

# CeraNews

## Pioneer in Ceramics

A quarter century of innovation in knee arthroplasty

**Professor Hinorobu Oonishi is one of the most prominent orthopaedic surgeons of the world. He has contributed enormously to the scientific development of joint replacement. He first used ceramic components in total knee replacement in 1979. Today, he has the longest term clinical experience with this form of arthroplasty. CeraNews asked him about clinical practice and results.**



Prof. Hinorobu Oonishi, M. D., Ph. D., is the Head of the H. Oonishi Memorial Joint Replacement Institute in Osaka, Japan.

**How many total knee arthroplasties with ceramic components have you performed?** In total it was more than 600. Total knee arthroplasty is not very common in our hospital, only between 10 and 20 per cent of all arthroplasties are knee replacements. And only about 20 hospitals in Japan use ceramic components. The total number of implanted ceramic knee components is around 8500. By now, we are using the third generation of knee implants.

**What are the main differences between the generations?** In 1981, after finishing the experimental phase, we started with ceramic femoral and tibial components with an UHMWPE insert. The rates of sinking and loosening were very high with cementless, however extremely low with cemented fixation. As the tibial component was quite thick and brittle, we changed to a titanium alloy tibial component in the second generation, implanted first in 1990. The femoral component was ceramic, and we used cemented fixation for both, achieving far better results. In the third generation, starting in 1993, a porous coating of ceramic beads was applied to the femoral component in order to improve cement fixation. Since 2001 we have used zirconia for knee replacement because of the greater strength of this material in comparison to alumina ceramics. With this change of material we

were also able to reduce the thickness of the component which is now identical to that of the metal variety.

**How about survival rates?** We have seen implants that are still in place after 25 years. In the third generation implants, with 6 to 14 years of follow-up, we have observed no case of sinking or loosening, a low occurrence of radiolucent lines and no case of osteolysis.

**Why do you prefer ceramics to metal?** Because of its significantly lower wear rates especially in the third body wear condition, its superior hydrophilic properties, the particular hardness and the proven bioinertness of the ceramic material. In primary TKA I use only ceramic femoral components.

**There are no contraindications?** No. In the case of large bone defects we use Hydroxyapatite (HA). I also use a special cementing technique, applying a granulous HA smear to the bone first. Thus, we achieve immediate mechanical stability and bone ingrowth into the HA a week after the operation. We call this interface bioactive bone cement. I do the same in hip arthroplasty since 1986.

**Can you tell us more about this technique?** I am very interested in both bioinert and bioactive ceramics. I have used intelligent bioactive bone cement technique by interposing HA granules between bone and bone cement at cementation for 20 years in 6500 cases. During this time we have seen only slight radiolucent lines and little osteolysis in very few cases. A longevity of over 40 years could be expected from these clinical results.

**Do you use ceramics in the hip, too?** Yes. I have been using ceramic ball heads for thirty years. Today, I combine them with crosslinked Polyethylene (XPE). We

11<sup>th</sup> BIOLOX® Symposium in Rome

3



Asian Perspectives

6



The World of Ceramics

7



## Focus on Reliability

### Dr. Heike Idink Oversees Quality

Mineralogist Dr. Heike Idink earned her doctoral degree in the field of technical ceramics and then completed an advanced program to become a quality management engineer. Having worked for more than ten years in the med-tech sector, her experience with complex specifications and manufacturing processes is accordingly extensive. "Our quality management begins at the initial stage of product development," she explains. "This is where the quality criteria, as well as the means of their verification, are established for each product."

The production processes are required to conform to Good Manufacturing Practice, as defined by the certifying institutions. Ensuring this entails the validation of each individual production step. Such compliance is regularly checked by the U.S. Food and Drug Administration (FDA) and the Deutsche Gesellschaft zur Zertifizierung von Managementsystemen (DQS). In addition to the FDA and the DQS, the endoprosthesis manufacturers supplied by CeramTec, also inspect our manufacturing processes. "The continual change of perspective that results from the regularly alternating external and internal inspections enables us to go about our work without blinders and to guarantee the fulfillment of all essential prerequisites," Dr. Idink explains. "Beyond this, we naturally also inspect the products them-



Dr. Heike Idink earned her doctoral degree in technical ceramics and is now responsible for quality management in the Medical Devices Division.

selves. Each individual component that we manufacture is required to pass extensive testing before it is released for shipment to the customer companies."

One of the key elements of the Quality System is the "Design Verification Testing" that CeramTec offers its customers. It consists of a thorough inspection of the interfaces between the ceramic and the metallic components, i.e. between the cone and the ball head and between the inlay and the cup. This begins with an exact measurement of the relevant dimensions. After the components to be tested are approved as meeting the design specifications they are then assembled and subjected to 20 million load cycles fatigue test. In addition a series of further tests (lever-out, push-out, rotational stability and burst tests) complete the verification of the design. The result of the efforts coordinated by Dr. Idink ensure that the product designs are safe and effective products for both physician and patient.



## Interview (continued)

have had very good results even with conventional PE, probably due to the lower average body weight of Japanese patients as compared to western patients. If using XPE it should be used with a ceramic ball head, because of the excellent surface properties of ceramics. With this combination I expect no significant wear problems at all.

**Back to the knee - you also made retrieval studies. What can you say about the in-vivo performance of ceramic femoral components?** With ceramic femoral components in the load bearing parts of the PE liner, the surfaces were smooth and burnished without scratches and pits. With a Co-Cr alloy femoral component we observed more and deeper scratches as well as a higher occurrence of the folding phenomenon. Generally the wear pattern with ceramic femoral components is far more favorable than with a metal component.

**What about economic considerations?** There is no difference between the prices of metal and ceramic components in Japan.

**What do you think about the future in knee arthroplasty generally? Which problems still have to be solved?** As the ceramic knee has an intricate shape and is

brittle, we need new materials consisting of a metallic base with a stable ceramic surface or new ceramics with higher strength.

**What are the major trends in TKA and THA in general and concerning the use of ceramics in Japan?** The number of the ceramic knees used in Japan is increasing. About 10 per cent of all the TKAs is performed with ceramic components at present. In Ceramic/Ceramic THA the 32 mm head size is better than the 28 mm. As people in Japan in general are smaller than in the west, the indication is limited, though.

**What is your take-home message from the BIOLOX symposium in Rome?** The BIOLOX Symposium is very important to spread the understanding of the ceramics in orthopaedics as an excellent material all over the world.



Heinrich Wecker is the Business Manager for Central Europe at CeramTec's Medical Product Division.

## Dear Reader

The BIOLOX symposium in Rome exceeded all of our expectations. We played host to more participants than ever before and we received much praise – both on our feedback questionnaires and in personal remarks – for the symposium's high scientific level and its outstanding organization.

This success was made possible by the congress presidents, Prof. Francesco Benazzo and Prof. Francesco Falez. They succeeded in attracting outstanding speakers and panelists from Italy and around the world that presented current and exciting scientific information. Ceramics, of course, was one of them, as well as many other aspects of arthroplasty.

New endoprosthetic concepts, innovative products and fascinating research projects were the subjects of spirited discussion in an open and interdisciplinary forum. Participants enjoyed a unique opportunity to hear expert responses to a comprehensive range of questions in the field of tribology. Light was shed on various aspects of hip resurfacing. Biomechanics and molecular medicine were discussed by prominent researchers. Experienced surgeons offered numerous tips and tricks drawn from their clinical experience. Many of the panelists and symposium participants pointed out that ceramics currently provide the best answer to numerous questions in the field of joint replacement.

Next year, we will be holding the symposium in Asia for the first time. Ceramics have come to play a vital role on the rapidly growing markets there. I am convinced that we again have a scientifically informative and fruitful congress ahead of us. It will be a great pleasure for me to have the opportunity to welcome you in Seoul in September 2007.

*Yours sincerely,  
Heinrich Wecker*

## Socratic Findings

11<sup>th</sup> BIOLOX® Symposium in Rome, 30<sup>th</sup> June to 1<sup>st</sup> July 2006

**The Symposium stood out for its extraordinary location which offered a unique view of the Eternal City, its smooth organisation and the technical quality of the program assembled by the Symposium Presidents Prof. Francesco Benazzo (Pavia) and Prof. Francesco Falez (Rome). In accordance with past tradition, the main theme of the Symposium was "Bioceramics and Alternative Bearings in Joint Arthroplasty". A series of new developments and high quality reports of pertinent clinical findings were presented along with a look at future developments in this field.**

### Large Diameters

All lecturers in this session pointed out the benefits offered by the use of large femoral heads and cups: the increased range of motion offered by them resulting in a lower risk of luxation and reduced microseparation. Such benefits are considered to be particularly valuable in the case of younger and active patients compared to conventional component designs. Prof. Jean-Yves Lazennec (Paris) reported on his experience with the use of "tripolar" ceramic bearings made of BIOLOX® *delta*. This type of bearing consists of a bipolar femoral head whose outside shell articulates against a ceramic cup insert and exhibits an extremely low rate of abrasion. Dr. Nicola Santori (Rome) reported on his experience with large femoral heads (36 mm) on short stems. He described this combination as a good alternative to resurfacing arthroplasty.

### Hip Resurfacing

The second session was devoted to the controversial subject of hip resurfacing. The session's discussions included detailed examinations of the advantages and disadvantages of the method. While the proponents of the method offered spirited rebuttals of the attacks put forward by the method's opponents, they also conceded that a number of problems with the method remain to be resolved.

### Hard-on-hard Bearings

At the third session, Prof. Youn-Soo Park (Seoul) presented a study on hypersensitivity to metal abrasion particles. The study confirmed a correlation between hypersensitivity to metal ions and osteolytic reactions. The absence of this problem in ceramic-on-ceramic bearings was cited by a number of discussants as a good reason for using ceramic when treating younger and more active patients. Dr. Alexander Olk (Erlangen) presented results obtained from the use of the DUOLOX® ceramic bipolar prosthesis. He stated that the introduction of this technology extended the range of application for bipolar treatment to include young patients. Dr. Douglas Dennis (Littleton, USA) reported on another benefit of ceramic-on-ceramic bearings that had been revealed with the help of fluoroscopic imaging: compared to all other bearings, ceramic-on-ceramic bearings exhibited the smallest degree of microseparation.

### Ceramic Knee

The pioneer of the ceramic knee, Prof. Hinorobu Oonishi (Osaka, Japan), is recognized as the world's most experienced expert when it comes to the various



The congress presidents Prof. Francesco Benazzo (left) and Prof. Francesco Falez

types of implants made of alumina ceramics/polyethylene and zirconia ceramics/polyethylene. Prof. Oonishi's clinical results and his analysis of explanted components clearly indicate that ceramic/polyethylene implants are superior to conventional metal/polyethylene implants.

The fact that metal abrasion and ion related problems are also important in knee arthroplasty was explained by Prof. Marc Thomsen (Heidelberg) using clinical case demonstrations. He emphasized that many questions have yet to be answered and that surgeons would be well-advised to investigate all signs of metal allergy. Eng. Paolo Dalla Pria (Villanova, Italy), development director of the Italian implant manufacturer Lima, described how a new real alternative to the use of metal femoral components was developed. In a joint venture, CeramTec and Lima have developed a ceramic component. Prof. Wolfram Mittelmeier (Rostock) reported on the comprehensive tests and investigations that the newly developed mixed oxide ceramic material BIOLOX®*delta* was subjected to at sites including Rostock. Prof. Mittelmeier expressed his conviction that the successful deployment of this ceramic material in the area of knee arthroplasty would lead to an extended implant service lives.

### Hip Revision

Prof. Jonathan Garino (Philadelphia, USA) opened the discussion on revision solutions by addressing the issue of whether the incidence of ceramic fractures has led to an increased need for revisions. His analysis indicates that ceramic fracture rates were very low even when the technology was first introduced and that improved design and material properties have made ceramics even more reliable in the meantime. A number of panelists recommended a shift away from metal and to ceramics when handling revisions. Prof. Jean-Yves Lazennec, Dr. Giovanni Pignatti (Bologna, Italy), Prof. Karl Knahr (Vienna) and Thomas Güttler of Aesculap (Tuttlingen) reported on their experience with the ceramic femoral head BIOLOX® OPTION, which can be deployed in cases where the stem is to remain in place.

### Tribology

Highly crosslinked polyethylene exhibits lower abrasion rates than conventional polyethylene. Prof. Christian Hendrich (Werneck) used a clinical study he conducted to illustrate how these rates can be reduced even further by using ceramic femoral heads. The tribology scientist Prof. John Fisher (Leeds, UK) showed the different results obtained in extensive simulator tests for cobalt/chromium and ceramic femoral heads in articulation with highly crosslinked polyethylene. After two million cycles, the abrasion in ceramic femoral heads drops below 50% of the rate for metal femoral heads. Dr. Ian C. Clarke of Peterson Tribology Lab (Loma Linda, USA) tested ceramic 36 mm femoral heads and inserts made of BIOLOX®*forte* and of BIOLOX®*delta* in a simulator that induces microseparation. The study showed that the BIOLOX®*delta* wear rates were considerably lower than the low abrasion rates obtained for BIOLOX®*forte*. Dr. James Buchanan (Newcastle, UK) pointed out to the interaction between the anchorage of the stem in the bone and the bearing. He recommended the use of

### The panelists participating in the Socratic debate



The BIOLOX symposium featured the first poster exhibition.

hydroxyapatitecoated stems together with ceramic-on-ceramic bearings for patients whose life expectancy exceeds 20 years. Dr. William Walter (Sydney, Australia) dealt with the rare phenomenon of squeaking in ceramic bearings. The phenomenon appears to be linked to edge loading in the bearings. He indicated that the risk of this phenomenon can be reduced by correctly positioning the cup.

### Tips and Tricks

Numerous tips and tricks relating to the implantation of ceramic components were given by experienced users. Dr. Karl-Heinz Widmer (Schaffhausen, Switzerland) introduced a very impressive geometric model for determining implantation safe zones. The model allows one to align the various placement parameters using a three dimensional algorithm.

### Finding a consensus

In the final Socratic debate, the panelists came together to achieve a consensus or formulate core statements with respect questions asked by the congress chairmen. Hip resurfacing was compared to Columbus' departure for India – nobody knows where the journey is to lead. Ceramic-on-ceramic bearings were assessed by nearly all of the participants as the optimal choice, particularly with respect to the treatment of younger and more active patients. The following was issued for identifying which bearing is most suitable for which patient group:

- Ceramic-on-ceramic bearings should be used for patients below the age of 65.
- Ceramic-on-polyethylene (or highly crosslinked polyethylene) bearing should be used for patients between 65 and 75.
- Metal-on-polyethylene bearings should be used for patients above 75 (i.e. in light of cost factors).

Two appeals were made to the implant industry: Dr. Widmer called upon the industry to provide to the surgeon maps or guides showing the system-related safe zones. Prof. Giacometti Ceroni called for the use of modular necks in the area of the stem.

Entire report and picture gallery at [www.bioloX.com](http://www.bioloX.com)

## Study of Serum Aluminum Levels

An Interview with Dr. Alexander Gröbl of the University Clinic for Orthopaedics in Vienna, Austria



**Dr. Alexander Gröbl found no association between ceramic bearings and increased aluminum levels.**

**What was the motivation for the study?** We wanted to ascertain whether there is any indication that the implantation of cement-free hip replacements made of titanium-aluminum alloys with ceramic-on-ceramic bearings can lead to significant increases in the level of serum aluminum detected in the body, either from the aluminum alloy or from the bearings. After all, aluminum is associated with a number of negative effects.

**Aluminum oxide is used in the production of ceramic endoprostheses. Is this also problematic?** The molecular bond of aluminum oxide is very stable. Moreover, its biocompatibility has been shown to be very good. We did not expect to see elevated levels of aluminum, but we wanted to know exactly, as no comparable studies had been carried out yet.

**What exactly was the focus of your investigation?** We compared serum values in two patient groups in a prospective randomized study. The patients in one group received cement-free hip replacements with metal-on-metal bearings. The other group received hip replacements of the same type, but with ceramic-on-ceramic bearings. Thanks to a rather elaborate study design, we were able to exclude all discernable cofactors. For instance, patients with existing implants were excluded from the study and those who were enrolled were not allowed to take certain vitamin tablets.

**What were the results of the study?** The patients in the metal-on-metal group exhibited the anticipated increase in metal ions. No increase was found in the ceramic-on-ceramic group. On the contrary, some patients in this latter group even showed a decrease in aluminum levels. There was no clinical difference whatsoever between the two groups. We concluded our follow-up at one year after discovering that no significant changes in aluminum levels had occurred after the first postoperative year. The outcome is different in the case of the metal ions, but they were not the focus of the study.

**What is your explanation of the results obtained for the ceramic bearings?** The results are apparently due to the extraordinary stability of the aluminum-ceramic bond. Aluminum oxide is not dissolved, and thus does not enter the serum. It therefore has no impact on naturally occurring aluminum levels, which are primarily determined by drinking water and diet.

**What clinical conclusions are to be drawn?** It seems safe to assume that the use of ceramic-on-ceramic bearings will not lead to elevated aluminum levels. The risk of elevated aluminum levels can therefore not be used as a reason for restricting the use of ceramic-on-ceramic bearings.

### Reference:

A. Gröbl, M. Weissinger, W. Brodner, A. Gleiss, A. Giurea, M. Gruber, G. Pöll, V. Meisinger, F. Gottsauner-Wolf, R. Kotz, *Serum aluminium and cobalt levels after ceramic-on-ceramic and metal-on-metal total hip replacement, JBJS (Br), Vol 88-B, No. 8, August 2006*



### Committee on Mutagenicity of Chemicals in Food, Consumer Products and the Environment (COM), Department of Health, UK

Statement on Biological Effect of Wear Debris Generated from Metal on Metal Bearing Surfaces: Evidence for Genotoxicity, COM/06/S1, July 2006

"The Committee agreed there was good evidence for an association between CoCr-on-CoCr and CoCr or TiAlV on polyethylene (PE) hip replacements and increased genotoxicity in patients. (...) The evidence for the increased genotoxicity observed and the increased blood levels of chromium and cobalt in patients with Co-Cr-on Co-Cr hip replacements or Co-Cr on polyethylene hip replacements, gave rise to concern because this may present a potential risk of carcinogenicity in humans."

[www.advisorybodies.doh.gov.uk/com/hip.htm](http://www.advisorybodies.doh.gov.uk/com/hip.htm)

### Cobalt Poisoning Caused by Unapproved Wear Couple

This article details a case report in which the use of an unapproved wear couple (metal ball head on a ceramic insert) created such a high degree of metallosis in a patient that it created almost a complete loss of vision and hearing in the patient.

The case involved a patient that required a revision due to instability. At the time of revision, the surgeon determined that a longer neck with more offset was required, however since the neck required was only available in a metal ball head, he chose to replace the ceramic head in place with a metal ball head. Both the acetabular component and the femoral stem were left in place. Postoperatively, movement of the hip joint became increasingly uncomfortable and painful and two years after the revision, the patient started complaining about increasing impairment of his eyesight followed by a gradual loss of hearing. At this time a second revision was performed, which showed a extensive damage to the metal ball head with extensive tissue staining and metal debris contamination of the bone and surrounding soft tissue. At the time of revision very high concentrations of the elements cobalt, chromium, and molybdenum were measured in tissue and serum. The concentration of cobalt, in particular, was remarkably high.

W. Steens, J. F. Loehr, G. von Foerster, A. Katzer, *Chronic cobalt poisoning in endoprosthetic replacement, in: Der Orthopäde 8, 2006*

### Asian Perspectives

CeraNews asked Prof. Jun-Dong Chang about the current state of arthroplasty in Korea

**Professor Jun-Dong Chang M.D., Ph.D., is Chief of the Department of Orthopaedic Surgery at the Hangeung Sacred Heart Hospital of the Hallym University College of Medicine in the Korean capital of Seoul. He is the President of the Korean Hip Society and the President of the Korean Musculoskeletal Transplantation Society.**

**How many arthroplasties are performed in Korea per year?** We perform approximately 20,000 hips, including bipolar hemiarthroplasties and 30,000 knees. Total elbow, total shoulder and total ankle are also performed in Korea, but in much smaller numbers.

**How important are ceramics in THA?** In the Korean population, all the newly developed bearing surfaces, such as ceramic-on-ceramic, metal-on-metal, cross-linked PE-to-metal, are important. In Korea, squatting and sitting with crossed legs are more common than in Western cultures. Moreover, in Korea, THAs are mainly performed in relatively young patients with osteonecrosis of the femoral head. It can be assumed that their daily workload would be heavier and involve more activity than that of elderly patients. The size of acetabular cups may be another consideration. The Korean population generally requires relatively small cups, which unfortunately are more susceptible to wear. Among the three newly developed bearing surfaces, in my opinion, ceramic-on-ceramic seems to be the most important for the Korean population. Metal-on-metal may cause an accumulation of metal ions, if it is retained in the body for a long time. Regarding cross-linked PE-to-metal, long-term results are not yet available. Thus, ceramic-on-ceramic gets more attention in Korea.

**What are the major trends in Korean arthroplasty?** In material and size the trend is going in the direction of ceramic-on-ceramic and bigger head sizes, such as 32 – 36 mm. Some Korean doctors are trying resurfacing. However, the main indication for hip arthroplasty in Korea is osteonecrosis of the femoral head. Minimally invasive (MIS) and computer assisted surgery (CAS) became more popular in TKA than in THA in Korea. Although CAS is rarely performed in THA, MIS is an interesting subject for the hip.



The next BILOX® Symposium will be held in Seoul on September 7 – 8, 2007

**Do economic factors have an influence on the choice of the implant price?** No. The price of the implant is controlled by the government health insurance, and it is the same for all bearing surfaces. 20 per cent of the implant price is charged to the patients.

**Which materials and wear-couples do you personally prefer?** I prefer ceramic-on-ceramic bearing surfaces and titanium cementless stems.

**Comparing Asian and European/American orthopaedics, and looking at the Biolog Symposium, what are the most important differences between East and West?** A number of Asian countries have had impressive economic growth in the past decade and with increasing economic prosperity, more people in Asia are able to afford the benefits of modern medical technologies. The science and clinical practice of arthroplasty is flourishing in Asia, and the number of arthroplasties is growing at a phenomenal rate. The Asian orthopaedic community is highly receptive to modern clinical and technological advances; however, the ethnic, cultural and lingual diversity of the region challenges those of us involved with the dissemination of this knowledge. The bearing surface is one of the most important issues for Asian arthroplasty surgeons. The Biolog Symposium with its focus on this subject is unique. I am sure, after the Biolog Symposium next year in Korea, Asian arthroplasty surgeons will pay even more attention to bearing surfaces, especially to ceramics.



Prof. Jun-Dong Chang M.D., Ph.D., President of the Korean Hip Society

## Cutting it Hot

### Using Ceramics for Metal Cutting

**Although they are small, unassuming and bear a certain resemblance to peppermints, you wouldn't want to chew on them if you value your teeth. Ceramic cutting inserts are second only to diamonds in terms of hardness. Capable of machining metal parts in seconds – even at ultrahigh temperatures – ceramic inserts show virtually no wear despite the hardest of working conditions.**

Turning or milling metal generates high temperatures. The friction involved in the process can elevate the temperature of the cutting insert and the metal part to 1,200° C. Cutting tools made of non-ceramic materials, including tungsten carbides, begin to fail at far lower temperatures (i.e. 700°) and thus require elaborate cooling. But even the best cooling system will soon reach its limit when facing the hard task of metal cutting.

Ceramic inserts offer an ideal solution. They can be used, for instance, to machine a brake disk from a blank to the finished part within around 60 seconds. The same procedure would take three to five minutes using tungsten carbide tools. The red hardness of carbide tools is simply no match for that of high performance ceramic tools. The shorter cycle times that can be achieved with ceramic inserts also introduce a tremendous production advantage. Here, cutting speeds of 1,000 meters per minute can easily be achieved. Moreover, given the fact that they do not need cooling, ceramic inserts allow one to avoid the high costs associated with buying and disposing of coolants and lubricants and at the same time make a contribution to environmental protection.



**Ceramic inserts and tooling for use in turning and milling applications**

The range of industrial applications for the small high-tech inserts includes the serial production of parts made of cast iron (e.g. brake disks, flywheels and clutch thrust plates). Ceramic tools are also used in manufacturing processes machining the surfaces of hardened gearwheels, roller bearing rings and motor blocks. A process that is known as hard-part machining and that makes use of especially fine-grained mixed-ceramic grades enables one to machine hardened steel parts in a single manufacturing step.

Depending on the particular target applications, oxide ceramic materials, mixed-ceramics and silicon nitride ceramics are used in production. Although they differ in terms of their chemical compositions and grain structure, their essential material properties are the same: exceptional hardness and exceptional resistance to abrasion and high temperatures. Despite the fact that the force is transferred during cutting process exclusively via the small cutting edge of the insert, this cutting edge retains its sharpness for long periods, far longer than cutting edges made from tungsten carbide exposed to the same conditions. Featuring up to eight cutting edges the these inserts offer further advantages in terms of cost effectiveness.



**High-performance ceramics make for smooth machining even at highest temperatures.**

## Training Opportunities for Doctors, Clinics and Sales Staff

Wen Chen organizes presentations, workshops and symposia as a means of informing up to 3,000 Chinese physicians a year about the use of ceramic components in the field of endoprosthetics. She also organizes training events at marketing and distribution companies that have been established in China by various endoprosthesis manufacturers. The aim of these events is to give sales employees an opportunity to acquire a comprehensive understanding of ceramics so that they can offer competent consultation services to the physicians.



Wen Chen supports CeramTec clients in China.

Wen Chen manages the Peking office of the CeramTec Medical Products Division. From there, she organizes training activities for the world's most populated country. The rapid growth of the Chinese market for joint replacement has generated a considerable need for sound information about ceramic materials, bearings and the particularities of handling ceramic components. To respond to this need, CeramTec has developed numerous practice-oriented animations and videos.

"In a dynamic field, there is no reason to give the very same presentation twice," says Wen Chen about her commitment to continuously updating her presentations. The regular inclusion of the latest data from basic and clinical research enables her to offer something new for each medical symposium and training course. For the employees of endoprosthesis manufacturers, she offers custom training programs that include practical workshops and interactive elements. Beyond this, CeramTec actively participates at major trade exhibitions and orthopaedic congresses in China.

The experts at the CeramTec Medical Products Division are ready to organize lectures, presentations, workshops and other training measures as a means of supporting physicians, surgical staff members and the sales employees of endoprosthesis manufacturers. These experts participate in demonstrations at clinics and at the CeramTec manufacturing facilities. Upon request, they would also be happy to take their training programs directly to the client.

**Please contact one of our representatives for more information:**

### in North America:

Ricardo J. Heros  
Phone: 901 / 7 67 47 27  
rheros@aol.com

### in China:

Wen Chen  
Phone: +86 / 139 / 01 18 42 44  
w.chen@ceramtec.com.cn

### in Italy:

Fabrizio Macchi  
Phone: +39 / 33 57 / 48 82 72  
f.macchi@ceramtec.de

### in all other European countries:

Sylvia Usbeck  
Phone: +49 / 172 / 9 74 33 71  
s.usbeck@ceramtec.de

■ **October 12 – 15, 2006**  
8<sup>th</sup> Annual Conference  
Asia Pacific Arthroplasty Society  
Shanghai, Portman Ritz Carlton Hotel  
Stand A1

■ **November 6 – 9, 2006**  
81<sup>ème</sup> réunion annuelle  
SOFcot  
Paris, Palais des Congrès  
CeramTec stand: F 13  
www.sofcot.fr

■ **November 12 – 16, 2006**  
91. Congresso Nazionale  
SIOT 2006  
Rom, Palazzo dei Congressi  
CeramTec stand: C4  
www.siot.it

■ **December 13-16, 2006**  
Current Concepts in Joint Replacement  
Orlando, Florida  
www.ccsr.com

■ **February 14 – 18, 2007**  
AAOS Annual Meeting  
San Diego, CA

■ **May 11 – 15, 2007**  
8. EFORT-Kongress  
Florenz, Fortezza da Basso  
www.efort.org

■ **September 7 – 8, 2007**  
12<sup>th</sup> BIOLOX<sup>®</sup> Symposium  
Seoul

## Imprint

### Published by:

CeramTec AG  
Innovative Ceramic Engineering  
Medical Technology  
Fabrikstr. 23–29  
D-73207 Plochingen, Germany  
Phone: +49 / 7153 / 6 11-828  
Fax: +49 / 7153 / 6 11 838  
medical\_products@ceramtec.de  
www.ceramtec.com

### Your contact:

Götz Griesmayr  
Phone: +1 / 301 / 22 96 704  
g.griesmayr@ceramtec.de  
(for North America)  
Paul Silberer  
Phone: +49 / 71 53 / 611 522  
p.silberer@ceramtec.de  
(all other countries)

### Text and layout:

LoopKomm  
InfoMarketing  
Terlaner Straße 8  
D-79111 Freiburg, Germany  
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**  
T H E C E R A M I C E X P E R T S