

Quest to maximize bone ingrowth keeps Dr. Joo Ong searching for answers

Is HA (hydroxyapatite) the best coating to apply to an implant to encourage osseointegration, or are there better coatings? How long should HA remain on an implant before its benefits outweigh the problems it can cause?

Is calcium phosphate the ideal material to use in creating a scaffold for bone defect reconstruction? Will the properties of calcium phosphate in the scaffold optimize cell ingrowth?

These are questions that drive the work of Dr. Joo Leng Ong, Hyde Professor of Orthopaedic Surgery and Biomedical Engineering for the University of Tennessee-Campbell Clinic Department of Orthopaedic Surgery. And even though Dr. Ong has been conducting research for more than 15 years in the field of early bone formation at the bone-bio-material interface, every question answered raises another question, and another.

Dr. Ong joined the UT-Campbell Clinic

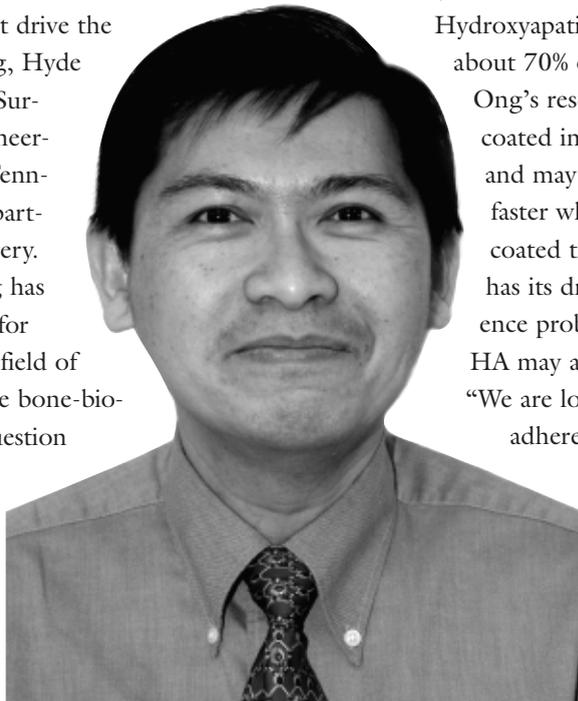
Department of Orthopaedic Surgery's research staff in 2004, along with Dr. David Carners and Dr. Yunzhi Yang. The three scientists had worked together in biomedical research in San Antonio.

"We are focusing on two studies, both concerned with the role of HA and other calcium phosphates on early bone cell activity," Dr. Ong said. "There has been a lot of progress in this area in the last decade, but we still have a lot to learn."

Hydroxyapatite, or HA, makes up about 70% of bone structure. Dr.

Ong's research indicates that HA-coated implants are biocompatible and may induce bony ingrowth faster when compared to non-coated titanium implants. But HA has its drawbacks, including adherence problems and the fact that HA may attract bacteria.

"We are looking at ways to make the adherence stronger," Dr. Ong said. "We've also learned that we may not want the HA to stay on for the life of the implant."



FACTS, IMPROVING IMPLANTS

- More than 300,000 knee and hip replacement surgeries are performed each year in the United States. Sixty-five percent of hip replacement and seventy-two percent of knee replacement surgeries are performed on people over the age of 65.
- Many credit Sir John Charnley, a British orthopaedist, with performing the first modern total hip replacement in the 1950s. His innovations included combining a metal

stem and ball with a plastic shell and using a methacrylate cement, similar to the cement used by dentists, to hold the devices in place.

- One problem with implants is loosening that can be the result of cracks in the cement caused by wear, particularly in patients who are very heavy or very active.
- Since 1980, new implant designs have been introduced that attach directly to bone without the use of

cement. These designs have a surface topography that is conducive to attracting new bone growth. It was hoped that cementless implantation would eliminate the problems of bone resorption and stem loosening caused by cement failure.

- Researchers are working to find coatings to apply to the surface of implants that will encourage the bone to grow into the prosthesis and hold it in place.

SOURCES: *American Academy of Orthopaedic Surgeons (AAOS)*, www.jointreplacements.com, www.medicalnewstoday.com

So we are asking what's the best process for applying HA to an implant surface so we get the short-term benefit of enhanced bone formation, but then we may want the HA to go away."

The goal of this research, Dr. Ong said, is to find the ideal implant surface for optimum osseointegration, thereby reducing implant failures that are expensive to patients in terms of costs, trauma, and recovery time.

In another study, Dr. Ong is looking at bone defect reconstruction, using tissue-engineered bone scaffolds rather than autograft (from the patient's own body) or allograft (from another human body) bone.

"It has been estimated that tissue-engineered products will be a \$5 billion market worldwide in the future," Dr. Ong said. "Because of the financial potential, there is a vast amount of research being conducted on three-dimensional scaffolds to persuade the body to heal or repair tissues that do not heal spontaneously."

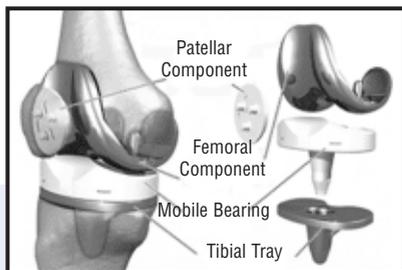
Some researchers have studied biodegradable polymeric scaffolds but have learned that this alternative

lacks sufficient mechanical strength and releases acidic degradation products that can cause inflammatory responses. Dr. Ong's team at UT-Campbell Clinic is focusing on the use of calcium phosphates, a primary component of bone.

"We have made some good progress in this area," he said. "Several companies are interested in the potential of this research."

Dr. Ong considers interaction with and input from Campbell Clinic surgeons valuable to his research. "Surgeons tell us what their problems are and it helps us in the thinking process," he said.

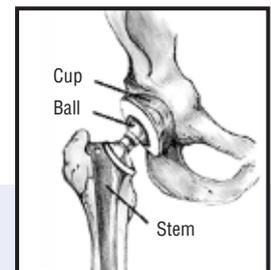
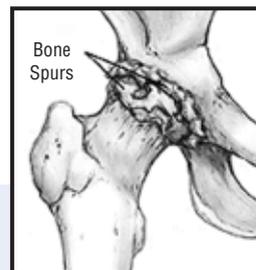
He also believes that working in a city with a strong medical device industry and multiple institutions engaged in musculoskeletal research benefit his work. "That's really the reason I was attracted to Memphis," Dr. Ong said. "You have the opportunity to work with people who are on the leading edge of the industry, and you see how you can contribute. It encourages you to work harder to make advancements."



Rotating Platform Knee Implant



Arthritic Hip Joint



Hip Replacement

THE GOAL OF HIS RESEARCH, DR. ONG SAID, IS TO FIND THE IDEAL IMPLANT SURFACE FOR OPTIMUM OSSEOINTEGRATION, THEREBY REDUCING IMPLANT FAILURES THAT ARE EXPENSIVE TO PATIENTS IN TERMS OF COSTS, TRAUMA, AND RECOVERY TIME.