Clinical Research in Orthopedics

Editorial

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Advances in Clinical Orthopaedics

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Advances in Clinical Orthopaedics have been a major source of improved mobility, physical performance, comfort and independence to persons worldwide. Most of these advances have come about due to improved implant technology, application of fundamental principles of musculoskeletal biology and mechanics, advances in imaging and newer bio-compatible materials. There remains the need to continue pushing forward with basic knowledge of the biological processes that govern bone and joint development and maintenance. And there needs to be a new generation of surgeons who understand the methods used to determine clinical success in delivery of care. Patients expect the safe and effective provision of orthopedics treatment without the uncertainty of the effectiveness of those surgeries.

There is no one single source of orthopedic knowledge that will generate the next 'big thing' in evaluation or treatment. At present there is research into genetic and cellular mechanisms of producing the tissue that comprise the musculoskeletal system. To date, very little basic research has resulted in bench to bedside implementation. Though no major breakthrough events in orthopedic surgery have come from bench work, there have been little victories over the years such as the use of bone morphogenic proteins in improving outcome of bone regeneration in spine surgery and non-union surgery. The application of progenitor cells is perhaps coming to fruition, as is the application of autocrine growth factors such as IGF and TGF-β.

Future discoveries of fundamental molecular importance, epigenetic and genomic expression and modulation of transcription and translation of nuclear material may be very nearby. If research slows or stops on the fundamentals of musculoskeletal development and repair, then future improvements in diagnosis and care will be diminished. The same may be said of investigations into newer biologic materials and non-biologic substitutes for missing limbs. If there is no financial and political will to improve orthopedic delivery of care then much of clinical research will dwindle.

It is true that much of current knowledge of repair and regeneration still awaits development into useful diagnosis and treatment. The application or discovery of scientific knowledge is often secondary to the practical application of things that just seem to work. Such was the case with anti-microbials that were discovered in the laboratory starting in 1929, first trialed in the 1940s and then became the source of much basic and applied research since 1950. An analogy in orthopedic surgery would be the development of the low friction arthroplasty for advanced arthritis of the hip by the team led by Sir John Charnley in the early 1960s. Mr. Charnley had an engineering pedigree and much experience with arthroplasty including some knowledge of the polymer chemistry of polyethylene, the metallurgy of L316 stainless steel along with fundamentals of structural engineering of the hip joint, tribology and the methyl methacrylate physical properties.

Much the way Thomas Edison pioneered many technological advance in the late 19th century, early pioneers in orthopedic implant techniques were pragmatic, empirical experimenters. Science, in the pure sense did not advance with joint replacement surgery. Science was needed to come to the aid of the engineers who needed to improve implants and the techniques used to place them in humans. The need to understand failures of implants, including aseptic loosening and septic processes, required teamwork among surgeons, non-surgical allied professionals (e.g. radiologists, infectious disease specialists, rheumatologists) and design engineers. Much has been learned from necessity concerning optimum joint physics, materials sciences, tissue reaction to foreign substances, neuromuscular rehabilitation and anatomic exposure for surgeries. And a small number of people face a life threatening challenge of lethal musculoskeletal sarcomas; many of those are childhood conditions. Collaboration between oncologists and orthopedist will be required to make advances against these deadly tumors.

The world of research was best summed up by Albert Einstein in the later years of his life "If we knew what we were doing, it wouldn't be research". So in the final analysis, orthopedic research shares with most all research the underlying question to be answered or problem to be solved. The science world has been divided since World War II into basic and applied. In fact most US schools of engineering are now title "School of Engineering and Applied Sciences" as recognition that many engineers are taking scientific knowledge and validated observations, and applying them to real world problems. I suspect that the many engineers working on solving orthopedic problems rely on fundamental research performed by those scientists who are working to reveal truths at the molecular, cellular and system level in the different tissues and structures of the musculoskeletal system.

Funding for basic and applied research in Orthopaedics has never been plentiful, especially from federal funding sources. More improvements are needed in joint disease, fracture healing, peripheral nerve regeneration, and muscle and tendon regeneration and wound healing/reduced scar formation. The need is great due to the high prevalence of Orthopedic conditions from newborns to elderly, the expanding and aging population, survivorship increasing from major trauma, expectations of injured athletes and the numbers of people living with implants and joint reconstructions. Advances in understanding joint mechanics, tissue. The compelling argument for all relevant research in the realm of Orthopaedics is to improve diagnosis and treatment in order to improve the quality of life for many citizens suffering pain and limb dysfunction, and to give life to those few with life threatening sarcomas.

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