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The University of Nebraska Medical Center Department of Orthopaedic Surgery and Rehabilitation Report

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Omaha was a hub of activity this summer with the Olympic Swim Trials, which were held at the Qwest Center in June-July of this year. It was a great honor to be asked to spearhead the coverage for this spectacular event. Several orthopaedic faculty, along with a group of UNMC Physicians medical professionals from various specialties and hospital personnel, volunteered to provide medical and support services for the exceptional athletes that came to participate in this high profile competition. It was an exciting week for the department and for Omaha to be able to participate in such a historic event.

We are excited to announce that we have recruited two sports medicine physicians to join our team. Dr. Mark Dietrich, fellowship-trained in orthopaedic sports medicine, and Dr. Miguel Daccarett, fellowship-trained in the orthopaedic subspecialties of sports medicine, trauma and oncology, have joined our full-time faculty. You can learn more about each of them in the faculty section of this report.

As time moves on, we are inevitably faced with the reality that even greatness cannot live forever. In July of 2007, we shared with you the unfortunate news of the loss of our past chairman and esteemed colleague, Dr. John Connolly. A respected orthopaedic surgeon and educator, Dr. Connolly was the department’s first full-time chairman and built a nationally recognized orthopaedic residency training program in Nebraska. In August of 2007, we paid tribute to Dr. Stanley Bach, a tireless supporter of Children’s Hospital and UNMC’s Department of Orthopaedic Surgery. Dr. Bach was honored by Children’s Hospital and its medical staff as a “Pediatric Legend.” In more recent news, we learned of the passing of legendary Omaha philanthropist, Charles W. Durham, a visionary leader and faithful patron of the medical center, the Department of Orthopaedic Surgery, and the entire Omaha community. In tribute to these inspiring individuals, I invite you to read more about their many contributions in the “In Remembrance” section of this report.

The official ribbon-cutting ceremony for the Nebraska Arthritis Outcomes Research Center happened in July of 2007. The center is located on the third floor of Poynter Hall, and was made possible by a major donation from Bill and Ruth Scott. We offer our most sincere appreciation to the Scotts for their generous gift, which will give us the opportunity to conduct studies that will provide a better understanding of arthritis through detailed analysis of the many determinants used to predict outcomes for arthritis sufferers.

In addition, we extend a sincere thank you to everyone who made private contributions to the department during the 2006-2007 calendar years. Please make sure to see the “Honor Roll of Contributors” we have published to show our appreciation for these gifts, which provide vital resources for the continued success of our department’s residency education program, research projects, and much more.

We will continue to keep you abreast of future changes and newsworthy happenings in the department. Hopefully you enjoy perusing the report and take heart in knowing that it is support from our alumni and friends of the department that helps us continue to fulfill our mission of excellence in patient care, resident education, and cutting-edge research. Thank you for your support!

Kevin L. Garvin, M.D.
Professor and Chair

MESSAGE FROM THE CHAIR

Remaining at the forefront of orthopaedic research is vital to all aspects of a successful orthopaedic program. Our Biomechanics Lab has worked diligently to become a premier implant testing facility that is directly impacting design and testing standards for total joint implants today, and our Nano-Biotechnology Lab is making great strides in the field of nanotechnology by building tougher, “smarter” implants for future generations. Being a part of this innovative scientific research is essential to our ability to provide increased educational opportunities for our residents and to continuously offer better treatment options to our patients.
ADVANCEMENTS IN OUR DEPARTMENT

Excellence in Orthopaedic Diagnosis and Treatment

The Department of Orthopaedic Surgery and Rehabilitation is a team of dedicated, caring, health professionals who specialize in the prevention, diagnosis, and treatment of musculoskeletal disorders in children, teenagers, and adults. Our department provides quality, cost-effective care to more than 35,000 patients each year from Nebraska, the Midwest, and around the world. Several of our department’s physicians are recognized on the annual “Best Doctors in America” list and many serve the profession as leaders in local, state, national, and international scientific organizations.
Adult Reconstruction and General Orthopaedics:
inflammatory and degenerative joint problems, bone and soft tissue reconstruction and prosthetic joint replacement

Foot and Ankle Surgery:
foot and ankle disorders ranging from the common to the complex, from bunions to fractures

Hand Surgery:
hand and wrist conditions such as arthritis, nerve compression, and repair of congenital hand deformities and injuries

Orthopaedic Oncology:
benign and malignant bone and soft tissue tumors, bone grafts and custom prosthetic implants

Shoulder and Elbow:
evaluation and management of shoulder and elbow arthritis, dislocations, fractures, and tendon tears

Trauma:
emergency evaluation, treatment, and long-term follow-up of fractures, dislocations, and other musculoskeletal injuries

Pediatric Orthopaedics:
limb and spine deformities, bone and joint infections, and fractures and dislocations of the arms, legs, and spine in infants, children, and teenagers

Sports Medicine:
treatment of injuries or illnesses related to sports such as sprains, ligament or cartilage injuries, or joint ailments in athletes of all ages

Spine:
evaluation and management of spine conditions such as deformities, injuries, and deterioration

Our orthopaedic surgeons work closely with caring, experienced nurses and consult with physicians in other medical specialties to provide the latest comprehensive care. Faculty physicians in the Department of Orthopaedic Surgery and Rehabilitation treat thousands of patients annually in these areas:
**TURNING CUTTING-EDGE RESEARCH INTO IMPROVED PATIENT OUTCOMES**

In order to bring the newest treatment options to our patients, our faculty and researchers must remain on the frontiers of orthopaedic research, which is also a large part of our department. Our Biomechanics Laboratory and Nano-Biotechnology Laboratory are housed in the Scott Technology Center (STC), located on the Aksarben campus. There, our research faculty and other engineers perform cutting-edge experimental simulation and testing of the next generation of orthopaedic implants, and contribute to the development of multi-axial implant simulators.

Our team of researchers and surgeons are developing a novel freehand surgical navigation system for use in knee replacement surgery. This aims to enhance the speed and economy of surgery by drastically reducing the complexity of mechanical surgical instrumentation, as well as to help patients with artificial joints recover more quickly.

Our Nano-Biotechnology Laboratory works with complex, highly sensitive equipment to produce novel nanocrystalline structures intended to improve the longevity of artificial joint implants. Additionally, in a close collaboration with researchers from the UNMC departments of Genetics, Cell Biology and Anatomy, as well as Pathology and Microbiology, significant progress has been made in our efforts to develop smart, durable coatings to promote bone marrow stromal cell growth while reducing the probability of infections. It is anticipated that these advanced technologies will enhance bone growth and reduce patient recovery time, will be instrumental in prolonging the life of orthopaedic prostheses, and will have many other scientific and biomedical applications.

The department’s researchers are attracting an increasing amount of external and international funding and acclaim, and have presented their results at prestigious national and international scientific and academic conferences.

The department continues to build on an ever-increasing surgery outcomes database, linking research, patient treatment, and education. Currently there are over 2,550 patients in the database who have undergone total joint replacement, revision joint surgery, shoulder surgery, or treatment for Whiplash Associated Disorders (WAD). The database serves as a valuable tool for surgeons to evaluate and compare the effectiveness of various treatments.

The department’s 20 orthopaedic residents are involved in daily patient care and important research activities during their five years of intensive training. Thirteen full-time faculty and numerous staff members instruct, evaluate, and mentor our residents at various hospital locations on the UNMC campus. Many more Omaha-area orthopaedic surgeons serve as volunteer faculty members, supervising our residents as they rotate through different subspecialty private practice situations. Other department faculty, technicians, and a full-time research coordinator assist residents with their research projects.

Faculty and staff members consult and collaborate with physicians and researchers in other UNMC departments and colleges, including professionals in engineering, dentistry and oral surgery, neurosurgery, pediatrics, cardiology, and oncology to assist with patient care and research. Many of our department’s scientists are collaborating with researchers around the world on innovative research projects that hold great promise for the future of orthopaedic surgery and other areas of medicine.
Dr. Kevin Garvin, chair of UNMC’s Department of Orthopaedic Surgery and Rehabilitation, was chosen to oversee medical coverage for the trials to ensure the health and well-being of all participating athletes. Dr. Garvin, a member of the Omaha Sports Commission (OSC), was asked by Harold Cliff, chief operating officer for the 2008 Olympic Trials, to spearhead the medical coverage for this special event.

“It was an exciting week for Omaha, and we are proud to have been able to participate in an event of this caliber,” said Dr. Garvin. “There are many high profile events happening in Omaha this year, but this was by far the most unique.”

A group of UNMC Physicians medical professionals volunteered to provide medical and support services in several specialties including orthopaedics, primary care (family practice and internal medicine), and emergency medicine. UNMC Physicians also worked with the hospital to provide physical therapy, pharmacy, and massage services. Staff was on-site for warm-ups as well as during the actual event, both morning and evening sessions. In the event of an emergency, staff was available by pager 24-hours a day. Physicians were on staff to assist with whatever ailments athletes or coaches suffered, ranging from a torn muscle or laceration, to coming down with a headache, the flu, or the common cold.

All physicians involved donated their time to help with this event, and in return had an opportunity to be involved in something special happening in Omaha. UNMC Physicians also graciously volunteered their services by donating supplies, as well as free use of basic medical equipment such as exam tables, etc.

“The UNMC Physicians medical community really pulled together to help make an already unique event even more spectacular,” said Troy Wilhelm, chief financial officer for UNMC Physicians. “It was about doing all we could to support the dream of every athlete participating in the trials to become an Olympian.”

The event, housed at the Qwest Center, featured two temporary 50-meter pools that were installed in the arena and filled with an estimated one million gallons of water. Connected to the arena was the USA Swimming Aqua Zone, the sponsor and fan experience mecca. Estimated seating capacity for the trials was 14,000, and in January ticket sales had already reached record-setting numbers.

The Olympic Trials featured more than 1,000 hopeful swimmers competing for a chance to represent the U.S. in the Beijing Olympics. Other big events in Omaha during 2008 include the College World Series, the Cox Classic, and NCAA basketball and volleyball.

OMAHA HOST OF 2008 OLYMPIC SWIM TRIALS

ORTHOPAEDIC DEPARTMENT CHOSEN TO OVERSEE MEDICAL COVERAGE

You might have seen the Countdown Ticker around town, counting the days, hours, minutes and seconds until the Olympic Swim Trials came bursting into the Omaha scene at precisely 11 a.m. on June 29, 2008. Not only did it shape up to be a big year for Omaha, but a big year for the Department of Orthopaedic Surgery as well.
KEVIN L. GARVIN, M.D. | is Professor and Chair of the University of Nebraska College of Medicine’s Department of Orthopaedic Surgery and Rehabilitation, as well as the L. Thomas Hood, M.D., Professor of Orthopaedic Surgery and Rehabilitation. He received his M.D. degree at the Medical College of Wisconsin. He completed an orthopaedic surgery residency program at the University of Arkansas for Medical Sciences in Little Rock and a fellowship in hip surgery at the Hospital for Special Surgery in New York City. Dr. Garvin has served as Associate Editor for the Journal of Bone and Surgery, as well as Deputy Editor for Clinical Orthopaedics and Related Research and continues to serve as a consultant reviewer for both publications. In addition, he is on the editorial board for Techniques in Knee Surgery. Dr. Garvin is a member of the American Orthopaedic Association (ABC Traveling Fellow, 1995; Chair, Resident Leadership Forum, 2006), the Hip Society (member-at-large, Board of Directors, 2008), the Knee Society, the Association of Bone and Joint Surgeons and the Mid-America Orthopaedic Association (President, 2004-2005). Dr. Garvin was selected as one of the Best Doctors in America from 1996-2008. He was also selected as one of America’s Top Doctors by Castle Connolly Medical, Ltd. 2007-present. He is a board certified orthopaedic surgeon with special interests in hip and knee reconstruction, as well as prevention and treatment of musculoskeletal infections.

MIGUEL S. DACCARETT, M.D. | is an Assistant Professor in the Department of Orthopaedic Surgery and Rehabilitation. He received his medical degree from Pontificia Universitas Xaveriana, IHS in Bogota, Colombia in 1992. In coordination with his last year of medical school, he completed a general rotating internship at St. Ignatius University Hospital, and in 2000 completed his orthopaedic residency program at El Bosque University Orthopedic Surgery Program in Bogota, Colombia. Dr. Daccarett has completed three orthopaedic fellowships, including an Orthopaedic Trauma Fellowship (University of Louisville, KY, 2004), an Orthopaedic Oncology Fellowship (University of Florida in Gainesville, FL, 2005), and an Orthopaedic Sports Medicine Fellowship (Harvard University/Children’s Hospital in Boston, MA, 2006). He is a candidate member of the Musculoskeletal Tumor Society, as well as a member of the American Orthopaedic Society for Sports Medicine (AOSSM), the Orthopaedic Trauma Association (OTA), and the AO Foundation of North America (AONA), the International Cartilage Repair Society (ICRS), and the International Society of Arthroscopy, Knee Surgery and Orthopaedic Sports Medicine (ISAKOS). His special interests include limb salvage surgery, the arthroscopic assessment of peri-articular fractures, and sports-related injuries, particularly in the pediatric and adolescent age groups.

MARK DIETRICH, M.D. | is an Assistant Professor in the Department of Orthopaedic Surgery and Rehabilitation. He received his medical degree from the University of Nebraska College of Medicine. Dr. Dietrich completed a five-year residency program at the University of Nebraska/Creighton University Health Foundation, followed by an Orthopaedic Sports Medicine Fellowship at Minnesota Sports Medicine in Minneapolis, Minnesota. He is a candidate member of the American Orthopaedic Society for Sports Medicine. Dr. Dietrich’s specialty interests include sports-related injuries, hip arthroscopy, and arthroscopic knee and shoulder reconstruction.
Hani Haider, Ph.D. is a Professor at the University of Nebraska College of Medicine’s Department of Orthopaedic Surgery and Rehabilitation. Dr. Haider received his medical degree from the University of Iowa College of Medicine in 1999. She completed her orthopaedic surgery residency at the Creighton University/University of Nebraska Medical Center Health Foundation. She then went on to complete her Foot and Ankle/Lower Extremity Reconstruction Fellowship at the Florida Orthopaedic Institute in Tampa, Florida. Dr. Reed is board certified in orthopaedic surgery. She is a member of the American Academy of Orthopaedic Surgeons, Orthopaedic Research and Education Foundation, American Orthopaedic Foot and Ankle Society, Orthopaedic Trauma Association, Mid-America Orthopaedic Association, and Emerging Leader Program of the American Orthopaedic Association. Dr. Reed specializes in foot and ankle disorders, lower extremity post-traumatic reconstruction, and general orthopaedics.

Paul W. Esposito, M.D. is a Professor of Orthopaedic Surgery and Pediatrics at the University of Nebraska College of Medicine. He received his M.D. degree from Hahnemann Medical College and Hospital. He completed his internship and residency in orthopaedic surgery at the U.S. Naval Hospital, Oakland, California, and a pediatric-orthopaedic fellowship at Children’s Hospital Medical Center Cincinnati. He is board certified and is a member of the Pediatric Orthopaedic Society of North America, a member of the American Orthopaedic Association, a Fellow of the American Academy of Orthopaedic Surgeons, and a Fellow of the American Academy of Pediatrics. He is active in the American Academy of Pediatrics, Section on Orthopaedics, having served on the Executive Committee since 2004. Dr. Esposito was once again selected as one of Best Doctors in America in 2007-2008, an honor he has received since 1998. Recently, Dr. Esposito assumed the Presidency of the Medical Staff at Children’s Hospital for a two-year term, 2008-2010. He has had several publications and national presentations in the last two years regarding the treatment of osteogenesis imperfecta. Dr. Esposito’s special interests are in children’s extremity deformities, osteogenesis imperfecta, congenital and developmental disorders, and cerebral palsy.

Lori K. Reed, M.D. is an Assistant Professor at the University of Nebraska College of Medicine’s Department of Orthopaedic Surgery and Rehabilitation. Dr. McGarry received his medical degree from the Creighton University School of Medicine in 1998. He completed a surgery internship at the University of Colorado Health Sciences Center in 1999. Dr. McGarry continued on at the University of Colorado Health Sciences Center to complete his orthopaedic residency in 2004. Following residency, he completed an orthopaedic oncology fellowship at the University of Florida – Shands Hospital in 2005, where he researched the role of stem cells in bone and soft tissue cancers. Dr. McGarry is a candidate member of both the American Academy of Orthopaedic Surgeons and the Musculoskeletal Tumor Society. He specializes in Orthopaedic Oncology with a focus on limb salvage.

Sean V. McGarry, M.D. is an Assistant Professor at the University of Nebraska College of Medicine’s Department of Orthopaedic Surgery and Rehabilitation. Dr. McGarry received his medical degree from the Creighton University School of Medicine in 1998. He completed a surgery internship at the University of Colorado Health Sciences Center in 1999. Dr. McGarry continued on at the University of Colorado Health Sciences Center to complete his orthopaedic residency in 2004. Following residency, he completed an orthopaedic oncology fellowship at the University of Florida – Shands Hospital in 2005, where he researched the role of stem cells in bone and soft tissue cancers. Dr. McGarry is a candidate member of both the American Academy of Orthopaedic Surgeons and the Musculoskeletal Tumor Society. He specializes in Orthopaedic Oncology with a focus on limb salvage.

Hani Haider, Ph.D. is a Professor at the University of Nebraska College of Medicine’s Department of Orthopaedic Surgery and Rehabilitation. He is also Director of Biomedical Engineering Research. Dr. Haider earned his bachelor’s and Ph.D. degrees in mechanical engineering at the University of Sheffield in England. He is a charter member of the Engineering Council and the Institute of Mechanical Engineers in England. He is also a member of the Orthopaedic Research Society, the International Society for Technology in Arthroplasty, and the American Society of Testing and Materials (ASTM). He chairs the International Standards Organization (ISO) workgroup to review Total Knee Replacement wear testing standards, and co-chairs two ASTM committees on knee wear testing. In his research career, Dr. Haider has won three university academic and research prizes (England), “The KLINGER International Research Prize” (Austria), the ASTM Robert Fairer Award, and two University of Nebraska Medical Center awards. In 2005, Dr. Haider received the prestigious HAP Paul award for Outstanding Research in New Technology for Joint Replacement. Dr. Haider’s focus in biomedical engineering and orthopaedics is on knee implant simulation and testing, minimally invasive implant design, and computer-aided orthopaedic surgery.
EDWARD V. FEHRINGER, M.D. | is an Associate Professor at the University of Nebraska College of Medicine’s Department of Orthopaedic Surgery and Rehabilitation. He received his medical degree at the University of Nebraska College of Medicine. He then completed a five-year orthopaedic residency at the Creighton University/University of Nebraska Medical Center Health Foundation. After completing his residency, Dr. Fehringer went on to complete a shoulder and elbow fellowship at the University of Washington School of Medicine in Seattle, Washington. He is board certified by the American Board of Orthopaedic Surgery, an Associate Member of the American Shoulder and Elbow Society, a fellow of the American Academy of Orthopaedic Surgeons, an associate member of the Arthroscopy Association of North America, and a member of the Mid-America Orthopaedic Association. He was selected as one of the Best Doctors in America for 2007-08. His clinical interests include shoulder and elbow arthritis, dislocations, fractures and tendon tears. His research interests include rotator cuff tears and their association with aging, and shoulder joint reconstruction in shoulders with arthritis.

ANTHONY J. LAUDER, M.D. | is an Assistant Professor at the University of Nebraska College of Medicine’s Department of Orthopaedic Surgery and Rehabilitation, with a joint appointment in the Department of Plastic Surgery. Dr. Lauder received his medical degree from the University of Nebraska Medical Center in 2000. He completed an orthopaedic residency at the University of Nebraska/Creighton University Health Foundation in 2005. Following residency he moved to the West Coast to complete a fellowship at the University of Washington Hand Surgery Program in Seattle, Washington. He is a candidate member of the American Society for Surgery of the Hand, and a resident member of both the American Academy of Orthopaedic Surgeons and Orthopaedic Research and Education Foundation. Dr. Lauder specializes in hand and upper extremity surgery and has special interests in traumatic and degenerative conditions related to the wrist.

SUSAN A. SCHERL, M.D. | is an Associate Professor at the University of Nebraska College of Medicine’s Department of Orthopaedic Surgery and Rehabilitation. She earned her M.D. degree from the Boston University School of Medicine. Dr. Scherl completed two years of a general surgery residency at St. Luke’s/Roosevelt Hospital Center in New York and completed a five-year orthopaedic residency at State University of New York Health Science Center, Brooklyn, New York. She did her pediatric orthopaedic fellowship at Case Western Reserve University in Cleveland. She is board certified in Orthopaedic Surgery. Dr. Scherl is currently served as chair of the Pediatric Orthopaedic Society of North America Trauma and Prevention Committee and is also a member of the AAOS Trauma Call Task Force. She is chair of the AAOS Orthopaedic Workforce Project Team (March 2008-2010). Her areas of focus are pediatric orthopaedic trauma and management of orthopaedic aspects of cerebral palsy. She has edited two textbooks on musculoskeletal medicine and authored numerous book chapters and article reviews.

MATTHEW A. MORMINO, M.D. | is an Associate Professor and Residency Program Director, as well as the Herman Frank, M.D., Professor of Orthopaedic Surgery and Rehabilitation at the University of Nebraska College of Medicine. He received his M.D. degree from the University of Illinois College of Medicine and completed his orthopaedic surgery residency at Creighton University/University of Nebraska Medical Center Health Foundation. He also completed a trauma fellowship at the University of Washington. A board certified orthopaedic surgeon, Dr. Mormino is a diplomate of the American Board of Orthopaedic Surgery. He is a member of the American Academy of Orthopaedic Surgeons, the American Orthopaedic Association, the Orthopaedic Trauma Association, and the Mid-America Orthopaedic Association. He serves as a consultant reviewer of the Journal of the American Academy of Orthopaedic Surgeons, and was recently selected as one of the Best Doctors in America 2005-2008. Dr. Mormino’s special concentrations include pelvic fractures, malunions and nonunions, foot and ankle trauma, and periarticular fractures.
BRIAN P. HASLEY, M.D. | is an Assistant Professor of Orthopaedic Surgery, University of Nebraska College of Medicine, Department of Orthopaedic Surgery and Rehabilitation. He earned his medical degree from the University of Nebraska College of Medicine and completed his residency in orthopaedic surgery at the University of Nebraska Medical Center. Following residency, Dr. Hasley completed the Dorothy and Bryant Edwards Fellowship in pediatric orthopaedic surgery and scoliosis at the Texas Scottish Rite Hospital for Children, University of Texas at Southwestern Medical Center, in Dallas, Texas. Dr. Hasley completed post fellowship spine research at the same facility. His areas of focus are pediatric orthopaedic and pediatric spine surgery. He is board eligible.

FEREYDOON NAMAVAR, SC.D. | is a Professor at the University of Nebraska College of Medicine’s Department of Orthopaedic Surgery and Rehabilitation, and Director of the Nano-Biotechnology Laboratory. He is an active member of the Nebraska Center for Materials and Nanoscience and a Courtesy Professor at the Department of Electrical Engineering at the University of Nebraska – Lincoln. Dr. Namavar earned a Doctor of Science, summa cum laude, degree in nuclear physics, from the Institute for Nuclear and Radiation Physics at the Katholieke Universiteit Leuven in Belgium. Presently, he is involved with the development of novel concepts and technologies to maximize the lifetime of orthopaedic implants and minimize the possibility of wear and revision surgery through the development of novel nanostructure materials for friction and wear reduction, substrates for tissue engineering and enhancement of bone growth, and novel anti-bacterial coatings for short- and long-term applications of prosthetic devices. In a collaborative research project with other UNMC faculty, Dr. Namavar is using stem cell nanotechnology to regulate cellular growth in order to enhance or prevent cell proliferation, to either improve health or prevent disease with an emphasis on orthopaedic applications. Dr. Namavar has received grants and contracts from a variety of corporations and government agencies, including NIH, NASA and NSF. He collaborates with scientists around the world and holds several patents (the latest, US patent 7,048,76, was awarded in May 2006).

N. ÅKE NYSTRÖM, M.D., PH.D. | is an Associate Professor at the University of Nebraska Medical Center’s Department of Orthopaedic Surgery and Rehabilitation, with a joint appointment in the Department of Plastic and Reconstructive Surgery. A native of Sweden, Dr. Nystrom completed his medical training, internship, and residency at the University of Umea School of Medicine in Sweden. After completing a fellowship in hand and upper extremity surgery at the University of Louisville, he returned to Sweden. He later finished a Ph.D. in anatomy with research concentration in venous anatomy. He joined the UNMC faculty in 2001 after serving as Program Director of Hand Surgery at the University of Pittsburgh, 1994-2001. Dr. Nystrom specializes in Hand and Upper Extremity surgery, as well as Plastic and Reconstructive surgery. He was selected as one of Best Doctors in America 2007-2008. His research interests focus on cold intolerance after hand trauma, microvascular surgery, and surgical treatment of chronic pain in the head and neck after whiplash.

GLEN M. GINSBURG, M.D. | is an Associate Professor at the University of Nebraska College of Medicine’s Department of Orthopaedic Surgery and Rehabilitation. He is also Medical Director of the Munroe-Meyer Institute Motion Analysis Laboratory. Dr. Ginsburg earned his M.D. degree from the State University of New York at Buffalo and completed an orthopaedic residency at the State University of New York at Buffalo. He completed a fellowship in pediatric orthopaedics at Children’s Hospital in Los Angeles. A board certified orthopaedic surgeon, Dr. Ginsburg is a member of the Gait and Clinical Movement Analysis Society, the American Academy of Cerebral Palsy and Developmental Medicine, the American Academy of Orthopaedic Surgeons, and the Pediatric Orthopaedic Society of North America. He is a fellow of both the American Board of Orthopaedic Surgery and the Scoliosis Research Society. Two research papers on scoliosis have been recently published in the Journal of Pediatric Orthopaedics and SPINE. His areas of focus include pediatric spine deformities and gait disorders. Dr. Ginsburg was once again selected as one of Best Doctors in America 2007-2008.
WALTER W. HUURMAN, M.D. | is a Professor Emeritus of Orthopaedic Surgery and Pediatrics at the University of Nebraska College of Medicine. He received his M.D. degree from Northwestern University and completed his orthopaedic residency at the U.S. Naval Medical Center in Oakland, California. Dr. Huurman completed training in pediatric orthopaedic surgery at the A.I. duPont Institute. A board certified orthopaedic surgeon, Dr. Huurman has served on the editorial boards of the American Academy of Pediatrics journal, Pediatrics in Review, and the Journal of Pediatric Orthopaedics. He has served as associate editor of the Journal of Bone and Joint Surgery and on the editorial review boards of the Journal of the American Academy of Orthopaedic Surgeons, and Clinical Orthopaedics and Related Research. He is an oral examiner for the American Board of Orthopaedic Surgery, a member of the Pediatric Orthopaedic Society of North America, the American Academy of Orthopaedic Surgeons, the American Academy of Pediatrics, the North American Spine Society, and the American Orthopaedic Association. His areas of concentration include the juvenile spine, clubfoot, and juvenile hip disease, as well as editing pediatric publications. Dr. Huurman retired to Professor Emeritus status on July 31, 2006.

“Just a thank you does not seem adequate for saving our daughter’s life, but it is a heartfelt and emotional thank you filled with gratitude for all you have seen her through.”  
- LYNN & ANNE C., PARENTS OF AN ORTHOPAEDIC ONCOLOGY PATIENT

JOHN F. CONNOLLY, M.D. 1936-2007 | Dr. John F. Connolly, respected orthopaedic surgeon and educator, died unexpectedly at his home in Orlando, Florida, on July 20, 2007, at the age of 71. He is remembered as a born educator and leader endowed with conviction and compassion, a mentor, friend and healer.

Born in Teaneck, New Jersey, on January 22, 1936, Dr. Connolly was a 1953 graduate of Regis High School in New York City. He graduated cum laude in 1957 from St. Peter’s College in Jersey City, NJ, and earned his medical degree with AOA honors at the New Jersey College of Medicine (formerly Seton Hall) in 1961. He then completed surgical training in Seattle, New York and the University of Miami Jackson Memorial Hospital. After two years service as a captain in the United States Air Force, he took a faculty position at Vanderbilt University (1968-1973), followed by a position at the University of Nebraska Medical Center (UNMC) where he conducted the bulk of his research career.

When asked why they initially made the move to Omaha, Dr. Connolly’s wife, Anne, stated, “John felt that he had the opportunity to build something there. He wanted to challenge himself.” And that he did.

Dr. Connolly’s role at UNMC was pivotal in the development of what is now a prominent residency program. In 1974, he joined the Department of Orthopaedic Surgery and Rehabilitation as its first full-time chairman and built a nationally recognized orthopedic residency training program. In 1985, he oversaw the development of the joint venture orthopaedics program of Creighton University-University of Nebraska, which he chaired until 1990.

“FRIEND” “MENTOR” “TEACHER”
“Until then, there had been a working relationship between Creighton and the University,” said Dr. Walter Huurman, professor emeritus at UNMC’s Department of Orthopaedic Surgery, and longtime friend and colleague of Dr. Connolly. “John recognized the deficits in each program and combined them to make a single, stronger program.” Creighton was lacking in basic science and orthopaedic research, and the University program was lacking in trauma. The residency review committee (RRC) was pushing for a combined program. It was a good fit.

Under Dr. Connolly’s direction, the combined program was soon able to attract residents from a much wider region. He began aggressively recruiting progressively qualified individuals for the residency program, as well as several new faculty members. During his term as chairman a total of 43 residents graduated from the program. Dr. Connolly also recruited several faculty members including Robert Cochran, II, M.D., Walter Huurman, M.D., Louis Lippiello, Ph.D., Dennis Chakkalakal, Ph.D., W. Michael Walsh, M.D., Paul Esposito, M.D., David Brown, M.D., Michael McGuire, M.D., and current department Chairman, Kevin Garvin, M.D.

Although Dr. Connolly had broad academic interests, much of his research focused on the healing process of difficult fractures. He did pioneering work on bone marrow stem cells, including stimulating the bone marrow through biologic and electrical techniques to promote healing of cartilage and bone. It was this work that allowed him extensive teaching and travel experiences, including as a senior Fulbright scholar at the University of Western Australia and as a trauma consultant in the Russian-Afghan war in 1986. During his successful career as an orthopaedic surgeon, Dr. Connolly authored more than two-hundred research articles and chapters and wrote seven medical textbooks, including the Third Edition of DePalma’s Management of Fractures and Dislocations: an Atlas which became a standard-bearer on the topic internationally.

In addition, he was an oral examiner for the American Board of Orthopaedic Surgery for 20 years.

In 1990, Dr. Connolly left UNMC to become the academic chairman and program director of the Orthopedics Residency Program at Orlando Regional Medical Center (ORMC) and guided its development for the next 15 years. He raised the level of that orthopaedic residency program from a relatively small community program to one of the most recognized in the nation.

Throughout the years, Dr. Connolly continued to show his support for UNMC’s Department of Orthopaedic Surgery. In 2004, a donation by Dr. Connolly established The Connolly Orthopaedic Surgery and Rehabilitation Fund to support ongoing research activities.

“I believe the old saying “you make a living by what you get; and you make a life by what you give,” Dr. Connolly had said at the time. “Research was fulfilling in my life, and this fund will be used to help residents and others conduct research and solve problems, which in turn benefits our entire field.”

After retirement, Dr. Connolly continued to teach and guide as Professor Emeritus in Orlando and established the Schuh Scholarship Program at his alma mater, St. Peter’s College in Jersey City, to mentor and nurture future generations of scientists. He continued in clinical practice, volunteering at a local health clinic in Orlando and was very active in his parish, Holy Family Catholic Church. He enjoyed traveling to visit his six daughters and their families around the country, and continued to challenge himself to learn and read extensively, truly a lifelong student and scientist. The encouragement Dr. Connolly lent to others, his positive influence and love of a good joke will be treasured.

Colleagues and residents from around the country remember Dr. Connolly with great affection and respect. A friend and colleague from St. Peters College described him as, “intellectually curious, doggedly industrious, and a very creative thinker with a great sense of humor.” Dr. Connolly was constantly searching for truth and was always true to himself, he said.

Beyond his professional achievements, Dr. Connolly was also a devoted husband and father of six daughters, and deeply committed to his religious beliefs. He is survived by his loving wife of 43 years, Anne, and six daughters, Mari, Katie, Ednamarie, Jeanine, Anne McGrath and Claire. He was also blessed by 15 grandchildren at the time of his death.

In Orlando, wake services were held at Woodlawn Funeral Home on August 2, 2007, and a Funeral Mass was held at Holy Family Catholic Church on August 4th. He was buried in New Jersey, with Mass held at St. Aloysius in Caldwell, New Jersey, on Monday August 6th, and burial at Holy Cross Cemetery in North Arlington, New Jersey.

Contributing author, Dr. Walter Huurman
Dr. Stanley Bach died on December 30, 2004. He was 88 years old. Dr. Bach was a tireless supporter of Children’s Hospital and UNMC’s Department of Orthopaedic Surgery, retiring from active clinical practice in 1998, 50 years to the day that he opened his orthopaedic practice in Omaha.

Dr. Bach attended Dana College in Blair, Nebraska, and graduated from the University of Nebraska College of Medicine. He completed an internship at University Hospital in 1941 and subsequently served in the army. In January of 1946 he began a preceptor-type of orthopaedic residency training program, which concluded in December 1948. Shortly thereafter, Dr. Bach entered private practice and was appointed to the voluntary clinical faculty of both Orthopaedic Surgery and Anatomy. In 1955, Dr. Bach was advanced to assistant professor of Orthopaedics, and associate professor of Anatomy and Physical Medicine and Rehabilitation. Dr. Bach recognized both the potential and the need for pediatric orthopaedic medicine. His multidisciplinary approach became the standard for treatment of the most fragile of children.

Like many members of his generation, he did not like to talk about his many accomplishments, service to his country as a medical officer with Patton’s 3rd army in Europe, long hours of work, many times for free, but rather the children and families he felt privileged to have helped over his many years of practice. Although he also did general orthopaedics as most orthopaedists did at that time, his true love was the care of children. When children would come to his office, they would run to him for a hug, and he never seemed to be threatening to them. His gentle demeanor and quiet voice could calm any child.

Dr. Bach was a gentle man who was a mentor to many students and residents over many years. Although he may not have written extensively, or done amazing research, he was a caring example to all who had the privilege to work with him, talk with him or be cared for by him. He was a tireless champion for children and Children’s Hospital and is sorely missed.

Contacting authors Drs. Walter Huurman and Paul Esposito

Excerpt from the February 2005 Issue of Children’s Hospital Newsletter

by Dr. Paul Esposito

Like many members of his generation, he did not like to talk about his many accomplishments, service to his country as a medical officer with Patton’s 3rd army in Europe, long hours of work, many times for free, but rather the children and families he felt privileged to have helped over his many years of practice. Although he also did general orthopaedics as most orthopaedists did at that time, his true love was the care of children. When children would come to his office, they would run to him for a hug, and he never seemed to be threatening to them. His gentle demeanor and quiet voice could calm any child.
In April of 2008, the entire UNMC campus took time out to remember Charles “Chuck” Durham, a visionary leader and tireless supporter of the medical center and the entire Omaha community. Durham, who died April 5 at the age of 90, is remembered as a legendary figure whose countless gifts to the medical center have made a profound impact on UNMC’s research program.

Their name synonymous with research excellence, Durham and his late wife, Margre, have donated millions to support the medical center’s vision of building a nationally recognized research program. The single largest donor to the University of Nebraska in lifetime giving, their generous gifts provided support for two 10-story research towers on the UNMC campus and established funds to benefit arthritis, prostate cancer and non-invasive surgery.

In 2003, the $77 million Durham Research Center (DRC) opened, providing a first-class facility for scientists to perform cutting-edge research. Inscribed on a plaque in the DRC is a phrase that captures Durham’s spirit of giving: “Champion for medical research to prevent, cure, give hope and advance the common good.” The second tower, named the Research Center of Excellence II, is slated to open in 2009.

In 1998, the Durhams established the Charles W. and Margre H. Durham Excellence in Medicine Fund at UNMC. The creation of this permanent endowment fund, through the University of Nebraska Foundation, was established to support innovative research in prostate cancer, arthritis and minimally invasive surgery. In recognition of this donation, the Outpatient Care Center was renamed the Durham Outpatient Center.

A portion of this fund was directed to the Department of Orthopaedic Surgery and Rehabilitation as a result of Durham’s experience when he first came to the medical center for knee arthritis. He underwent a knee replacement in 1996 and became aware of the department’s excellent patient care and innovative research projects. The Durhams were added to the Department’s Wall of Honor, which permanently recognizes individuals and organizations that have given $100,000 or more to the Department of Orthopaedic Surgery and Rehabilitation.

“The generous gift provided by the Durhams continues to support vital research being done in our Biomechanics and Nano-Biotechnology laboratories,” said Dr. Kevin Garvin, chair of Orthopaedic Surgery. “We have created a premier implant testing facility in our lab that is directly impacting design and testing standards for total joint implants today, and we are making great strides in the field of nanotechnology by building tougher, ‘smarter’ implants for future generations.

“Making a difference in people’s lives was Durham’s ultimate goal, including improved healthcare for all Nebraskans, which he felt he could do best through supporting innovative research. In the fall of 2003 he was quoted as saying, “It is an honor to be associated with a medical center that has a vision to be world-class, to improve the health of all the people of Nebraska and beyond, advance medical knowledge through research and educate outstanding health professionals and scientists.”

Durham was born on September 28, 1917, in Chicago, and grew up in Iowa. He graduated in 1939 with a bachelor’s degree in general engineering from Iowa State University. He continued on at Iowa State, earning a bachelor’s degree in civil engineering (1940) and a professional degree (1944) also in civil engineering.

He served as chairman of the board and chief executive officer of Durham Resources, an investment company. Previously he was chairman and CEO of HDR, Inc., one of the nation’s top engineering and architectural companies.

Survivors include his son, Steve Durham of Dallas; daughters, Sunny Lundgren and Lynne Boyer, both of Omaha, and Debra Durham of Fremont, Nebraska; nine grandchildren and six great-grandchildren.

““The generous gift provided by the Durhams continues to support vital research being done in our Biomechanics and Nano-Biotechnology laboratories.”

- Dr. Kevin Garvin
MTF Establishes Annual J. R. Neff Award | In January of 2007, the department received notification that the late Dr. James R. Neff was honored by the Musculoskeletal Transplant Foundation (MTF) with the establishment of the annual J. R. Neff Research Award. Each year, the highest ranked science proposal submitted to the MTF will receive the J. R. Neff peer reviewed grant in the amount of $125,000.

The first person to be awarded this honor was Edward Schwarz, Ph.D., of the University of Rochester for his proposal entitled, “Revitalizing rAAV-FOP Coated Allografts.” His was one of only 10 peer reviewed grants awarded by the MTF in 2006/2007, selected from 54 proposals.

A press release by the MTF regarding the newly established award in honor of Dr. Neff stated, “The Foundation wishes to recognize his leadership, educational demeanor, and his accomplished past by naming the highest ranked science proposal by peer review the J. R. Neff Grant.” The MTF is the world’s largest tissue bank. The primary intent of its internationally recognized Board of Directors and Medical Board of Trustees is to further orthopaedic research and education through its granting program.

Dr. Neff was president of MTF’s Medical Board of Trustees and also a member of the Board of Directors. Regarding Dr. Neff, the MTF wrote, “[he] was a MTF Board activist who strongly supported orthopaedic research and education.” Dr. Neff was chairman of the Department of Orthopaedic Surgery and Rehabilitation from 1991-2000.

NEFF LEGACY CONTINUES TO PROLIFERATE

NEW PATENT ISSUED FOR NEFF INVENTION

The Dynamic Compression Device and Driving Tool was one of several inventions Dr. James Neff conceived during his lifetime. Although he was not here to see it come to fruition, in February of 2007 the dynamic compression device and driving tool was officially patented by the United States Patent and Trademark Office. Envision a specialized screw used to fasten portions of a fractured bone together, tightly securing them in place while allowing the bone to heal. Although there are several types of these devices, the screw Dr. Neff developed is designed to alleviate a common issue that can arise with some other screws.

For instance, one of the techniques for fixing and stabilizing fractures is termed interfragmentary compression. In this technique, the two fracture fragments are aligned perfectly and a screw is placed perpendicular to the fracture fragment. When the screw head engages into the outer surface of the bone, screw threads on the other side of the fracture pull the fracture together with continued tightening of the screw. This is called rigid fixation. As the bone heals, 1-2 millimeters of bone is resorbed at the fracture interface, theoretically loosening the rigid fixation.

“The dynamic compression device continuously imparts a force that pulls the bone together even as bone is resorbed to prevent loosening as the bone heals,” explained Dr. Sean McGarry, who specializes in Orthopaedic Oncology in the Department of Orthopaedic Surgery at UNMC.

This device is not the only patent held by Dr. Neff. Over twenty-five years ago, Dr. Neff also developed and patented the “Neff Nail,” a device still widely used today as a knee fusion device for failed knee surgeries.
Thank you to all who have gone before us, who made the road we walk today a more enlightened one.

In recent years the department has suffered the loss of several physicians who each played a tremendous hand in the shaping of our orthopaedic residency program. Since the residency program’s official induction in 1969 under the direction of Dr. L. Thomas Hood, the department has experienced the leadership of five chairs, including our current Chairman, Dr. Kevin L. Garvin. From 2003 to 2007, the department has sadly suffered the loss of four of these outstanding individuals, as well as a highly respected educator, and we would like to take this opportunity to list below their names, their term as chair, and the date of their passing. Note: Although Dr. Jackson Bence did not serve as chair of the department, we include him because of his never-ending enthusiasm and dedication to the teaching of dozens of orthopaedic residents over the course of 31 years as a volunteer professor.

Dr. L. Thomas Hood (chair, 1968-1974), August 2003
Dr. Jackson Bence (volunteer faculty, 1973-2004), February 2004
Dr. O. Max Jardon (acting chair, 1982), August 2004
Dr. John Connolly (chair, 1974-1990), July 2007
Dr. James Neff (chair, 1991-2000), July 2005

Advancements in the Residency Program

Our orthopaedic residents are involved in daily patient care as well as important research activities during their intensive training. As part of The Nebraska Medical Center, the University Hospital is a Level I Trauma Center, and our orthopaedic surgery residents play an integral role on the hospital trauma team.
The UNMC Department of Orthopaedic Surgery and Rehabilitation is combined with Creighton University Medical School under the auspices of the Nebraska-Creighton Health Foundation. Located in metropolitan Omaha, our residency program provides an outstanding educational experience, a safe town with affordable living, and an enriched social environment.

The combined program is directed by Matthew Mormino, M.D., associate professor of orthopaedic surgery at UNMC. The program includes training in all the orthopaedic subspecialties:

- hand
- foot and ankle
- major joint reconstruction
- oncology
- pediatric orthopaedic surgery
- shoulder and elbow
- spine
- sports medicine
- trauma

The program received full accreditation by the Residency Review Committee of the Accreditation Council for Graduate Medical Education (ACGME) in February 2006, with the next review coming in August 2008. Recent changes have been added to the residency curriculum to address the six core competencies as outlined by the ACGME outcome project for Resident Education:

- patient care
- interpersonal and communication skills
- professionalism
- medical knowledge
- systems based practice
- practice based learning and improvement

Likewise 80-hour work week restrictions have been met in our residents’ schedules. Overall the addition of new attending staff and the changes to the curriculum improved an already excellent residency training program.

Of all the men and women who have completed their orthopaedic surgical training through the Nebraska program, more than half are now practicing in the state or the Midwest. The remaining physicians are practicing around the country and overseas. Doctors throughout the region regard UNMC as a source of continuing education where they can learn the latest techniques for diagnosis, treatment, and prevention of bone and joint diseases.
Despite the city’s vibrant growth, residents enjoy a low-stress, small-town atmosphere. Visitors notice the friendly smiles and soon feel right at home. Omaha residents are proud of their city’s reputation for superb healthcare, agriculture, telemarketing and high-tech businesses, and the affordable quality of life. Located on the west bank of the Missouri River in the U.S. “heartland,” Omaha welcomes visitors from all over the world as they arrive at the city’s international airport, located only minutes from the medical center and comfortable accommodations.

Outside of work, residents can enjoy a variety of social activities including many wonderful restaurants and nightclubs, several sporting events, numerous music and arts venues, and various social gatherings held by the residents and their families throughout the year.

We tout a claim to fame for the Nebraska Cornhuskers, College World Series, Creighton University basketball, Omaha Royals baseball, three hockey teams and the annual Cox Classic, amongst others.

Omaha is also well known for the historic Old Market, Qwest Center Omaha, Joslyn Art Museum, Holland Performing Arts Center, Bemis Center for Contemporary Arts, Durham Western Heritage Museum and many more wonderful theatre and arts facilities.

Qwest Center Omaha is the site of the 2008 NCAA Men’s Division I Basketball First and Second Rounds, the 2008 Women’s Division I Volleyball Championship, the 2008 U.S. Olympic Swimming Trials and the 2010 NCAA Division I wrestling championships. Rosenblatt Stadium is home to the NCAA Men’s College World Series and the Omaha Royals AAA baseball team.

If you enjoy the outdoors, Omaha’s world-famous Henry Doorly Zoo is a great place to start. Other local outdoor features include the beautiful Lauritzen Gardens, Omaha’s Botanical Center near the Missouri River, Memorial Park and its fabulous rose gardens, or Zorinsky and Cunningham lakes located in west Omaha. The Omaha area also features many city and state parks, dozens of jogging and biking trails, family entertainment and water parks, championship golf courses, and several other lake and recreation areas.

Each year residents get together for the infamous Crawfish Boil, Oktoberfest, Halloween, Christmas and New Years. There is an annual Welcome BBQ for incoming residents and various other events such as flag football and intramural basketball throughout the year.
MEET THE RESIDENTS

CLASS OF 2009

ERICA BURNS, M.D.
Hometown: Moxee, WA
College: Central Washington University
Medical School: Creighton Medical School
Area of clinical/research interest: Shoulder and elbow
Activities/hobbies: Volleyball & other sports, hiking, biking, outdoors, and spending time with my husband and two daughters

CASEY JOHNSTON, M.D.
Hometown: Alliance, NE
College: University of Nebraska
Medical School: University of Nebraska Medical Center
Area of clinical/research interest: Sports medicine
Activities/hobbies: Fishing, hunting, golf, outdoor activities, and Nebraska football

BRIAN KLEIBER, M.D.
Hometown: St. Louis, MO
College: University of Missouri
Medical School: University of Missouri
Area of clinical/research interest: Trauma; Foot and ankle
Activities/hobbies: Racquetball, hunting, fishing, Mizzou sports, St. Louis Cardinals fan

JUSTIN SIEBLER, M.D.
Hometown: Lincoln, NE
College: University of Nebraska-Omaha
Medical School: University of Nebraska Medical Center
Area of clinical/research interest: Research project–Sacral fractures
Activities/hobbies: Spending time with my wife and kids

CLASS OF 2010

RYAN ARNOLD, M.D.
Hometown: Omaha, NE
College: Vanderbilt University
Medical School: University of Nebraska
Activities/hobbies: Basketball, golfing, outdoor activities, music

KURT BORMANN, M.D.
Hometown: Algona, IA
College: Truman State University
Medical School: University of Iowa
Activities/hobbies: Home improvement, spending time with my wife and St. Bernard, reading

GUSTAVO CORDERO, M.D.
Hometown: Northridge, CA
College: University of California, Los Angeles
Medical School: University of California, Davis
Area of clinical/research interest: Total joints; Evaluation of various fixation devices for fractures
Activities/hobbies: Fishing, skiing, basketball, computers

MICHAEL SHEVLIN, M.D.
Hometown: Helena, MT
College: Carroll College
Medical School: University of Washington
Area of clinical/research interest: General orthopaedics
Activities/hobbies: Golf, skiing, watching football, reading
After completing their training at Nebraska, residents move on to the next stage of their training. Many opt to continue their education by choosing one of many fellowship opportunities around the country. For some, going directly into a practice opportunity is the right choice. Below is a list of our most recent graduates and the fellowship or practice opportunities they chose.

**2008 GRADUATES**

Left to right: Drs. Randon Johnson, Curtis Hartman, Michael Hawks, and Leonard Kibuule.

**Curtis W. Hartman, M.D.** | Rush Adult Reconstructive Surgery Fellowship, Rush University Medical Center, Chicago, IL.

**Michael A. Hawks, M.D.** | Orthopaedic Trauma Fellowship, R. Adams Cowley Shock Trauma Center, University of Maryland Medical Center, Baltimore, MD.

**Leonard K. Kibuule, M.D.** | Orthopaedic Spine Surgery Fellowship, William Beaumont Hospital, Royal Oak, MI.

**2007 GRADUATES**

**David C. Buck, M.D.** | Practice: Heartland Orthopaedics & Sports Medicine; Hospital: Fremont Area Medical Center, Fremont, NE.

**Beau S. Konigsberg, M.D.** | Fellowship: Rush University Medical Center/Central DuPage Adult Joint Reconstruction Fellowship, Chicago, IL.

**Scott A. Swanson, M.D.** | Fellowship: Florida Orthopaedic Institute, Foot and Ankle Surgery/Lower Extremity Reconstruction, Tampa, FL.

**Kimberly A. Turman, M.D.** | Fellowship: University of Virginia Health System, Sports Medicine Fellowship, Charlottesville, VA.

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**RECENT POST-GRADUATE FELLOWSHIPS**

2008 INCOMING RESIDENTS | CLASS OF 2013

**Annie Kneirim**
- Medical School: Creighton University Medical Center

**Eric Samuelson**
- Medical School: University of Nebraska Medical Center

**Nate Sneddon**
- Medical School: University of Nebraska Medical Center

**Jeremy Toomey**
- Medical School: University of Nevada
Of all of the men and women that have completed their orthopaedic residency training through the Nebraska program, more than half are now practicing in the state or the Midwest. The following is a list of all department alumni since the orthopaedic residency program was established in 1971. The accompanying map shows the locations of our residents in the United States, according to the department’s most recent records.

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<tr>
<th>NAME</th>
<th>STATE</th>
<th>YEAR GRADUATED</th>
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<td>Lowell Niebaum</td>
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Advances in diagnosis, care, and prevention of diseases come from years of careful scientific research. The Department of Orthopaedic Surgery and Rehabilitation is building a world-class research program focusing on the areas of musculoskeletal diseases, molecular biology and genetics, development of less invasive surgical techniques and biomedical engineering, especially knee implant simulation and testing and computer-aided and robotic surgery. This adds up to the latest techniques and most advanced diagnosis and treatment—with personal care for patients and their families.
At the Nano-Biotechnology Laboratory in the Department of Orthopaedic Surgery, bigger is not necessarily better. Dr. Fereydoon Namavar, professor of Orthopaedic Surgery and director of the Nano-Biotechnology Laboratory, works with super-small nanostructures that are undetectable to the human eye to make a big impact in the field of orthopaedic surgery. Dr. Namavar and his team are using these minuscule structures to create super-hard, extremely wettable, “smart” infection-resistant coatings that will prolong the life of orthopaedic implants by reducing wear, thus reducing the need for revision surgery.

**THE LOTUS EFFECT**  
Recently, Dr. Namavar and his team mimicked the nanostructural properties of the lotus leaf, a symbol of purity known for its hydrophobic properties and ability to stay clean, in order to create a novel coating with ultra-hydrophilic surfaces for use in orthopaedic implant devices.

When a drop of water hits a lotus leaf, the water becomes a self-cleaning mechanism as it rolls off the surface and washes away dirt and dust. Dr. Namavar’s team has created the opposite effect, and engineered a nanocrystalline cubic Zirconia coating with super-hydrophilic properties and total wettability to water. Achieving total water wettability of one of the articulating surfaces in a joint implant can result in the reduction of friction, thus minimizing adhesive wear.

Their work recently garnered national attention when their findings, entitled “The Lotus Effect in Engineered Zirconia,” were published in the April issue of *NanoLetters* journal, a leading forum for nanoscale research.

These coatings have the potential to be used for many applications including orthopaedic artificial implants, tissue engineering, and cell adhesion and proliferation. Dr. Namavar’s research group used ion-bombardment to develop transparent nanocrystalline Zirconia films that possess the combined properties of hardness and complete wetting behavior designed to benefit tribology, wear-reduction and biomedical applications requiring ultra-hydrophilic surfaces.

**NANO-BIOTECHNOLOGY LABORATORY**

The ion beam assisted deposition (IBAD) process is the key.

**IBAD**  
The core technology in the Nano-Biotechnology Lab is the ion beam assisted deposition system, which combines evaporation with concurrent ion beam bombardment in a high vacuum environment. IBAD generates a vapor flux of metal, alloy, or ceramic atoms from several crucibles. The crucible is heated to a few thousand degrees Fahrenheit by an intense electron beam from a powerful electron gun. The energetic ions are then employed to produce engineered nanocrystals with superior mechanical properties that are ‘stitched’ to any substrate by bombardment. This ion-bombardment process is crucial for creating the nanostructured characteristics of surfaces that result in improved hardness, adhesion, morphology and chemical composition. This state-of-the-art system can operate in a unique twin IBAD mode to produce multi-nano-layer (super lattice structure) coatings with superb surface properties that are not possible through conventional techniques.

The IBAD system in the Nano-Biotechnology Lab in Nebraska is unique in its characteristics such as power, size, vacuum ability and potential.
“To our knowledge, it is unparalleled in any academic institution in the United States and is comparable or better than most systems used by high technology companies,” Dr. Namavar said.

In a collaborative effort with the department’s Biomechanical Laboratory, directed by Dr. Hani Haider, these super-hard coatings are then tested on a suite of instruments, including full knee and hip simulators, as well as a simpler pin-on-disk wear simulator and test system, to screen their potential for use in orthopaedic implants.

The creation of nanocrystalline super-hard, ultra-hydrophilic coatings will prolong the life of joint implants by reducing friction and wear. Although prosthetic joints often last over 15 years, the current devices are not always durable enough for younger, more active patients. Revision surgery is generally less successful than the primary surgery and is costly in terms of patient hardship and expense. Extending the life of artificial joint implants would eliminate suffering and save substantial healthcare dollars. While the potential impact of this research is huge, our orthopaedic researchers are not stopping there.

"To our knowledge, it is unparalleled in any academic institution in the United States and is comparable or better than most systems used by high technology companies.”

-DR. NAMAVAR
Remaining at the forefront of scientific research and staying abreast of the latest advances in orthopaedic technology is an integral part of having a successful orthopaedic program. The staff at the Biomechanics Laboratory in the Department of Orthopaedic Surgery is not only using the latest techniques, they are actively creating some of them.

Dr. Hani Haider, director of the Biomechanics Lab and professor of Orthopaedic Surgery, and his team have taken what began as a relatively small research endeavor and propelled it into what is now an internationally known premier implant testing facility. The 5,000 square feet laboratory at the Scott Technology Center is one of the largest and most active implant testing facilities in an objective university environment in the United States. Cutting-edge in vitro testing of orthopaedic implants is performed in the lab with a suite of knee simulators and various other innovative designs of testing equipment, some of which were manufactured in-house.

Today’s implants need to last longer and perform better to suit the modern patient, who is younger and more active. Rigorous testing must be completed to determine their performance, as well as their durability, before implants are approved for clinical use. Researchers at the Biomechanics Lab continue to play an integral role in setting international standards for developing the next generation of methodologies and simulators for wear testing of implants. In the past, simulators that were principally designed to test for wear fell short of capturing aspects of implant performance such as high flexion and other extremes of motion. The team at the Biomechanics Lab designed and built a lower limb simulator to test these high-flex implants, which includes a feature that, to their knowledge, is unique. Resembling a robotic leg, this simulator uses pneumatically driven “fluidic muscles,” which exert more realistic forces onto cadaveric or synthetic knee specimens. This machine is designed to help solve total knee replacement design to prevent bony impingement, subluxation and to improve patellar tracking.

The team has also adapted a knee simulator to allow for testing of a total ankle replacement system. In addition, they recently commissioned a new state-of-the-art hip wear simulator to test total hip replacement systems. The innovative work on wear testing of joints being done in the lab here in Nebraska is helping to set national and international standards for testing of knee replacement systems. Some of the data and performance criteria from these experiments have directly influenced the latest international testing standards, such as those of knee replacement wear, constraint and standardized specification of range of motion.

Presenting the results of their work at international scientific conferences has gained the lab national attention and eventually succeeded in securing funding in the form of a $5 million dollar, five-year donation used to fund the expansion of the department and catapult their research to a new level. In addition, they have secured over 25 different extramurally-funded research contracts over recent years totalling $1.3 million dollars.
In addition to implant testing, the team at the Biomechanics Lab invented the concept of, and was the first to demonstrate on a test bench, a self-powered piezo-electronically driven microprocessor to be housed on-board futuristic orthopaedic implants. The piezoelectric effect is expected to allow the forces within a knee implant to self-generate enough energy to run electronics on board the implant. With each step the patient takes, loading of the joint would produce a minute electric charge. Future “Smart Implants” could then collect information about the status of the implant including wear and alignment, amongst other data. This data could then be communicated to a patient’s surgeon via a radio link from outside the body during a patient’s follow-up visits. The ultimate goal of the project would be the creation of a smart implant capable of early detection of implant wear, misalignment and/or loosening. In the more distant future, Dr. Haider envisions an even smarter, self-adapting implant that could perhaps correct its own alignment. He points out that this, however, is in the much longer term. Having inspired the international research community with this concept and its first bench prototype, progress on this in Nebraska is currently on hold requiring funding. The same concept has been taken up in other institutions, especially in Europe where a consortium group of orthopaedic manufacturers and researchers has been heavily funded to take this technology to the next stage.

Another area of exciting research undertaken in the Biomechanics Lab is Computer-Aided Orthopaedic Surgery (navigated freehand bone cutting for total knee replacement surgery). This Nebraska-born technology reduces the need for bulky alignment instruments (jigs) during knee replacement surgery. Researchers in the lab developed software that first creates a patient-specific, 3-D bone model on a computer screen. The system then links cameras to track movement of instruments and bones, and render those movements realistically on a computer screen in real-time. The optimal surgical bone cuts are represented as target planes superimposed on the 3-D models of the bones. The surgeon can visualize on the screen the desired target cuts and view the instantaneous movement of their hand-held cutting tools or other instruments.
Since 2003, the Department of Orthopaedic Surgery has been gathering information for a growing surgery outcomes database that allows surgeons to track patient’s treatment results and study emerging trends in surgical outcomes.

Offering superior patient care requires the continuous evaluation of current practices and establishment of improvement objectives. To ensure that diagnosis and treatment are continually evolving in the orthopaedic department, we participate in the collection, interpretation and analysis of clinical and patient response outcomes data.

“Being able to utilize this type of patient outcomes information is vital to our ability to continuously offer better treatments to patients suffering from these types of conditions,” said Dr. Kevin Garvin, professor and chair of Orthopaedic Surgery. “In addition, we are able to share our research findings with the scientific community, as well as provide increased educational opportunities for our residents.”

Currently there are 2,550 participants enrolled in the database who have been surgically treated for a hip, knee or shoulder condition, or for a Whiplash Associated Disorder (WAD). After patients consent to participating in the database study, they fill out a five-minute survey that collects information about pain, joint function, and general physical and psychological health. Patients are asked to complete the survey prior to surgery, and again at six, 12, and 24 months post surgery, and then every second year indefinitely. Clinical research coordinator, Dana Schwarz, oversees all the department’s research activities, including the outcomes database. According to Schwarz, most patients are willing to participate in the study and perform the required follow-up surveys. This year, however, the department has instituted an electronic prompting notification so that when patients are unable to return for follow-up visits, surveys are mailed to them when they are due. This is just one more safeguard to ensure that we are accruing accurate results, said Schwarz.

In addition to studies being utilized in the outcomes database, there are a variety of clinical studies being performed in the department. On the following page is a list of all outcomes and clinical studies that have taken place in the department from 2006 to present.

### ACTIVE STUDIES

- Evaluation of a Cuff Tear Arthropathy Hemiprostheses for the Treatment of Glenohumeral Arthritis in the Presence of a Chronic Rotator Cuff Tear
- Functional Outcomes after Plate Fixation of Humerus Shaft Fractures: Anterior versus Posterior Approach
- Computed Tomographic and Functional Follow-up of Glenoid Anchor Peg Component Fixation Utilizing Autologous Bone Graft in Total Shoulder Arthroplasty
- Orthopaedic Registry to Monitor Treatment Outcomes
- Full Thickness Rotator Cuff Re-tear Prevalence and Correlation with Shoulder Function in Patients 65 Years and Older
- Acute Bracing of Humerus Shaft Fractures
- Outcomes Following Fixation of Proximal Humerus Fractures with Short Intramedullary Locked Nail
- Radial Head Replacement Stem Loosening and its Association with Forearm Systems
- Outcomes of Total Hip Replacement Utilizing Oxidized Zirconium Femoral heads on Cross-Linked Polyethylene
- Why Are Total Hip Arthroplasties Revisited?
- Outcomes Following Acetabular Fracture
- Assays of Stem Cell Function in Clinical Aging Research
- An Evaluation of Outcomes of Total Joint Arthroplasty in Orthostopic Liver Transplant Recipients
- Displaced Femoral (Neck Fracture) Arthroplasty Consortium for Treatment and Outcomes
- A Study in the Simulation of Chondrocytes in 3-D Culture by Continuous Ultrasound
- Distinguishing Commercial versus Pathologic Staphylococcus Species in Cases of Fracture Nonunion after Internal Fixation
- A Prospective Study on the Effect of Surgical Treatment for Chronic Posttraumatic Headaches (Whiplash Associated Disorders) on Photophobia
- Follow-up after Surgical Treatment for Whiplash Associated Disorder
- Factors that Influence Medical Students’ Choice of Residency
- Early Operative Experience of the Fassier-Duval Telescopic Rod System for Children with Osteogenesis Imperfecta

### COMPLETED STUDIES

- Comparison of the Single vs. Double Incision Technique for Achilles Tendon Reconstruction with Flexor Hallucis Tendon Transfer – Is the Second Incision Really Necessary?
- Osteotomy Healing in Pediatric Osteogenesis Imperfecta Patients Receiving Low-Dose Pamidronate Therapy
- Should Obese and Morbly Obese Patients Wait for TJA?
- Non-prosthetic Resurfacing of the Shoulder with Prosthetic Replacement of the Humerus Registry
- Correlation of Body Mass Index to Outcomes Following Hip and Knee Arthroplasty
- Gait Analysis after Intramedullary Fixation of Femoral Shaft Fractures
- Non-operative Treatment of Zone III Sacral Fractures
- Correlation of Upper Extremity Function with Angulation of the Humerus after Humeral Fracture
- Osteoporosis Diagnosis and Education Following Frailty Fracture
Our orthopaedic faculty, researchers and research staff are continuously involved in new and innovative research projects in an effort to advance current orthopaedic knowledge and techniques, and remain at the forefront of cutting-edge orthopaedic advancements. For your perusal, we have included sixteen research abstracts covering some of the research completed in the department in 2006-2007.

INTRODUCTION

The purpose of this study is to determine which provides a more accurate assessment of leg length, a single exposure hip-to-ankle digital radiograph or a CT scanogram. Our hypothesis is that a CT scanogram is more accurate, especially in larger subjects, due to distortion caused by magnification with a single-beam image. At our institution, CT scanograms have been the standard leg-length measurement technique since 1987. In 2006, digital radiography was installed, and a switch to single exposure hip-to-ankle digital radiographs for measurement of leg lengths was made. It was felt that this would be quicker and as accurate, and involve less radiation exposure. However, we started to notice inconsistencies and discrepancies in measurement values and Moseley-Green straight line graph plots in children who had undergone digital radiography, consistent with magnification error, leading us to undertake this study.

METHODS

A single exposure hip-to-ankle digital radiograph (DR) and a CT scanogram (CT) were obtained for the left leg of each of two plastic skeletons, one large (adult-sized) and one small (child-sized). All studies were performed using standard protocols. As a control, images of a standardized ruler were also obtained. Three independent sets of clinical leg length measurements for each skeleton were obtained and averaged. The resulting clinical leg length value was then compared to those obtained by the two radiographic methods.

RESULTS

For the small skeleton, the leg length as measured by DR was 38.6 cm, and by CT was 37.6, for a differential of 1.0 cm. For the large skeleton, the leg length as measured by DR was 80.3 cm, and by CT was 78.4, for a differential of 1.9 cm. The 70.0 cm ruler measured 70.6 cm by DR and 70.0 cm by CT. Clinical leg length measurement for the small skeleton was 38.0 cm for a differential for DR of 0.6 cm and for CT of 0.4 cm. Clinical leg length measurement for the large skeleton was 78.1 cm, for a differential for DR of 2.2 cm and for CT of 0.3 cm.

DISCUSSION

Historically, there have been several methods for radiographic evaluation of leg lengths. A teleoroentgenogram is a single exposure of both legs on a long cassette with a ruler. The beam is centered over the knees. The advantages of this technique are that it is simple, and limb deformities are readily visible. The main disadvantage is that parallax of the beam causes magnification error. An orthoroentgenogram is also performed on a long cassette with a ruler, but three individual exposures are made, one centered over each joint. Advantages are less magnification error, and the technique is fairly simple, however the patient must be cooperative and remain still. A scanogram is performed by obtaining three exposures, moving the film and x-ray beam for each one. This technique results in less magnification error and more accurate measurements, providing that the patient remains still and that the technologist has properly centered the beam and positioned the cassette. It does not allow for visualization of the entire limb, and the radiation exposure utilizing this technique is relatively high. CT scanograms, in which leg length is measured by the computer from AP scout films, have been found to be very accurate, and have decreased radiation exposure compared to an orthoroentgenogram or scanogram. The drawbacks to CT scanograms are that they are relatively time consuming, and need to be scheduled at the hospital in advance.

In our experiment, the measurements obtained with CT were more accurate, in the case of the control ruler as well as with both skeletons. As predicted, as the subject increased in size, magnification error increased as well, and the differential in accuracy became more pronounced. Our explanation for this is that despite the addition of digital technology, the DR is essentially a teleoroentgenogram, obtained with a single beam exposure centered over the knee. This technique is relative...
results inherently in parallax and magnification. We calculated radiation exposure of a CT scanogram to be roughly 2.8 times that of a hip-to-ankle digital radiograph, but approximately half that of a traditional scanogram. At our institution, patient charges for the two tests are identical.

Limitations of this study are that the plastic skeletons we used had no soft tissue covering over their limbs, which may affect positioning somewhat. The small skeleton was a miniature version of an adult skeleton, and not a reproduction of a child’s skeleton, so proportion may have been somewhat different than found in vivo. Also, we had no absolute values for the lengths of the skeleton limbs, and instead utilized a mean value derived from three independent clinical measurements.

CONCLUSION | CT scanograms are a more accurate modality for leg length measurement than hip-to-ankle digital radiographs. The measurement differential for DR due to magnification increases as subject size increases, which has implications for serial studies obtained over time for charting and extrapolation to a Moesley-Green straight line graph. Therefore, we have switched our leg length measurement technique protocol back to routine use of CT scanograms.

REFERENCES


OPINION SURVEY REGARDING PEDIATRIC ORTHOPAEDIC TRAUMA CALL AND EMERGENCY TRAUMA TRAUMA MANAGEMENT

Members of the Pediatric Orthopaedic Society of North America Trauma and Prevention Committee, 2005-2006:

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INTRODUCTION | The purpose of this study is to determine the attitudes and practices of pediatric orthopaedic surgeons regarding various aspects of on-call coverage and emergency trauma management. In 2006, the members of the Pediatric Orthopaedic Society of North America (POSNA) Trauma and Prevention Committee were charged by the POSNA Board with surveying the membership about their management of emergency on call responsibilities. The charge was in response to the Board’s perception that pediatric orthopaedic surgeons are currently overwhelmed with such responsibilities, in the face of increasing demand for specialist service, decreasing willingness of general orthopaedic surgeons to care for trauma in children, and an aging and decreasing pediatric orthopaedic workforce.

METHODS | A 32-question on-line survey was sent to all 397 active members of the Pediatric Orthopaedic Society of North America. Completion was voluntary and not compensated. There were 296 completed surveys corresponding to a response rate of 79.6%. Twenty-four questions were yes/no or multiple choice. The remainder were open-ended. There were three questions concerning respondent demographics.

RESULTS | 83.1% of respondents were male. Respondents ranged in age from 30 to over 70, with 54% between the ages of 36 and 50 years, corresponding to an average of 13 years in practice. 77% of respondents felt that taking trauma call is an integral aspect of being a pediatric orthopaedic surgeon. 63.9% take trauma call, either mandatory or voluntary, 10-19 nights of call. 57.8% take trauma call more than 20 nights/year. 26% of respondents take call more than 20-19 nights of call. 2.7% take 20 or more, and 10.6% take no call. Many of the pediatric orthopaedic surgeons taking no trauma call commented that they either work at a Shriners Hospital without an emergency department, or are “senior” partners who have speeded out of the call schedule. The number of orthopaedic surgeons taking call per practice is fairly evenly distributed between 3 and 10. Call is equally distributed in 32% of cases, and mandatory in 23%.

52.5% of respondents work at a Level I trauma center, 23.4% at a Level II, 9.7% at a Level III, and 9.7% work at a hospital that is not a trauma center. In 56.3% of cases, trauma call is pediatricly oriented, and combined pediatric and adult in 43.7%. In groups in which there are both adult and pediatric orthopaedic surgeons, the pediatric orthopaedic surgeons assume care of pediatric trauma patients from their adult colleagues the next day in 58.7% of cases. Spine trauma is included in call responsibility in 62.5% of cases. Only 10% of respondents have a designated fracture clinic. 5.1% of respondents have a designated spine clinic.

37% of respondents have a designated hand clinic. There is no fracture clinic in 10.7% of cases, no hand clinic in 12.5% of cases, and both in 26.2% of cases. Of those practices that do have a fracture clinic, 41.7% of cases this takes place just once a week. 23% of respondents have fracture clinic five times a week, and 2.1% hold weekend fracture clinics. Most commonly, fracture clinics run four hours, or a half-day (4.4%), but 25.6% run eight hours, or a full day. The number of patients seen per fracture clinic ranges from fewer than ten to over one hundred, but averages between 20 and 50. Sedation or anesthesia is unavailable in 84.5% of fracture clinics, fluoroscopy is unavailable in 64.5%, and no reductions are performed in 63.4%. Institutional support to finance or staff the fracture clinic is received in 30.5% of practices.

DISCUSSION | Currently, there is a national shortage of physicians willing to cover emergency trauma call. Orthopaedics is among the list of subspecialties most often cited as being unavailable to emergency departments. While it has been estimated that 90% of emergency orthopaedic conditions can be successfully treated at the community hospital level, the percentage of emergency departments reporting difficulty in obtaining subspecialty coverage is 63-81%, depending on the region, and there has been a 33% increase in the number of transfers from one emergency department to another. In fact, the situation has become so critical that the American College of Surgeons has proposed a new subspecialty, “acute care surgery,” in which general surgeons would be trained to perform orthopaedic emergency procedures, such as the application of external fixators.

Often, covering community orthopaedic surgeons request that a patient be transferred to a trauma center, tertiary care center, or children’s hospital because they do not “feel comfortable” taking care of the problem at hand. This situation can be frustrating not only to patients, whose care is delayed and who incur bills from multiple institutions, but also to receiving physicians, who perceive such transfers as “dumping” patients. The American Academy of Orthopaedic Surgeons (AAOS) and the Orthopaedic Trauma Association (OTA) conducted a survey in 2005 in which 93% of respondents felt that there was a “looming crisis” in access to emergency orthopaedic care. The recommendations that came out of the survey were that all orthopaedic surgeons should take call, and maintain basic core competency in acute care and “damage control” orthopaedics, despite subspecialization. It emphasized that medical school and residency training should stress the importance of “sharing the burden” of call, and that faculty should model behavior by taking call, including chairman and senior faculty.

Similarly, the American Academy of Orthopaedic Surgeons (AAOS) formed a task force on the subject, which published a position statement in 2006. It states that all orthopaedic surgeons share an obligation to society to take emergency call, and that hospitals and the government have a reciprocal obligation to provide the necessary support financial and otherwise, for physicians to do so, and that physicians, hospitals, and politicians need to work together to ensure an environment conducive to the timely, effective, and appropriate care of patients.
These issues become intensified when applied to the care of injured children. Many general orthopaedic surgeons do not wish to care for children, and increasingly problems that were once often managed in the community, are now being referred directly to a pediatric specialist. For example, one study found that in an eight-year period, the percentage of supracondylar humerus fractures treated by a pediatric orthopaedic surgeon increased from 37% to 68%. Moreover, the high percentage of children who are uninsured or under-insured makes it difficult for fund providers to want to accept them as patients. All of these factors contribute to what is increasingly being felt as the “burden” of trauma care faced by practicing pediatric orthopaedic surgeons.

With the exception of those pediatric orthopaedic surgeons practicing within the Shriner’s Hospital system, almost all pediatric orthopaedic surgeons spend some portion of their professional lives taking care of trauma patients. However, there are relatively few pediatric orthopaedic surgeons who consider themselves to have a primary professional interest or focus on pediatric orthopaedic trauma. Only 9 (1.5%) of the 597 active POSNA members are also members of the OTA, membership in which requires 30% of one’s practice to be trauma-related. Therefore, many of the respondents to the survey commented that caring for trauma patients was “bothering” and interfered with or took away from their elective practices and their areas of interest. About half of respondents have a dedicated fracture clinic, the main benefit of which (according to respondent comments) is to consolidate fracture care to a specified time and place, since in the vast majority of cases reductions are not performed in the clinic. Complaints about fracture clinic are mainly that it is “bothering”, “time-consuming”, “crowded”, and a “dumping ground” for Medicaid patients.

Most of the respondent comments centered around issues of fairness in the call schedule, call compensation, transfer of patients for non-medical reasons, and lack of next-day OR block time. Lack of access to next-day OR block time is particularly critical, since having a dedicated trauma room has been identified as a factor that greatly improves the morale and lifestyles of those providing acute trauma care, and is a recommended by the OTA as a “trauma service requirement.” Many also noted a lack of equity in trauma call compensation between adult and pediatric orthopaedic surgeons, as well as a general sense of being overwhelmed by the volume and demands of trauma patients.

CONCLUSIONS | The majority of pediatric orthopaedic surgeons (77%) feel that taking trauma call is an integral aspect of being a pediatric orthopaedic surgeon. However, increasing volumes of pediatric trauma patients, combined with a lack of financial and institutional resource support for the care of such patients, is felt by practicing pediatric orthopaedic surgeons as a burden. Strategies to reduce the burden of trauma care include institutional support in the form of financial compensation for call, availability of a dedicated trauma OR, and increased resources for fracture clinics; fair and equitable call schedules and call compensation structures; and adoption of the OTA and AAOS position statement guidelines designed to decrease the transfer of patients for non-medical reasons.

REFERENCES

INTRODUCTION | The hearing surface of total hip arthroplasty is one of the most critical factors for long-term survival of hip implants. Several alternative bearing surfaces have been developed in an attempt to prolong the survival. A ceramic femoral head on a polychloroethylene acetabular liner is among the most common alternative bearing couples currently used in total hip arthroplasty. Ceramic bearings offer the advantage of improved friction, smoother surface finish, improved resistance to scratching, and are biologically inert compounds. Clinical studies have demonstrated mean linear wear rates with ceramic on polyethylene are between 0.03 and 0.1 mm/yr in patients followed for up to 18 years. The risk of fracture with monolithic ceramic heads has been one drawback to the use of this material, particularly in young, active patients, and has led to the development of oxidized zirconium. The purpose of this study is to evaluate the in vivo wear rates of total hip arthroplasties utilizing oxidized zirconium femoral heads and highly cross-linked polyethylene, and compare these to published wear rates of cobalt chrome on standard or cross-linked polyethylene. Clinical studies have shown that acetabular components with zirconium metal or ceramic heads have lower wear rates than cobalt chrome heads, and that zirconium is a safe material for use in a bearing surface.

MATERIALS AND METHODS | We performed a retrospective review of a select series of patients who underwent total hip arthroplasty between March 2003 and March 2005 using an oxidized zirconium femoral head and a highly cross-linked polyethylene acetabular liner. Patients were determined to be candidates for oxidized zirconium by the senior surgeon based primarily on age (generally < 65 years), relative activity level, and overall health status. Wear was evaluated using use X-ray, AP pelvic radiographs, and osteolysis was evaluated with AP and lateral radiographs of the hip. Acetabular inclination angle and radiographic anteversion were also measured. In vivo femoral head penetration was determined using the semi-automated computerized measuring method HAS Version 8.0.4.0 (Hip Analysis Suite, The University of Chicago). The mean femoral head penetration was calculated by determining the magnitude of femoral head penetration between the first postoperative radiograph and the longest follow-up film, and dividing by the radiographic follow-up interval in years. True wear rates (without bedding-in) were also calculated based on the slope of the best fit regression line through a plot of all total penetration values vs. years from surgery using the one year film as a baseline.

RESULTS | At a minimum follow-up of two years all 54 patients were available for clinical evaluation. The Harris Hip Score improved from a mean of 51 (range 26-72) preoperatively to 97 (range 74-100) at the final follow-ups. There were 49 patients with excellent results, five with good results, and two with fair results. The slope of the regression line for the plot of displacement (micrometers) vs. time (year) using data points from 12 months to 10 years/ year (95% confidence intervals = +/- 59 microns/year). Average inclination angle was 15.4 (35-36). Average radiographic anteversion was 16.6 (3-20.7). No patient had radiographic evidence of osteolysis and no patient had been revised for mechanical loosening or wear.

Our complications included one DVT, one non-fatal pulmonary embolus, and one femoral head dislocation. The dislocation was discovered in the recovery room and it was felt that the cup position was not contributing factor. The patient was returned to the operating room for open reduction and cup reposi- tioning. The femoral head was inspected and found to be free of damage. The patient had no further instability.

DISCUSSION | Our findings of a true linear wear rate of four microns/year are among the lowest reported in the literature and have encouraged us to continue using this bearing couple. Manning et al also reported compa-
The limitations of our study include the inherent flaws of a retrospective review of a select series, the small cohort and short follow-up. The strengths of the study include the measurement technique, single surgeon series, and an active patient population which should highlight wear. Lastly, to our knowledge we are the first to publish in vivo wear results using this bearing.

In conclusion, the early wear rates in a relatively young patient population with oxidized zirconium and cross-linked polyethylene total hip arthroplasties are very low. The results have encouraged the continued use of this alternative bearing surface.
A total of 304 subjects 65 years or older were recruited to obtain 200 shoulders, as eight subjects had undergone previous shoulder surgery in one of their shoulders. Full thickness rotator cuff tear prevalence was 22% (44/200) with a 95% confidence interval (15.5–28.5%). After adjusting for age and gender, shoulders with full thickness rotator cuff tears had significantly lower functional scores than those that did not, for both the Simple Shoulder Test and Constant-Murley scores. On average, shoulders with full thickness tears had Constant scores 12.0 points lower than those without (p<0.0001). For those without tears, the odds of having a Simple Shoulder Test score of 9 or greater were 0.22 times the odds for those with tears (p<0.0001). We found no evidence of decreased shoulder function with increased tear size. However, this finding could also be due to lack of power in our data, with only 44 shoulders having a tear. The odds Ratio (OR) of a full thickness tear for subjects 10 years older was 2.69 times (95% CI is (1.35, 5.47)) the odds of a full thickness tear for subjects 65 years and older, and correlate the findings with shoulder symptoms for those 65 and older, to assess shoulder comfort and function in these shoulders, and to identify other co-morbidities possibly associated with tears.

In this study, full thickness rotator cuff tear prevalence was 22% in patients 65 years and older. Increased age correlated with increased rotator cuff tear prevalence. Adjusting for age and gender, those with intact rotator cuff tears had better function than those with torn rotator cuff tears based upon their Simple Shoulder Tests and Constant Scores. Finally, for those with rotator cuff tears that had seen a physician, there was no difference in age, gender, SST score, or Constant scores.

DISCUSSION
Rotator cuff disease affects shoulder comfort and function in many older patients. However, those patients often have variable shoulder symptoms. Some with shoulder dysfunction undergo MRI scans that identify large rotator cuff tears that are more extensive than anticipated and/or are not well-explained by recent trauma. Previous studies have shown that rotator cuff tears increase with age, that rotator cuff repairs heal more poorly in older patients, and that some older patients with larger tears have shoulders that function well despite an untreated rotator cuff tear. However, no study has looked specifically at patients 65 years and older to correlate full thickness rotator cuff tears with age, function, and co-morbidities. In fact, two frequently referenced studies on rotator cuff tears and their association with aging include one that focused on patients aged 19 to “greater than 69” (46 patients >60 years old), and another with patients aged 50-99 (23 patients >60 years old). The purpose of our study was to assess the prevalence of full thickness rotator cuff tears in 200 shoulders of patients 65 years and older, and correlate the findings with shoulder comfort, function, and patient co-morbidities.

The interpretation of our data has several important limitations. 1) Our patients were recruited from lower extremity orthopaedic clinics (hip/knee and foot/ankle). This method of recruitment does not yield a true cross-section of the population and may result in a selection bias toward less healthy patients. 2) Both shoulders were included in this study. It is possible that those with or without rotator cuff disease in one shoulder may have had comparable cuff status on the opposite shoulder. An alternative would have been to include only one shoulder from each patient in view of inter-patient variability. 3) Our data may not be adequately powered to exclude relationships of co-morbidities. 4) Finally, diagnoses such as heart disease and diabetes are difficult to answer with a ‘yes-no’ format. It is challenging to crisply define these diagnoses and, therefore, our results were likely affected because of it. None of these limitations, however, diminish the value of this attempt to define full thickness rotator cuff tear prevalence in patients 65 and older, to assess shoulder comfort and function in these shoulders, and to identify other co-morbidities possibly associated with tears.

One question has been asked: Are mobile-bearings the main reason behind the excellent results of the mobile-bearing tears, or have other factors been involved? Various studies [3,13,16] have compared mobile-bearings with fixed-bearing TKRs, but the mobility of the bearing had not been the only difference. Either the femoral component or other design details were different and/or the testing had been performed under the displacement-control or a hybrid regime, where the two types of bearings had been given different pre-selected kinematics as test inputs. As the kinematics affect wear, prescribing different motions as inputs indirectly dictates the wear results. The purpose of this study was to compare the resulting kinematics and wear of mobile to fixed-bearings, using identical femoral components and the same force-control inputs, including identical soft-tissue restraint simulation.

RESULTS
The kinematics (Figure 1) of the RP revealed a more anterior average position of the tibia relative to the femur during stance, compared to the FB. The AP displacement was similar for the two in stance, but the RP showed marginally less AP range in the swing phase. Both showed similar trends of internal-external (IE) rotation during stance, but the RP intermittently rotated around a rotationally offset range, shifted by up to ± 2°. The IE rotations of the FB were generally smaller (peaking at 4–5° internally just before toe-off than the RP peaking at 6–10° internally). Too of the RP specimens showed very infrequent, transient and mostly temporary dislocations of the UHMWPE insert.

INTRODUCTION
One of the theoretical benefits of mobile-bearing knee designs is the reduction in contact stress. Second, the rolling-sliding motion in rotating platform bearings is separated from the rotation motion onto two separate articulating surfaces. This reduces cross-paths which accelerate UHMWPE wear [1-3]. Third, there is high-rotational laxity, especially at flexion, with less stress transmitted to the prosthetic bone interface [4,5]. Finally, some argue that it is an adjustable implant with tilial self-alignment which enhances patellar tracking [6-7]. The clinical results of uni mobile bearings and rotating platform TKRs have been excellent at 10 and 18 years respectively [8,9]. Fixed-bearing TKAs have had comparable success in kinematic ability, wear, osteolysis and loosening [10-14]. One question has been asked: Are mobile-bearings the main reason behind the excellent results of the mobile-bearing knees, or have other factors been involved? Various studies [3,13,16] have compared mobile-bearings with fixed-bearing TKRs, but the mobility of the bearing had not been the only difference. Either the femoral component or other design details were different and/or the testing had been performed under the displacement-control or a hybrid regime, where the two types of bearings had been given different pre-selected kinematics as test inputs. As the kinematics affect wear, prescribing different motions as inputs indirectly dictates the wear results. The purpose of this study was to compare the resulting kinematics and wear of mobile to fixed-bearings, using identical femoral components and the same force-control inputs, including identical soft-tissue restraint simulation.

MATERIALS AND METHODS
Four Fixed-Bearing (FB) and four Rotating Platform (RP) PFC Sigma PCL retaining TKR specimens were installed in a fully-staggered order on two four-station force-control knee simulators. They were tested for 6 million walking cycles at 1Hz with diluted serum lubricant with 20g/l protein concentration at 37°C. They were given identical ISO standard force inputs and spring-based soft-tissue restraint simulating a resected anterior cruciate ligament (ACL) and retained posterior cruciate ligament (PCL). Anterior posterior (AP) displacement and axial rotation, along with many other variables, were logged to prove their consistency and to compare to the ideal (desired) waveform. Wear was measured gravimetrically and all of the articulating surfaces were photographed at different stages to record the features of the articulation/wearing regions.

RESULTS
The kinematics (Figure 1) of the RP revealed a more anterior average position of the tibia relative to the femur during stance, compared to the FB. The AP displacement was similar for the two in stance, but the RP showed marginally less AP range in the swing phase. Both showed similar trends of internal-external (IE) rotation during stance, but the RP intermittently rotated around a rotationally offset range, shifted by up to ± 2°. The IE rotations of the FB were generally smaller (peaking at 4–5° internally just before toe-off than the RP peaking at 6–10° internally). Too of the RP specimens showed very infrequent, transient and mostly temporary dislocations of the UHMWPE insert.
Wear regions on the proximal surface of the bearing inserts were similar, with marginally more pitting on the fixed-bearing. On the distal surface of the inserts, very minor blemishes (if any) could be seen on the fixed-bearings with the original machining marks still very visible even at the end of the test. However, on the rotating platform specimens, the machining marks had totally disappeared (or had been polished out) and some pitting could be observed, especially near the central pivot.

The wear rate (Figure 2) for the FB averaged $8.14\pm2.63$ mg/million cycles (Mc) and the RP averaged $6.78\pm1.74$ mg/Mc. Both were very low wear rates compared to other implants tested similarly in the same laboratory. The 17% lesser wear of the RP was accompanied by increased rotational laxity for the RP compared to the FB.

**Discussion**

The DePuy PFCΣ polyethylene wear of the rotating platform design was lower but not significantly lower ($p > 0.05$) than the fixed-bearing design. The magnitudes of wear that resulted from this study were not far different from the recent results of another lab [16] comparing these two implants. The wear of the Sigma FB was reported as $8.8\pm4.8$ mm$^3$/Mc ($=8.2\pm4.5$ mg/Mc) and the PFC Sigma RP was $5.2\pm2.2$ mm$^3$/Mc ($=4.9\pm2.1$ mg/Mc), with clear superiority for the RP.

The method used in [16] was a mixture of force and displacement control, and the soft-tissue restraint simulation was not specified. That study was sensitive to the inputs actually prescribed to each implant type, and indeed, varying those inputs from previous studies by the same lab naturally varied the results. The test of our current study provided identical inputs in every way, and identical soft tissue simulation, leaving the mobility of the bearing and the detailed geometry due to this mobility as the only differences.

Our in vitro study did not address other benefits of the rotating platform design such as rotating laxity, less stress transmitted to the prosthetic bone interface, and tibial self-aligning. On the other hand, there have been some risks reported with mobile-bearings, such as potentially more backside wear, high friction by lubricant starvation, edge loading or abrasion due to debris intermittently reducing mobile-bearing rotation, and a tiny risk of bearing insert subluxation. The benefits of rotating platforms should be considered multi-factorial, involving higher rotational laxity at higher flexion, less torques on the bone, and self-aligning. Significantly reduced wear due to the bearing mobility alone is yet to be proven in controlled-variable like-with-like testing.

**References**

INTRODUCTION | Certain metallic ions released from total knee replacement (TKR) can trigger immune response and allergy reactions in patients. Nickel (Ni) is one such ion. Currently the only options for patients sensitive to ion release are femoral components implanted with nitrogen ions or coated with oxidized zirconium (Oxinium). Patients would benefit from more options that shield against ion release. A novel coating, PVD hard Titanium Niobium Nitride (TiNbN), has been marketed internationally and used on many patients in Europe.

The coating is intended as a diffusion barrier to prevent migration of Ni to the surface and help bind nickel within the substrate. The elevated hardness of this coating should resist abrasion and reduce overall wear, or at least not prohibitively compromise them. This study investigates the wear of ultra-high molecular weight polyethylene (UHMWPE) tibial inserts paired with TiNbN coated femoral components and assesses the longevity of the coating itself.

MATERIALS AND METHODS | Testing was performed on a four station Instron-Stanmore force-control knee simulator which applies flexion, induces anatomically realistic joint reaction forces and torques between tibia and femur (ISO 14243-1 [1]), and includes a spring-based system to simulate self-tissue restraining forces and torques [2,3]. Four 60mm Vanguard-PS CoCrMo TKR femoral components were tested. Three of them were coated in PVD TiNbN and one was uncoated for control. They were lubricated with bovine serum diluted with deionized water to have 20g/l protein concentration, at 37°C. Deionized water was added to compensate for evaporation.

The TKR specimens were subjected to the force-control waveforms of the walking cycle as specified in ISO-14243-1 [1]. The loading, rotations, and torques were continually observed to ensure consistency with the desired waveforms. The tibial bearing inserts were weighed at 0, 0.1, 0.5, and every 0.5Mc afterwards for 8.0Mc. The lubricant was changed at each wear measurement interval. Liquid absorption was corrected by the use of two passive soak control bearing inserts maintained in similar temperature controlled serum during the test.

RESULTS | No gross delamination or fracture of the tibial inserts was observed. Inserts paired with coated and uncoated TKRs showed almost linear wear. After correction for liquid absorption, tibial bearings for the three coated specimens were paired with coated and TiNbN coated femoral components over an 8 million cycle test. Results from a 2004 5-million cycle test on two uncoated specimens of the same type are also shown.

At 2.5Mc, it was noted that the TiNbN coating started wearing away on some implants (Fig 2). By 5Mc all implants showed a small area of missing coating on the medial femoral condyles. These bare regions continued to increase in size as the test progressed to 8Mc. Upon completion of the test, surface analysis verified that this area was indeed a region where the coating had worn away and revealed the CoCrMo substrate. This region articulated near the edge of the medial condyle wear crater in the UHMWPE tibial bearing inserts (i.e. rim of the wear region) and thus could be associated with higher compressive, shear stress and motion combinations which are more robustly simulated in force-control testing.

DISCUSSION | The PVD TiNbN coated TKRs’ moderately higher wear rate may be due to the morphology of the surface of the femoral component introduced by the coating process. The benefits that TiNbN coated implants can offer to patients sensitive to nickel ions may outweigh any negatives due to the slightly higher wear rate. However, the coating process must be altered to create a more durable coating, able to withstand many years of articulation within the body, at least on this type of implant. It is understood by the authors that this very coating and exact process has been used recently on thousands of metal sensitive patients in Europe. The results of this study should therefore raise some concern.

REFERENCES
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Table 1: Average wear rate (in mg/Mc) and overall weight loss of UHMWPE tibial components paired with coated and TiNbN coated femoral components over an 8 million cycle test. Results from a 2004 5-million cycle test on two uncoated specimens of the same type are also shown.

<table>
<thead>
<tr>
<th>Specimen Name</th>
<th>Wear Rate (mg/Mc)</th>
<th>Total weight loss (mg)</th>
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<td>Coated Specimen 1</td>
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<tr>
<td>UHC. Specimen 2004-2</td>
<td>9.62</td>
<td>47.29 (± 5Mc)</td>
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</table>
AN OUTCOME STUDY OF NON-OPERATIVE TREATMENT OF DENIS ZONE III SACRAL FRACTURES

Justin G Siebler, M.D., Brian P Hasley, M.D., and Matthew A Mormino, M.D.

BACKGROUND | The data for non-operative treatment of sacral fractures is limited to small case reports or subgroups of larger series with marginal clinical outcomes and no functional outcomes. Zone III fractures are the least common and the least studied of sacral fractures. These are associated with higher rates of neuro-motor deficits in the lower extremities, saddle anesthesia, bowel, bladder, and sexual dysfunction. To our knowledge there have been no studies of outcomes of non-operative treatment of Denis Zone III sacral fractures reported.

PURPOSE OF THE STUDY | The purpose of this study is to report the natural history and outcome of non-operative treatment in patients with Denis Zone III sacral fractures at a minimum of two years follow-up.

MATERIALS AND METHODS | From 1997 to 2002, 18 patients with Denis Zone III sacral fractures were treated. Three patients required operative intervention secondary to associated pelvic ring instability; 15 patients were treated non-operatively. Charts and radiographs of these patients were reviewed to assess fracture pattern, initial neurologic and/or motor deficits, bowel and bladder function, and Gibbons classification.

RESULTS | Eleven patients were available for follow-up questionnaires; of those nine participated in a physical exam. Age ranged from 15 to 47; seven males and four females. Time to final follow-up averaged 43.5 months (range 25-67). Initial fracture patterns included five Roy-Camille type 1 fractures and six type 2 fractures. All fractures healed. Three of the type 2 fractures had an increase of kyphosis of 10-17 degrees from time of injury to follow-up. All seven patients with initial neurological deficits had subjective improvement. Eight had residual bowel, bladder, and/or sexual dysfunction (Figure 2).

CONCLUSIONS | Non-operative treatment of Denis Zone III sacral fractures yields consistent healing with some increase in kyphosis. Increase in kyphosis did not correlate with final outcomes. SF-36 scores showed decreases compared to weighted age matched norms, but were biased more by associated injuries. Despite improvement in initial neurologic deficits, residual complaints were common.

SUGGESTED READING LIST

One patient died at three months post-injury and three were lost to follow-up, leaving 11 patients at two-year minimum follow-up. Evaluation consisted of SF-36 and Roland-Morris back pain questionnaires, injury specific assessment of bowel, bladder, and sexual function, and physical exam. Radiographs demonstrating healed fractures were evaluated for position loss in all subjects.

Figure 1:

<table>
<thead>
<tr>
<th>TYPE</th>
<th>NEUROLOGICAL DEFICIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>None</td>
</tr>
<tr>
<td>2</td>
<td>Paraparesis Only</td>
</tr>
<tr>
<td>3</td>
<td>Lower Extremity Motor Deficit</td>
</tr>
<tr>
<td>4</td>
<td>Bowel/Bladder Dysfunction</td>
</tr>
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</table>

Table 2:

<table>
<thead>
<tr>
<th>FINDING</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Urinary Symptoms</td>
<td>6 Total (55%)</td>
</tr>
<tr>
<td>Urinary frequency</td>
<td>5 (43%)</td>
</tr>
<tr>
<td>Urinary urgency</td>
<td>1 (9%)</td>
</tr>
<tr>
<td>Neurologic</td>
<td>2 (18%)</td>
</tr>
<tr>
<td>Difficulties initiating urination</td>
<td>1 (9%)</td>
</tr>
<tr>
<td>More than one of above</td>
<td>2 (18%)</td>
</tr>
<tr>
<td>Bowel Symptoms</td>
<td>6 Total (55%)</td>
</tr>
<tr>
<td>Constipation</td>
<td>4 (36%)</td>
</tr>
<tr>
<td>Loss of control</td>
<td>4 (36%)</td>
</tr>
<tr>
<td>More than one of above</td>
<td>2 (18%)</td>
</tr>
<tr>
<td>Sexual Symptoms</td>
<td>4 Total (36%)</td>
</tr>
<tr>
<td>Dyspareunia</td>
<td>1 (9%)</td>
</tr>
<tr>
<td>Difficulty with orgasm</td>
<td>2 (18%)</td>
</tr>
<tr>
<td>Erectile dysfunction</td>
<td>2 (18%)</td>
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<tr>
<td>More than one of above</td>
<td>2 (18%)</td>
</tr>
<tr>
<td>Pain (back, buttock, lower extremity)</td>
<td>7 (64%)</td>
</tr>
<tr>
<td>Sacral Prominence</td>
<td>3 (27%)</td>
</tr>
<tr>
<td>Hypo/Parasthesias (back, buttock, lower extremity)</td>
<td>7 (64%)</td>
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<tr>
<td>Subjective Weakness (back, buttock, lower extremity)</td>
<td>4 (36%)</td>
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<tr>
<td>Physcial Exam</td>
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<tr>
<td>Decreased lower extremity sensation</td>
<td>5 (56%)</td>
</tr>
<tr>
<td>Decreased deep tendon reflexes</td>
<td>5 (56%)</td>
</tr>
</tbody>
</table>

Figure 3 demonstrates the SF-36 scores were all uniformly lower, but within one standard deviation of their weighted age matched norms. Concomitant injuries were frequent, most common being lumbar spine fractures. Final Roland-Morris scores averaged 3.5±3.3. The mean Gibbons classification score at the time of injury was two (standard deviation 1.2). The initial and final Gibbons scores are within their standard deviations. One patient had sacral decompression at four weeks post-injury for delayed cauda equina syndrome.
EXPERIENCE WITH NAVIGATED FREEHAND BONE CUTTING FOR TOTAL KNEE REPLACEMENT SURGERY


University of Nebraska Medical Center, Omaha, Nebraska
New York Medical Center

INTRODUCTION

Previous studies in Pittsburgh [1] and Nebraska [2] investigated the concept of navigated freehand bone cutting (NFC) with Computer Aided Orthopaedic Surgery (CAOS). NFC allows surgeons to cut/reshape bone without using mechanical alignment cutting blocks (jigs). Instead the user reshapes/cuts the bones while following graphical guidance from a computer, while bones and cutting tools are tracked in space with navigation technology. While minimally invasive efforts in arthroplasty have focused on reducing the size of jigs, NFC aims to fundamentally reduce the size of the incision and simplify the surgical procedure by eliminating the cutting blocks altogether. However, to justify clinical use of this novel concept, the quality and speed of the NFC cuts should at least equal the conventional approach.

An earlier pilot study [3] evaluated preliminary navigated freehand cuts and quantitatively compared their speed and surface cut quality in 3-D in the hands of local surgeons among the research team. This study reports a formal experimental evaluation in the hands of many independent surgeons with widely-varying total knee replacement (TKR) experience.

MATERIALS AND METHODS

The subjects in this experiment were seven orthopaedic surgeons at different stages of their careers, varying from the just-qualified/fellowship-trained, to the internationally renowned expert. Identical replicas of a right femur were molded from synthetic material to emulate the ‘cutting feel’ of real bone. A bone-fixture was built to mount the samples on a surgical table (Figure 1). An early version of the Nebraska Orthopaedics Minimally Invasive Surgery System (NoMiss) was used to navigate the bone specimen and an oscillating bone saw fitted with passive reference frames (Figure 1). The NoMiss system was programmed with the ideal locations of the five distal femur cuts for a widely used TKR. Preparation of each experimental run included registration of the bones prior to cutting, based on anatomical landmarks. The user interface provided real-time graphical guidance during cutting, and the surgeons were allowed to select the sequence of planes to cut based on their own preferences. Each surgeon performed five formal experiments in a one-day session, after only one non-documented trial.

Each trial required the completion of all five distal cuts of one femur specimen (and fine shaving when needed), and the placement of an implant. Timing of each test started when the users attempted to align the saw for the first cut, and ended when they verbally communicated that they would be ready to cement the implant if it was a real patient. The level of comfort and satisfaction felt by the surgeons were documented, and the quality of each cut was quantitatively assessed. An exhaustive protocol was followed for each cut bone to assess ‘quality’ of cut. Implant ‘fit and alignment’ were physically measured with a navigated implant trial, which produced numeric fit and alignment indices. All cut bones were also digitized to compute smoothness and alignment indices, representing the rotation (in 3-D) and offset of each bone surface relative to ideal.

RESULTS

The surgeons varied in speed but showed a steep learning curve, with 10.2±4.3min average cutting time. This was even faster than measured in our previous studies, which were in turn faster than with conventional instruments, promising savings in surgeon and OR tourniquet times. From the thousands of digitized surface points on each cut surface, the average roughness (Ra) was 0.185um, and the difference between the highest 50-peaks and lowest 50-valleys was <±1.2um. These confirmed previous measurements, indicating that smoothness was reproducible and adequate, especially for cemented cases. Although tightness was not targeted for this cemented implant, 21 out of 35 bones were tight on the implant trial, and others slightly loose (without cementation). Worst looseness was in the ‘flexion’ sense with average range <1.6°, and <1.2° sagittally, <3° horizontally and <7° axially. Linear translation errors averaged 1.4mm, and <4.2mm everywhere, with some systematic undercutting evident of the distal plateau. Digitization and 3-D analysis of all cut surfaces echoed the above results, showing extreme outliers to be the chamfers, which were treated as less important by most surgeons.

DISCUSSION

This study showed high reproducibility of cuts and a narrow envelope of alignment error. Alignment with NoMiss in previous studies was much superior to cutting with conventional TKR cutting blocks, and this was evaluated here with a wide range of independent surgeons. Neither speed nor quality had good correlation to the experience of the surgeon, which makes the technique even more promising. Surface roughness did not represent a problem for cemented implants, and it is still in the limit for acceptance established in the published literature (1.0 to 2.0mm) for non-cemented cases. Qualitative feedback from the surgeons surpassed our expectations, even with the bare minimum level of technology used. We anticipate significant further improvements with the inclusion of novel smart software/hardware techniques under development. We now confidently believe that this technique can provide a fundamental improvement in the future for arthroplasty. Navigated freehand bone cutting can free arthroplasty from cumbersome and highly invasive bone-cutting jigs, confirming its clinical significance and promise to offer a serious alternative for easier and better minimally invasive arthroplasty.

REFERENCES


Figure 1: NoMiss CAOS system and experimental setup.
OBlique Ulnar Shortening Osteotomy with a New Plate and Compression System

Anthony J. Lauder, M.D., and Thomas E. Trumble, M.D.

INTRODUCTION | The ulnar shortening osteotomy has become the gold standard for correcting positive ulnar variance. Ulnar variance is defined as the difference in length between the distal ulnar corner of the radius and the distal most aspect of the head of the ulnar. Positive ulnar variance occurs when the bone of the distal ulna is more distal than the ulnar corner of the distal radius. This positive variance leads to ulnar-sided wrist pain and degenerative processes due to the overload that occurs between the ulnar head and the ulnar carpus. Thus, the goals of the shortening procedure are to relieve pain and prevent arthritis by re-establishing a neutral or slightly negative ulnar variance. The typical indications for the osteotomy include ulnar impaction syndrome, non-repairable tears of the triangular fibrocartilage complex (TFCC), previous radial head excision and associated Essex-Lopresti lesions, attritional lunotriquetral ligament tears, ulnar non unions, radial malunions, and early post-traumatic distal radio-ulnar joint (DRUJ) arthritis. Numerous authors have introduced methods and systems for performing, and hopefully simplifying, the osteotomy. This study compares the results of shortening ulnas with a new plate and compression system to a previously described and accepted method.

MATERIAL AND METHODS

Dynamic Compression Plating | Thirty-seven patients underwent an ulnar shortening osteotomy using a dynamic compression plate and an AO compression/distraction device (Synthes, Paoli, PA) as described by Chen and Wolfe. Sixteen patients were male and 21 were female. Average patient age at the time of the shortening osteotomy was 36 years. Six of the osteotomies were performed to relieve symptoms stemming from distal radius malunions that had healed shortened. The remaining 14 osteotomies were performed for degenerative TFCC tears.

This new system implements a 3.5 mm 6-hole dynamic compression plate (Synthes, Paoli, PA). Perfectly parallel freehand osteotomies must be made at 45-degree angles to the plate. This is followed by the placement of a lag screw inserted perpendicular to the approximated osteotomies. After completing the osteotomy the AO compression/distraction device is used to further reduce and compress the distal and proximal bone ends.

New Ulnar Shortening Osteotomy System | Seventeen patients underwent an ulnar shortening osteotomy utilizing a new system manufactured by Trimed (Valencia, CA). Seven of the patients were male and 10 were female. Average patient age at the time of surgery was 38 years. Three of the osteotomies were performed to relieve symptoms stemming from distal radius malunions that had healed shortened. Thirteen osteotomies were performed for degenerative TFCC tears.

This new system, designed by the senior author (TET), implements a new plate allowing for compression at the osteotomy site. Results of shortening ulnas with a new plate and compression system to a previously described and accepted method.

OUTCOME MEASURES | All patients were evaluated for pre- and postoperative range of motion and grip strength. These measures were recorded for the surgical side and then compared as a percentage to the contralateral arm. Pain levels were recorded according to the Visual Analog Scale, where a score of zero is no pain and a score of 10 is the worst pain that individual has ever experienced. Patient function was established using the Disabilities of the Arm, Shoulder and Hand (DASH) Outcome Measure. This is a 30 item self-administered questionnaire designed to measure function of the upper extremity. The test is scored from 1-100 with a higher score representing increased disability.

RESULTS | All patients were followed for a minimum of 12 months. Bony union, defined as bridging of the trabecular bone and cortical margin blurring, was achieved at an average of 7.43 weeks for the dynamic compression group and 7.41 weeks for the new Trimed system. Shortening of the ulna averaged 3.95 mm and 4.12 mm for the dynamic compression group and the Trimed group respectively. Pain scores decreased from an average of 5.97 preoperatively to 0.78 after surgery in the dynamic compression group. The patients in the Trimed group had a similar experience with their scores changing from 5.80 to 0.71.

Pre- and postoperative range of motion, grip strength, pain and DASH scores are tallied in Tables 1 and 2.
Complications were few. In the dynamic compression group, 16 plates were removed for prominence and two cases of carpal tunnel syndrome developed in the non-immediate postoperative period. Four plates were removed in the Trimed group and one patient developed carpal tunnel syndrome in the postoperative period. There were no infections, delayed unions, or nonunions in either group.

DISCUSSION | The ulnar shortening osteotomy has proven benefits for patients with ulnar-sided wrist pain stemming from positive ulnar variance. Presumably, pain is relieved through a decompression effect provided by the correction of the radio-ulnar length discrepancy. Many methods for correcting this overloading of the distal ulna and triquetrum have been proposed. In 1941 Henry Milch was the first to describe a shortening technique using nothing more than a wire and plaster immobilization. Plate and screw fixation of an osteotomy was not proposed until the early 1970s. Since that time several plating systems have been developed to make a technically demanding procedure more facile while simultaneously decreasing complication rates. This study compared the patient outcomes of ulnar shortening ostotomies made with two different surgical systems and techniques. The first system (dynamic compression) has been used in the past with good results. However, this technique requires osteotomy cuts be made perfectly parallel to assure good alignment and opposition of the cut bone ends. Furthermore, the plate must be moved during the procedure to complete the osteotomy. This adds both time and room for error. With the new system (Trimed), ostotomies are made through guides attached to the plate, thus, eliminating freehand cuts and plate reapplication.

Our data shows that patients improved rather dramatically both quantitatively and qualitatively after undergoing an ulnar shortening with either system. Postoperative range of motion and grip strength increased to nearly 100% of the contralateral non-operative side. Furthermore, DASH scores demonstrated that patients felt they were functioning at much higher levels after surgery, while Visual Analog pain scores dropped to near negligible levels. This illustrates the utility of this procedure in appropriately selected patients. Importantly, the similar results for both systems demonstrates our new system works as well as a proven technique. We believe our system offers several technical advantages, however, helping to eliminate surgical time and postoperative complications.

RECOMMENDED READING


RADIOLUCENCIES SURROUNDING A SMOOTH-STEMMED RADIAL HEAD COMPONENT DO NOT CORRELATE WITH POOR ELBOW FUNCTION OR FOREARM PAIN

Erica M. Burns, M.D., Annie Knierim, B.S., Junfeng Sun, Ph.D., Kimberly A. Apker, M.D., Robert E. Berg, M.D., and Edward V. Fehringer, M.D.

INTRODUCTION | Comminuted radial head fractures have been effectively treated with metallic radial head implants with smooth stems. It has been proposed that a smooth-stemmed prosthesis allows for stem rotation inside the radial shaft or shaft rotation on the stem, in addition to radiocapitellar motion. The lesser fit has been proposed to accommodate differences between the native radial head and the prosthesis during various positions of the elbow and forearm. In studies assessing these prostheses, stem radiolucencies have been seen in up to 50% of those reviewed. These radiolucencies have been dismissed as insignificant if the elbow was stable, its motion was adequate, and comfort was reasonable. However, radiolucencies have been associated with dysfunction in other joints with prosthetic implants. Prior reports of radial head implant outcomes have noted satisfactory patient outcomes using the elbow scoring systems, but have not specifically assessed for forearm pain. The purpose of this study was to evaluate a potential relationship between radiolucencies associated with smooth-stemmed metallic radial head implants and forearm discomfort, as well as elbow discomfort and dysfunction.

MATERIALS AND METHODS | Seventeen consecutive patients (18 elbows) with comminuted radial head fractures, who underwent elbow radial head replacement with a smooth prosthetic stem, were asked to return at a minimum of 24 months after surgery. No “over-reaming” of the radial shaft was performed at the time of surgery. All were approached through a posterior skin incision and all were prescribed three weeks of sustained-release Indomethacin in the postoperative period. Ligament repairs, when necessary due to ligament disruption from injury associated with the fracture, were performed with number two braided sutures through bone tunnels. Forearm pain was assessed with a visual analog score (0-10); elbow function with a Mayo elbow index. Bilateral elbow and forearm motion were measured with a goniometer. An investigator other than the surgeon of record performed all testing. Mayo and visual analog scores were correlated with stem radiolucencies, obtained as consensus digital measurements by two musculoskeletal fellowship-trained radiologists. There were six measurements obtained to the nearest tenth of a millimeter for each elbow, based on three radiographs for each AP, lateral in maximum flexion, and lateral in maximum extension. As an example, in the AP view a maximum lucency on each side (lateral and medial) of the stem was measured. The mean between the six measurements (two for each view) for each elbow was used for the analysis. Statistical analyses were performed using Pearson and Spearman correlation coefficients.

Clinical and radiographic views of one study patient
RESULTS  |  Mean stem radiolucency did not correlate with forearm pain or Mayo scores using Pearson’s or Spearman’s correlation coefficients. P-values for Pearson’s were 0.613 & 0.585 for pain and Mayo scores, respectively; for Spearman’s: 0.627 & 0.370, respectively. One of 18 was lost to follow-up. Sixteen of 17 elbows had Mayo scores of 80 (range 65-100) or greater at follow-up of 24-49 months; one patient who had a worker’s compensation claim had the only score less than 80 and a pain score of 5. Mean pain score was 1.3. Mean extension-flexion was 7-135 degrees; mean rotation arc was 168 degrees. Sixteen of 17 elbows had stem radiolucencies, ranging from 0.3mm to 3.4mm. One patient underwent a second procedure for heterotopic bone formation that limited motion. There were no other complications.

DISCUSSION  |  In this study, comminuted radial head fractures treated with a smooth-stemmed radial head prosthesis had satisfactory short-term results. Stem radiolucencies did not negatively affect elbow function or forearm comfort.

A METHOD FOR QUALITY MANAGEMENT OF BONE RESHAPING FOR TKR

Barrera, OA; Haider, H; Crosno, RE, and Garvin, KL

INTRODUCTION  |  The success of total knee replacement (TKR) surgery is highly dependent on proper alignment of the components as well as secure fixation to the bone, both of which are directly related to the quality of bone preparation. While TKR clinical scoring methods such as HSS, KSS/ARSS, Oxford, and BOA scores the overall outcome and patient satisfaction, they do not evaluate the bone cuts directly. Arthroplasty is a procedure that already requires a high level of expertise, and with the introduction of newer equipment and techniques, surgeons have to decide what technology to adopt. As they face a choice between a growing number of options (conventional or navigated jigs, minimally invasive surgery (MIS), robotics, a variety of oscillating saws, mills, etc.) surgeons need a direct and objective way of assessing bone cuts made in the operating room with any combination of these options. Researchers, as well as manufacturers of implants and surgical tools, would also benefit from such a method in laboratory setups.

This study lays the foundation for such a technique through analyses and experimental examination of the parameters needed to fully capture and characterize the quality of bone preparation for arthroplasty.

MATERIALS AND METHODS  |  The present method requires a navigation system and an experimental Computer Assisted Orthopaedic Surgery (CAOS) system which was built to test these concepts. The following are the parameters suggested to define bone preparation quality:

1) Implant Fit error ($F$): The looseness or “play” of an implant due to the bone shape after cutting and prior to cementation (if needed). Using navigation, the bone and a trial implant were tracked, logging hundreds of different anatomical positions that the implant was able to take relative to the bone. $F$ indicated the maximum range found in all rotations (flexion/extension, varus/valgus, internal/external) and all translations (anterior/posterior, medial/lateral, proximal/distal) of the implant.

The extreme rotations and translation values were condensed to one parameter, to formulate the root mean square (rms) of the rotational error. Translational errors were coupled with the rotational errors and were therefore included in this value. The worse the fit, the higher $F$ became.

2) Implant Location error ($Lr$ and $Lt$): These are the minimum errors in alignment/location of the implant that the achieved cuts permitted after insertion. The $F$, $Lr$, and $Lt$ parameters are linked, and were extracted from the same data-set. As with $F$, rms was used. High values of $Lt$ (translation in mm) or $Lr$ (rotation in degrees) indicated inaccurate cuts in terms of location and alignment.

3) Bone-cut Surface Roughness ($Ra$) and Worst Peaks/Valleys ($R_{pm}$, $R_{vm}$ and $R_{tm}$): Rough cut surfaces can leave gaps between bone and implant, compromising bone ingrowth for cementless situations and exceeding the gap distance required for proper cement mantle to stress concentrations and cracking. Roughness was analyzed by digitizing the cut surfaces. Navigated scriber or 3-D Laser scanner can be used intra-operatively; CMM, CT (used for this test), etc. in the laboratory.

$Ra$ was the average of a sample of absolute deviations from the mean in a direction normal to the cut surface. Because sharp spikes and deep pits are disproportionately detrimental to both fixation and alignment, $Rpm$ and $Rvm$ (mean of the 10 worst peaks/valleys, respectively) were also analyzed. Most femoral TKRs require several cuts, so to condense these further, the rms of the $Ra$’s on all surfaces, and the rms of all $R_{pm}$’s ($R_{pm}$ – $R_{vm}$) were used, which resulted in two indices (in mm) to characterize the surface roughness. High values indicated poor quality of cut in terms of surface texture/roughness.
The Ra, Rpm and Rvm parameters for the anterior cut of Bone 2 resulted higher than on Bone 1, clearly indicating the PR (from Pf, Pv, Pr) as well as the overall implant location error (L) were lower in Bone 2 despite its rougher surfaces.

Experiments were conducted on identical synthetic distal femoral bones cut with an oscillating saw. Only two bones were cut of bone cutting.

RESULTS: | ROUGHNESS | FIT ERROR | LOCATION ERROR | PLANE CUTS |
<table>
<thead>
<tr>
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<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Roughness</td>
<td>Fit Error</td>
<td>Location error</td>
<td>Planar cuts</td>
</tr>
<tr>
<td>Ra</td>
<td>Rtm</td>
<td>F</td>
<td>Lx</td>
</tr>
<tr>
<td>Bone 1</td>
<td>0.17mm</td>
<td>0.80mm</td>
<td>0.14º</td>
</tr>
<tr>
<td>Bone 2</td>
<td>0.48mm</td>
<td>1.60mm</td>
<td>0.35º</td>
</tr>
</tbody>
</table>

Table 1: Only the final condensed results table is presented (due to space).

Finally, implant fit error (F) of both bones was similar because no deliberate differences were created during cutting.

DISCUSSION | These parameters characterize the quality of bone reshaping independent of the surgeon, cutting tool, or surgical technique. They isolated and objectively quantified the errors of looseness and misalignment of the implant. The surface finish and alignment of each planar cut were also isolated. Coherent and quantitative capture of the quality of bone cutting has potential as a standard test method for assessing bone preparation in arthroplasty and for comparing navigation systems. This method is applicable to the proximal tibial cut and other arthroplasties.

The detail is sufficient to allow researchers and developers of navigation systems to evaluate different tooling, software, and cutting methods. The methodology is also adaptable to allow surgeons to assess bone cutting in the operating room.

BEARING DIAMETER, RADIAL CLEARANCE AND THEIR EFFECT ON WEAR IN CERAMIC-ON-METAL TOTAL HIP REPLACEMENTS

Hani Haider1, Joel Weisenburger1, Malcolm Naylor2, David Schroeder1, Richard Crosno1 and Garvin, Kevin L.1

1Department of Orthopaedic Surgery and Rehabilitation, University of Nebraska Medical Center, Omaha, Nebraska
2Biomet, Inc., Warsaw, Indiana

INTRODUCTION | To eliminate ultra-high molecular weight polyethylene (UHMWPE) debris, hard-on-hard bearing surfaces are regaining favor. Besides metal-on-metal and ceramic-on-ceramic combinations, ceramic-on-metal hips are emerging, which combine the high hardness of bulk ceramic heads with the toughness of metallic shells. This combination is intended to eliminate the risk of fracture for a thin brittle ceramic shell, provide reduced metal ion release compared with a totally metal-on-metal system, and target lower adhesive wear from articulation of identical materials. However, the differential hardness and bulk properties of ceramic-on-metal may be associated with a different sensitivity to the radial clearance between head and liner. This study investigates the wear rates of various sizes of ceramic-on-metal total hip replacements (THRs), with different radial clearances.

MATERIALS AND METHODS | Twelve THRs comprising transformation toughened, platelet reinforced alumina femoral heads (BioLox-Delta, CeramTec, Germany) and CoCr acetabular shells were simultaneously tested on a hip simulator (AMTI, Boston). Six 28mm and six 36mm diameter THRs were tested. Three from each group had a higher clearance (HC) of 81.7±3.7µm, and three had a lower clearance (LC) of 29.5±4.3µm.

The specimens were mounted anatomically and were lubricated with bovine serum diluted with deionized water, which had a 20g/L protein concentration. The lubricant was continually circulated and kept at 37°C. The THR specimens were subjected to the loading and rotations of the walking cycle as specified in ISO-14242-1 at 1Hz for 5 million cycles (Mc), without distraction/micro separation. The loading and rotations were continually observed to ensure consistency with the desired sawframes. The femoral heads and acetabular liners were carefully cleaned, gravimetrically weighed, and the lubricant was changed at 0, 0.25, 0.5, and every 0.5Mc afterwards.

RESULTS | No wear could be detected on the larger size (36mm) hip liners. The overall weight change of both HC and LC liners was <1.0mg at 5Mc and positive (weight gain) with rates of 0.05±0.027mg/Mc and 0.061±0.044mg/Mc, respectively. As shown in Fig. 1, all three smaller size 28mm hips with HC liners exhibited break-away wear in that they relatively quickly lost several milligrams (5.95mg, 6.17mg, 6.05mg) after showing virtually negligible wear. One 28mm LC liner also showed break-away wear (10.22mg). All alumina femoral heads gained a small amount of net weight by 5Mc (28mm alumina heads gained 2.11±0.02mg, 36mm heads gained 0.92±0.01mg). The overall weight change of the different component types can be found in Table 1.
Our simulator results confirmed extremely small wear overall for ceramic-on-metal THRs. As in one other study [2], we did find ‘run-in’ wear on all combinations near the beginning of the test, and we conclude that ceramic-on-metal is not free of this phenomenon. The low clearance and large diameter showed the lowest wearing combination. Small clearance and large diameters increased the contact area between bearing surfaces, reduced contact stress and increased the lubricant film thickness, resulting in lower wear. Although doubling or tripling the clearance had no measurable effect on the very modest wear for the larger hip size, it induced break-away wear in the smaller size, which is worthy of note. It is likely that the observed weight gain of all alumina femoral heads was due to material transfer from the softer CoCr acetabular liners. This was evidenced by dark regions/stripes on the femoral heads that could not be removed in the cleaning process (Fig. 2). It is also interesting that while the advanced (latest design) hip-simulator used in this study was capable of inducing micro separation, this feature was not used in this test. Yet, the stripes seen on in-vivo retrieved hips had occurred and are clearly visible with these materials.

**DISCUSSION**

<table>
<thead>
<tr>
<th>Liner Type</th>
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<tr>
<td>36mm HC</td>
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</tr>
<tr>
<td>36mm LC</td>
<td>2.10 ± 0.02</td>
</tr>
<tr>
<td>28mm HC</td>
<td>2.13 ± 0.03</td>
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<tr>
<td>28mm LC</td>
<td>2.51 ± 0.58</td>
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</table>

<table>
<thead>
<tr>
<th>Head Type</th>
<th>Overall Weight Change (mg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>36mm HC</td>
<td>0.91 ± 0.04</td>
</tr>
<tr>
<td>36mm LC</td>
<td>0.92 ± 0.03</td>
</tr>
<tr>
<td>28mm HC</td>
<td>0.99 ± 0.05</td>
</tr>
<tr>
<td>28mm LC</td>
<td>1.39 ± 0.18</td>
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</tbody>
</table>

Fig. 1: Weight change of the 28mm low and high clearance liners over 5 million cycles showing break-away wear.

**Fig. 2:** Dark regions of metal transfer on two 28mm femoral heads after 5 million cycles.

**REFERENCES**


**PROGRESSION OF SCOLIOSIS IN PATIENTS WITH SPASTIC QUADRIPLEGIA AFTER INSERTION OF AN INTRATECAL BACLOFEN PUMP**

Glen M. Ginsburg, M.D. and Anthony J. Lauder, M.D.

**STUDY DESIGN**

<table>
<thead>
<tr>
<th>Objective</th>
<th>Medical and radiographic review of 19 consecutive patients with spastic quadriplegia before and after intrathecal baclofen pump insertion with special attention paid to progression of scoliosis.</th>
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<tbody>
<tr>
<td>Methods</td>
<td>To document the magnitude and rate of scoliosis progression after the placement of an ITB pump, the charts and radiographs of 19 consecutive nonambulatory patients with spastic quadriplegia and ITB pump were reviewed. To document the rate of scoliosis progression, each patient had at least two pre- and post-pump insertion spinal radiographs made. All radiographs were made with the patients in the supine position without orthoses. A board-certified orthopaedic surgeon reviewed the radiographs. Skeletal maturity was assessed using Risser grading. Catheter tip location and rate of baclofen administration were recorded.</td>
</tr>
<tr>
<td>Results</td>
<td>For 19 patients with complete radiographic data, average Cobb Angles were 10.2° before pump insertion and 25° at an average of 20.9 months after pump insertion (P&lt;0.0001). These 19 patients had a mean rate of change in their Cobb Angles of 1.825°/year before pump insertion and 10.95°/year at an average of 23.9 months after pump insertion (P&lt;0.001). These results represent a 6-fold increase in the curve progression rate after pump insertion. There was no association between catheter tip location and rate of baclofen infusion on curve progression.</td>
</tr>
<tr>
<td>Discussion</td>
<td>In published data, the rate of progression of scoliosis in skeletally immature nonambulatory patients with cerebral palsy was 4.5°/year. In this study, the average rate of progression of the scoliosis for the immature patients was 90°/year. For the skeletally mature bedridden patients, the worst-case natural history progression was 4.4°/year. The comparable rate of change in skeletally mature Risser 3 nonambulatory patients (17° in this study) is 18.4°/year. This study demonstrates a significant increase in the rate of scoliotic curve progression after ITB pump placement when compared with published natural history data. The evidence of the beneficial effects of ITB on spasticity has been confirmed, and as larger, prospective randomized studies are conducted, the authors think that support for continued use of this treatment will increase. However, early bracing and spinal fusion may be warranted to prevent significant increases in spinal deformity if scoliosis is anticipated to progress more than 10°/year for patients with spastic quadriplegia and ITB pump. The authors are now performing spinal fusions for curves that exceeded 40° to 50° in the presence of an ITB pump as recommended by previous reviews of scoliosis and accompanying quadriplegia.</td>
</tr>
</tbody>
</table>

**CONCLUSION**

In summary, to document the magnitude and rate of scoliosis progression after the placement of an ITB pump, the charts and radiographs of 19 consecutive nonambulatory patients with spastic quadriplegia and ITB pump were reviewed. To document the rate of scoliosis progression, each patient had at least two pre- and post-pump insertion spinal radiographs made. All radiographs were made with the patients in the supine position without orthoses. A board-certified orthopaedic surgeon reviewed the radiographs. Skeletal maturity was assessed using Risser grading. Catheter tip location and rate of baclofen administration were recorded.

**SUMMARY OF BACKGROUND DATA**

The authors had noticed rapid progression of scoliosis in spastic quadriplegic patients after intrathecal baclofen pump insertion. This had been noted at other centers, but no significant statistical analysis had been done comparing prepump to postpump scoliosis progression in these patients.
DEVELOPMENT OF SMART DURABLE COATINGS TO PROMOTE BONE MARROW Stromal CELL GROWTH WHILE PREVENTING BIOFILM FORMATION

Fereydoon Namavar, John D. Jackson1, J. Graham Sharp1, Tom Gustafson, Leonard K. Kibunle, Ethan Mann1, Kenneth W. Bayles1, Hani Haider and Kevin L. Garvin

Department of Orthopaedic Surgery and Rehabilitation, University of Nebraska Medical Center
Department of Pathology and Microbiology, University of Nebraska Medical Center
Department of Genetics, Cell Biology and Anatomy

ABSTRACT | This paper describes ongoing searches for materials with “smart” surfaces that optimize resistance to wear, anti-infective and osteointegrative properties. Ideally, the future design of prostheses should emphasize the optimization of these components. In addition to having a wear-resistant surface, it should be anti-infective. It possible, the surface should be designed to be “smart” and boost its anti-infective properties in response to the presence of infectious agents. Finally, the surface should interact positively with mesenchymal stromal cells (MSC) and their pre-osteoblast progeny to promote and maintain osteointegration. In this report, we summarize and compare the growth and proliferation of bone marrow stromal cells (MSC) and their pre-osteoblast progeny to promote and maintain osteointegration. In this report, we summarize and compare the growth and proliferation of bone marrow stromal cells (MSC) on pure cubic ZrO2 with a 16 GPa nano-hardness (2) which is 3 times harder than CoCr, and bulk hydroxyapatite (HA). As it is shown, growth of bone marrow stromal cell OMA-AD on pure cubic ZrO2 is nearly three times more than that measured for HA. In addition, we report for the first time the ability of OMA-AD to differentiate into osteoblast-like cells when grown on nanocrystalline transparent pure cubic ZrO2. We will also discuss the antiinfective properties of our nanocrystalline silver coatings for Staphylococcus aureus (S. aureus), Staphylococcus epidermis (S. epidermis) and Escherichia coli (E-Coli). Our investigations have shown reduced S. aureus (3), S. epidermis, and E-Coli attachment and growth on nanostructured silver as compared to titanium.

INTRODUCTION | Although total joint replacements typically exhibit a ten to fifteen-year lifespan, they are not always adequately durable for the younger, more active or heavier patients. The primary concerns of orthopaedic devices are wear (4), infection (3, 6), and failure of biointegration (7, 8). Wear of the component produces nano and micro-sized particles that cause an immunological response and adjacent bone resorption (4). Infection, although less common, is devastating to the patient and costly to the health care system (3, 6). Failure of osteointegration of the prosthesis prevents long-term stability, which contributes to pain (8), implant loosening (8), and infection (7) that often may necessitate revision. Based on a phenomenon that was termed by Gristina (9) as “a race for colonization” between bacteria and host cells, a good osteointegration will reduce the probability of infection and prevent biomaterial formation. Thus, it would be very beneficial to have a surface that encourages host cell adhesion and increases the rate of host cell growth. HA and bioactive glasses have been studied for decades because of their bioactive properties “as they enhance bone tissue formation” (10). However, concerns have been raised about the bioabsorption of the HA layer, the mechanical strength of the HA layer (10, 11), and the HA layer debonding from the metal implant (11, 12). Our studies were performed using a cloned bone marrow stromal cell line from C57Bl mice termed OMA-AD cells (1). This is a spontaneously immortalized undifferentiated stromal cell population that resembles multipotential mesenchymal stromal cells (MMSC). In vitro, the OMA-AD cell line duplicates, and retains all of the characteristics of primary mesenchymal stem cells. This is a valid experimental model to probe the impact of nanocrystalline hard ceramic coatings on the attachment, survival and growth of bone marrow stromal cells.

Figure 5a shows Alamar Blue Assay (13) results for growth of OMA-AD on a hydrophilic nanostructure of ZrO2, with a zero contact angle (14) and a total wettability to water, compared with bulk hydroxyapatite and culture plates. As shown here, cubic zirconia supported the highest cell growth for OMA-AD when compared to bulk HA. Figure 1b shows OMA-AD grown on an osteoblast stimulating medium and stained using Alizarin Red. A measure of differentiation of mesenchymal cells is the ability of the cells to differentiate into osteoblast-like cells by deposition of calcium. Alizarin Red stains calcium and can be used to visualize calcium deposits (15). Large areas of stained calcium (red deposits) can be seen in the photomicrograph indicating the differentiation of OMA-AD into osteoblast-like cells. The results clearly indicate that OMA-AD has the ability to differentiate into osteoblast-like cells when grown on nanocrystalline pure cubic-ZrO2: This film was produced at room temperature and has been shown to possess total wettability to water (14) and has a nanohardness of about 10 GPa, which is 3 times harder than CoCr (2).
We studied the growth of E. coli on nanocrystalline titanium, silver and semiconductor quality silicon samples. We observed that three to four times fewer colonies are formed on nanocrystalline films, as compared to titanium, over an eight hour incubation time. We also performed continuous flow biofilm assays using a common nosocomial pathogen, Staphylococcus aureus. Samples were placed in a flow cell chamber and inoculated with S. aureus strain 15981 and grown for 24 hours. The total number of viable cells measured after washing the samples was three times less on the nanocrystalline silver as compared to the nanocrystalline titanium [3].

**CONCLUSION** | Nanocrystalline silver based coatings have shown positive antimicrobial properties against some common infective organisms that are found with implant-related contamination. Our preliminary results have shown less S. epidermidis, E. coli and S. aureus attachment and growth on antimicrobial nanocrystalline produced with silver as compared to titanium.

Our ongoing and comparative studies of IBAD nanostructurally stabilized, transparent, pure cubic ZrO2 film indicate that it is superior in supporting growth, adhesion, and proliferation of the bone marrow stromal cell line from C57Bl mice (termed OMA-AD) when compared with the most commonly used orthopaedic metallic and ceramic materials, including hydroxyapatite (HA). Current results show that OMA-AD has the ability to differentiate into osteoblast-like cells when grown on this IBAD-engineered film. Furthermore, the main advantage of IBAD nanostructurally stabilized transparent pure cubic ZrO2 films, is that they can be deposited onto any materials (even polymers) with excellent adhesion and mechanical stability [2]. The combination of transparency with high wettability [14] and chemical and mechanical integrity of nanoceramics make these new surfaces ideal for tissue engineering and bone growth.

**REFERENCES**

15. H. Puchler; N.M. Melsen; M.S. Terry, J. Histochem Cytochem, 17(2), 160-164, 1969.

**ANTIMICROBIAL EFFECT OF NANOCRYSTALLINE SILVER**

We also report preliminary results of antibacterial nanocrystalline silver coatings produced by IBAD. These coatings also possess well-defined surface morphologies and film characteristics. Antimicrobial properties of our nanocrystalline silver coatings were studied for their effect on S. epidermidis strain 1457, E. coli strain DH5Σ and S. aureus biofilm and compared with nanocrystalline titanium coatings. Figure 2a demonstrates S. epidermidis colony-forming units grown on nanostructures of titanium vs. silver. The number of colony-forming units grown on both silver and titanium was determined by the application of trypticase soy agar plating. This data suggests that 3.5 times fewer colonies were formed on silver. Note that the experimental culture was inoculated with 7.4 104 colony-forming units per mL and the sample size was about 1 cm.

**Figure 1.** (a) Growth of OMA-AD (as determined by Alamar Blue Assay) on nanocrystalline hydrophilic cubic ZrO2 coatings produced by ion beam assisted deposition (IBAD) processes compared with bulk HA and culture plates. The amount of fluorescence produced is directly proportional to the number of viable cells and (b) shows typical OMA-AD grown and stained with Alizarin Red. Significant calcium deposits can be seen in the photomicrograph which indicates coatings produced by IBAD processes compared with bulk HA and culture plates. The film characteristics. Antimicrobial properties of our nanocrystalline silver coatings were studied for their effect on S. epidermidis strain 1457, E. coli and S. aureus attachment and growth on antimicrobial nanocrystalline produced with silver as compared to titanium.

**Figure 2.** (a) S. epidermidis (b) E-coli growth on nanocrystalline titanium and silver.

**Figure 2a** demonstrates S. epidermidis colony-forming units grown on nanostructures of titanium vs. silver. The number of colony-forming units grown on both silver and titanium was determined by the application of trypticase soy agar plating. This data suggests that 3.5 times fewer colonies were formed on silver. Note that the experimental culture was inoculated with 7.4 104 colony-forming units per mL and the sample size was about 1 cm.
SIMULTANEOUS SURGICAL TREATMENT OF MULTIPLE LOWER EXTREMITY DEFORMITIES IN CHILDREN WITH OSTEOGENESIS IMPERFECTA

Paul W. Esposito, M.D., Bridget A. Burke, PA-C, Kimberly Turman, M.D., Horacio Plockin, M.D., and Susan A. Scherl, M.D.


INTRODUCTION

The ability to treat children with osteogenesis imperfecta (OI) has been remarkably improved with the advent of early treatment with bisphosphonates. The use of pamidronate to treat OI in infants and children was pioneered at the Shrine Hospital in Montreal. This has enhanced their function and comfort, decreased their fracture rate, and allowed for improved surgical options. Children who in the past were doomed to be in wheelchairs are now candidates for realignment and stabilization, not only to improve comfort, but also function.

Intra-medullary nailing for children with moderate to severe osteogenesis imperfecta was pioneered by Sofield and Mullar in 1959. This required an extensive soft tissue dissection, removing the bone periosteally. The bone was then cut into segments and replaced into the perosteal muscular bed. Bailey and Dubois developed a telescoping rod system, which required fewer revisions with growth, but still used the open technique with significant soft tissue trauma. Percutaneous techniques were described by Rossoy, et al., in 1987 as well as early percutaneous treatments described by McHale, et al. in 1991. They demonstrated that this could be done safely in severely involved young children, with improved development and comfort. The Fassier-Duval nail was developed in Montreal and utilizes the advantages of a telescoping system with percutaneous technique. This decreases blood loss and minimizes the need for arthrodesis. This allows for earlier surgical treatment and the ability to perform re-alignment and stabilization of multiple bones simultaneously.

The indications for surgery in children with moderate to severe OI were multiple recurrent fractures and severe bowing, which does not remodel in these children, and which interferes with psychomotor development. The vast majority of children are considered for surgery when they begin to stand, as this is the time when they begin to fracture repetitively. With severe bowing of the femur and tibia, it is very predictable that once they stand, fractures will occur. The most common bowing is in the proximal and middle femur, with bowing both anteriorly and laterally. An anterior bow gives an asymmetrical varus bow. The tibia tends to bow anteriorly, with the mid to distal diaphysis often having an asymmetrical varus bow.

MATERIALS AND METHODS

This retrospective study was IRB approved by the University of Nebraska Medical Center as well as the Children’s Hospital, Omaha. It was a study of patients treated between September 2003 and August 2005. The goal of the study was to demonstrate that multiple bone deformities could be treated safely and efficaciously at one surgical setting.

The study involved 19 patients, 14 females and 5 males. The average age at surgery was 25 months with a range of 13-61 months. The average follow-up was 16 months. This was a consecutive series, all performed by one surgeon.

RESULTS

There were a total of 59 bones, including 36 femurs and 23 tibias. The femurs were all treated with Fassier-Duval nails. Seven of the tibias in older children were treated with Fassier-Duval nails. In younger children, because the distal tibial epiphysis was too small to accommodate for the Fassier-Duval nail, nine were treated with Rush rods and seven with K-wires. Eleven of the femurs were done with an open technique, while the others were done percutaneously. There were on average two osteotomies per femur, almost exclusively done percutaneously. One bone was treated in eight patients, two bones in 13 patients, three bones in three patients, and four bones in five patients. The number of bones was based on degree of deformity and fracture, condition of the child during surgery, and parental desires. Of the open femoral procedures, one had a retained plate that required removal and four had acutely displaced fractures. Overall blood loss averaged 304.8cc. There was significantly less when the percutaneous technique was used. Blood loss also varied by the number of procedures performed, averaging 75cc for one bone, 66cc for two, 40cc for three, and 15cc for four bones. Five patients total were transfused, including one with three bones, two with two bones, and four of five with four bones. The one-bone patient had an overgrown retained plate.

Postoperatively a splint was used for three to four weeks with full activities and passive range-of-motion by the child’s family when the child was comfortable. They stood with support and participated in water therapy at 4-6 weeks postoperatively. The children began to ambulate when comfortable. Bracing was done only for soft tissue instability, typically at the ankle because of the associated joint laxity of these children. One spica and two 3-D braces were used early in the series, but subsequent experience is that this is rarely required.

Early in the series, complications were encountered with one child who required advancement of the femoral nail for proximal migration of the female portion of the nail; one had a prominent male nail that required advancement; one child was placed in a spica cast because of suspected protrusion of the nail into the knee and perceived poor proximal fixation; and two patients subsequently developed coxa vara.

All of the rods lengthened. There were no non-union, infection, or long-term pain. There was no delay in healing with the early immobilization without bracing. There were three spiral fractures after initial healing of the osteotomies, which healed uneventfully with short-term splinting (on average 10 days).

This simultaneous treatment of multiple bones with the percutaneous technique of multiple osteotomies with intramedullary fixation in children with OI appropriately treated with bisphosphonates can be safely performed. This minimizes the number of hospitalizations and surgeries these children require while optimizing their comfort and development. It is anticipated that the non-spooling femoral nails used in very young children will require early revision because of bowing at this distal tip, but enhanced psychomotor function clearly is improved and correction to a telescoping nail will be significantly less traumatic to the child.

This treatment requires a coordinated multidisciplinary team headed by a metabolic disease specialist, with bisphosphonate treatment early in life, to be most effective. Experienced anesthesiology, PT, OT, and nutrition are also vital. Many institutions regard to surgical indication, bracing, and outcomes studies to document the improved function, comfort and quality of life, as well as the optimal length of treatment with bisphosphonates.

BIBLIOGRAPHY


Figure 1: Preop lateral.

Figure 3: Postop osteotomies.
Each year the Department of Orthopaedic Surgery hosts several visiting speakers who present seminars for orthopaedic faculty, residents, staff, and practicing surgeons in the area. Bringing in speakers who share their knowledge and expertise on a variety of topics is a large part of providing a well-rounded educational experience for our residents. Private contributions from alumni and friends to the Department’s Development Fund allow us to continue to bring guest speakers who offer new and innovative ideas in surgical techniques, research topics, and patient care.

Below is a list of all presentations given by visiting speakers from January 2006 through June 2008.

JUNE 2008
27-28 Graduation Ceremonies
Guest Speaker, James Goulet, M.D., University of Michigan
“Fractures of the Distal Tibia: Our Biggest Challenge?”
“Traumatologists and (gasp) Hip Replacements: Is there a Role for Arthroplasty for Acute Fractures?”

MAY 2008
12 Dr. Ivan Tarkin
University of Pittsburgh
“Scapula Fractures”
19 Dr. John McClellan
Nebraska Spine Center, LLP
“Spine”

APRIL 2008
10 Kyle Dickson, M.D.
University of Texas Medical School at Houston
“Acetabulum and Pelvic Malunions and Nonunions: from Start to Finish”

MARCH 2008
14 Klaus Draenert, M.D., Ph.D.
Technical University of Munich, ZOW Center of Orthopaedic Sciences Munich, Germany
“Autologous Osteochondral Transplantation”

FEBRUARY 2008
4 Chad Vokoun, M.D.
UNMC Internal Medicine
“Surgical Clearance”

JANUARY 2008
28 Erik Otterberg, M.D.
Gross Iwersen Kratochvil and Klein, PC
“Avascular Necrosis of the Hip”

DECEMBER 2007
28 Lynn Crosby, M.D.
Wright State University
“Complications of Total Shoulder Arthroplasty”

NOVEMBER 2007
16 Resident Research Forum
Vincent Pellegrini, Jr., M.D.
University of Maryland
“A Career in Academic Orthopaedics: for whom?”
19 Mark McGuire
Advanced Prosthetics
“Advances in Prosthetics”
28 Jose Romero, M.D.
UNMC Pediatrics Infectious Disease
“Septic Arthritis and Osteomyelitis”

OCTOBER 2007
17 Dr. Michael Ain
Johns Hopkins Hospital
“Achondroplasia”

SEPTEMBER 2007
7 Dr. Steve Haddad
Northwestern University
“Total Ankle Arthroplasty”
**UNMC Orthopaedic Biennial Report 2007**

**AUGUST 2007**

7  Richard Komistek, Ph.D.
    Center for Musculoskeletal Research, University of Tennessee
    “Scientific Advancements in Total Knee Replacement”

29  Aiguo Wang, Ph.D.
    Vice President, Reconstrucitive Technologies
    Stryker Orthopaedics
    “The History and Tribology of Polyethylene in Orthopaedic Implants”

**JUNE 2007**

1  Dr. Thomas Thornhill
    Brigham & Women’s Hospital
    “Mobile Bearing TKA: Indications, Techniques & Pitfalls”

8  Dr. Armodios Hatzidakis
    Western Orthopaedics
    “Reverse Shoulder Arthroplasty”

22-23  Graduation Ceremonies
    Guest Speaker, Dr. Roy Sanders
    Florida Orthopaedic Institute
    “Treatment of Proximal Femur Fractures”
    “Calcaneus Fractures”

**MAY 2007**

16  Dr. Robert Hart
    Oregon Health & Science University
    “Spine”

21  Dr. David Iota
    Gross Iwersen Kratochvil & Klein
    “Achilles Tendon Reconstruction”

25  Dr. Mark Labbe
    Baylor University
    “Rotator Cuff Repair”

**APRIL 2007**

22  Robert Anderson, M.D.
    Miller Orthopaedic Clinic
    “Midfoot Surgical Procedures”

26  Dr. James Benjamin
    University of Arizona
    “Total Knee Arthroplasty”

**JANUARY 2007**

15  Thomas Franco, M.D.
    Alegent Health/Immanuel Rehabilitation Center
    “Spinal Cord Injury and Rehabilitation”

22  Robert Recker, M.D.
    Creighton University Medical Center
    “Metabolic Bone Diseases”

29  Ted Mikals, M.D.
    University of Nebraska Medical Center
    “Crystalline Arthroplasty”

**NOVEMBER 2006**

14  Mr. Lew Bennett
    Abbott Spine
    Austin, TX
    “Building a Successful Medical Practice”

16  Aaron Rosenberg, M.D., FACS
    Rush Medical College
    “Diagnosing and Managing Infection in Total Joint Arthroplasty”

17  Aaron Rosenberg, M.D., FACS
    Rush Medical College
    “Knee Arthroplasty Resealable”

**OCTOBER 2006**

4  Derek McMinn, FRCS
    The McMinn Centre and the Royal Orthopaedic Hospital
    Birmingham, United Kingdom
    “The Tribology of Metal-Metal Hip Arthroplasty”

**SEPTEMBER 2006**

29  Resident Research Forum
    John Connolly, M.D. Professor Emeritus
    Orlando Regional Medical Center
    “Resident Contributions to our 20-year Experience in the Use of Marrow Stem Cells to Stimulate Osteogenesis”

**JUNE 2006**

5  Jack Lemons, Ph.D.
    University of Alabama at Birmingham
    “Device Retrieval and Analyses: 30 Years and Evidence Based Education”

16  Graduation Ceremonies
    Guest Speaker, K. Donald Shelbourne, M.D.
    The Shelbourne Clinic at Methodist Hospital
    “Proposed Mechanism for ACL Injury”
    “What I’ve Learned about the ACL”

21  Dr. David Inda
    Gross Iwersen Kratochvil & Klein
    “Arthritis of the Wrist”

25  Dr. Mark Labbe
    Baylor University
    “Indication for the High Tibial Osteotomy in Sports Medicine”

**MARCH 2006**

13  John Sojka, M.D.
    University of Kansas
    “R.I.A. Bone Graft Technique: Harvest for Segmental Lower Extremity Defects and Recalcitrant Nonunions”

**FEBRUARY 2006**

6  Erik Otterberg, M.D.
    Gross Iwersen Kratochvil & Klein
    “Blood Conservation in Total Joint Arthroplasty”

13  Jack McCarthy, M.D.
    Gross Iwersen Kratochvil & Klein
    “Arthritis of the Wrist”

27  Ronald Hollins, M.D.
    UNMC Plastic & Reconstructive Surgery
    “Soft Tissue Coverage for Traumatic Injuries”

**JULY 2006**

Hena Ziaee, BSc
The McMinn Centre
Birmingham, United Kingdom
“Metal Ion Analysis in Patients”

Timothy Burd, M.D.
Nebraska Spine Center, LLP
Omaha, NE
“Cervical Disc Disease”

Resident Research Forum
John Connolly, M.D. Professor Emeritus
Orlando Regional Medical Center
“Resident Contributions to our 20-year Experience in the Use of Marrow Stem Cells to Stimulate Osteogenesis”

Jack Lemons, Ph.D.
University of Alabama at Birmingham
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Graduation Ceremonies
Guest Speaker, K. Donald Shelbourne, M.D.
The Shelbourne Clinic at Methodist Hospital
“Proposed Mechanism for ACL Injury”
“What I’ve Learned about the ACL”

Dr. Mike Walsh
OrthoWest: Orthopaedic & Sports Medicine Specialists
“Report of the Omaha Patellofemoral Rehab Consensus Conference”

Dr. Rick Davis
Mike O’Callaghan Federal Hospital
“Arthroscopic Meniscus Repair: Long-term follow-up with radiographic results”

Dr. Steven Goebel
Nebraska Orthopaedics
“Indication for the High Tibial Osteotomy in Sports Medicine”

Dr. Charles Burt
Nebraska Orthopaedic Hospital
Moderator, Case Presentations

Michael Reis, M.D.
UCSF Medical Center
“Knee Arthroplasty”

David Inda, M.D.
Gross Iwersen Kratochvil & Klein
“Hallux Valgus”

Eileen Inda, M.D.
Boys Town National Research Hospital
“Regional Anesthesia”

Richard Komistek, Ph.D.
Center for Musculoskeletal Research, University of Tennessee
“Scientific Advancements in Total Knee Replacement”

Aiguo Wang, Ph.D.
Vice President, Reconstrucitive Technologies
Stryker Orthopaedics
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The McMinn Centre and the Royal Orthopaedic Hospital
Birmingham, United Kingdom
“The Tribology of Metal-Metal Hip Arthroplasty”
GRANTS, FUNDS, AND ENDOWMENTS:
ADVEMENTS IN MEDICAL EDUCATION, SCIENTIFIC INNOVATION, AND PATIENT CARE

The UNMC Department of Orthopaedic Surgery and Rehabilitation has a national reputation for educating outstanding surgeons, and our reputation for innovative research is garnering national attention. In addition to research related to patient care, departmental faculty members are doing research in basic science, biomechanical engineering, computer simulation, and nano-biotechnology.

The following list shows the names, sources and funding of grants the department has received from 2006 through early 2008.

A. PEER-REVIEWED GRANTS:

<table>
<thead>
<tr>
<th>Source</th>
<th>Amount</th>
<th>Description</th>
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<tr>
<td>National Institute of Health</td>
<td>$937,500</td>
<td>(annually) *“Assays of Stem Cell Function in Clinical Aging Research”</td>
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<tr>
<td>National Institute on Aging</td>
<td>$319,723</td>
<td>*“Design of nanoceramic materials with enhanced wettability and reduced brittleness”</td>
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<tr>
<td>Otis Glebe Foundation</td>
<td>$132,000</td>
<td>*“Otis Glebe Foundation - Navigated Freehand Bone Cutting for Knee Replacement”</td>
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Total of Peer-Reviewed Grants: $1,389,223

B. INDUSTRY:

<table>
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<th>Company</th>
<th>Amount</th>
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<tr>
<td>Howmedica Osteonics</td>
<td>$14,763</td>
<td>*“A Study to Investigate the Wettability of Different Coatings for Orthopaedic Implants”</td>
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<td>Biomet Inc.</td>
<td>$46,000</td>
<td>*“Collaborative Research with Biomet Inc to investigate the Longevity of a TiNiN hard Coating on Vanguard PS knee femoral components”</td>
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<tr>
<td>Biomet Inc.</td>
<td>$65,000</td>
<td>*“An In-Vivo Wear Durability Study of the Biomet Ceramic-on-Metal Total Hip Replacement System”</td>
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<tr>
<td>Biomet Inc.</td>
<td>$110,000</td>
<td>*“Evaluation of a New Highly Crosslinked UHMWPE Stabilized with Vitamin E for Patellar-Stabilized Total Knee Replacements”</td>
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<tr>
<td>SpineMedica Corporation</td>
<td>$22,000</td>
<td>*A Pre-Durability Study of Cervical Spine TDR Prototypes”</td>
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<tr>
<td>Exactech Inc.</td>
<td>$63,000</td>
<td>*“Wear Testing of Total Knee Replacement Implants. Cutting Edge Know-How and Support; from the University to the Implant Manufacturing Industry to Help Patients.”</td>
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<tr>
<td>Exactech Inc.</td>
<td>$30,000</td>
<td>*“Evaluation of the effects of posterior slope installation on the wear of DCM UHMWPE TKR bearings”</td>
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Total of Industry Funds: $350,763

Total of categories A, B, C, and D: $1,739,986
Endowed funds provide perpetual resources for a variety of education and research activities. When an individual establishes an endowed fund through the University of Nebraska Foundation to benefit the Department of Orthopaedic Surgery, the principal of the fund is invested and the earnings from the invested endowment provide spendable funds for assistantships, resident education, equipment and technology purchases, library resources, seed money for scientific research projects, and much more.

The department also maintains several non-endowed funds at the University of Nebraska Foundation in Omaha. Some funds have been established by generous individuals for specific purposes, while the department’s Development Fund is a department-wide, unrestricted resource used primarily for resident training activities, such as supporting residents and the research projects at national meetings, bringing renowned speakers to campus to share their knowledge with students, faculty, and staff, and helping to make resident graduation a memorable celebration. Although this fund is not large or endowed, it provides vital, flexible resources to support a variety of resident education and faculty-related projects.

Jackson Bence, M.D. Education and Research Fund
- Resident education, research and related activities

James R. Neff, M.D. Musculoskeletal Fund
- Establishment of James R. Neff, M.D.
- Chair of Musculoskeletal Oncology

The Nebraska Arthritis Outcomes Research Center
- Establishment, benefit and support of the Nebraska Arthritis Outcomes Research Center

L. Thomas and Herman Johnson Excellence Fund
- Faculty support/professorship

Dr. Foster Matchett Research Assistantships
- Research assistantships

Frank P Stone Professorship of Orthopaedic Surgery
- Faculty support/professorship

H. Winnett Orr Memorial Research Fund
- Research and teaching supplies and materials

James R. Neff, M.D. Children’s Orthopaedic Cancer and Molecular Genetics Fund
- Orthopaedic surgery and rehabilitation

Jean Brug Jardou Endowment Fund
- Residents library and teaching resources

Robert C. Headler, M.D., Fund
- Center for Excellence in Muscular Skeletal Diseases

Robert G. Volz, M.D. Research Fund
- Research and education

The Chapin Endowment Memorial Fund
- Orthopaedic research support

Orthopaedic Oncology Research Development Fund
- Oncology research support

Christina M. Hixson
- Endowment Established for Research in Orthopaedic Surgery and Rehabilitation Medicine

Dr. Richard and Kathryn Pettee
- Orthopaedic Excellence Fund (academic research)

Wayne and Eileen Ryan
- Orthopaedic Research Development Fund

Connolly Orthopaedic Surgery and Rehabilitation Fund
- Department Development Fund

Orthopaedic Surgery Department Development Fund

Endowed funds include:

Establishment of James R. Neff, M.D., Children’s Orthopaedic Oncology Research Center
- Resident education, equipment and technology purchases

Establishment, benefit and support of the Nebraska Arthritis Outcomes Research Center
- Resident education, equipment and technology purchases

Endowed funds have been established by generous individuals for specific purposes, while the department’s Development Fund is a department-wide, unrestricted resource used primarily for resident training activities, such as supporting resident projects at national meetings, bringing renowned speakers to campus to share their knowledge with residents, faculty, and staff, and helping to make resident graduation a memorable celebration. Although this fund is not large or endowed, it provides vital, flexible resources to support a variety of resident education and faculty-related projects.

Total of Endowments/Donations: Greater than $10,000,000

$10,000 AND ABOVE

Edward S. Ackerman Charitable Fdn, Inc.
- Carrie A. Brown, M.D.
- Paul W. Eapos, M.D.
- Edward V. Feininger, M.D.
- Kevin L. Gourn, M.D.
- Glenn M. Oienburg, M.D.
- Brian P. Hoyle, M.D.
- Marjorie J. Hoyle
- Neuser Charitable Foundation, Inc.
- Lievense Charitable Foundation, Inc.
- Mehlman
- Matthew A. Monroe, M.D.
- Musculoskeletal Transplant Foundation
- Nestor K. Krell, M.D.
- Scott Carter Foundation
- Synstel BioMedical
- Weiler Charitable Foundation

$5,000 – $9,999

Julia A. Bridge, M.D.
- Sharron K. Doar
- Stephen L. Doran, M.D.
- Sean V. Garry, M.D.
- Jan Volkov, M.D.
- N. Alie Noyens, M.D.
- John W. Petersen
- Barbara Radke, M.D.
- Susan A. Schoell, M.D.

TOTAL OF ENDOWMENTS/DONATIONS: GREATER THAN $10,000,000

* Those who contributed to the Department of Orthopaedic Surgery Development Fund during calendar years 2006-2007 are included in the department’s Honor Roll of Contributors listed on the following page.
SCOTT’S SUPPORT MAKES NEW ARTHRITIS CENTER A REALITY

by Vicky Cerino and Tom O’Connor, UNMC public affairs

Two of UNMC’s biggest supporters, Ruth and Bill Scott, were on campus in July 2007 to participate in a ribbon-cutting ceremony for the Nebraska Arthritis Outcomes Research Center located on the third floor of Poynter Hall. The center, made possible by a major donation by the Scotts, was established to conduct studies that will provide a better understanding of arthritis through detailed analysis of the many determinants used to predict outcomes for arthritis sufferers.

“Information is powerful,” said Ruth Scott, “and that’s what this new center is all about—finding answers to how we can better manage arthritis and come up with the best possible outcomes. Bill and I have seen three generations of our families suffer from arthritis. We believe this new center has the potential to truly make a difference for future generations. We are honored to be associated with it.”

“We are thrilled to add the Nebraska Arthritis Outcomes Research Center to our ever-growing research arsenal. I’m confident that it will produce world-class research that will benefit countless individuals with arthritis,” said Harold M. Maurer, M.D., UNMC chancellor. “Ruth and Bill Scott are true heroes for making it possible. We can’t thank them enough for their generous support.”
The Scotts are both graduates of the University of Nebraska-Lincoln. Bill Scott is a former vice president of Berkshire Hathaway. Ruth Scott is a bridge instructor and founder of the Omaha Bridge Studio.

The center marks the third major gift the Scotts have made to the medical center. In 2003, their contribution to the Durham Research Center established the Ruth and Bill Scott Neuroscience Research Laboratories located on the third floor. In 2006, they made the largest gift to the University of Nebraska Foundation in support of the Michael E. Sorrell Center for Health Science Education. Construction of the Sorrell Center, which will serve as home to the UNMC College of Medicine, will be completed in 2008.

The Nebraska Arthritis Outcomes Research Center is headed by two of UNMC’s leading physicians—James O’Dell, M.D., professor of internal medicine and chief of the rheumatology and immunology section, and Kevin Garvin, M.D., professor and chairman of orthopaedic surgery.

“The Scotts’ generous gift solidifies the ongoing collaborative efforts between rheumatology and orthopaedics,” Dr. O’Dell said. “By working together and combining our expertise, we think we will be able to make a huge impact in the care of arthritis sufferers.”

“The Scotts are truly visionary people,” Dr. Garvin said. “They understand the value of research, and they realize that it can produce major dividends over the course of time. We can’t thank them enough for giving us this wonderful opportunity.”

Much of the day-to-day research in the Nebraska Arthritis Outcomes Research Center will be conducted by Ted Mikuls, M.D., associate professor in the rheumatology section of the department of internal medicine, and Kaleb Michaud, Ph.D., assistant professor, internal medicine. Presently, Drs. Mikuls and Michaud have more than a dozen research projects underway. One of their top projects is investigating surgical outcomes in arthritis patients undergoing total joint replacements. Total joint replacement of the knee and hip are increasingly used treatments for patients with end stage joint disease secondary to arthritis. Each year, approximately 120,000 patients undergo total hip replacement and an additional 270,000 undergo total knee replacement in the U.S.

Using a large national database of 30,000 patients from the National Surgical Quality Improvement Program database and through the Veterans Affairs hospitals, the researchers will explore determinants of poor outcomes in arthritis suffers. Findings from this study will guide the development of future interventions aimed at improving surgical outcomes in arthritis sufferers, Dr. Garvin said.

Since being recruited to the Nebraska Arthritis Outcomes Research Center five months ago, Dr. Michaud has helped author or co-author five different papers for research journals and submitted 15 abstracts for scientific meetings.

“We are working with people all over the world,” said Dr. Michaud, a physicist who earned his Ph.D. from Stanford University and worked for several years with Fred Wolff, M.D., of Wichita, Kan., one of the leading rheumatologists in the country. “The research opportunities are endless. One of our key roles is to figure out what studies make the most sense and what papers need to be written.”

“Our center is interested in studying drug safety and trying to determine which drugs will be most beneficial to patients with the fewest side effects. There are six new biological drugs with five more ready to be launched as treatments for rheumatoid arthritis, but their average cost is $15,000 per year. So understanding their true effect or benefit becomes even more important for the patient and the paying society.”

The center is using the national database to determine those arthritis patients who are the best candidates for joint replacement surgery. Some of the criteria physicians use to decide whether joint replacement may be beneficial include the patient’s pain, function, structural damage, age, and what they expect to be able to do after surgery. Dr. Mikuls said, noting that about one-third of rheumatoid arthritis patients will undergo joint replacement surgery.

“We’d like to be able to provide some objectivity for physicians to make decisions,” Dr. Mikuls said. “The disease can be devastating. Thirty to 50 percent of working-age folks with rheumatoid arthritis will be work-disabled 10 to 20 years after having the disease. That’s huge, and we know the disease reduces life expectancy.”

The center will be exploring both osteoarthritis, the most common form of arthritis, which affects up to 30 percent or more of the population, and rheumatoid arthritis, which is found in about 1 percent of people.

The Centers for Disease Control and Prevention (CDC) estimate that arthritis impacts the daily lives of more than 40 million Americans, including more than 500,000 Nebraskans. The annual cost of treating arthritis in the U.S. is nearly $64 billion. For Nebraska, this translates into annual costs of more than $320 million.

Another center study, led by rheumatologist Amy Cannella, M.D., and orthopaedic surgeon, Ed Fehringer, M.D., will examine the frequency and impact of chronic rotator cuff tears in patients with rheumatoid arthritis. Researchers will be recruiting UNMC and Omaha VA patients with rheumatoid arthritis. The patients will be examined using state-of-the-art imaging techniques including dynamic ultrasound. Findings from this study will allow researchers to better quantify the contribution of shoulder problems to poor outcomes in rheumatoid arthritis.

A native of Lincoln, Dr. Volz graduated from UNMC’s College of Medicine in 1957. He then completed his orthopaedic specialty training at the University of Kansas Medical Center, and went on to practice for several years in Denver, Colorado, where he served as the Head of the Orthopedic Service at the Denver Children’s Hospital.

Meanwhile, in 1971, an orthopaedic program was being founded at the University of Arizona Health Sciences Center (AHSC) by Dr. Leonard Peltier, previously the chair of orthopaedic residency program at the University of Kansas, where Dr. Volz completed his training. In 1973, Dr. Peltier recruited Dr. Volz to begin a program in total joint surgery, and in 1985 Dr. Volz was appointed Professor and Chairman.

While at AHSC, Dr. Volz designed some of the earliest joints used in the United States, including the first artificial wrist, as well as an artificial elbow implant and knee implant. The artificial knee he designed has been used in more than 40 countries. In addition, Dr. Volz was co-founder of the Arizona Arthritic Center, a nationally recognized endowed research and teaching center.

Since his retirement in 1992, he and his wife, Ann, have kept busy volunteering in several foreign countries. Subsequent to their move to Jackson, Wyoming, in 1994, Dr. Volz was publicly elected as a Trustee of St. John’s Medical Center, was appointed as a member of the Wyoming Governor’s Medical Advisory Committee, and has also served on several not-for-profit human resource agencies. He led efforts to secure several statues from the Wyoming Legislature, resulting in the creation of free medical clinics for the medically uninsured, which are staffed by retired physicians who have been granted legal immunity from malpractice claims.

“Dr. Volz has shown ongoing support of our residency program,” said Dr. Garvin, professor and chair of Orthopaedic Surgery. “Without this type of support we would not be able to offer such an outstanding educational experience for our residents.”
Paul Esposito, M.D.

\textbf{Refereed Articles:}

\textbf{Honors and Awards:}
- President, Medical Staff Services, Children's Hospital, 2008-2010
- Board of Directors, Children's Hospital
- Quality and Patient Safety Committee, 2005-present
- American Academy of Pediatrics YU Committee, 2006
- Council on Children with Disabilities, 2005-present
- Children's Hospital Medical Staff Committees: Focused Peer Review Subcommittee, 2004-present.
- Physician's Health Committee, 2006-present.
- The Bone Group, 2009-present.
- Surgical Information Technology Committee, 2006-present.
- Credentials Committee, 2008-present.
- Allied Health Committee, 2008-present.
- Pharmacy and Therapeutics, 2008-present.
- Infection Control, 2008-present.
- Surgical Services, 2008-present.
- Promoted to Professor in the Departments of Orthopaedic Surgery and Pediatrics (courtesy), July 2006.
- Special Achievement, UNMC College of Medicine's Faculty Honors Convocation, Omaha, NE, March 13, 2006.
- President-Elect, Medical Staff Services, Children's Hospital, 2006-2007.

Edward Fehringer, M.D.

\textbf{Research Interests:}
- Rotator cuff tears and their association with aging and other co-morbidities
- Shoulder socket reconstruction in shoulders with arthritis

\textbf{Current Research Grants:}
- Synthes grant to assist with a biomechanical study of standard bicortical plate and screw construct fixation versus unicortical locking plate and screw fixation, $3,000, Co-investigator.

\textbf{Refereed Articles:}
Honors and Awards:
Special Professional Achievement, University of Nebraska Medical Center Faculty Honors Convocation, for becoming an Associate Member of the American Shoulder and Elbow Surgeons, March 25, 2008.
Promoted to Associate Professor, Department of Orthopedic Surgery and Rehabilitation, University of Nebraska Medical Center, June 1, 2007.
Excellence in Clinical Practice Award, UNMC College of Medicine’s Faculty Honors Convocation, Omaha, NE, March 2007.
Awarded the opportunity to attend: National Institute on Aging (NIA)’s Grant Writing Technical Assistance Workshop, based upon a proposal submitted on rotator cuff disease in those 65 and older, Dallas, TX, November 16-17, 2006.
Delegate, University of Nebraska Medical Center, September 2006 – present.
Special Achievement, UNMC College of Medicine’s Faculty Honors Convocation, Omaha, NE, March 9, 2006.
“The Doc, You Call Coach” Award as part of The Nebraska Medical Center’s Doctor’s Day 2006; nominations and voting by hospital staff.
Outstanding Physician of the Year Award for 2006 - Association of Operating Room Nurses of Omaha Chapter 2801.

Research Interests:
Adult reconstruction | Prevention and Management of Musculoskeletal Infections

Current Research Grants:

Refereed Articles:


Book Reviews/Chapters:

KEVIN GARVIN, M.D.

GLEN GINSBURG, M.D.

Research Interests: Gait disorders | Spinal deformity

Refereed Articles:

Research Interests: Knee implant simulation and testing | Minimally invasive implant design | Computer-aided orthopedic surgery

Current Research Grants:

Refereed Articles:

Research Interests: Spine deformity

Refereed Articles:

Research Interests: Hand and wrist

Refereed Articles:

Honors and Awards:

Honors and Awards:

Honors and Awards:
- Appointed by Dr. Harold Maurer to the Search Committee for a new Director of Munroe Meyer Institute for Genetics and Rehabilitation, University of Nebraska Medical Center, June 2007.
- Special Achievement, UNMC College of Medicine’s Faculty Honors Convocation, March 9, 2006.

Honors and Awards:


**Book Chapters:**


**Research Interests:** Clinical outcomes in orthopaedic oncology

**Refereed Articles:**


**Book Chapters:**


**Honors and Awards:**

Member, Bylaws Committee, Children’s Hospital, 2008.

Member, Musculoskeletal Transplant Foundation: MTF Medical Board of Trustees, April 2006.


**Research Interests:** Infected nonunions | Humerus fractures | Sacral fractures

**Refereed Articles:**


**Honors and Awards:**

Program Committee Chairman, Mid-America Orthopaedic Association Annual Meeting, 2007-2008.


Best Doctor in America, 2002-2008.

Member, American Orthopaedic Association, June 2007 – present.

Board Member, Mid America Orthopaedic Society, 2006-2010.
Research Interests: Application of nanotechnology in total joint arthroplasty:
- Controlling the bone growth
- Development of antibacterial surfaces for short and long-term applications
- Reducing the wear of orthopaedic implants and revision surgery

Interaction of stem cells and organisms with micro and nanostructured engineered materials (hard tissue engineering)

Effect of electrical stimulation on growth and differentiation of (adult) stem cells on nano-engineered surfaces (Combining Nanotechnology with stem cell technology; adult stem cell purification and proliferation)

Development of smart coatings for orthopaedic and dental implants

Current Research Grants:

Refereed Articles:

Honors and Awards:
- Co-President and Session Chairman, 11th Meeting-Seminar of Ceramics, Cells and Tissues: Nanotechnology for Functional Repair and Regenerative Medicine; the Role of Ceramics as in Bulk and as Coating, Institute of Science and Technology for Smart Surfaces for Implant Devices, Proceedings of the 11th Meeting-Seminar of Ceramics, Cells and Tissues: Nanotechnology for Functional Repair and Regenerative Medicine; the Role of Ceramics as in Bulk and as Coating, edited by Ravaghi, A. and Krajewski, A., Consiglio Nazionale Delle Richerece, Faenza, Italy, p. 26-37, April 2008.

Research Interests:
- Pediatric orthopaedic trauma, especially femur fractures
- Non-accidental pediatric orthopaedic trauma
- Neuromuscular disorders
- Medical student and resident education

Refereed Articles:

Book Chapters:

Honors and Awards:
- Appointed Member, Workforce Project Team, American Academy of Orthopaedic Surgeons, January 2007 – present (Chair, 3/08 – 3/10).
- Appointed Member, University of Nebraska Ad Hoc CME Task Force, October 2006 – present.
- Special Achievement, UNMC College of Medicine’s Faculty Honors Convocation, March 9, 2006.
DEPARTMENT LIFE

Left to right: Paul Esposito, M.D., Chairman Kevin Garvin, M.D., and UNMC Chancellor Harold M. Maurer, M.D., take a moment to catch up during the 2007 graduation banquet held at the Joslyn Art Museum.

Dr. Matthew Mormino and wife, Gabrielle, seated in front of a beautiful fountain in Joslyn Art Museum’s Storz Fountain Court, during the 2007 graduation banquet.

Dr. Michael Hawks (2008) and wife, Jennifer, enjoy the banquet and annual chief resident roast at the 2007 graduation ceremonies held at the Joslyn Art Museum.


Left to right: Susan Siebler, academic support to Chairman Dr. Kevin Garvin and past residency coordinator, and Geri Miller, current residency coordinator, are recognized during the 2006 graduation ceremonies.

Left to right: Dr. Brian Kleiber (HO V) and wife, Allison, at the 2006 holiday party.

Bridget Burke, PA, and husband, Ryan, at the 2006 holiday party.

Dr. Brian Hasley and fiancé, Katie Shetlar, at the 2006 holiday party.

ORTHOPAEDIC ACADEMIC STAFF | Left to right: Donna Paul, Michael Cihal, Dana Meyer, Dana Schwarz, Elie Balaban, Tami Jenson, and David Staier. Not pictured: Gerianne Miller, Susan Siebler, Christine Pracht, and Daniel Hatz.


CONTINUING ADVANCEMENTS IN ORTHOPAEDIC RESEARCH AND CARE