander Gröbl** et al. (Vienna, Austria) reported 1.3% proximal lesions in femurs and 2.6% in the acetabulum at 10 years, but without subsequent revisions. **Youn-Soo Park** et al. (Seoul, Korea) reported that after a minimum follow-up of 24 months 5.9% of the patients had an early osteolysis localized to the greater trochanter. The histologic examination of retrieved periprosthetic tissues showed perivascular infiltration of lymphocytes and mononuclear phagocytes, which were similar to the histopathological changes around MoM joints reported by **Willert** et al. in 2000.

Harradine and Vail conclude: Women seem to be more susceptible to hypersensitivity than men. MoM is accepted to be contraindicated in cases of renal dysfunction and for women of child bearing age.

Joshua J. Jacobs (Chicago, USA) found that very large numbers of nanoparticles with high specific surface areas are largely responsible for the release of metal ions. These can interact with proteins or anions in the local bodily fluids producing specific metal-protein complexes or inorganic salts or oxides. High levels of debris due to component malposition and/or impingement cause metallosis often associated with large areas of necrosis and periarticular masses.

Fractured Crosslinked Polyethylene

Jevan Furmanski et al. (Berkeley, USA) reported of 4 clinically failed, fractured XPE liners (irradiated with 50–100 kGy) from different manufacturers. The liners were fractured along the rim. All patients reported noises, leading to revision surgery after 4 months to 5.4 years in vivo. The liners showed signs of impingement that seem to be the cause of the fractures. The authors stated that XPE is more susceptible to fracture than conventional PE and suggest to modify the design specially on the rim area.

Ceramic-on-Ceramic

James A. D'Antonio (Moon Township, USA) summarized the specifics of CoC bearings and stated that they have no potential for ion release. Ceramic debris is less reactive than polyethylene or metal. Femoral head separation in the acetabulum during gait is highest in metal-on-polyethylene and smallest in CoC. A 10 year prospective randomized and controlled study has demonstrated greater survivorship of CoC (97%) compared with metal-on-polyethylene (91.3%)

Revision for the Long Term

Dr. Frederic Borrione is a Marseille-based orthopaedic surgeon specializing in knee and hip arthroplasty. Revision arthroplasty is a special focus of his clinical and scientific activities.



Why are hip revisions one of the special focuses of your work?

I have been using mainly ceramic-on-ceramic bearings in my daily work for many years. A while ago I conducted an extensive review of the literature. I was astonished to find that there was not a single article that addressed the subject of hip revision using ceramic-on-ceramic bearings. I decided then to conduct a study on my own, involving 25 cases and a follow-up investigation at 3 years. Problems with revision bearings generally turn up within the first 18 months after surgery. I performed my first revision with a ceramic-on-ceramic bearing in February 2001.

What were the reasons for the revisions?

Twenty-two cases were “classic.” These included 17 cases of aseptic loosening in both components, 4 cases of pain and 1 case of instability. The remaining 3 revisions had become necessary on account of implant failure, including the fracture of a ball head made of zirconium oxide.

Why did you select ceramic-on-ceramic bearings for the revisions?

The answer can be found in the epidemiological analysis of the reasons for the revisions. The most common factor – in this particular study and in general – is aseptic loosening in conjunction with osteolysis. It is therefore logical to select a bearing – a ceramic-on-ceramic bearing – whose resistance to wear eliminates the source of the complication. In the case of revision made necessary by a fractured ceramic component, one cannot rule out the possibility that ceramic particles will remain in the joint no matter how thoroughly the site is cleaned. Ceramic-on-ceramic bearings are obligatory here because they are the only bearings that permit to avoid the risk of early wear.

What do you do when the cup is loose, but the stem is intact and well-fixed?

Surgeons performing isolated cup revisions of the sort necessary on account of instability used to face a certain problem: the manufacturers always advised against placing a ceramic ball head on a stem taper that was to remain in situ, especially whenever the taper showed signs of damage. This is also the official recommendation of the Medical Device Agency (MDA) in Great Britain. In the meantime,

Dr Frederic Borrione

however, there is a technical solution involving the placement of a titanium sleeve over the largely intact taper. A special revision ball head of ceramics is then placed on the sleeve. Full system stability is maintained.

What is your recommendation regarding the use of ceramic-on-ceramic bearings for hip revisions?

As a result of loosening and its mechanical impact, revisions almost always involve acetabular defects that make it necessary to use larger cups. It follows that the use of larger ball heads does not present a problem. In our study, 22 revisions were carried out using ball heads whose diameter was at least 32mm. This allows the risk of impingement between the neck of the stem and the cup to be minimized. Revision using ceramic-on-ceramic bearings is especially advantageous for young, active patients who show good muscle tone and bone quality. I think that the Paprosky Acetabular Defect Class IIc represents the limit for this method. Patients can be treated with conventional cups that permit the use of a ceramic-on-ceramic bearing up until this defect class. One should definitely use this option if it is available.



Reason for revision: loosening on both sides in a 44-year-old female patient



Uncemented revision with femoral osteotomy and ceramic-on-ceramic bearing

Market Opening for South America

Access to the Brazilian market for ceramic joint components was limited up until recently. Just a few weeks ago, the Brazilian Health Agency (ANVISA) issued implant manufacturers in Brazil the necessary approval to use these components. Expert **Daniel Stainer**, who has been employed by CeramTec in Brazil since 2007, was just the right person to take charge of managing the approval process. He has a university degree in chemical engineering and a Master's degree (M. Sc.) in engineering, where he focussed on ceramics. From 1998 to 1999, he conducted research funded by the Krupp Foundation in the area of ceramic materials engineering at the RWTH University in Aachen, Germany.

He can now concentrate exclusively on his new assignment of informing physicians and implant manufacturers about the use of ceramics in the field of arthroplasty and marketing BIOLOX® products in Brazil. What is more, he has already taken a look beyond the borders of his country. "The Brazilian market has the status of a reference for manufacturers in all of South America. Those who are able to establish themselves here will also have access to the remaining countries on the continent," he explains. Stainer will be representing CeramTec this year at the Brazilian Orthopaedic Congress in Porto Alegre.



Daniel Stainer, Brazil

Easy Persuasion

Roger Sparks is one of the true veterans in the field. In 1981 he began work in the area of orthopaedic implants and helped a leading manufacturer establish a solid business foundation in New Zealand. He has held various positions in the field ever since and has more than 25 years of experience when it comes to supporting physicians and surgical staff in the handling of med-tech products. Since the beginning of 2008, he has had the opportunity of using this experience in the organizing of training programs relating to BIOLOX® components. His daily responsibilities also include maintaining an intensive exchange with representatives of various implant manufacturers.



Roger Sparks, New Zealand

In addition to his home country of New Zealand, he is also responsible for neighboring Australia. He participates in all important orthopaedic events on the fifth continent and maintains close contact to leading representatives in the field throughout the South Pacific. "Australia is one of the few countries with its own arthroplasty register," he emphasizes. "The awareness on the part of Australians in the field for the real problems and opportunities associated with joint replacement is therefore very pronounced. The well-documented clinical results offer clear testimony of the advantages of ceramics. That makes my job of persuading people a lot easier."

■ **August 24–28**
SICOT
Hongkong, China

■ **September 16–19**
BOA
Liverpool, UK

■ **September 18–20**
SPLLOT
Brescia, Italy

■ **September 24–26**
Hip Toulouse 2008
Toulouse, France

■ **October 1–3**
SECOT
Valencia, Spain

■ **October 1–4**
International Society for
Technology and Arthroplasty
Seoul, Korea

■ **October 9–11**
SIGASCOT
Bari, Italy

■ **October 12–17**
Australian Orthopaedic Association (AOA)
Hobart, Australia

■ **October 19–23**
NZOA Annual Meeting
Napier, New Zealand

■ **October 21–24**
Bioceramics
Buzios, Brazil

■ **October 22–25**
Deutscher Kongress für Orthopädie-
Unfallchirurgie
Berlin, Germany

■ **November 13–16**
Chinese Orthopedic Association
Suzhou, Jiangsu, China

■ **November 7–8**
Hip and Knee Surgeons Meeting
Dallas, USA

■ **November 10–13**
SOFOT 2008
Paris, France

■ **November 12–15**
CBOT
Porto Alegre, Brazil

■ **November 23–27**
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Fabrikstr. 23–29
D-73207 Plochingen, Germany
Phone: +49 / 7153 / 6 11-828
Fax: +49 / 7153 / 6 11 838
medical_products@ceramtec.de
www.biolo.com

Your contact:

Paul Silberer
Phone: +49 / 71 53 / 611 522
p.silberer@ceramtec.de

Text and layout:

LoopKomm Infomarketing
Terlaner Straße 8
D-79111 Freiburg i. Brsg.
Phone: +49 / 7634 / 55 19 46
Fax: +49 / 7634 / 55 19 47
mail@loopkomm.de
www.loopkomm.de

Concept and coordination:

Sylvia Usbeck
Heinrich Wecker

CeramTec
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