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Editor's Spotlight/Take 5: Natural Polyphenols Enhance Stability of Crosslinked UHMWPE for Joint Implants

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With nearly 1.4 billion citizens, China is by far the most-populous country in the world. In fact, if the difference in population between China and the second-largest country (India) were turned into a country, it would be the 13th largest in the world, as more than

100 million souls would reside therein [2]. But as a contributor to scientific and medical research, China historically has punched below its weight.

No longer.

While only six papers with coauthors from China were published in the *Nature* family of journals in 2000 [9], by 2012, that number had increased to more than 300. Work from China now accounts for more than 8% of the papers published in those journals [7], which is one reasonable benchmark of high scientific achievement. That number continues to grow fast; in the last 12 months, the top two institutions from China alone accounted for 305 articles in those journals, and there are 265 other institutions represented on that list [8]. Substantial investments in research and development [10], along with a growing economy, and a more outward-looking approach to training engineers, scientists, and physicians all have contributed to this extraordinary growth.

In 2014, *CORR*® published only seven papers whose corresponding author was from China, not much different from the volume in the *Nature* journals about 15 years ago [9]. But with the Chinese Orthopaedic Association claiming 130,000 members [3], budgets for research and development in China increasing more than 20% per year for the last decade or so, and sales of orthopaedic spine, joint, and trauma products in that country expected to continue to climb 16% to 19% per year through 2015 [6], it does not take a great leap of imagination to conclude that China, once called “the sleeping giant,” is awakening.

Against this backdrop, we present with pride the winner of the first *Clinical Orthopaedics and Related Research*® Best Paper award for work from China. Although (as noted just above) there were relatively few entries this year, their quality was uniformly high, and, again, we expect the quantity to increase quickly in the years to come. We thank the Chinese Orthopaedic Association for helping us to promote the 2014 award to its members.

The award-winning paper, “Natural Polyphenols Enhance Stability of

Note from the Editor-In-Chief: In “Editor’s Spotlight,” one of our editors provides brief commentary on a paper we believe is especially important and worthy of general interest. Following the explanation of our choice, we present “Take Five,” in which the editor goes behind the discovery with a one-on-one interview with an author of the article featured in “Editor’s Spotlight.”

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Crosslinked UHMWPE for Joint Implants,” by Shen and colleagues, evaluated the effect of a new family of additives, called natural polyphenols, on the material properties of ultrahigh molecular weight polyethylene. The goal of using natural polyphenols is to enhance oxidative stability of the polyethylene—and perhaps resistance to fatigue failure [1]—without decreasing its resistance to abrasive wear. To date, the antioxidant Vitamin E has been used for this purpose, but polyphenols may offer even greater resistance to oxidation.

This well-designed laboratory study confirmed that natural polyphenols, which have been shown in other settings to be effective antioxidants [4, 5], improved polyethylene’s oxidative stability, preserved its tensile and impact properties after accelerated aging, and did not adversely affect wear performance in simulator testing. Obviously, such developments must make a long leap across a deep chasm to get from experiments like these to clinical use, and many products do not clear that gap—or worse, the products appear to make it, get introduced, and fail badly when used in patients. Even so, this is exciting work. We are glad to feature it in this section, and to present the authors with the first *CORR*[®] – China Best Paper Award.

As an aside, the source of the “sleeping giant” aphorism is believed

to be Napoleon Bonaparte, who was said to have made the comment while looking at a map of China. It is worth noting how the quote concludes: “... and when he awakes, he will stun the world.” No doubt this will come to pass in medicine and orthopaedic surgery, as it already has in science, engineering, and manufacturing. Please join me for the Take-5 interview that follows, in which Professor Jun Fu discusses the challenges and rewards of performing leading-edge research in China, among other fascinating topics.

*We would like to remind clinician and laboratory scientists from China that the next *CORR*[®] – China Best Paper Award will consider work published in Clinical Orthopaedics and Related Research[®] through the end of 2015.*

Take Five Interview with Jun Fu PhD, senior author of “Natural Polyphenols Enhance Stability of Crosslinked UHMWPE for Joint Implants”

Seth S. Leopold MD: *Congratulations on your paper, and on winning the first *CORR*[®] – China Best Paper Award. We were very impressed with your*

work. Perhaps you could begin by talking a bit about the challenges and rewards of performing musculoskeletal research in China—how is life as a scientist different in China than in the west, and how is it similar?

Jun Fu PhD: Thanks a lot. It is a great honor and surprise for me to win this award. As a polymer scientist, I am so lucky that I stepped into the musculoskeletal research area in 2007 when I joined the Harris Orthopaedic Laboratory at Massachusetts General Hospital (MGH). One of the most impressive things to me is the close collaboration of materials scientists, engineers, and clinical professionals at MGH, which I believe effectively boosts the innovation in both fundamental and clinical

Jun Fu PhD

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researches, and which was so evident to me in the meetings of the Orthopaedic Research Society that I attended. More importantly, many fundamental findings eventually get commercialized and put into clinical use. In China, with the largest population and an aging one, the demand for orthopaedic implants including artificial joints is rapidly increasing. Therefore, musculoskeletal research has been attracting unprecedented interest of not only materials scientists and engineers, but also physicians. Challenges include how to understand the clinical needs and to translate them into scientific languages, and how to help the practicing surgeons improve their knowledge on basic disciplines of materials science and engineering. Based on the collaborations I observed during my fellowship at MGH, I started collaborations with surgeons at home to figure out and solve real clinical problems.

Dr. Leopold: *Your work has been recognized widely by others. I note that you have been funded by the “Hundred Talents” program of the Chinese Academy of Sciences, as well as the Scientific Research Foundation for the Returned Overseas Chinese Scholars. I imagine most of our readers are unfamiliar with these programs, although they*

have been very important to scientists in China. Can you tell us a bit about each of these programs, and how they have influenced your career development?

Professor Fu: The year 2014 is the 20th anniversary of the Hundred Talents Program of the Chinese Academy of Sciences (CAS). This program aims to recruit and support outstanding young scientists to perform cutting edge research in the CAS. Beyond the generous package, it is also a great honor for the promising young scientists who receive this award, as it was for me. It has been one of the most influential and effective programs in China to build up the many, large research teams in the CAS. In the past two decades, thousands of young scientists have been supported by this program, and many of them have become leading scientists in their fields. Also, I would like to thank the Scientific Research Foundation for the Returned Overseas Chinese Scholars, affiliated to the Ministry of Education of China, for a grant. It is highly competitive. These awards do not only provide the funds to start my team and research, but also represent the recognition of the importance of my research. Generally speaking, these grants serve as a startup package for a young scientist to establish his/her own independent research program.

Dr. Leopold: *Since there is a “Returned Overseas Chinese Scholars” program, one surmises that many important Chinese scientists indeed have spent time training or working elsewhere. How important is it for a biomedical scholar from China to spend part of his or her career outside China, and what are the tradeoffs involved in remaining abroad versus returning home?*

Professor Fu: The experience training or working abroad is very important for me to establish communications with the leading scientists in the world, to learn cutting edge science and technology, and to exchange research ideas with scientists outside China. While many Chinese scholars stay abroad for their career, many, including me, decided to return home. I think this is a personal decision. I felt the offer from my current Institution could provide better chance for me to establish the research program that I dreamed to achieve.

Dr. Leopold: *What challenges have you faced getting your work published in western journals?*

Professor Fu: As a non-native English speaker, sometimes I find it difficult to find the right words and sentences to express my ideas precisely. Another challenge is to fully understand the styles of different journals so as to best follow it when writing. For example,

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journals of materials science and clinical research are quite different, and sometimes it is not intuitive to switch freely between these journals. In fact, it took a lot of time for us to understand the style at *CORR*[®], since this was the first time we wrote for this journal. Indeed, we are very grateful to the reviewers whose suggestions helped us to polish this paper. We have greatly benefited from reviewers during my publishing experience.

Dr. Leopold: *What are the next steps for this project on natural polyphenols and UHMWPE in particular? How do you envision taking your findings from the laboratory to the operating room?*

Professor Fu: As presented in the paper, the natural polyphenol-blended UHMWPE shows promising oxidative resistance, low wear, and good strength. The additives were carefully chosen based on a philosophy that no potentially toxic molecules should be introduced into the materials, because we want to eventually take this research to the clinical setting. Starting from these laboratory results, though, there is still a long way to go. The next steps would

probably involve simulator testing, debris study, biocompatibility, and animal testing. Extensive collaborations are needed with biomedical engineers and even manufacturers to demonstrate the feasibility of these materials to joint implants. Even so, we are quite optimistic about taking these laboratory findings to the operating room.

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