BREAKTHROUGHS IN MOTION

DEPARTMENT OF ORTHOPAEDIC SURGERY AND REHABILITATION

Biennial Report 12-13
THE UNIVERSITY OF NEBRASKA MEDICAL CENTER (UNMC)
DEPARTMENT OF ORTHOPAEDIC SURGERY AND REHABILITATION
IS PROUD TO BE A PART OF UNMC’S “BREAKTHROUGHS FOR LIFE.” HELD
TO THE HIGHEST STANDARDS IN 2012/2013 AND BEYOND, THIS GROWING
DEPARTMENT WILL CONTINUE TO STRIVE FOR ADVANCEMENTS IN PATIENT
CARE, RESEARCH AND EDUCATION – HELPING TO SHAPE THE FUTURE OF
ORTHOPAEDIC MEDICINE WITH LIMITLESS “BREAKTHROUGHS IN MOTION.”
Transformative Breakthroughs in Motion

UNMC has strengthened alignment with our clinical and hospital partners, now known as "Nebraska Medicine." The Nebraska Medical Center, Bellevue Medical Center and UNMC Physicians came together as one organization in 2014. Though Nebraska Medicine and UNMC remain two separate entities, we now share an emblem that symbolizes our longstanding commitment to highly coordinated patient care.

The UNMC Department of Orthopaedic Surgery and Rehabilitation is continually evolving to impact more patients, with exceptionally personalized, safe and cost-effective care, provided by the most well-educated surgeons and underpinned by highly innovative research.

The size of our full-time faculty has tripled since 1999. With this increase in faculty numbers, clinical volumes are continuously rising and surgical volumes climbed by 10 percent from 2012 to 2013. Hospital revenues have risen on a parallel path, as have department revenues; and as our practice grows we continue to become a larger share of the hospital’s revenue stream. We have been fortunate to welcome three new surgeons to our clinical faculty within just the last two years: Matthew J. Teusink, M.D., shoulder and elbow; Philipp N. Streubel, M.D., hand and upper extremity; and Justin C. Siebler, M.D., orthopaedic traumatology.

For over two decades, the main orthopaedic clinic has been housed on the second floor of UNMC’s Durham Outpatient Center (DOC). We are pleased to announce that our department has outgrown our current space, and our primary clinic will move to the Lauritzen Outpatient Center in 2016, thanks to a generous donation from Bill and Ruth Scott. Relocating to the state-of-the-art center, which is now officially under construction on campus, will allow us to continue to efficiently serve the community with comprehensive services as we enter a new era in health care.

The department’s footprint has grown across the city to better reach the increasing number of patients closer to where they live and work in West Omaha, and exciting growth opportunities continue to emerge. Additionally, we are proud to play a role in Nebraska Medicine’s provision of 24/7 Level 1 trauma coverage, which began in August 2014.

Ongoing improvements in patient care are just one facet of the remarkable work stemming from our department. The Nebraska Orthopaedic Residency Training Program continues to yield the brightest young orthopaedic surgeons, many of whom go on to build their careers in the Midwest. We had 450 applicants to our orthopaedic residency program in 2013 alone.

By testing new materials and developing revolutionary surgical tools in the department’s Orthopaedics Biomechanics and Advanced Surgical Technologies Laboratory, we anticipate improving the lives of patients around the world. I am delighted to share that the cutting-edge computer-aided surgical navigation system— Invented, built and refined by Hani Haider, Ph.D., and our research team—was officially patented in 2013. It is an honor to have such significant work happening in Nebraska, at our university.

We publish a biennial report to share updates of progress with the peers and friends of the department who make our successes possible through their motivation, collaboration and donation. As many of our advancements in orthopaedics are a reflection of Nebraska Medicine’s growth and UNMC’s “Breakthroughs for Life,” we have fittingly titled these 2012 and 2013 highlights "Breakthroughs in Motion." (You may notice some continued references to, for example, "The Nebraska Medical Center" throughout the report, as it reflects on two years prior to the formal integration of Nebraska Medicine.)

In a previous biennial report, we had the honor of sharing some of our patients’ stories. Because they were so well received, six additional patients agreed to let us share their experiences with you this year. Their stories are woven throughout this book to demonstrate the tremendous, tangible impact of our tripartite mission on lives in Nebraska and beyond.

Thank you for your support. I hope you enjoy reading about the Breakthroughs in Motion that your contributions make possible.

KEVIN L. GARVIN, M.D.
Professor and Chair
Orthopaedic Surgery and Rehabilitation
DEPARTMENT: UNMC Orthopaedic Biennial Report

OUR MISSION IS TO IMPROVE THE QUALITY OF ORTHOPAEDIC MEDICINE THROUGH THE FUSION OF STATE-OF-THE-ART PATIENT CARE, SUPERIOR EDUCATION AND INNOVATIVE RESEARCH. THE UNMC DEPARTMENT OF ORTHopaedic SURGERY AND REHABILITATION, LIKE MANY DEPARTMENTS IN ACADEMIC MEDICAL CENTERS AROUND THE WORLD, IS BUILT ON A “THREE-LEGGED STOOL” OF PATIENT CARE, RESEARCH AND EDUCATION.
PATIENT CARE
Provide state-of-the-art care for patients afflicted with musculoskeletal disorders, including a full spectrum of adult reconstructive and general orthopaedics, foot and ankle surgery, hand and upper extremity surgery, shoulder and elbow surgery, orthopaedic oncology, trauma service, pediatric orthopaedics, sports medicine and spine surgery.

RESEARCH
Conduct world-class research to advance the prevention and treatment of orthopaedic conditions through the department’s Biomechanics and Advanced Surgical Technologies Laboratory, Nano-Biotechnology Laboratory, clinical outcomes research and collaborative research projects.

EDUCATION
Equip tomorrow’s best orthopaedic surgeons with hands-on training in all nine subspecialties of patient care and research during five years of orthopaedic residency at UNMC, with rotations at Nebraska Medicine and throughout the Omaha community.

Successful integration of the three legs is the key to ensuring that we continue to give our patients the best diagnosis and treatment possible, produce the next generation of accomplished orthopaedic surgeons, and develop cutting-edge clinical procedures and techniques.

We expand upon patient care, research and education throughout this report in dedicated sections and highlight patient breakthroughs that illustrate the importance of strong integration of each facet of our tripartite mission.
The UNMC Department of Orthopaedic Surgery and Rehabilitation clinical faculty take an assertive, interdisciplinary approach to the prevention, diagnosis and treatment of musculoskeletal disorders to realize Breakthroughs in Motion.

Our leading orthopaedic surgeons work closely with experienced nurses and collaborate with other physicians to treat pediatric, upper extremity, lower extremity, sports medicine, orthopaedic oncology, spine, trauma and adult reconstructive patients. Every member of the department is personally and professionally invested in ensuring that children, adolescents and adults in need of orthopaedic medicine receive the most effective care possible.

Meet our clinical faculty and learn about their specialized clinical and research interests on the pages that follow. See their full biographies and faculty activities beginning on Page 66.
ADULT RECONSTRUCTION AND GENERAL ORTHOPAEDICS

The department’s adult reconstructive surgeons specialize in inflammatory, degenerative and post-traumatic joint problems; bone and soft tissue reconstruction; and prosthetic joint replacement.

At UNMC, we perform more than a thousand total knee and total hip arthroplasties every year; taking great measures to improve patients’ outcomes.

We also play an important role in the advancement of joint arthroplasties, corrective osteotomies, implants, biomaterials, and bone, cartilage and soft tissue treatment, through clinical research. Our practice is able to take advantage of translational biomechanics research and industry-leading testing of knee replacement implants. (See Page 27 for details about developmental research.)

KEVIN L. GARVIN, M.D., CHAIRMAN
ADULT RECONSTRUCTIVE SURGERY
Dr. Garvin has special interests in hip and knee reconstruction, and the prevention and treatment of musculoskeletal infections. He has extensive experience with primary and complex hip and knee surgeries and has maintained an active clinical practice—performing over 400 primary hip and knee arthroplasties and periacetabular or femoral osteotomies per year. He is also an active researcher, having published more than 120 scientific articles.

CURTIS W. HARTMAN, M.D.
ADULT RECONSTRUCTIVE SURGERY
Dr. Hartman specializes in comprehensive care for adult patients with hip and knee arthritis. His research focuses primarily on the diagnosis and management of prosthetic joint infections, and the implementation of new technology in hip and knee arthroplasty.

BEAU S. KONIGSBERG, M.D.
ADULT RECONSTRUCTIVE SURGERY
Dr. Konigsberg specializes in comprehensive care for adult patients with hip and knee arthritis.
SPINE

The department’s spine surgeons provide comprehensive evaluation, treatment and management for a wide range of routine and complex conditions, involving all cervical, thoracic, lumbar and sacral aspects of the spine, and including deformities, injuries and deterioration. We specialize in arthritis, spinal stenosis, tumors, trauma and other specialized treatments in adults; as well as various conditions that impact children, including scoliosis, hip dysplasia, sports injuries, limb deformity and trauma.

CHRIS A. CORNETT, M.D.
ADULT SPINE SURGERY

Dr. Cornett’s clinical expertise is in all aspects of adult spine surgery (cervical, thoracic, lumbar and sacral). In his spine-only practice, he treats a variety of conditions, including degenerative conditions/arthritis, spinal stenosis, myelopathy, spondylolisthesis, disc herniations, instability, scoliosis, tumors and trauma.

ORTHOPAEDIC ONCOLOGY

At UNMC, we care for a variety of bone and soft tissue tumors and tumor-like conditions with an interdisciplinary team of surgeons, radiologists, pathologists, medical and radiation oncologists, and allied health professionals. We address all areas of the axial and appendicular skeleton and emphasize a modern approach to surgical preservation of skeletal function, often with bone graft and custom prosthetic implants.

SEAN V. MCGARRY, M.D.
MUSCULOSKELETAL ONCOLOGY

Dr. McGarry specializes in orthopaedic oncology with a focus on limb salvage.
PEDIATRIC ORTHOPAEDICS

The department’s specialty-trained pediatric surgeons are dedicated to the care of all musculoskeletal problems in infants, children and adolescents at Nebraska Medicine and Children’s Hospital & Medical Center. We treat limb and spine deformities, including clubfeet, scoliosis and hip dislocations; gait abnormalities; bone and joint infections; and fractures and dislocations of the arms, legs and spine. Children with spina bifida, cerebral palsy, muscular dystrophy, osteogenesis imperfecta and other congenital and developmental problems receive coordinated care in pediatric orthopaedics with the highest level of surgical and non-surgical treatments.

PAUL W. ESPOSITO, M.D.  Pediatric Orthopaedic Surgery

Dr. Esposito’s special interests are in children’s extremity deformities, osteogenesis imperfecta, congenital and developmental disorders, cerebral palsy, and musculoskeletal effects of pediatric obesity.

BRIAN P. HASLEY, M.D.  Pediatric Orthopaedic and Spine Surgery

Dr. Hasley’s areas of focus are pediatric orthopaedic surgery and pediatric spine surgery.

M. LAYNE JENSON, M.D.  Pediatric Orthopaedic and Spine Surgery

Dr. Jenson’s particular interests include scoliosis, hip dysplasia, pediatric and adolescent sports injuries, limb deformity and trauma.

SUSAN A. SCHERL, M.D.  Pediatric Orthopaedic Surgery

Dr. Scherl’s special focus areas are pediatric orthopaedic trauma and management of orthopaedic aspects of cerebral palsy.
TRAUMA

The department’s trauma team specializes in evaluation, treatment and long-term follow-up of fractures, dislocations and other musculoskeletal injuries, ranging from common to complex. We use internal, intramedullary and external fixation techniques, as well as microvascular techniques for the repair of fractured joints and damaged soft tissues.

At our Level 1 trauma center, patients with polytrauma, long bone and/or pelvic trauma benefit from a comprehensive array of emergency services, diagnostic imaging, and medical and surgical consultation. Our outpatient clinic is also available for long-term follow-up.

As of August 2014, our hospital partner, Nebraska Medicine, began providing 24/7 trauma coverage to Omaha and surrounding communities. (Read more about our trauma center on Page 15.)

MIGUEL S. DACCARETT, M.D.
ORTHOPAEDIC TRAUMATOLOGY
AND SPORTS MEDICINE

Dr. Daccarett’s special interests include pelvis and periarthicular fractures; the treatment of sports-related injuries and multi-ligament injuries of the knee, including ACL and PCL reconstruction; and cartilage repair procedures, including osteoarticular cartilage and meniscal transplantation, meniscal repair and autologous chondrocyte transplantation (ACI).

JUSTIN C. SIEBLER, M.D.
ORTHOPAEDIC TRAUMATOLOGY

Dr. Siebler’s clinical and research interests include orthopaedic fractures, injury and trauma, with special concentration on periarticular fractures, fragility fractures, and fractures of the pelvis and hip socket.

MATTHEW A. MORMINO, M.D.
ORTHOPAEDIC TRAUMATOLOGY
AND LOWER EXTREMITY

Dr. Mormino’s special concentrations include pelvic fractures, malunions and nonunions, foot and ankle trauma, and periarticular fractures.

LORI K. REED, M.D.
FOOT & ANKLE AND GENERAL ORTHOPAEDIC SURGERY

Dr. Reed specializes in foot and ankle disorders, lower extremity post-traumatic reconstruction, and general orthopaedics.

FOOT AND ANKLE

We are experts in managing complex and common reconstructive foot and ankle disorders, ranging from bunions to fractures, including problems in the heel, ankle, toe and forefoot areas. At UNMC, using an integrated team approach, we treat foot deformities resulting from fractures, overuse or osteoarthritis with conservative management techniques or surgical reconstruction.
SPORTS MEDICINE

The department’s sports medicine specialists treat competitive and recreational athletes’ injuries or illnesses, with a goal to help them return to their active lifestyles as quickly as possible. Ailments we often see include strains, sprains, or ligament and cartilage injury of the knee, hip, shoulder and ankle joints; instability of these major joints; and running injuries.

HAND AND UPPER EXTREMITY

The department’s orthopaedic surgeons treat a full range of degenerative, traumatic and sports-related conditions affecting the hand, wrist, shoulder and elbow. Fractures, dislocations and tendon injuries; degenerative, rheumatoid and post-traumatic arthritis; carpal and cubital tunnel syndrome, among many other conditions, are treated with alternatives ranging from non-operative modalities to state-of-the-art surgical interventions. Treatments range from arthroscopy over joint replacement, to fracture fixation and ligament and tendon repair or reconstruction.

SHOULDER AND ELBOW

The department provides comprehensive evaluation and management for a wide range of shoulder and elbow disorders, including arthritis, dislocation or instability, fractures, rotator cuff and tendon tears, joint stiffness, and complications due to previously unsuccessful surgeries. We use a multidisciplinary team approach to consider non-surgical and surgical treatment plans, ranging from exercises to full reconstructive operations, with a goal to maximize joint function.

MARK E. DIETRICH, M.D.
SPORTS MEDICINE AND ARTHROSCOPIC SURGERY

Dr. Dietrich’s focus areas include sports-related injuries and arthroscopic knee and shoulder reconstruction, as well as a special interest in hip arthroscopy.

PHILIPP N. STREUBEL, M.D.
HAND AND UPPER EXTREMITY SURGERY

Dr. Streubel specializes in the comprehensive care of the upper extremity. His clinical interests focus on degenerative conditions, and traumatic and overuse injuries of the shoulder, elbow, wrist and hand. His research interests include treatment of elbow stiffness and instability, shoulder arthroplasty, and management of thumb arthritis, wrist fractures, and trauma of the proximal and distal humerus.

MATTHEW J. TEUSINK, M.D.
SHOULDER AND ELBOW SURGERY

Dr. Teusink’s clinical expertise is in shoulder and elbow replacement, fractures and arthroscopy. His special interests are in reverse shoulder replacement, including revision shoulder replacements, as well as arthroscopic management of tendon and ligament tears around the shoulder. He has published/presented several papers on outcomes of reverse shoulder arthroplasty. His research interests include evaluating polyethylene liner wear in reverse and total shoulder replacements, and use of nanoscaffolds in rotator cuff healing.
THE DEPARTMENT OF ORTHOPAEDIC SURGERY AND REHABILITATION IS GROWING BOTH IN FOOTPRINT AND SCOPE. PURSUANT TO OUR MISSION, WE STRIVE TO REACH PATIENTS IN NEED WITH THE VERY BEST ORTHOPAEDIC CARE POSSIBLE. CONTINUED ADVANCEMENTS, BOTH CAMPUS-WIDE AND AT THE DEPARTMENT LEVEL, HAVE ENABLED US TO SERVE MORE PATIENTS THAN EVER BEFORE. EACH PIONEERING STRIDE IS CONTRIBUTING TO BREAKTHROUGHS IN MOTION.
The Nebraska Medical Center, UNMC Physicians and Bellevue Medical Center—once three separate yet interconnected organizations—now operate under one name: Nebraska Medicine. The newly integrated organization allows UNMC’s hospital partner to strengthen services by enhancing collaboration and providing patient-access to more physicians, hospital beds and clinics in and around Omaha.

UNMC and Nebraska Medicine remain separate entities, but share an emblem—signifying extraordinary alignment and dedication to providing highly coordinated care for patients.

A contemporary executive leadership model will undoubtedly position UNMC and Nebraska Medicine for success and increased national recognition in a new era of health care reform.

In February 2014, Jeffrey P. Gold, M.D., was welcomed as UNMC Chancellor and chairman of what is now the Nebraska Medicine Advisory Board.

Dr. Gold is a nationally recognized trailblazer in the field of academic medicine, and a board-certified thoracic surgeon specializing in adult and pediatric cardiac surgery. Before coming to Nebraska, he served as chancellor of the University of Toledo’s health science campus.

Dr. Gold follows in the footsteps of Chancellor Emeritus Harold M. Maurer, M.D., who led outstanding developments at UNMC during his 15 years as chancellor (1998-2014). Dr. Maurer continues his groundbreaking work on campus with the University of Nebraska Foundation, to spearhead fundraising for the Fred & Pamela Buffett Cancer Center and the Lauritzen Outpatient Center.

Glenn A. Fosdick announced his retirement in 2013, after 12 years as president and CEO of The Nebraska Medical Center, and more than 35 years in health care administration. It was his pioneering vision that guided the medical center to become the leading hospital in the region. Bradley Britigan, M.D., and Bill Dinsmoor now serve as president and CEO, respectively, of Nebraska Medicine.

Becker’s Hospital Review publishes an annual compilation of the most prominent, forward-thinking and focused healthcare facilities in the nation, entitled “100 Great Hospitals in America.” For the first time, The Nebraska Medical Center joined The Mayo Clinic, Massachusetts General, Cleveland Clinic and 96 other renowned medical centers on the list for 2014.

The recognized institutions provide best-in-class patient care, have a rich history as the birthplaces of many medical and scientific breakthroughs, and serve as academic hubs or local mainstays in their communities. The Nebraska Medical Center is the only Nebraska hospital included on the list.

The editorial team for Becker’s Hospital Review determines the 100 Great Hospitals by considering nominations and evaluating reputable hospital ranking sources, including U.S. News & World Report and others.
Nebraska Medicine and UNMC have announced plans for a new ambulatory care center, located near the intersection of 41st and Emile Streets in Midtown Omaha. This sophisticated facility, named the Lauritzen Outpatient Center, will provide new space and cutting-edge technology to offer much-needed outpatient care for a variety of medical conditions.

The Lauritzen Outpatient Center will have more than 170,000 square feet of surgical, research and educational space, and will be home to a number of outpatient clinics, including general surgery and orthopaedics. A significant part of the new Midtown center will be the Fritch Surgery Center, which includes a suite of 10 state-of-the-art operating rooms specifically designed for outpatient procedures.

The Department of Orthopaedic Surgery and Rehabilitation is pleased to announce that it will be moving to the Lauritzen Outpatient Center upon its completion in 2016. The orthopaedic clinic will be located on the first floor and, thanks to a generous gift from Ruth and Bill Scott, the top floor will house orthopaedic research laboratories and academic space. The fourth floor will also include a new center for telemedicine, providing a hub for teaching and outcomes research.

“We believe so strongly in UNMC’s leadership and that of Dr. Kevin Garvin and the Department of Orthopaedic Surgery and Rehabilitation,” said Ruth Scott. “Our family has personally benefited from their expertise, and we want to help ensure this quality of care continues through extraordinary research and education. We also support Dr. Gold’s vision for advancing telemedicine and the tremendous benefits it will bring to Nebraskans across the state.”

The main orthopaedic clinic has been located on the second floor of the Durham Outpatient Center for more than 20 years. At one point, our research facilities were also located near the academic offices, but the laboratories were transitioned to the Scott Technology Building on the Aksarben campus due to spatial constraints. This facility will allow the orthopaedic clinic, academic offices and research labs to be housed in one location for the first time in many years.

“The value of this change in departmental structure – which will bring our surgeons, researchers, residents and staff together in closer working proximity – cannot be overstated,” said Dr. Kevin Garvin, department chair. “It will create an optimal environment for translational research to improve orthopaedic care. I cannot thank Bill and Ruth Scott enough for their ongoing support of our department.”

Integrating clinical programs with a multidisciplinary team-based model, while differentiating between inpatient and outpatient environments, will improve clinical operations. Matthew J. Teusink, M.D., was chosen to represent the department on a committee that toured four other newly developed ambulatory surgical.
centers and reflected upon the importance of creating a comfortable and efficient patient experience: “This will be a comprehensive facility from an orthopaedic standpoint – with x-ray suites in the clinic, convenient CT/MRI within the building, and adjacent physical and occupational therapy services. The new outpatient surgical center is going to be a game-changer, meaning less time in the hospital and more time at home.”

“When patients come in for consultation or follow-up visits, they have a lot on their minds,” Garvin said. “This new center is completely focused on providing them a better experience, from the moment they park their car right outside, to the moment they go home from their appointment or procedure.”

The Lauritzen Outpatient Center is made possible by a number of generous benefactors, including the namesake families of Bruce Lauritzen and Charles Fritch, M.D. Bruce Lauritzen is president of Clarkson Regional Health Services, one of Nebraska Medicine’s two parent organizations. Dr. Fritch is a graduate of UNMC College of Medicine and a renowned ophthalmologist who practices in Bakersfield, California.

UNMC Chancellor Jeffrey P. Gold, M.D., expressed gratitude to the Lauritzens, Ruth and Bill Scott, and Dr. Charles and Judy Fritch for their tremendous gifts and commitments: “This support will enable us to provide the very best ambulatory and outpatient surgical care, right here in Omaha, as well as the finest research and education spaces and the opportunity to advance our leadership.”

Also under construction on UNMC’s campus, the Fred & Pamela Buffett Cancer Center is expected to open in 2017. The new facility will ensure that patients have convenient access to the latest breakthroughs in cancer diagnosis, treatment and therapy, as the health care industry enters a new era of personalized medicine. Nebraska Medicine broke ground on this $323 million project – the largest in its history – in July 2013.

Nebraska Medicine, the premier health care facility in the region, has expanded its trauma services to meet the needs of Omaha and surrounding communities. As of August 2014, the nationally recognized trauma center operates 24 hours a day, seven days a week, 365 days a year.

“We welcome this opportunity to better serve the state of Nebraska and to continue our mission to provide full orthopaedic trauma coverage to its citizens,” said Matthew A. Mormino, M.D.

This ushers in specific growth for the Department of Orthopaedic Surgery and Rehabilitation, as well. In August 2014, Justin C. Siebler, M.D., orthopaedic traumatology, and Philipp N. Streubel, M.D., hand and upper extremity, joined the full-time faculty, enabling the department to guarantee comprehensive, best-in-class 24/7 emergency coverage.

For more than a decade, The Nebraska Medical Center partnered with Alegent Creighton Health Creighton University Medical Center to cooperatively run one of the few combined trauma centers in the country. In 2013, external reviewers reassessed the Omaha trauma system for the State of Nebraska. Though it met patient needs, they recommended further optimization: “With outstanding trauma leadership and executive commitment, The Nebraska Medical Center Trauma Center could function independently and provide outstanding Level 1 care to the greater Omaha community.”

The medical center acted upon the reviewers’ recommendation to “vigorously” explore development of an independent trauma center. Becoming a full-time trauma program will now allow the hospital to acquire Level 1 recognition from the American College of Surgeons, the national accrediting body that sets the gold standard for U.S. trauma centers.

Traumatic injury is the No. 1 cause of death of Nebraskans under age 44 and a leading cause of death among older citizens; however, research shows that treatment at a Level 1 trauma center reduces the risk of death by 25 percent.
BEST CHILDREN’S HOSPITAL IN ORTHOPEDICS 2014-2015

Our pediatric clinical partner, Children’s Hospital & Medical Center, was recognized by U.S. News and World Report as a Best Children’s Hospital in Orthopedics for 2014-2015. It is ranked No. 29 of 50 in orthopedics based on quality, range of services available, volume, availability of subspecialists and other clinical support in a pediatric setting.

THE NEBRASKA MEDICAL CENTER NAMED TOP HOSPITAL IN THE STATE; RANKED BEST REGIONAL HOSPITAL IN EASTERN NEBRASKA FOR ORTHOPEDICS

The Nebraska Medical Center, UNMC’s hospital partner, was named the Top Hospital in Nebraska for 2014-15, and again recognized as the Best Regional Hospital in Eastern Nebraska for Orthopedics. U.S. News & World Report surveyed nearly 5,000 hospitals across the country to come up with this year’s list of Best Hospitals, of which fewer than 150 are nationally ranked. This is the third consecutive year the hospital has been designated No. 1 in the state.

The Medical Center was nationally ranked in six of the 16 specialties assessed by U.S. News & World Report in 2014-15, and deemed “high-performing” in eight others, including orthopedics. In 2012-13, the orthopedic program was ranked No. 36 in the nation and also named Best Regional Hospital in Eastern Nebraska for Orthopedics.
DEPARTMENT CHAIR ELECTED INTO THREE PRESTIGIOUS ORTHOPAEDIC SOCIETIES

Kevin L. Garvin, M.D., professor and chair of the department, is now an active member of three of the most distinguished groups in the field of orthopaedic surgery: the International Hip Society, The Hip Society, and The Knee Society.

International Hip Society
Dr. Garvin was elected into membership of the International Hip Society (IHS) in April 2012. The society’s members include expert surgeons from Australia, Austria, Canada, China, France, Germany, Japan, Korea, Italy, New Zealand, Spain, Sweden, Switzerland, the United Kingdom, and the U.S.

The Hip Society
As education committee chair of The Hip Society for 2012-2013, Dr. Garvin was program chair for The Hip Society Specialty Day during the 2014 Annual Meeting of the American Academy of Orthopaedic Surgeons (AAOS) in New Orleans, Louisiana, in March 2014. He has also been named treasurer for 2014-2015.

The Knee Society
Dr. Garvin is also currently serving on The Knee Society Executive Board as research committee chair from 2012 through 2015.

DEPARTMENT SURGEONS RECOGNIZED AMONG THE BEST IN THE NATION

The clinical faculty at the Department of Orthopaedic Surgery and Rehabilitation are recognized annually by peers, both regionally and nationally, for excellence in patient care.

Best Doctors in America
Five department surgeons were selected by impartial peer review to appear on the prestigious Best Doctors in America® list for 2014, an honor held by just 5 percent of U.S. doctors: Drs. Kevin Garvin, Paul Esposito, Brian Hasley, Matthew Mormino and Susan Scherl. All have been named among the “best” for eight years or more.

The Best Doctors in America® database profiles more than 53,000 of the best U.S. doctors in over 40 specialties and 400 subspecialties of medicine. It is assembled by Best Doctors, Inc., and audited and certified by Gallup®. Peer physicians polled, prior to thorough evaluation of the results and inclusion criteria, are asked to answer one simple question: “If you or a loved one needed a doctor in your specialty, to whom would you refer?”

America’s Top Doctors
Annually, Castle Connolly seeks nominations and input from thousands of medical specialists, department chairs, residency program directors, vice presidents of medical affairs and presidents of the leading healthcare institutions to identify the top 1 percent of specialists and sub-specialists across the country. Kevin L. Garvin, M.D., has been recognized as one of America’s Top Doctors® for eight years running (2007-2014).

Regional Top Doctors
Castle Connolly’s physician-led research team also seeks peer nominations to identify outstanding physician leaders in their communities and metropolitan areas as Regional Top Doctors®. Matthew A. Mormino, M.D., has been included in this top 10 percent of specialists in the department’s geographic region for 2012, 2013 and 2014.
The department’s spine surgery, hip replacement and knee replacement programs at The Nebraska Medical Center earned Blue Distinction Centers+ recognition from Blue Cross Blue Shield of Nebraska in 2013.

The research-based Blue Distinction Centers for Specialty Care® program honors medical facilities that have demonstrated expertise in delivering quality specialized patient care. Blue Distinction Centers+ demonstrate improved outcomes for patients, with better care, lower rates of complications, fewer readmissions and 20 percent better cost effectiveness than their peers, to earn the highest Blue Distinction Centers award.

“Receiving this recognition is a result of the experience, skills, depth of expertise and commitment to high quality care that our staff provides to patients afflicted with arthritic conditions of the hip and knee,” said Kevin L. Garvin, M.D.

Orthopaedic surgeons and neurosurgeons at the spine center provide comprehensive treatment of acute and chronic spinal conditions, including congenital, degenerative and traumatic conditions of the cervical, thoracic, lumbar and sacral spine. Additionally, orthopaedic surgeons at Nebraska Medicine perform primary and complex hip and knee replacements on patients with arthritis, problems with joint disease from trauma, childhood hip and knee diseases, and prosthetic joint infections.

Less than a decade ago, Kevin L. Garvin, M.D., was essentially a one-man show in the department, treating all patients suffering from hip and knee disorders. Now three surgeons, Drs. Kevin Garvin, Curtis Hartman and Beau Konigsberg, all specialize in adult reconstructive surgery. Patient volumes and corresponding clinical revenues have since multiplied – not to mention further upgrades to the department’s comprehensive joint surgery expertise made possible by the addition of upper extremity specialists Matthew J. Teusink, M.D., and Philipp N. Streubel, M.D.

Drs. Garvin, Hartman and Konigsberg performed approximately 2,000 joint replacements in 2012 and 2013. Significant national research has indicated that the aging Baby Boomer generation will lead to even greater increases in demand for total hip and knee arthroplasties (THA and TKA, respectively) in the near future. (See Page 52 for a story about one of Dr. Garvin’s THA patients, including a brief description of said projections.)

Dr. Garvin and fellow surgeons have placed strong emphasis on decreasing patient risk of infection during surgery and post-operatively. Research has shown that 8 percent of people in the hospital’s geographic region are carrying Methicillin-resistant Staphylococcus aureus (MRSA) bacteria that resist antibiotics commonly used to prevent and treat staph infections. With cultures of the skin and mouth, the surgical team can proactively determine whether a patient will require a different course of antibiotic treatment. All pre-op patients are also asked to scrub with a chlorhexidine gluconate antiseptic for three consecutive days to reduce naturally occurring bacteria levels. As a result, patient rates of post-operative infection are exemplarily low. The percentage of surgical patients readmitted due to staph infection decreased 4.7 percent from 2012 to 2013 alone.
Since Chris A. Cornett, M.D., joined the full-time faculty in 2011, the department’s spine surgery practice has grown substantially. Our dedicated team of adult and pediatric spine surgeons has the capacity to superlatively treat any spine condition in adults or children: skull to sacrum, complex or routine. Patient demand has proven its worth to the community.

Dr. Cornett’s spine surgical volumes at the medical center rose more than 40 percent from 2012 to 2013, not including surgeries performed at the Nebraska Orthopaedic Hospital.

Dr. Cornett was fellowship-trained in spine surgery at the University of Pittsburgh Medical Center before joining the department, and holds a master’s degree in physical therapy from UNMC. This combination of non-surgical and surgical experience makes him a unique asset, both to the department and the medical community.

The department’s spine surgery practice is further strengthened by pediatric orthopaedic surgeons M. Layne Jenson, M.D., and Brian P. Hasley, M.D. (Read about one of Dr. Hasley’s scoliosis patients, Annie Lange, on Page 38.)
THREE ORTHOPAEDIC SURGEONS JOINED THE DEPARTMENT’S FULL-TIME FACULTY

STRENGTHENING SHOULDER AND ELBOW SURGERY WITH DR. MATTHEW TEUSINK

Matthew J. Teusink, M.D., was welcomed to the department’s full-time faculty in August 2013. As a shoulder and elbow specialist, his particular areas of interest include shoulder and elbow arthroplasty, trauma and arthroscopy.

Dr. Teusink’s contributions to the team cannot be overstated. In just the latter half of 2013, departmental shoulder and elbow surgical volumes multiplied nearly eight times over 2012. He also represented the department on a committee involved with development of the Lauritzen Outpatient Center, helping to create the vision for the new state-of-the-art facility that will become the department’s home in 2016.

After obtaining his medical degree and completing residency at the University of Iowa, Dr. Teusink was a fellow at the Florida Orthopaedic Institute. He joined UNMC following, and has been building his practice at the Durham Outpatient Center and Oakview Medical Building. See Dr. Teusink’s full-time faculty activities on Page 78.

EXPANDING COMPREHENSIVE ORTHOPAEDIC TRAUMA COVERAGE WITH DR. JUSTIN SIEBLER

Justin C. Siebler, M.D., joined the faculty in August 2014, substantially adding to the department’s full-time orthopaedic traumatology service, just as Nebraska Medicine began offering 24/7 trauma coverage to Omaha and the surrounding communities.

With specialized expertise in orthopaedic fractures, injury and trauma, Dr. Siebler is an outstanding addition to the orthopaedic team. His surgical concentrations include fractures in and around the joints (periarticular fractures), fractures of the pelvis and hip socket, and fragility fractures.

Dr. Siebler earned his medical degree at UNMC and completed residency in Omaha, as well, through the Creighton University/University of Nebraska Health Foundation Orthopaedic Surgery Residency Program. After finishing an orthopaedic traumatology fellowship in Tampa, Florida, he served as an assistant clinical professor at Creighton University from 2010 through 2014. He currently sees patients at the Durham Outpatient Center. See Dr. Siebler’s complete biography on Page 78.

ENHANCING THE HAND AND UPPER EXTREMITY SERVICE WITH DR. PHILIPP STREUBEL

The department recently welcomed hand and upper extremity surgeon Philipp N. Streubel, M.D., to the full-time orthopaedic faculty as an assistant professor. With the addition of Dr. Streubel, the department is fully equipped to address any patient hand or upper extremity concerns — ranging from common to highly complex, inflammatory to degenerative, including major trauma — with the best-quality clinical and surgical care.

Dr. Streubel specializes in comprehensive care of the upper extremity, with particular interest in degenerative conditions and injuries of the shoulder, elbow, wrist, and hand resulting from trauma or overuse.

He sees patients at the Durham Outpatient Center and Oakview Medical Building. Dr. Streubel’s research experience is as striking as his clinical practice. He has completed three surgical fellowships in the areas of orthopaedic trauma, shoulder and elbow surgery, and hand, wrist, elbow and microsurgery. Prior to joining the department, he was an upper extremity surgeon and assistant professor of orthopaedics at the Mayo Clinic in Minnesota. See Dr. Streubel’s complete biography on Page 79, among the department’s full-time faculty biographies and activities.
EXTENDING OUR REACH IN WEST OMAHA: NEBRASKA ORTHOPAEDIC HOSPITAL AND OAKVIEW ORTHOPAEDIC CLINIC

The department has renovated clinic space in the Oakview Medical Building and teamed up with the Nebraska Orthopaedic Hospital to offer more convenient options for patients throughout the Omaha metropolitan area.

Renovation of the Oakview Medical Building, located at 144th and West Center Road in Omaha, was complete in fall 2013. Nebraska Medicine – Oakview Orthopaedics’ beautifully expanded, state-of-the-art clinic offers consultation, radiology, physical therapy and follow-up care at one location that is readily accessible on the building’s first floor.

Our orthopaedic surgeons are also now able to provide surgical treatment at the adjacent Nebraska Orthopaedic Hospital. The department’s orthopaedic surgeons currently practicing at the Oakview Medical Building and Nebraska Orthopaedic Hospital include Drs. Kevin Garvin, Chris Cornett, Miguel Daccarett, Mark Dietrich, Curtis Hartman, Beau Konigsberg, Lori Reed, Philipp Streubel and Matthew Teusink.

GIVING BACK TO THE COMMUNITY WITH SPORTS MEDICINE

Sports injuries are as diverse as the range of recreational and competitive athletes who endure them. The department’s sports medicine team collaborates with physicians and medical professionals across 18 different specialties and subspecialties at UNMC and Nebraska Medicine to develop customized diagnosis, treatment and rehabilitation programs for each patient.

The Sports Medicine Program has worked closely with the Omaha Sports Commission to ensure that some of the nation’s finest athletes receive the highest-quality care while competing in Omaha. Department physicians have donated dozens of hours of coverage to participants at recent sporting events, including the 2013 NORCECA Continental Volleyball Championships, the 2013 U.S Figure Skating Championships, the 2013 National Age Group Short Track Speedskating Championships, and the 2008 and 2012 U.S. Olympic Swim Trials.
BREAKTHROUGHS TO THE FINISH LINE

DANIEL CARLSTEDT
Daniel Carlstedt had always been physically active – playing baseball through college, cross-training and more – but he didn’t take up long-distance running until his late 20s. Unfortunately, at the heels of the newfound hobby came insufferable pain.

In 2011, Carlstedt’s wife encouraged him to join her in dedicating a half marathon to their friend’s young son who had recently passed away. He was motivated by the powerful cause and invigorated by the endurance sport. Shortly after completing the race and beginning training for his second, Carlstedt began to feel unbearable discomfort in his left hip hours after exercise; at times, after sitting, he would not be able to stand and walk. Soon both hips were afflicted.

“I had never experienced pain like that,” Carlstedt remembered.

He promptly sought care and counsel from a series of physical therapists and chiropractors, and tried exercises and anti-inflammatories, yet found no solution. Swimming and biking offered Carlstedt minimal relief from the pain caused by running and he was eager to stay physically active. As a father to three children under age 6, full range of motion was imperative. He was finally referred to Mark Dietrich, M.D., in 2012.

Dr. Dietrich immediately identified that Carlstedt was suffering from symptomatic femoroacetabular impingement, with associated chondral labral pathology. In other words, the proximal femur (thigh bone) and the acetabulum (hip socket) were poorly matched, causing the bones to rub together and damage the hip joint.

There are two potential components to abnormal bony morphology: aspherical shape of the proximal femur and an overly deep acetabulum. Individuals with symptomatic femoroacetabular impingement may suffer from one or both of these abnormalities, resulting in two possible types of impingement: cam-type, which occurs when the femoral head cannot rotate smoothly inside the acetabulum; or pincer-type, which occurs from overgrowth of bone at the rim of the acetabulum. Carlstedt was enduring both significant cam-type and mild pincer-type impingement.
Many people with impingement sustain long, active and healthy lives without ever knowing they have it. Others begin to suffer from damage to the labrum (articular cartilage), which causes pain in the groin and hip to progress. Patients typically present under the age of 50, and when symptoms persist despite activity modification and non-steroidal anti-inflammatory, surgical treatment may be carefully considered.

Upon review of the x-rays, Dr. Dietrich ordered a magnetic resonance imaging (MRI) arthrogram to assess the need for surgical intervention. He talked through the condition and possible procedure with Carlstedt—not only as an experienced physician, but also a former surgical patient. His candor and cautious approach put Carlstedt at ease.

“What I really loved about Dr. Dietrich was that he took the time to answer any and every question in terms I could understand,” Carlstedt explained. “Knowing his experience doing the procedure, that he’d had it himself and that he wanted to do the MRI first, made it clear that he was the guy. I felt more comfortable with him.”

The MRI demonstrated significant injury to cartilage and surrounding tissue. Furthermore, because Carlstedt saw temporary relief from an intra-articular injection at the time the arthrogram was administered, Dr. Dietrich had confirmation that the pain was truly coming from inside the joint. Surgical objectives would include repairing the damaged cartilage, debriding the frayed or torn labrum, and recontouring the bones to prevent further impingement.

Nationally, femoroacetabular impingement is an ever-evolving diagnosis and niche surgical specialty. Some cases are best treated with a surgical hip dislocation and an osteotomy. However, Dr. Dietrich has a high skill level with, and preference for, the less invasive arthroscopic procedure, which is done through two to three small incisions while the hip is distracted. He operates on patients like Carlstedt approximately 120 to 150 times annually, and also teaches the procedure to fourth-year residents who express sincere interest in sports medicine during their rotations with him.
Dr. Dietrich operated on Carlstedt’s left hip in January 2013. Within three weeks, Carlstedt weaned off crutches and began physical therapy to support the left hip, as well as pre-habilitation to strengthen the muscles around his right hip prior to the second outpatient procedure.

Just three months after the first surgery and mere weeks after the second, Carlstedt was on his feet and back at physical therapy. He quickly took up swimming and was jogging on an antigravity treadmill within 12 weeks.

“I don’t take any run or workout for granted,” he said.

Carlstedt got back to avid running multiple times per week without any significant discomfort less than six months post-op, and was already training for his third half marathon in early 2014. Dr. Dietrich is confident that his symptoms and function will be significantly improved over the long term.

“I’m so grateful for the activities I can do without pain,” Carlstedt reflected. “I’m that guy who’s running outside in the freezing cold with a big smile on his face.”

Recognizing the relative novelty of this procedure, Dr. Dietrich is monitoring long-term outcomes for patients like Carlstedt. Because residual impingement increases the likelihood of degenerative arthritis, he and peer specialists anticipate that early arthroscopic treatment will prevent the need for later hip replacement in most cases.

In an interesting twist, it was discovered that Dr. Dietrich’s father, an obstetrician, had delivered Carlstedt 30 years prior. Connections like these exemplify the powerful benefits of keeping great UNMC-trained doctors in Nebraska. (See the Nebraska Orthopaedic Alumni Map on Page 46.)
ORTHOPAEDICS BIOMECHANICS AND ADVANCED SURGICAL TECHNOLOGIES LABORATORY

Traversing the Cutting Edge of Orthopaedic Technology

Breakthroughs in the Orthopaedics Biomechanics and Advanced Surgical Technologies Laboratory are on a much larger scale than the rows of test tubes one might imagine. Under the direction of Hani Haider, Ph.D., 10 professional engineering scientists and technicians are developing cutting-edge surgical technology, while also testing joint implants’ ability to sustain everyday activity. Their mission is to help improve orthopaedic medicine to benefit future patients in Nebraska and around the globe. The lab’s international acclaim is stunning and humbling, even to the distinguished members of Dr. Haider’s team.

Ushering in a New Era of Orthopaedic Surgery

Navigated freehand bone cutting technology, born in the department’s lab here in Nebraska, will change the way orthopaedic surgeons worldwide perform total joint arthroplasty (TJA). In October 2013, after years of design, testing and refinement, Dr. Haider and the team received a United States Patent for “Method and Apparatus for Computer-Aided Surgery.”

The computer-aided surgical technique and “smart” devices facilitate TJA with similar precision as manual alignment instruments (jigs) allow, but with much more utility. The software developed in-house first creates an accurate 3-D model of patients’ bones using computer tomography (CT) scans. From the computer, a surgeon can then plan a joint replacement procedure according to his/her operating preferences and a patient’s unique case. Various implants can be “mocked up” graphically to optimize choice of size, fit and alignment of the implant, taking into account the patient’s particular anatomy for bone conservation, soft-tissue restraint and other biomechanical considerations.

During surgery, no implant-specific cutting blocks are needed. The handheld saw/drill interacts dynamically with the preprogrammed software. An adjustable wireless microcomputer touch screen provides meaningful graphical feedback.

HANI HAIDER, PH.D.
DIRECTOR, ORTHOPAEDICS BIOMECHANICS AND ADVANCED SURGICAL TECHNOLOGIES LABORATORY

Hani Haider, Ph.D., is a professor in the department and Director of the Orthopaedics Biomechanics and Advanced Surgical Technologies Laboratory. He was the principal mechanical and software engineer who produced the Instron-Stanmore Knee Simulator and was instrumental in the development of the International Standards Organization (ISO) method for simulation and wear testing of knee replacement systems. Dr. Haider is also the main inventor of the award-winning innovations in navigated freehand bone cutting technology for joint replacement.

Since joining the UNMC faculty in 2000, Dr. Haider has received over 65 research contracts and federal research funding, totaling over $8 million. His special research interests include developing methods for in vitro testing of orthopaedic implants and innovative computer-aided surgical technologies. See Dr. Haider’s biography and recent accomplishments among the full-time faculty biographies and activities, on Pages 70 and 71.
The concept for this revolutionary computer-aided surgical navigation system began with computer-drafted, 2-D, black-and-white mechanical and electronic circuit drawings. The team manufactured and populated the electronic circuit boards, which are housed within the handheld device, using hundreds of electronic components. With guided tracking technology similar to a global positioning system (GPS), and also optionally slows or stops the instrument if the surgeon deviates from his/her designated error threshold. This navigated freehand bone cutting enables more accurate and radically simpler operation with 15 percent greater efficiency of cutting; ensures better implant alignment; is less traumatic to a patient’s bone and soft tissue; reduces infection risk and recovery time; and is, therefore, far less costly than other systems of TJA.

From a 2-D schematic, to an electronic circuit board, to a 3-D printed device, to a surgeon’s hands in real-time, this technology has grown from a brilliant idea into a revolutionary tool. A multi-million dollar grant from the U.S. Navy helped move the technology from a very elementary but award-winning proof-of-concept to a multi-channel wireless model, and readied it to be more like a system for clinical application.

“I am pleased to be told by some that our UNMC lab is becoming one of the leading orthopaedic research centers in the world,” Dr. Haider said. “Come to think of it, not many university labs, let alone medical school orthopaedic departments, have the capacity to conceive, design, build, rapid-prototype and test their own technology with sophisticated innovative mechanical components, electronic microprocessor-driven circuitry and wireless communications.”

This international award-winning technology is now being configured and documented for submission for U.S. Food and Drug Administration (FDA) approval, clinical trials and commercialization through a Nebraska-based startup company, called TrakSurgical, Inc. Dr. Haider describes its potential impact on TJA to be more fundamental than the incremental progress seen with previous technologies.
Setting Industry Standards to Ensure Joint Implants Can Keep Up with Patients

However remarkable and cost-effective the advanced surgical technology is, TJA can only be as valuable to patients as the replacement joints themselves. Using leading-edge knee and hip simulators, many of which were engineered by Dr. Haider and his colleagues, department researchers mimic prolonged wear of replacement joints in the modern patient to ensure durability and safety over their lifetimes.

This lab has grown to be one of the largest implant testing facilities in the nation and the world – pioneering new testing methods, characterizing and ensuring the safety of joint implants, and actively helping to set international standards for implant testing. Since 2000, when Dr. Haider arrived, the lab has held 60 industrial contracts with more than 26 different companies, mostly from the U.S., as well as Japan, Germany, France, Italy and other countries.

In vitro simulators create lifelike forces and torques, which induce linear implant motions and rotations to mirror everyday wear and tear on human joints. Many simulators in the lab run 24/7 for many months to help assess the functionality and longevity that the given implants might provide. During testing, department researchers also collect wear debris that is released from implants into the body over time for later analysis.

Many of these implants go on to receive U.S. FDA approval. In some cases however, research in the lab reveals potentially harmful effects of extended implant wear and duly prevents them from moving into clinical trials. For example, an alluring implant coating that had been previously tested and approved for surgical use in Europe was recently being introduced to the U.S. With innovative testing at UNMC, Dr. Haider’s team proved that the implant coating can detach, releasing abrasive debris into the body with accelerated wear over time, and was thus unfit for patients.

It is because of such diligent investigation that medical research centers and governing bodies trust UNMC’s biomechanics lab to objectively test implants and safeguard lasting results for orthopaedic surgery patients around the world. The Orthopaedics Biomechanics and Advanced Surgical Technologies Laboratory at UNMC adds to Nebraska’s quietly growing gems of innovation and success.
Researchers at the department’s Nano-Biotechnology Laboratory are also addressing the durability and biointegration of surgical implants, at a molecular level. Fereydoon Namavar, Sc.D., and colleagues have engineered a nanostructured coating that can improve orthopaedic implant surfaces’ wettability, encourage natural cell growth and optimize wear. This work has far-reaching possibilities, not only for orthopaedic surgery, but other medical fields, as well as departments of energy for safe storage of nuclear waste.

Developing a Smart Implant Surface that Mimics Live Cells
It is of heightened importance in the field of orthopaedics to understand the interaction of living cells with nanomaterials in order to regulate cell growth, prevent disease, reduce joint-surface friction and encourage patients’ overall health. Exploring osteointegration of prosthetic surfaces will lead to more efficient tissue growth and vascularization, resulting in faster patient recovery and substantial health care cost savings.

Dr. Namavar hypothesized, in response to the pros and cons of mainstream orthopaedic materials, that implant surfaces should have opposite hydrophilic (water-attracating) and hydrophobic (water-repelling) properties to achieve total wettability and hardness. By observing the hydrophilic properties of cubic zirconia (a diamond simulant) and mimicking the hydrophobic nanostructure of a lotus leaf, Dr. Namavar applied innovative ion beam assisted deposition (IBAD) technology to engineer a nanocrystalline cubic zirconia coating that is hard, wettable and also produces the effect of a living cell to activate adhesive proteins.

The body’s self-healing cell-cell interactions are mediated by activation of compact adhesive proteins like fibronectin (FN). Cells are not naturally interested in surviving on metal, ceramic or polyethylene surfaces, however, the nanocrystalline coating designed in the department’s lab can create electrostatic interactions that activate and partially unfold FN to make an implant surface “available” for natural cell growth.

Fereydoon Namavar, Sc.D., is a professor emeritus, director of the Nano-Biotechnology Laboratory and a member of the Nebraska Center for Materials and Nanoscience. He has received grants and contracts from a number of agencies, and collaborates with scientists around the world. His special interests include researching how cells attach to nanostructured surfaces, designing nanostructures that simulate the effects of a cell in cell-cell interactions, tissue engineering, developing infection-resistant coatings for orthopaedic and dental implants, and testing the application of nanotechnology in total joint arthroplasty. See Dr. Namavar’s biography and recent accomplishments among the full-time faculty biographies and activities on Page 76.
Most recently, Dr. Namavar and collaborators conducted an animal study to test the adhesion and proliferation of mammalian cells on the nanostructured surface. The test compared bone growth in young rats to bone formation in protein- and calcium-deficient older rats, paralleling aging human patients who might require replacement joint implants. Results showed that cell adhesion and proliferation in older rats with the nanocrystalline implants was as successful as the bone growth in young rats. This finding confirms Dr. Namavar’s astute hypothesis and brings his nano-biotechnology research one step closer to life-changing implications for joint arthroplasty patients.

“We first needed to learn how cells attach to cells, with mediation from adhesive proteins; then explore how to replicate that motility in a prosthetic implant,” Dr. Namavar explained. (See Figures (a) and (b) on Page 32.) “We are the first to combine theory, modeling, and in vitro and in vivo experimentation to demonstrate and replicate superior cell adhesion and proliferation. At UNMC, in a hospital setting, biologists, clinicians and students are working together to achieve this goal.”

Dr. Namavar has co-authored, published and presented this research around the world. He holds two patents for orthopaedic material research, as well as five others, and is currently working on a comprehensive paper to patent this technology.

The IBAD machine in the UNMC Nano-Biotechnology Laboratory is one of few in the country. It allows nano technologists to combine bombardment of a large number of energetic ions (atoms that have gained an electrical charge by losing an electron) with physical vapor deposition (evaporation), in an ultra-high vacuum environment, to produce engineered nanocrystals that have superior mechanical properties.
MIMICKING CELL-CELL INTERACTIONS ON A NANOSTRUCTURED SURFACE:

Fibronectin (FN) - an adhesive protein that mediates cell attachment, proliferation and differentiation and is present in blood - is a large extracellular matrix made up of positively and negatively charged globular domains, which are stabilized by “electrostatic lock.” These domains participate in inter-molecular FN-FN binding when the FN dimer is converted into the extended (activated) form.

(a) On a smooth surface, FN adheres to the implant by van der Waals interaction, but remains compact (non-active).

(b) On a nanostructured surface, FN adheres to the implant surface and is partially unfolded (extended/activated). Electrostatic interactions between negatively charged implant surface patches and positively charged FN domains expose its cryptic sites to initiate FN matrix assembly – a prerequisite of cell adhesion.
Robert Mann was riding his motorcycle to work on July 7, 2012, when a car failed to yield to the traffic light and hit him. He flew through the air, landed on his back and suffered bilateral hip fractures, a right distal humerus (elbow) fracture, a knee injury, cracked ribs and a minor brain bleed. He was immediately taken to The Nebraska Medical Center emergency room.

A helmet likely kept Mann from dying; but Matthew Mormino, M.D., fellow surgeons and UNMC orthopaedic residents, who were among the first responders to the emergency room, saved his quality of life.

Mann’s lower extremity injuries required urgent attention so that he could get up and moving again as soon as possible. Together, Dr. Mormino and the orthopaedic trauma surgery residents conceived a treatment plan. To avoid complications from lack of blood supply to the ball of the femur, they surgically stabilized Mann’s hips with plates and screws right away.

The following day, Dr. Mormino repaired Mann’s distal humerus fracture with a plate and screws. He had two surgical options: to detach the tricep tendon from the elbow and perform an olecranon osteotomy (cutting the end of the ulna) or, preferentially, to get exposure to the fracture by working around the tricep without detachment of the tendon or cutting the ulna. By choosing the latter, innovative approach, he facilitated quicker rehabilitation of the elbow. Where other techniques would have likely kept Mann immobile for approximately six weeks while he was unable to bear weight on his legs, Dr. Mormino allowed him to use his elbow immediately for walker ambulation.

Mann was in the intensive care unit for a week before spending approximately one month in an assisted care facility. He attended physical therapy three times a week and was able to return to work as a day custodian for Millard Public Schools in February 2013. Although he occasionally suffers from muscle soreness upon exertion, it’s nothing he can’t handle.

“If it wasn’t for [Dr. Mormino], I don’t know where I’d be,” Mann said. “I’m grateful that I’m able to get up and around like nothing really happened. It felt good to get back to work.”

See Pages 80 and 96, for Dr. Mormino’s correlated clinical research abstracts: “Outcomes following extra-articular distal humerus fractures treated with a single lateral plate utilizing a paratricipital approach” and “Outcomes following distal humeral fracture fixation with an extensor mechanism-on approach.”

PATIENT BREAKTHROUGHS IN MOTION:

ROBERT MANN
The Orthopaedic Registry to Monitor Treatment Outcomes is active at UNMC and Nebraska Medicine, including surgeries performed at the Nebraska Orthopaedic Hospital. The registry now includes more than 5,000 surgical subjects who have undergone total joint replacement, revision joint surgery, shoulder surgery or back/spine surgery.

Any pre- or post-surgical patient who is seeing an orthopaedic surgeon may be included in the database. Participants are asked to fill out routine questionnaires regarding their health, quality of life and functional status, preoperatively and at regular postoperative intervals. If they are unable to return for follow-up, they are contacted by phone and receive questionnaires by mail. These patient questionnaires supplement clinically obtained assessments and retrospective medical record reviews, including radiographs, to populate the database.

Collection, interpretation and analysis of clinical outcomes information leads to establishment or clarification of improvement objectives, specialized advancements in the department’s patient care, and an increase in generalized knowledge that can be presented or published for the broader orthopaedic community.

In addition to advancements made through the outcomes database, the department pursues a variety of clinical studies. Eight studies were completed in 2012 and 2013, and there are 27 active Institutional Review Board (IRB) approved research studies, as of early 2014.

The following is a list of all outcomes and clinical studies that have taken place in the department between 2012 and early 2014, including one being conducted at the Veteran’s Administration Hospital, one in collaboration with Alegent Creighton Health, and four in collaboration with Children’s Hospital & Medical Center:

**ACTIVE**

- Does Surgical Decompression of Spinal Stenosis Improve Gait Dynamics during Ambulation and Trunk Position?
- Functional Outcomes after Posterolateral Plate Fixation of Humerus Shaft Fractures
- Initial Results and Experience with Intramedullary Rodding (Fassier-Duval Telescoping Intramedullary Rodding) in Children with Osteogenesis Imperfecta
- Outcomes of Total Hip Replacement Utilizing Oxidized Zirconium Femoral Heads on Crosslinked Polyethylene

Orthopaedic research is not limited to the laboratories. The department continues developing our patient outcomes database to evaluate the effectiveness of various diagnoses, surgical treatments and long-term results. In doing so, we are helping to ensure that orthopaedic care – provided by our surgeons, those in our residency training program, and physicians around the globe – is continually evolving for patients’ best interests.
Clinical Results of Uncemented Tapered Stems with Total Hip Arthroplasty in Patients Ages 50 Years or Younger

Orthopaedic Registry to Monitor Treatment Outcomes

Long-term Follow-up of Joint Infections after Reimplantation

The Coefficient of Friction of Human Osteoarthritic Cartilage on Joint Repair Materials Lubricated by Human Osteoarthritic Synovial Fluid

A Multicenter, Randomized, Clinical Outcome of Visionaire Patient Matched Technology vs. Standard Surgical Instrumentation in Total Knee Arthroplasty

Sonication for Enhanced Diagnosis of Prosthetic Joint Infection

An Analysis of the Accuracy of Radiographic Reference Markers for Digital Templating in Total Hip Arthroplasty

Clinical Outcomes Comparison between a Single Injection of Hylan GF20 and a Series of Five Injections of Sodium Hyaluronate in Patients for Treatment of Osteoarthritis of the Knee: A Randomized Prospective Study

The Utility of Oral Antibiotic Therapy Following Two-Stage Revision Arthroplasty for Infected Prosthetic Hips and Knees

Vertical Expandable Prosthetic Titanium Rib

Outcomes of Total Hip Arthroplasty for Post-traumatic Arthritis after Acetabular Fracture

Tumor Registry

Patient Outcomes Following Rotationplasty Treatment (Versus Expandable Prostheses) for Osteosarcoma of the Distal Femur or Proximal Tibia

Distinguishing Commensal versus Pathologic Staphylococcus Species in Cases of Fracture Nonunion after Internal Fixation

CT versus X-ray in Measuring Displacement and Angulation in Clavicle Fractures

Evaluating the Epidemiology of Pediatric Musculoskeletal Injuries at One Academic Pediatric Practice

Five-year Outcome Follow-up of Glenoid Anchor Peg Component Fixation Utilizing Autologous Bone Graft in Total Shoulder Arthroplasty

Defining the Role of Head of Bed Angle in Cerebral Deoxygenation Events during Upper Extremity Surgery in the Beach Chair Position

In collaboration with other departments:

Immune Panel Repertoire

Descriptive Analysis of the Effect of Surgeries on Human Immune Status

Enhanced Detection of Staphylococcus Aureus Colonization in Patients Undergoing Prosthetic Joint Implantation

In vitro Models of Cartilage Development, Homeostasis and Disease

Anterior Knee Pain after Intramedullary Nailing of Tibial Fractures by Suprapatellar Approach

COMPLETED

Early Operative Experience of the Fassier-Duval Telescopic Rod System for Children with Osteogenesis Imperfecta

Outcomes Following Acetabular Fracture

Horseback Riding and/or Motorcycle Riding After a Total Hip Arthroplasty

Periprosthetic Fractures of the Tibia After Total Knee Arthroplasty: An Overview and Description of a Surgical Technique Using Locking Plates, Cables and Augmentation with an Anterior 1/3 Tubular Plate

Results of Total Knee Arthroplasty Revision for Rotational Malalignment

CSSG Multicenter Retrospective and Prospective Observational Data Registry for Clinical and Radiographic Outcomes of Spinal Surgery Comparing Instrumentation and Procedures

Can Stem Cells Predict Orthopaedic Surgical Outcomes?

Total Hip Arthroplasty Revision with Impact Grafting
TAKING CARTILAGE RESEARCH A STEP FURTHER

Cartilage and bone disorders that result from genetic defects, aging or injury have a major impact on quality of life and economic welfare, as do infections. For example, a prosthetic joint infection may result in additional surgical procedures, lengthy hospital stays, long courses of IV antibiotics, prolonged immobility, and extended unemployment and disability.

Researchers from the departments of Orthopaedic Surgery, Microbiology/Pathology and Infectious Disease are collaboratively expanding the understanding of prevalent osteoarthritis and staph infections, as well as advanced treatment for these conditions, through in vitro study to replicate relevant cellular interactions and microenvironments in diseased, non-diseased and aging tissue. Previously, model organisms helped researchers gather extensive findings on the processes of skeletal development, homeostasis and degeneration. However, those advancements have been limited by the relative lack of information about how human genetics, injury and disease disturb skeletal cell biology, endogenous repair and regeneration.

With patient permission, bone, cartilage, connective tissue, marrow and synovial fluid that would otherwise be discarded are now collected and distributed to multiple laboratories across campus. (Each specimen includes patient age, gender and orthopaedic diagnosis, yet all personal identifiers are removed.) These specimens support researchers in making intelligent connections between the effects of specific molecular processes and patient observations.

MULTIDISCIPLINARY PROGRESS WITH THE CENTER FOR STAPH RESEARCH

The UNMC Center for Staphylococcal Research (CSR) is the first in the nation dedicated to staphylococcal research and translational treatment strategies. Utilizing a team approach, practitioners and researchers lessen the impact of staphylococcal disease on human health. The CSR is dedicated to further understanding staphylococci (staph) and improving the ability to prevent, diagnose and treat staph-related disease, which is the leading cause of nosocomial and implant-related infections nationwide.

The CSR is a true UNMC collaborative research group. The Department of Orthopaedic Surgery and Rehabilitation’s research at the CSR focuses on the management of musculoskeletal infections caused by emerging multi-resistant strains of bacteria in the surgical setting. Our department is also very fortunate to be working together with researchers from Infectious Disease, as well as basic scientists from Pathology and Internal Medicine who are studying staph infections.

In addition to the pathogenesis of staph infection, there is ongoing collaboration with Dr. Tammy Kielian regarding the eradication of post-arthroplasty Staphylococcus aureus biofilms, as well as Dr. Dong Wang’s project for early detection and intervention of orthopaedic implant loosening using polymer theranostics.
GAINING GROUND
WITH THE NEBRASKA ARTHRITIS OUTCOMES RESEARCH CENTER

Through a collaborative effort between the departments of rheumatology and orthopaedic surgery, researchers at the Nebraska Arthritis Outcomes Research Center (NAORC) are exploring the determinants of poor surgical outcomes among U.S. veterans with arthritis undergoing joint replacement. Results will guide the development of future preventative and operative treatments to improve outcomes for those suffering from arthritis. This information will be a unique resource for researchers and caregivers in Nebraska and elsewhere.

The NAORC was established in 2007 through a generous donation by Ruth and Bill Scott, strong supporters of the Department of Orthopaedic Surgery and Rehabilitation and UNMC.

CADAVER LABS & EDUCATIONAL OPPORTUNITIES

The department holds ongoing cadaver lab research projects and educational sessions. These projects, made possible by generous anatomical donation, allow surgeons to develop, practice and refine leading-edge techniques that benefit living patients without any additional risk.

These dynamic surgical workshops are invaluable to not only our departmental faculty and residents, but often other physicians throughout the region as well. The following list includes lab workshops hosted during the 2012 and 2013 calendar years, and early in 2014:

**2012 LAB WORKSHOPS**

- **January 10, 2012:** Dr. Kevin Garvin, Dr. Brian Vernon, Dr. Brent Hood (Clinical Teaching – Periacetabular Osteotomy)
- **January 18, 2012:** Dr. Thomas Ferlic, Dr. Todd Gaddie (Clinical Teaching – Hand)
- **February 01, 2012:** Dr. Thomas Ferlic, Dr. Todd Gaddie (Clinical Teaching – Hand)
- **February 14, 2012:** Dr. Jeremy Toomey (Clinical Teaching – Ankle)
- **February 28, 2012:** Dr. Kevin Garvin, Dr. Miguel Daccarett (Clinical Teaching – Hip)
- **April 12, 2012:** Dr. Jeremy Toomey (Clinical Teaching – Upper Extremity)

**2013 LAB WORKSHOPS**

- **June 18, 2013:** Dr. Kevin Garvin, Dr. Nolan May (Clinical Teaching – Hip Anterior Approach)

**2014 LAB WORKSHOPS**

- **March 19, 2014:** Dr. Matthew Teusink (Resident Teaching – Rotator Cuff Reconstruction and Elbow Arthroplasty)
- **March 19, 2014:** Dr. Matthew Mormino (Resident Teaching – Compartment Pressure Checks, Leg Compartment Releases)
BREAKTHROUGHS
ON THE
GROWTH CHART
ANNIE LANGE
Paula and David Lange adopted Annie from China in 2008. Their beautiful little girl arrived at age 3 weighing just 16 pounds, with a severe scoliotic curve that would soon require medical attention.

The Langes knew Annie had scoliosis before she arrived in the U.S., yet had been led to believe that it was a congenital form. After spending more than a year doing Internet research on the condition, treatment options and capable surgeons, they brought Annie to Brian Hasley, M.D., at Children’s Hospital & Medical Center, UNMC and Nebraska Medicine’s pediatric hospital partner.

“Scoliosis” is abnormal lateral curvature of the spine. The three-dimensional deformity affects approximately 2 percent of the global population and varies in severity from minor 10-degree curves to those like Annie’s of more than 100 degrees. It can be congenital or caused by a number of conditions such as cerebral palsy, muscular dystrophy, spina bifida or neurological abnormalities, but most cases are “idiopathic,” meaning that their cause is unknown.

Idiopathic scoliosis most commonly presents in late childhood before puberty, and more often in females. Symptoms include uneven shoulders, prominent shoulder blades, elevated hips, uneven waist or tendency to lean to one side. There are several treatment approaches: Many minor cases are simply monitored over time. “Medium-sized curves” between 20 and 45 degrees are braced to prevent progression. Severe curves of more than 50 degrees generally require surgical intervention. Spinal fusion surgery, applying the same principle as one would to heal a bone fracture, is warranted for adolescents; however, cases in younger children are challenging and delicate.

A child’s torso more than doubles in length between birth and adolescence, and lungs continue to develop through age 8. When suffering from scoliosis, growth can accelerate the spine deformity and result in encroachment of vital organs (heart and lungs) – in some instances, causing thoracic insufficiency syndrome. Dr. Hasley explained three main concerns with early onset scoliosis in children under age 5, who still have significant growth remaining: presence and worsening of the deformity itself, continued growth of the spine, and the potential impact on the ribs and organ development.

“Early onset scoliosis is a particular concern, and no two kids are exactly alike,” Dr. Hasley explained. “Our goals with growing rod surgery are to, one, control the deformity; two, allow growth; and three, maintain lung development and long-term heart function.”

At the time, Annie was so tiny and the bend in her upper body was so extreme that she was wearing clothes meant for a 1-year-old, measuring in the zero percentile for weight at her age, and falling frequently, due to lack of balance.
Dr. Hasley knew that she had far too much growth ahead of her, in terms of height and organ development, to allow for immediate spinal fusion. He would need to insert “growing rods,” a titanium splint that internally anchors to the top and bottom of the spine to straighten, strengthen and lengthen it.

Telescopic growing rod surgery advanced in the 1990s, and the technique continues to be refined as understanding of the effects on spinal growth and lung development become clearer. To treat early onset scoliosis, orthopaedic surgeons may attach growing rods or a Vertical Expandable Prosthetic Titanium Rib (VEPTR), which functions the same way by anchoring the spine to the ribs to correct a chest wall deformity and allow thoracic growth. These implants are lengthened in outpatient surgeries approximately every six to eight months. If a child outgrows the initial implants, potentially after two or three years, they may be replaced. Ultimately, the rods are removed and inevitable spinal fusion surgery is performed.

Due to Annie’s low weight and his desire to delay growing rod implantation, Dr. Hasley put her in a cast until she gained some pounds prior to surgery. He and the family collaborated with Children’s Feeding & Growth Clinic to help her develop necessary muscle to protect the implants. She was fed nutrients through nasogastric intubation (an NG tube) for six months to gain weight and finally, in November 2009, Dr. Hasley inserted the growing rods.
At the time of her first surgery, Annie was in just the fourth percentile on the growth chart for children her age. One year and two extension procedures later, she had moved up to the 14th percentile and the numbers continue to increase.

Annie is now a healthy child who loves to run and play with her three older siblings and fellow classmates. Like most pre-teenagers, she is preoccupied with just being “one of the girls.” She adores being a Girl Scout and going to the movies.

“Annie has always had a good attitude,” said her mother, Paula Lange, who has been at Annie’s side through every surgery for five years. “She just wants to fit in... [and she’s] keeping up with the best of them!”

One of the Lange family’s greatest hurdles relates to benchmarking Annie’s growth. Given that she is from southern China, not to mention has scoliosis, her frame is naturally smaller than an average North American child’s, which makes it difficult to plot on a U.S. height and weight chart. Paula and David work closely with Dr. Hasley and the Feeding & Growth Clinic at Children’s Hospital to ensure that Annie’s unique growth rate is reasonable and healthy. Comparing Annie’s size before her first surgery and her stature at age 9, people marvel at how much she has grown.

Around the time that Annie celebrates her 12th birthday, Dr. Hasley expects to remove the growing rods and perform permanent spine fusion surgery.

Long-term clinical outcomes for patients like Annie remain to be seen. Dr. Hasley hopes to follow her and others throughout their lives, whether or not they need ongoing managed care. Because Children’s is closely affiliated with UNMC, he appreciates the valuable opportunity to work with qualified orthopaedic residents who may consult with these young patients once they enter adulthood.
EDUCATION: FUTURE ORTHOPAEDIC SURGEONS IN MOTION
On any given day, 20 residents in the Department of Orthopaedic Surgery and Rehabilitation are actively caring for patients, consulting on diagnoses and treatment plans, assisting in the operating room forwarding important research activities and taking advantage of everything the Omaha medical community has to offer.

The five-year program, directed by Matthew A. Mormino, M.D., professor of orthopaedic surgery at UNMC, includes intensive training in each of the department’s nine subspecialties:

- Foot and Ankle
- Hand and Upper Extremity
- Joint Reconstruction
- Oncology
- Pediatrics
- Shoulder and Elbow
- Spine
- Sports Medicine
- Trauma

The Nebraska Orthopaedic Residency Training Program is affiliated with Nebraska Medicine, Children’s Hospital & Medical Center, Omaha Veterans Affairs Medical Center and Bergan Mercy Medical Center.

Fully accredited by the Residency Review Committee of the Accreditation Council for the Graduate Medical Education (ACGME) and aligned with American Academy of Orthopaedic Surgeons (AAOS) requirements, the curriculum addresses six core competencies:

- Patient care
- Interpersonal and communication skills
- Professionalism
- Medical knowledge
- Systems-based practice
- Practice-based learning and improvement

Sixteen full-time clinical faculty and numerous staff members instruct, evaluate and mentor residents across the UNMC campus. Two full-time research faculty members, lab technicians and a clinical research coordinator assist them with their research projects.

As new clinicians join our department to develop their practices, resident education opportunities continue to grow; and because Nebraska Medicine is a Level I trauma center, orthopaedic residents have unique opportunities as some of the first responders to the emergency room in the event of patient trauma.

In addition, many other Omaha-area orthopaedic surgeons serve as volunteer faculty members, supervising residents’ rotations through a variety of subspecialty private practice environments.

“Omaha is blessed with an incredible medical community and we feel strongly that our residents should have rotations at our hospital, Nebraska Medicine, as well as in private practices,” Dr. Mormino said. “Since many will go on to become private practitioners, it’s important for them to have a feel for that.”
Though there is more than enough happening on the UNMC campus and in the medical community to keep residents occupied, they find time to take advantage of life in this safe, affordable and friendly city.

Located in the country’s “heartland” on the west bank of the Missouri River, Omaha is renowned for excellent healthcare, agriculture, technology and quality of life. The greater metropolitan area is home to nearly 900,000 people and counting. Still, locals and visitors alike appreciate the small-town charm and low-stress atmosphere that distinguishes Omaha from the hectic pace of most major cities.

A wonderful local food scene, thriving arts community and world-class zoo are just a few of the things that make Omaha shine. The University of Nebraska Cornhuskers, NCAA College World Series and Omaha Storm Chasers baseball team all call the area home.

Cultural amenities include the historic Old Market, CenturyLink Center Omaha, public trails and recreation areas, championship golf courses and many other opportunities for family entertainment.

Each year, department residents form flag football and intramural basketball teams, and get together for a Welcome BBQ, infamous Crawfish Boil, Oktoberfest, holiday festivities and more.

Many of our residents go on to build their careers in Nebraska and the Midwest. See Page 46.
Lauren Petit had spent her lunch break walking around the Columban Fathers’ grounds just hours before the temperature dropped, and never imagined that black ice would send her airborne on the way to her car that Friday evening in November 2013. Nonetheless, when she looked down, her foot was lodged under the tire and clearly pointed in the wrong direction. Ill at the sight of her mangled leg and panic-stricken that nobody could hear her cries, she called her husband for help. Soon, a co-worker found her and directed first responders to her location.

Petit was taken by ambulance to the nearest medical facility, where an x-ray clearly indicated spiral fractures of the tibia and fibula (shin and calf bones). Unfortunately, no orthopaedic surgeon was on-call at the time, so she was told she might be sent home for the night. Her husband, a former x-ray technician in the U.S. Air Force, recognized the severity of the injury and insisted that she be transferred elsewhere for surgical attention as soon as possible. The Nebraska Medical Center admitted Petit into the care of Lori K. Reed, M.D.

“Once I got to UNMC, everything fell into place,” Petit said with a sigh of relief. “From the minute I got there, I was amazed at how kind everyone was, from Dr. Reed, to the residents, to the staff. Even the woman who cleaned my room was obviously proud to be a part of the Med Center. It was such a good experience.”

There, a computerized axial tomography (CAT) scan revealed that, in addition to the “tib-fib” fractures, Petit had sustained another tibial fracture extending from the ankle joint.

The chief resident performed an initial reduction to align the tibia and fibula that evening. Dr. Reed operated on Saturday, inserting an intramedullary nail inside the canal to hold the tibia in place and four screws to stabilize the leg.

“I have never seen such exceptional orthopaedic results,” Chris Petit, Lauren’s husband, wrote in a letter to the department. “I have no doubt that [Dr. Reed’s] skills are at the top of her profession. More importantly, she has the one attribute that separates great clinicians from great healers: She listens.”

By Monday, Petit was home. Seven weeks later she was up, moving and eager to resume her routine. Physical therapy several times per week has helped her get back in shape, back to work and back to her therapeutic daily power-walks.
OF THE MANY MEN AND WOMEN THAT COMPLETED THEIR ORTHOPAEDIC SURGICAL TRAINING AT UNMC, MORE THAN HALF NOW PRACTICE HERE IN NEBRASKA OR THE MIDWEST. MANY GO ON TO BECOME EDUCATORS THAT APPLY THEIR OWN TRAINING EXPERIENCES TO TEACH THE NEXT GENERATION OF BRILLIANT PHYSICIANS. DOCTORS THROUGHOUT THE REGION SEEK CONTINUING EDUCATION AT UNMC TO LEARN THE LATEST TECHNIQUES FOR DIAGNOSIS, TREATMENT AND PREVENTION OF MUSCULOSKELETAL CONDITIONS.
## NEBRASKA ORTHOPAEDIC ALUMNI

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 alumni in the U.S., according to the department’s most recent records.

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<thead>
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<th>Name</th>
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*Deceased
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*Deceased
**Unable to contact
ANDREW TAIBER, M.D.
Hometown: Cedar Rapids, IA
College: University of Iowa
Medical School: University of Iowa
Area of clinical/research interest: Hand
Activities/hobbies: Golf, tennis, college sports, grilling, snow skiing, live music

TODD GADDIE, M.D.
Hometown: East Grand Forks, MN
College: University of Minnesota (Undergraduate & Graduate)
Medical School: University of North Dakota School of Medicine and Health Sciences
Area of clinical/research interest: Hand
Activities/hobbies: Fly fishing and fly tying, conventional fishing, lifting weights, running, camping, riding mountain bikes, reading, cooking

GREGORY DAMMANN, M.D.
Hometown: Lena, IL
College: Monmouth College
Medical School: University of Illinois College of Medicine
Area of clinical/research interest: Sports medicine
Activities/hobbies: Golf, traveling, watching my kids’ swim meets

BRENT HOOD, D.O.
Hometown: Fort Collins, CO
College: Union College (Undergraduate); University of Nebraska–Lincoln (Undergraduate)
Medical School: Des Moines University–Osteopathic Medical Center
Area of clinical/research interest: General orthopaedics, including hip and knee arthroplasty, sports medicine, foot and ankle reconstruction
Activities/hobbies: Golfing, cooking, Husker football, spending time with my six children and wife, sound engineer/technician for my local church
PAUL NIELSEN, M.D.
Hometown: Columbia, MO
College: University of Missouri - Columbia
Medical School: University of Missouri - Columbia
Area of clinical/research interest: General orthopaedics, upper extremity surgery
Activities/hobbies: Outdoor activities (camping, fishing, boating, hunting, bicycling), recreational sports (golf, football, basketball, tennis), military history

KAITLIN NEARY, M.D.
Hometown: Tacoma, WA
College: University of Minnesota
Medical School: Creighton University School of Medicine
Area of clinical/research interest: Foot and ankle
Activities/hobbies: Running, soccer, golf, cycling, climbing, hiking, marathons/triathlons, attending sporting events, playing the guitar and violin, cooking

PAUL HONG, M.D.
Hometown: Naperville, IL
College: Northwestern University (Undergraduate), Indiana University (Graduate)
Medical School: University of Illinois - Peoria
Area of clinical/research interest: Spine
Activities/hobbies: Classical and contemporary piano, crawfish boiling, cooking ethnic foods, technology blogs

CLASS OF 2016

CLASS OF 2017

PAUL JOHNSON, M.D.
Hometown: Brookfield, WI
College: Creighton University
Medical School: Medical College of Wisconsin
Area of clinical/research interest: Spine, joints, shoulder/elbow
Activities/hobbies: Cycling, hockey, waterskiing, Alpine and Nordic skiing

ERIC BONNESS, M.D.
Hometown: Omaha, NE
College: University of Nebraska at Lincoln
Medical School: University of Nebraska College of Medicine
Activities/hobbies: Basketball, lifting weights, running, crossword puzzles, snowboarding, hiking, watching NBA/NFL/ NCAA football, spending time with family and friends

COURTNEY GRIMSRUD, M.D.
Hometown: Sisseton, SD
College: South Dakota State University
Medical School: Sanford School of Medicine at the University of South Dakota
Activities/hobbies: Sports (especially basketball and running in half-marathons), spending time outdoors, watching movies, reading, being with family and friends

ANDY KIRKPATRICK, M.D.
Hometown: Appleton, WI
College: University of Wisconsin - Stevens Point
Medical School: Medical College of Wisconsin
Activities/hobbies: Basketball, golf, fishing, hunting, watching football, traveling
LEONID (LENNY) GROSSMAN, M.D.  
**Hometown:** St. Louis, MO  
**College:** Saint Louis University (Undergraduate & Graduate)  
**Medical School:** Creighton University School of Medicine  
**Area of clinical/research interest:** Osteogenesis Imperfecta research  
**Activities/hobbies:** Woodworking, skiing, automotive repair, cooking, spending time with family

BENJAMIN (BEN) OGDEN, M.D.  
**Hometown:** Ogden, UT  
**College:** Weber State University  
**Medical School:** University of Virginia  
**Activities/hobbies:** Running, lifting weights, skiing, cycling, playing piano, artistic illustration

SAYFE JASSIM, M.D.  
**Hometown:** Sioux Falls, SD  
**College:** University of Minnesota  
**Medical School:** Sanford School of Medicine at the University of South Dakota  
**Area of clinical/research interest:** Sports medicine and arthroscopy; shoulder/elbow  
**Activities/hobbies:** Watching and playing sports, concerts, golf, hunting/fishing, running, cars/motorcycles, spending time with family and friends

NOAH PORTER, M.D.  
**Hometown:** Omaha, NE  
**College:** Nebraska Wesleyan University  
**Medical School:** Creighton University School of Medicine  
**Activities/hobbies:** Golf, reading, exercise

**CLASS OF 2018**

TODD GILBERT, M.D.  
**Hometown:** Ogden, UT  
**College:** Weber State University  
**Medical School:** Virginia Commonwealth University  
**Activities/hobbies:** Running, biking, climbing

ERIC BOWMAN, M.D.  
**Hometown:** Memphis, TN  
**College:** University of Tennessee  
**Medical School:** University of Tennessee Health Science Center  
**Activities/hobbies:** Hiking with my dog, snowboarding, camping, all major sports especially college football and baseball, weight lifting, traveling

RYAN MILLER, M.D.  
**Hometown:** Fullerton, CA  
**College:** University of California, Irvine  
**Medical School:** Creighton University Medical Center  
**Activities/hobbies:** Watching and playing sports, hiking, BBQ, cars, time with family

**CLASS OF 2019**

TYLER LARSON, M.D.  
**Hometown:** Rochester, MN  
**College:** University of Minnesota Duluth  
**Medical School:** University of North Dakota  
**Activities/hobbies:** Spending time with my family, weight lifting, running, playing golf, fishing, boating

LEONID (LENNY) GROSSMAN, M.D.  
**Hometown:** St. Louis, MO  
**College:** Saint Louis University (Undergraduate & Graduate)  
**Medical School:** Creighton University School of Medicine  
**Area of clinical/research interest:** Osteogenesis Imperfecta research  
**Activities/hobbies:** Woodworking, skiing, automotive repair, cooking, spending time with family

BENJAMIN (BEN) OGDEN, M.D.  
**Hometown:** Ogden, UT  
**College:** Weber State University  
**Medical School:** University of Virginia  
**Activities/hobbies:** Running, lifting weights, skiing, cycling, playing piano, artistic illustration

SAYFE JASSIM, M.D.  
**Hometown:** Sioux Falls, SD  
**College:** University of Minnesota  
**Medical School:** Sanford School of Medicine at the University of South Dakota  
**Area of clinical/research interest:** Sports medicine and arthroscopy; shoulder/elbow  
**Activities/hobbies:** Watching and playing sports, concerts, golf, hunting/fishing, running, cars/motorcycles, spending time with family and friends

NOAH PORTER, M.D.  
**Hometown:** Omaha, NE  
**College:** Nebraska Wesleyan University  
**Medical School:** Creighton University School of Medicine  
**Activities/hobbies:** Golf, reading, exercise

**CLASS OF 2018**

TODD GILBERT, M.D.  
**Hometown:** Ogden, UT  
**College:** Weber State University  
**Medical School:** Virginia Commonwealth University  
**Activities/hobbies:** Running, biking, climbing

ERIC BOWMAN, M.D.  
**Hometown:** Memphis, TN  
**College:** University of Tennessee  
**Medical School:** University of Tennessee Health Science Center  
**Activities/hobbies:** Hiking with my dog, snowboarding, camping, all major sports especially college football and baseball, weight lifting, traveling

RYAN MILLER, M.D.  
**Hometown:** Fullerton, CA  
**College:** University of California, Irvine  
**Medical School:** Creighton University Medical Center  
**Activities/hobbies:** Watching and playing sports, hiking, BBQ, cars, time with family
RECENT POST-GRADUATE FELLOWSHIPS

After completing their training at UNMC, residents move on to the next stage of medical training. Many opt to continue their education by choosing one of many fellowship opportunities around the country. Our most recent graduates and the fellowships they chose are listed below.

CLASS OF 2013

NOLAN MAY, M.D.
Southern California Orthopedic Institute, Sports Medicine Fellowship, Los Angeles, CA

JEREMY TOOMEY, M.D.
University of Massachusetts Medical Center, Hand & Upper Extremity Surgery Fellowship, Worchester, MA

ANNIE KNIERIM, M.D.
Reno Orthopaedic Clinic, Trauma Fellowship, Reno, NV

ERIC SAMUELSON, M.D.
OrthoCarolina, Shoulder & Elbow/Sports Medicine Fellowship, Charlotte, NC

CLASS OF 2014

KEVIN LINDGREN, M.D.
Adult Reconstruction Fellowship, University of Utah, Salt Lake City, UT

KHALID AZZAM, M.D.
Adult Reconstruction Fellowship, Rush University, Chicago, IL

DAVID MINGES, M.D.
Spine Fellowship, University of Pittsburgh, Pittsburgh, PA
BREAKTHROUGHS
IN THE
DAY-TO-DAY
JOHN LINDLEY
John Lindley is the proud owner of Lindley Clothing, a menswear store in Omaha, Nebraska, and has made a living literally “thinking on his feet” for 16 hours a day. Unfortunately, by age 40, he was suffering from debilitating degenerative arthritis in his left hip and taking up to 1600 milligrams of ibuprofen daily to suppress the pain.

“I work retail. I’ve spent 16 hours a day on my feet, 300 days a year, for 34 years,” Lindley explained. He was young at the time, but he knew a hip replacement was unavoidable. “Dr. Garvin was the only guy that gave me time and eye-to-eye conversation.”

Lindley reached a point where the ache in his groin area was so bad that he could only take half steps. He knew he would need a new hip in order to continue doing what he loves, and despite the stigma that “people don’t usually need hip replacements until they’re 70,” he refused to put it off any longer. In 1999, he interviewed several orthopaedic surgeons and Kevin L. Garvin, M.D., was the only one that seemed to give his discomfort and workload careful consideration.

Dr. Garvin describes that although age is one important criterion for joint replacement, it is not sufficient in isolation; he duly considers any “pain that awakens” his patients, or requires narcotics after failing non-surgical treatments. No matter how young, “if you’re disabled, you’re disabled.”

Highly crosslinked polyethylene is a durable biomaterial alternative to metal-on-metal implants, ceramic-on-ceramic implants or regular (non-radiated) polyethylene implants that are otherwise available. At the time of Lindley’s surgery, many physicians were relying on metal-on-metal articulation, which originally appeared to be extraordinarily durable, yet clinical results have been concerning because of high levels of metal ions and toxicity released into the body as the implants wear over time.

The relative “risk” Dr. Garvin took using a new material was highly calculated and supported by the department’s biomechanics laboratory research. It was a fortuitous choice for Lindley and hundreds of other patients, as proven by clinical outcomes 10-plus years later. Not a single one of Dr. Garvin’s patients in receipt of a highly crosslinked polyethylene implant has required an otherwise relatively common revision procedure for mechanical operation. (See the corresponding research abstract, beginning on Page 90.)

*Figure 1: The projected number of primary total hip arthroplasty (THA) and total knee arthroplasty (TKA) procedures in the United States from 2005 to 2030. (Reproduced, with permission, from Rockwood, Inc.: Projections of Primary and Revision Hip and Knee Arthroplasty in the United States from 2005 to 2030, Steven Kurtz, Ph.D; Kevin Ong, Ph.D; Edmund Lau, MS; Fionna Mowat, Ph.D; Michael Halpern, MPH, MD, PhD; J Bone Joint Surg Am, 2007 Apr;89(4):780-785.)
X-ray of arthritic hips prior to the initial THA

X-ray of fully stabilized highly crosslinked polyethylene hip implants
Five years after his first surgery, Lindley returned to Dr. Garvin for THA of his right hip. Both he and Dr. Garvin had known that it was only a matter of time before the excruciating arthritis caught up with his right side as well, but wanted to delay the replacement as long as possible.

In 2004, Lindley returned to the showroom floor with two virtually indestructible hips and now, more than 15 years after the first THA, Lindley’s hips are wearing just as they should be: not at all.

"Since then, I’ve had absolutely no pain," Lindley said. He visited Dr. Garvin for a follow-up x-ray early in 2014. "My hips have not moved. They are perfect," he said.

At age 55, “I’m still on my feet 16 hours a day,” Lindley continued. “I do weights twice a week; I bike twice a week; I’m physically active as can be. My hips [function at] 110 percent.”

“Our goal when replacing joints is to allow patients to function at such a high level that they are unrestricted by the surgery,” Dr. Garvin explained of the department’s aspirations. Proof of success, Lindley and fellow THA patients report satisfaction rates in the 90s.

On average, the department’s THA patients report post-operative satisfaction upwards of 90 percent, where 100 percent is the usual, active and pain-free lifestyle to which one had previously been accustomed. Considering patients like Lindley who have decades of life ahead of them, that corresponding rate of quality adjusted life years (QALY) is outstanding. The QALY method is the international standard for comparing clinical effectiveness of health care procedures, treatments and medications. TJA ranks very well because the cost is relatively low, the operation is a one-time investment, complications are few, and most importantly, the vast majority of patients can quickly return to their previous level of function. TJA has been consistently regarded as one of the great contributions to health care in the last century.
COMMUNITY:

ADVANCEMENTS IN MOTION
VISITING SPEAKERS

The Department of Orthopaedic Surgery and Rehabilitation hosts speakers from around the region, country and world to engage faculty, residents, staff and peers. By sharing their knowledge and expertise in a variety of disciplines, these visitors enhance the lifelong educational experience fostered by UNMC and the department.

Contributions to the department’s Development Fund from alumni and supporters allow us to continue bringing guest speakers that enrich our understanding of patient care, surgical techniques, contemporary research and other topics.

The following list includes those who presented to the department during the 2012 and 2013 calendar years:

<table>
<thead>
<tr>
<th>FEBRUARY 2012</th>
<th>APRIL 2012</th>
<th>JUNE 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>29 Aaron Jacobsen</td>
<td>Dr. Mark Puccioni</td>
<td>15-16 GRADUATION CEREMONIES</td>
</tr>
<tr>
<td>Hanger Prosthetics and Orthotics, Omaha, NE</td>
<td>Midwest Neurosurgery &amp; Spine Specialists, Omaha, NE</td>
<td>15 Dr. James Kang</td>
</tr>
<tr>
<td>“Lower Extremity Prosthetics”</td>
<td>“Neurosurgical Issues in the Pediatric Spine”</td>
<td>Vice Chairman, Department of Orthopaedic Surgery; Director, Ferguson Laboratory for Spine Research, University of Pittsburgh Medical Center, Pittsburgh, PA</td>
</tr>
<tr>
<td>MARCH 2012</td>
<td>25 Dr. Adam Reinhardt</td>
<td>“Novel Advances in Biological Therapies for Disc Degeneration: A Surgeon-Scientist Perspective”</td>
</tr>
<tr>
<td>12 Dr. Karl Bergmann</td>
<td>Children’s Specialty Physicians, Omaha, NE</td>
<td>Harold Andersen</td>
</tr>
<tr>
<td>Assistant Professor, Creighton University Medical Center, Omaha, NE</td>
<td>“Pediatric Rheumatology”</td>
<td>Former Publisher of the Omaha World-Herald; Past President of the American Newspaper Publishers Association, Omaha, NE</td>
</tr>
<tr>
<td>“Patella Fractures”</td>
<td>30 Dr. Michael Gross</td>
<td>“Beyond the Scalpel”</td>
</tr>
<tr>
<td>19 Dr. Ryan Arnold</td>
<td>GIKK Ortho Specialists, Omaha, NE</td>
<td>16 Dr. Mark Rupp</td>
</tr>
<tr>
<td>OrthoWest, Omaha, NE</td>
<td>“Medical Missionary Work”</td>
<td>Professor, UNMC Infectious Disease, Omaha, NE</td>
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<tr>
<td>“Osteochondritis Dissecans”</td>
<td>MAY 2012</td>
<td>“Prevention of Surgical Site Infection in Spine Surgery”</td>
</tr>
<tr>
<td>10 Dr. William Hennrikus</td>
<td>Dr. William Hennrikus</td>
<td>Dr. James Kang</td>
</tr>
<tr>
<td>Professor, Pediatric Orthopaedic Surgery &amp; Sports Medicine, Penn State Hershey Bone and Joint Institute, Hershey, PA</td>
<td>Professor, UNMC Internal Medicine, Omaha, NE</td>
<td>Vice Chairman, Department of Orthopaedic Surgery; Director, Ferguson Laboratory for Spine Research, University of Pittsburgh Medical Center, Pittsburgh, PA</td>
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<tr>
<td>JULY 2012</td>
<td>DECEMBER 2012</td>
<td>MARCH 2013</td>
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<tr>
<td>20 Dr. Jonathan Buzzell</td>
<td>3 Dr. Kenneth Bayles</td>
<td>4 Dr. Ted Mikuls</td>
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<tr>
<td>OrthoWest, Omaha, NE</td>
<td>Professor, UNMC Pathology/</td>
<td>Professor, UNMC Department</td>
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<tr>
<td>“Shoulder Arthroplasty”</td>
<td>Microbiology, Omaha, NE</td>
<td>of Internal Medicine, Section</td>
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<tr>
<td>30 Sandi Anderson</td>
<td>“Biofilm and Biofilm-Related”</td>
<td>of Rheumatology, Omaha, NE</td>
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<tr>
<td>UNMC Physicians, Omaha, NE</td>
<td>Infections”</td>
<td>“What’s New in Rheumatoid</td>
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<tr>
<td>“Billing and Documentation</td>
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<td>Arthritis”</td>
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<tr>
<td>Compliance”</td>
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<tr>
<td>SEPTEMBER 2012</td>
<td>10 Don Rock</td>
<td>20 Aaron Jacobsen</td>
</tr>
<tr>
<td>17 Dr. Jane Meza</td>
<td>Attorney at Law, Omaha, NE</td>
<td>Orthotist, Hanger Prosthetics</td>
</tr>
<tr>
<td>Professor, UNMC Biostatistics</td>
<td>“Medicolegal Issues in</td>
<td>and Orthotics, Inc., Omaha, NE</td>
</tr>
<tr>
<td>College of Public Health, Omaha, NE</td>
<td>Orthopaedics”</td>
<td>“Lower Extremity Orthotics”</td>
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<tr>
<td>“Statistics in Orthopedic Papers”</td>
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<tr>
<td>OCTOBER 2012</td>
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<tr>
<td>22 Rusty McKune, P.T.</td>
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<tr>
<td>Sports Medicine Program</td>
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<tr>
<td>Coordinator, The Nebraska</td>
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<tr>
<td>Medical Center, Omaha, NE</td>
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<tr>
<td>“Rehabilitation Following</td>
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<tr>
<td>Knee Injuries”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26 RESIDENT RESEARCH</td>
<td>21 Dr. Kimberly Apker</td>
<td></td>
</tr>
<tr>
<td>SYMPOSIUM</td>
<td>Associate Professor, UNMC</td>
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</tr>
<tr>
<td>Dr. Wayne Proprosky</td>
<td>Department of Radiology</td>
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<tr>
<td>Professor, Rush University</td>
<td>“MRI of the Elbow”</td>
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<tr>
<td>Medical Center, Chicago, IL</td>
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<td>“Revision THA: How Far Have</td>
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<tr>
<td>We Come?”</td>
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<tr>
<td>29 Dr. Justin Siebler</td>
<td>28 Dr. Don Coulter</td>
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<tr>
<td>Assistant Professor, Orthopaedic</td>
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<tr>
<td>Surgery, Creighton University</td>
<td>Department of Pediatrics, Section of Hematology/Oncology, Omaha, NE</td>
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<tr>
<td>Medical Center, Omaha, NE</td>
<td>“Adjunct Therapy in Bone Tumors”</td>
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<tr>
<td>“Femoral Shaft Fractures”</td>
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<tr>
<td>NOVEMBER 2012</td>
<td>11 Dr. Angela Hewlett</td>
<td>10 Chris Fugman &amp; Joe Cuda</td>
</tr>
<tr>
<td></td>
<td>Assistant Professor, UNMC</td>
<td>Northwestern Mutual, Glendale, WI</td>
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<tr>
<td></td>
<td>Infectious Disease, Omaha, NE</td>
<td>“Financial Planning, Debt, and</td>
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<td>“Antibiotic Resistance in</td>
<td>Disability Insurance”</td>
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<td></td>
<td>Staphylococcal Infections”</td>
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<td>13 Dr. Philipp Streubel</td>
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<tr>
<td></td>
<td></td>
<td>Assistant Professor, Mayo Clinic, Rochester, MN</td>
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<tr>
<td></td>
<td></td>
<td>“Proximal Humerus Fractures”</td>
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<tr>
<td></td>
<td>25 Dr. Karl Bergmann</td>
<td>22 Eric Rose</td>
</tr>
<tr>
<td></td>
<td>Assistant Professor, Department of Surgery, Section of Orthopaedic Surgery, Creighton University Medical Center, Omaha, NE</td>
<td>Director, HCA Physician Services, Mountain Division (Arranged by OREF/HCA.)</td>
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<tr>
<td></td>
<td>“Scapula Fractures”</td>
<td>“Finding the Right Practice”</td>
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<tr>
<td></td>
<td></td>
<td>(Focusing on Practice Types, Employment Contracts, Negotiation Strategies, and Legal/ Financial Considerations)</td>
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### JUNE 2013

<table>
<thead>
<tr>
<th>Date</th>
<th>Lecture Title</th>
<th>Speaker</th>
<th>Institution/Location</th>
<th>Presentation Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>17</td>
<td><strong>AUSTRIA, SWITZERLAND &amp; GERMANY (ASG) TRAVELING FELLOWS LECTURES</strong></td>
<td>Dr. Andreas Niemeier</td>
<td>University Medical Center Hamburg-Eppendorf, Hamburg, Germany</td>
<td>“Bone Preserving Implants in Shoulder Arthroplasty”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dr. Tobias Renkawitz</td>
<td>Regensburg University Medical Center, Bad Abbach, Germany</td>
<td>“Computer-Assisted Total Joint Replacement”</td>
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<td></td>
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<td>Dr. Rainer Biederman</td>
<td>Medical University of Innsbruck, Innsbruck, Austria</td>
<td>“Cost Effectiveness of Universal Ultrasound Screening for Developmental Dysplasia of the Hip”</td>
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<tr>
<td></td>
<td></td>
<td>Dr. Fabian von Knoch</td>
<td>Schulthess Clinic Zurich, Switzerland</td>
<td>“Combined Unicompartmental Knee Arthroplasty and High Tibial Osteotomy”</td>
</tr>
<tr>
<td>22</td>
<td><strong>GRADUATION CEREMONIES</strong></td>
<td>Dr. Bernard Morrey</td>
<td>Professor of Orthopedics at the Mayo Clinic and the University of Texas Health Science Center in San Antonio, San Antonio, TX</td>
<td>“Total Elbow Arthroplasty – It Isn’t Rocket Science”</td>
</tr>
<tr>
<td>21</td>
<td></td>
<td>Dr. Bernard Morrey</td>
<td>Associate Professor, Department of Orthopaedic Surgery, Dartmouth-Hitchcock Medical Center, Lebanon, NJ</td>
<td>“Carpal Instability-What Every Orthopaedic Resident Needs to Know”</td>
</tr>
<tr>
<td>24</td>
<td></td>
<td>Dr. Lance Warhold</td>
<td></td>
<td>“Regional Blocks for Upper and Lower Extremity Surgery: What the Literature Says”</td>
</tr>
</tbody>
</table>

### AUGUST 2013

<table>
<thead>
<tr>
<th>Date</th>
<th>Lecture Title</th>
<th>Speaker</th>
<th>Institution/Location</th>
<th>Presentation Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td></td>
<td>Rhonda S. Frans, CPC, CEMC</td>
<td>Compliance Auditor, UNMC Physicians, Omaha, NE</td>
<td>“Documentation and Billing Compliance”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dr. Andrew Dudley</td>
<td>Associate Professor, UNMC Genetics, Cell Biology &amp; Anatomy,</td>
<td>“Concussions”</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dr. Ivan Tarkin</td>
<td>University of Pittsburg, Pittsburgh, PA</td>
<td>“Innovations in Pelvic Trauma Reconstruction”</td>
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<tr>
<td></td>
<td></td>
<td>Dr. Jennifer Ahlers</td>
<td>Assistant Professor, UNMC Department of Anesthesiology, Omaha, NE</td>
<td>“Roles of Statewide Trauma System in the Management of the Polytrauma Patient”</td>
</tr>
</tbody>
</table>
The department’s mission hinges upon effective integration of scientific research, medical education and patient care. Grants, funds and endowments are essential to our ongoing success with linking these three functions to achieve Breakthroughs in Motion.

**RESEARCH GRANTS**

Just as the Nebraska Orthopaedic Residency Training Program has a strong reputation for preparing exceptional orthopaedic surgeons, our research program has earned national and international attention. Departmental faculty members conduct research in basic science, biomedical engineering, computer simulation and nano-biotechnology, in addition to clinical outcomes. By combining resources and insights, we continue to be able to offer the most advanced diagnoses and surgical treatments for our patients.

The following list includes the names, sources and funding of grants received by the Department of Orthopaedic Surgery and Rehabilitation during the 2012 and 2013 calendar years, and in early 2014:

<table>
<thead>
<tr>
<th>FEDERAL:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2013</strong></td>
</tr>
<tr>
<td><em>Early Detection and Intervention of Orthopaedic Implant Loosening using Polymer Theranostics</em> $1,379,231</td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>INDUSTRY:</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>2012</strong></td>
</tr>
<tr>
<td><em>Ortho Development – Pin-on-Disk Screening Wear Test of Four Types of UHMWPE</em> $15,000</td>
</tr>
<tr>
<td><em>Ortho Development – Wear Testing of 2 Types of UHMWPE Using Force-controlled Knee Simulators per ISO 14243-1</em> $110,000</td>
</tr>
<tr>
<td><em>Arthrex – A Battery of Tests to Characterize the Arthrex TKR System – Contact Area &amp; Stress, Constraint and Range of Motion, and Modular Interlock Strength</em> $100,000</td>
</tr>
<tr>
<td><em>Arthrex – Wear Tests for the Arthrex CR, CR-CS and PS THR Components</em> $180,000</td>
</tr>
</tbody>
</table>

| **2013** |
| *U of Toyko – In Vitro Wear Evaluation of Total Knee Replacement Systems with MPC Coated Polyethylene* $100,000 |

| **2014** |
| *Biomet – Structural Integrity and Overall Survivability Testing of a Novel Hinged Total Knee Replacement System by Biomet* $69,999 |
| *Arthrex – A Prolonged Simulator Wear Study of Metallic-on-plastic Total Hip Replacement Systems from Arthrex* $59,999 |
| *Arthrex – A Prolonged Simulator Wear Study of Metallic-on-plastic Total Hip Replacement Systems under Abrasive Conditions* $129,999 |
| *Exponent – An In Vitro Wear Durability Study of the Stelkast Knee Systems, Comparing Two Bearing Material Types under Abrasive Conditions* $34,999 |
| *Arthrex – A Knee Simulator Wear Study of an Arthrex PS TKR Design Comparing Two Bearing Materials* $119,999 |

<table>
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<tr>
<th>OTHER:</th>
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</thead>
<tbody>
<tr>
<td><strong>2012</strong></td>
</tr>
<tr>
<td><em>Tohoku University – Wear Characterization of Metal-on-metal Total Hip Replacement Components with Differing Carbon Content</em> $84,000</td>
</tr>
</tbody>
</table>

| **2014** |
| *TRAK Surgical – Work Order No. 1* $218,000 |
ENDOWMENTS & DONATIONS

Endowments provide much-needed perpetual resources for a variety of departmental education and research activities. When an individual establishes an endowed fund through the University of Nebraska Foundation to benefit the Department of Orthopaedic Surgery and Rehabilitation, the principal of the fund is invested and a portion of the earnings support assistantships, resident education, equipment and technology purchases, library resources, research project seed money, faculty chairmanships and much more, depending upon the donors’ interests.

The department also maintains several non-endowed funds at the University of Nebraska Foundation. Our Development Fund is an unrestricted resource that is neither large nor endowed, yet provides valuable, flexible resources to make various resident- and faculty-related projects possible. This fund is used primarily for resident activities, including supporting those who present research at national meetings, bringing in visiting speakers and making graduation a memorable celebration. Some other funds have been established for specific applications.

The following is a list of currently active endowed and non-endowed funds that have been established or pledged to the department since its inception:

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

Bill and Ruth Scott, The Nebraska Arthritis Outcomes Research Center (NAORC)
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 Jardon Endowment Fund
Resident’s library and teaching resources

Robert C. Hendler, 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
Osteoporosis research support

Orthopaedic Oncology Research Development Fund
Oncology research support

Christina M. Hixson Endowment
Sub-fund 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
Research, education and clinic activities

John F. Connolly Resident Excellence Fund
Resident fund

Orthopaedics Research and Education Fund
Benefit and support of faculty and resident research and education

UNMC Orthopaedics Excellence Fund
Equipment and other capital needs

Operation Walk Nebraska Fund
Faculty outreach activities

James R. Neff Research Fund
Benefit and support of research

Tom and Maren Hood Fund for Orthopaedic Surgery
Benefit and support the Department Chair

Harold and Marian Andersen Lectureship for Orthopaedic Surgery
Establishment of annual lectureship to support non-orthopaedic graduation speaker

Robert G. Volz, M.D., Chair of Biomechanics
Establishment of the Robert G. Volz, M.D., Chair of Biomechanics

Orthopaedic Surgery Department Development Fund

Orthopaedic Surgery Resident Support Fund
Benefit and support of residents

Total Endowments/Donations:
GREATER THAN $17,000,000

Please note that those who contributed to the Development Fund between January 2012 and December 2013 are included in the Honor Roll of Contributors, listed on Page 62.
HONOR ROLL OF CONTRIBUTORS

2012 - 2013

Private contributions make a significant difference in the day-to-day educational opportunities, cutting-edge laboratory research, and life-altering patient treatment proudly provided by the Department of Orthopaedic Surgery and Rehabilitation. Generous gifts from alumni, friends, foundations, corporations and faculty support various departmental programs that may not otherwise be possible.

Some choose to contribute to our department-wide Development Fund, which is primarily dedicated to resident education, while others specify their gifts be applied to scholarships, research, library resources, laboratory equipment or other resources.

This honor roll alphabetically lists the names of individuals and organizations that supported the department during the 2012 and 2013 calendar years. Those who have made donations in 2014 will be recognized in the next biennial report and in issues of our department newsletter, Breaking News.

$100,000 AND UP
Harold and Marian Andersen
Ms. Christina M. Hixson
Mrs. L. Thomas Hood
Lied Foundation Trust
Dr. Robert and Anne Volz

$10,000 AND UP
Dr. Chris Cornett
Dr. Miguel Daccarett
Dr. Mark Dietrich
Dr. and Mrs. Paul J. Duwelius
Dr. Paul Esposito
Dr. Kevin Garvin
Dr. and Mrs. Roy J. Guse
Dr. Curtis Hartman
Dr. Brian Hasley
Thomas R. and Maren Hood
Dr. M. Layne Jenson
Dr. Beau Konigsberg
Dr. Sean McGarry
Dr. Matthew Mormino
Dr. Lori Reed
Wayne L. Ryan, Ph.D.
Dr. Susan Scherl

$5,000 – 9,999
Bryan D. Breidhauer, M.D., and Ms. Gertrude A. Breidhauer
Bryan D. Breidhauer, M.D., P.C.

$1,000 – 4,999
Dr. and Mrs. Kirk D. Green
Dr. and Mrs. R. Michael Mendlick
Dr. and Mrs. Jeffrey S. Moore

OSS Health
Dr. David A. and DuAnn Peterson
Dr. James and Joanne Scott-Miller
Dr. and Mrs. Michael J. Sicuranza
Dr. and Mrs. Samuel E. Smith
Dr. Robert J. Tait
Robert J. Tait, M.D., P.C.
Dr. Matthew Teusink
Dr. Jeffrey and Nancy Tiedeman

$0 – 999
Dr. and Mrs. Jeffrey M. Farber
Dr. and Mrs. Timothy C. Fitzgibbons
Ms. Kristine Gottula
Ms. Annie Knierim
Jean A. Lewandowski, Ed.D.
Orthopaedic and Spine Specialists, P.C.

The Department of Orthopaedic Surgery and Rehabilitation’s faculty, residents and staff sincerely thank you for your generosity and support.

If you have a question or concern related to this Honor Roll of Contributors, please contact the University of Nebraska Foundation’s Omaha office, located at 2285 South 67th Street, Suite 200, Omaha, NE 68106, or call 402-502-0300.
The Department of Orthopaedic Surgery and Rehabilitation’s Wall of Honor permanently recognizes the remarkable individuals and organizations whose generosity has benefited departmental research, education and patient care.

The Wall of Honor was installed in 2003. A series of brushed metal plaques feature the names and etched portraits of donors who have given $100,000 or more in support of the department’s mission. A brief history of Nebraska’s orthopaedic program, rooted in the art and science of the field, appears in the plaque’s center.

French physician and professor Nicholas de Bois Andry introduced the term “orthopaedics” in a 1741 text, along with an illustration of a crooked tree anchored to a straight stake. This image became a universal symbol for orthopaedics and an important element of the department’s identity.

In Nebraska, Dr. H. Winnette Orr (1877-1956) and Dr. Robert Schrock (1884-1960) were pioneers in the field. Leading innovators for the treatment of musculoskeletal disorders in children and adults, they were also early presidents of the American Orthopaedic Association (1937) and American Academy of Orthopaedic Surgeons (1941), respectively.

Contemporary Omaha surgeons established the University of Nebraska orthopaedic resident education program in 1968. Today, the department continues to thrive and reach new milestones of outstanding medical education, scientific exploration and humanitarian care.

HONORED ARE THOSE WHOSE GENEROSITY HAS BENEFITED THE DEPARTMENT OF ORTHOPAEDIC SURGERY AND REHABILITATION
HIXSON SUPPORTS ONGOING RESEARCH AND EDUCATION WITH ENDOWED FUND

Christina M. Hixson has generously supported more than a decade of breakthroughs in research and education at the UNMC Department of Orthopaedic Surgery and Rehabilitation – and ensured that more world-class advancements will be achieved here in the future.

The Christina M. Hixson Endowed Research Fund for Orthopaedic Surgery and Rehabilitation was established at the University of Nebraska Foundation in 2001, through the Lied Foundation Trust. The fund is a permanent endowment to support various innovative research projects with a portion of its annual earnings. Resulting studies have generated great interest in, and additional funding for, the department’s biomechanics laboratory. In December 2012, Hixson made another substantial gift for ongoing research and orthopaedic resident education.

“The department would not be where it is today without the philanthropic vision of remarkable foundations and trustees like Christina M. Hixson,” said Kevin L. Garvin, M.D., who first met Hixson as an arthritis patient, more than 13 years ago.

Hixson moved to Omaha at age 17, and soon began working for Ernst Lied. Over the next 40 years, her responsibilities and his entrepreneurial interests grew; though business took Lied to Las Vegas, Nevada, he always considered Nebraska “home.” When he died in 1980, Hixson was named the sole trustee of the Lied Foundation Trust.

In a video produced by the University of Nebraska Foundation in 2012, Hixson discussed her role with the trust, which has now funded more than $300 million in charitable projects: “When [Mr. Lied] passed away, we didn’t have any money; we had all this land. I must have had an angel on my shoulder because I sold that land and invested in people. … You can’t forget, this is really Lied who gave everything he had to the general public.”

“[Ms. Hixson] has created a far-reaching legacy, well beyond the orthopaedic department, the University of Nebraska and even the state of Nebraska,” Dr. Garvin said. “We cannot thank her enough for her support.”

HAROLD AND MARIAN ANDERSEN LECTURESHP FOR ORTHOPAEDIC SURGERY

Harold and Marian Andersen have been long-time supporters of the Department of Orthopaedic Surgery and Rehabilitation and the University of Nebraska, as alumni, patients and donors. In 2012, the generous couple funded a lectureship to focus on “non-scientific issues that enhance the education, diverse interests and community involvement of faculty and residents.”

The first annual Harold and Marian Andersen Lecture was given at the 2012 graduation ceremony by the witty Mr. Harold Andersen, himself – a former publisher of the Omaha World-Herald. Retired NASA Astronaut Clayton C. Anderson followed suit in 2013, inspiring broad interests and enriching experiences through a memorable lecture about “The Dream of a Lifetime.”

ROBERT G. VOLZ, M.D., CHAIR OF BIOMECHANICS

Robert G. Volz, M.D., is a UNMC College of Medicine alum, distinguished orthopaedic surgeon and benevolent friend of the Department of Orthopaedic Surgery and Rehabilitation. Dr. Volz earned his degree from UNMC in 1957, and formed a lasting friendship – rooted in passion for advancing the field of orthopaedic surgery – with the late Dr. James Neff, who served as department chair from 1991 to 2000.

In 2012, Dr. Volz made a future gift to the department for a new Chair of Biomechanics, including an annual salary and stipend to support scholarly research and creative activities, to be funded through his estate. He previously created the Robert G. Volz, M.D., Research Fund, which generates annual support for educational and research-focused initiatives that enhance the orthopaedic residency program.
Makenna Placzek could hardly dream of going a day without dancing. During her junior year of high school, a crippling stress fracture associated with a calcaneal (heel bone) cyst gave her a terrible scare.

Most bone cysts, like Makenna’s, are discovered incidentally because the neoformations expand and weaken the bone, making it susceptible to fractures that warrant an x-ray or MRI. They occur in approximately 1.5 per million people, usually in the second decade of life.

When Makenna badly twisted her ankle for a second time in December 2012, her doctor in Grand Island, Nebraska, discovered a cyst “the size of an egg” in her calcaneus. He explained the possibility that it was malignant (cancerous), but was unable to offer her family any more information and suggested they see a specialist. Upon returning to Omaha after a much-anticipated performance at a college bowl game, Makenna went straight to see Sean McGarry, M.D., at UNMC.

Dr. McGarry articulated a short list of possible, likely benign, diagnoses that would require surgery once the pathologic stress fracture had time to heal. In February 2013, he took Makenna to the operating room for a biopsy and, because he and the pathologist were able to confirm that the active aneurysmal cyst was non-cancerous, he removed it immediately.

Dr. McGarry performed a curettage to exteriorize the tumor and scrape it out, used a high-speed burr to take another few layers of bone and prevent regrowth, applied Argon plasma coagulation to cauterize the area, and finished with allograft (cadaver bone graft). He performs approximately 20 to 30 curettage and bone grafting procedures each year on different parts of the body. Due to the varying nature of orthopaedic oncology cases, acquisition of substantial clinical outcomes data is more challenging and time-consuming than it is for anatomical specialties. Thus, Dr. McGarry is in conversations with physicians at peer institutions about developing a formalized data consortium.

Makenna went home on crutches the day of surgery and was able to put weight on her foot 10 weeks later. Together, she and Dr. McGarry succeeded in meeting her goal to reach full activity by the time of dance camp that summer.

“Dancing is my life’s passion and it’s all I’ve ever known,” Makenna Placzek said in a heartfelt note to Dr. McGarry. “You gave me my senior year back.”

In all, Makenna missed roughly seven months of dance, but is building up her strength and joined the dance team at the University of Nebraska–Omaha in 2014. Inspired by her own experiences with post-operative physical therapy, she plans to pursue a career in exercise science.
KEVIN L. GARVIN, M.D., CHAIRMAN
ADULT RECONSTRUCTIVE SURGERY

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 medical degree at the Medical College of Wisconsin in 1982. He completed an orthopaedic surgery residency program at the University of Arkansas for Medical Sciences in Little Rock (1987) and a fellowship in hip surgery at the Hospital for Special Surgery in New York City (1988). He is a board-certified orthopaedic surgeon.


Dr. Garvin has served as associate editor for the Journal of Bone and Joint Surgery, as well as deputy editor for Clinical Orthopaedics and Related Research, and continues to serve as a consultant reviewer for both publications. He has been selected as one of the Best Doctors in America from 1996-2014 and one of America’s TopDoctors by Castle Connolly Medical, Ltd., from 2007-2014.

Current Research Grants:


Refereed Articles:


Book Chapters & Reviews:


CHRIS A. CORNETT, M.D.

ADULT SPINE SURGERY

Chris A. Cornett, M.D., is an assistant professor in the Department of Orthopaedic Surgery and Rehabilitation, and medical director of Physical and Occupational Therapy at Nebraska Medicine – Nebraska Medical Center and Bellevue. Dr. Cornett received his master’s degree in physical therapy (2001) and medical degree (2005) from the University of Nebraska Medical Center. He completed both an orthopaedic surgery internship and orthopaedic surgery residency at the University of Wisconsin Hospital and Clinics in Madison, WI, in 2006 and 2010, respectively. Following residency, Dr. Cornett completed a spine surgery fellowship at the University of Pittsburgh Medical Center in 2011. He is a member of the American Academy of Orthopaedic Surgeons, the North American Spine Society, the Nebraska Orthopedic Society, and the Metro Omaha Medical Society (MOMS). He also serves on the Physician Advisory Team and is the OneChart Department Deputy for Orthopaedics at Nebraska Medicine. Dr. Cornett is a board-certified orthopaedic surgeon.

Refereed Articles:


Book Chapters & Reviews:


Honors, Awards & Offices Held:

Medical Director of Physical and Occupational Therapy, The Nebraska Medical Center and Bellevue Medical Center, Omaha, NE, 2014-present.
Department Deputy for Orthopaedics, OneChart, 2013-present.
Member, Physician Advisory Team Committee, The Nebraska Medical Center, 2013-present.
MIGUEL S. DACCARETT, M.D.
SPORTS MEDICINE AND ORTHOPAEDIC TRAUMATOLOGY

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 conjunction with his last year of medical school, Dr. Daccarett 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 board certified in orthopaedic surgery. Dr. Daccarett is a member of the American Orthopaedic Society for Sports Medicine (AOSSM) and the Orthopaedic Trauma Association (OTA), and faculty member of AO North America (AONA). He is also a member of the Colombian Society of Orthopedic Surgery, the International Society of Arthroscopy, Knee Surgery and Orthopaedic Sports Medicine (ISAKOS), and the Nebraska Orthopedic Society.

Refereed Articles:


Honors, Awards & Offices Held:

Review Panel Member, Orthopedics, 2013-present.
Faculty Diversity Award: $50,000, University of Nebraska Academic Affairs, Omaha, NE, July 2012-June 2014.

MARK E. DIETRICH, M.D.
SPORTS MEDICINE AND ARTHROSCOPIC SURGERY

Mark E. Dietrich, M.D., is an assistant professor in the Department of Orthopaedic Surgery and Rehabilitation. He received his law degree from the University of Nebraska College of Law in 1994, and his medical degree from the University of Nebraska College of Medicine in 2001. Dr. Dietrich completed a five-year residency program at the University of Nebraska/Creighton University Health Foundation in 2006, followed by an orthopaedic sports medicine fellowship at Minnesota Sports Medicine in Minneapolis in 2007. He is a board-certified orthopaedic surgeon. He is a member of the American Academy of Orthopaedic Surgeons, American Orthopaedic Society for Sports Medicine, Nebraska Orthopaedic Society and Nebraska State Bar Association.

Honors, Awards & Offices Held:

Co-medical Director and Medical Provider, 2013 NORCECA Continental Volleyball Championships, Ralston, NE, September 16-21, 2013.
5 Years of Service, UNMC, April 2013.

Co-medical Director, U.S. Figure Skating Championships, January 20-27, 2013.
Event Physician, 2012 U.S. Olympic Swimming Trials, Omaha, NE, June 2012.

Surgical Services Executive Committee Member, The Nebraska Medical Center, 2011-present.
Sideline Physician for area high school sports teams, 2012-present.
PAUL W. ESPOSITO, M.D.

PEDIATRIC ORTHOPAEDIC SURGERY

Paul W. Esposito, M.D., is a professor of Orthopaedic Surgery and Pediatrics at the University of Nebraska College of Medicine, and clinical service chief of Orthopaedics at Children's Hospital & Medical Center. He received his medical degree from Hahnemann Medical College and Hospital in 1977. He completed his internship and residency in orthopaedic surgery at the U.S. Naval Hospital in Oakland, California (1978 and 1983, respectively), and a pediatric orthopaedic fellowship at Children's Hospital Medical Center in Cincinnati in 1984. Dr. Esposito is a board-certified orthopaedic surgeon. He is a member of the Pediatric Orthopaedic Society of North America, and a fellow of the American Academy of Orthopaedic Surgeons and the American Academy of Pediatrics (AAP). He is a member of the Section on Orthopaedics of the AAP (and past member of the executive committee of this section), and is also active in the Section on Sports Medicine. Dr. Esposito is a reviewer for PEDIATRICS and the Journal of Pediatric Orthopaedics. He is on the advisory board of directors at Children's Hospital & Medical Center, and served as president of the medical staff (2008-2010). He is a member of the medical advisory board of the Osteogenesis Imperfecta Foundation. He has published multiple book chapters on osteogenesis imperfecta (OI) and made numerous presentations in the last two years regarding the treatment of OI. Dr. Esposito was once again selected as one of Best Doctors in America in 2012-2014, an honor he has received since 1998.

Current Research Grants:


Refereed Articles:

- Jacobs, J; King, T; Klippel, J; Berven, S; Burri, D; Caskey, P; Elderkin, P; Esposito, P; et al.: Beyond the Decade: Strategic Priorities to Reduce the Burden of Musculoskeletal Disease. The Journal of Bone and Joint Surgery, 95(17): e125(1-6), September 4, 2013.

Book Chapters & Reviews:


Honors, Awards & Offices Held:

- One World Health Center
  - Executive Committee, March 2013-March 2014
  - Board Chairperson and Executive Committee Chair, March 2011-March 2013
  - Board of Directors, March 2008-present
  - U.S. Bone and Joint Initiative
  - Chairman, Pediatric Specialty Group, 2013-present
  - Liaison representative of the American Academy of Pediatrics, 2009-November 2013
  - Co-chairman of the Pediatric Strategic Planning Group, 2009-2010
  - Board of Directors, Physician Director, Children’s Specialty Physicians, February 2012-2015
  - 25 Years of Service, UNMC, July 2012.
  - Special Achievement: Alpha Omega Alpha (AOA) & Faculty Honors Convocation, UNMC, Omaha, NE, March 22, 2012

Osteogenesis Imperfecta Foundation

- Medical Advisory Council, July 2011-2014
- Scientific Meeting Committee, 2010-present
- Children’s Hospital & Medical Center
  - Board of Directors, Advisory Board 2010-present
- Quality and Patient Safety Committee, 2008-present
- Medical Staff Committees
  - Ethics Committee, Omaha, NE, Children’s Hospital, 2010-present
  - Clinical Service Chief, Orthopaedic Surgery 2009-present
  - Information Technology Oversight Committee, 2009-present
- Allied Health Committee, 2008-present
- Bylaws Committee, 2008-present
- Credentials Committee, 2008-present (Chair, 2011-2013)
- Surgical Services Committee, 2008-present
- Focused Peer Review Committee, 2004-2014
- Quality Safety Leadership Team, 2006-present
- Physician’s Health Committee, 2004-present
- Surgical Information Technology Committee, 2006-present
- Member, Metro Omaha Medical Society Foundation, Board of Directors, 2010-present.

Reviewer, Clinical Orthopaedics and Clinical Research, 2010-present.


Consultant Reviewer, PEDIATRICS, 2005-present.

HANI HAIDER, PH.D.
DIRECTOR, ORTHOPAEDICS BIOMECHANICS AND ADVANCED SURGICAL TECHNOLOGIES LABORATORY

Hani Haider, Ph.D., is a professor in the Department of Orthopaedic Surgery and Rehabilitation, and director of Biomedical Engineering Research. Dr. Haider studied in England for his first degree and Ph.D. in Mechanical Engineering. From a fluid dynamics and mechatronics faculty teaching background at the University of Sheffield, he joined the faculty of University College London Medical School at the well-known Centre of Biomedical Engineering in Stanmore in 1997. He was the principal mechanical and software engineer who designed and produced the Instron-Stanmore Knee Simulator and was instrumental in the development of the International Standards Organization (ISO) method for simulation and wear testing of knee replacement systems. He was invited to join the faculty of the University of Nebraska Medical Center in March 2000.

Dr. Haider was awarded three different university prizes during his student career, and two as faculty from the University of Nebraska Medical Center for Special and Outstanding Professional Achievement. Nationally, he was the recipient of the Iraqi Academic Conference Award, given to four of the most distinguished academics of Iraqi origin in the United States, for his accomplishments in Engineering. Internationally, he has received the “The KLINGER International Research Prize”/Austria, the HAP Paul Award by the International Society for Technology in Arthroplasty (ISTA) for innovation in joint replacement technology, as well as the Robert Fainer Award and the Manny Horowitz Award from the American Society for Testing and Materials (ASTM) for his contributions to international standards development. Most recently, ISTA awarded Dr. Haider an “Honorary Lifetime Membership” for outstanding contributions to technology in arthroplasty and to ISTA.

While at UNMC, Dr. Haider has received over 65 research contracts, mostly from orthopaedic companies in the USA, but also Europe and Japan, plus federal research funding, altogether totaling over $8 million. He has presented over 200 papers in peer-reviewed journals and international conferences regarding orthopaedic biomechanics.

In October 2013, Dr. Haider and his colleague Osvaldo Andres Barrera were issued United States Patent #8560047 for ‘Method and Apparatus for Computer-Aided Surgery.’ Further innovations, for ‘On-Board Tool Tracking System and Methods of Computer-Assisted Surgery,’ have been submitted for patenting in the U.S., Australia, Canada, Japan, China, Europe and India. These cutting-edge inventions allow orthopaedic surgeons navigated freehand bone cutting for joint replacement. In 2012, a start-up company, Trak Surgical, Inc., was formed in partnership with UNEMed (the IP and commercial arm of the University) to bring this technology from the laboratory into the marketplace.

Professor Haider is a member of the Biomedical Engineering Committee of the American Academy of Orthopaedic Surgeons (AAOS), is representative of the Orthopaedic Research Society (ORS) to the AAOS, and is a member of the ORS’s Basic Science Committee. He co-chairs the committee for Knee Implant Wear Testing of ASTM International, chairs the ASTM International Ankle Replacement Testing Standard Committee, and coordinates the standards writing group of friction measurements for hip replacement systems. Dr. Haider is the U.S. liaison for the International Standards Organization’s work on artificial joint replacement wear testing standards. He is the Scientific Review and Information Technology Director of the International Society of Technology in Arthroplasty (ISTA) and is a member of its Board of Directors. Dr. Haider is the Reviews Editor for the Journal of Engineering in Medicine, is on the editorial boards of two international scholarly journals, and is a reviewer for various others.

Current Research Grants:


Refereed Articles:


Honors, Awards & Offices Held:


International Society for Technology in Arthroplasty (ISTA) Honorary Lifetime Member for Outstanding Contribution to Technology in Arthroplasty and to ISTA, January 1, 2013.


International Society of Technology in Arthroplasty (ISTA)


Editorial Board Member, Journal of Engineering in Medicine, IMechE Part H, 2009-present.


Basic Science Education Committee (BSEC), The Orthopaedic Research Society, 2011-present.

Reviewer, Journal of Clinical Orthopaedics and Related Research (CORR), July 2010-present.

Appointed to the Editorial Board for the Journal Advances in Orthopedics, June 2010-present.

American Academy of Orthopaedic Surgeons

Associate Member Basic Science, February 2012

Appointed Member/Consultant, Biomedical Engineering, February 2010-March 2012.

Reviewer of abstracts (Re-appointment), Orthopaedic Research Society, August 2009-present.


Editorial Board Member, Journal of Engineering in Medicine, IMechE Part H, 2009-present.


Basic Science Education Committee (BSEC), The Orthopaedic Research Society, 2011-present.

Reviewer, Journal of Clinical Orthopaedics and Related Research (CORR), July 2010-present.

Appointed to the Editorial Board for the Journal Advances in Orthopedics, June 2010-present.

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Associate Member Basic Science, February 2012

Appointed Member/Consultant, Biomedical Engineering, February 2010-March 2012.

Reviewer of abstracts (Re-appointment), Orthopaedic Research Society, August 2009-present.


Editorial Board Member, Journal of Engineering in Medicine, IMechE Part H, 2009-present.
CURTIS W. HARTMAN, M.D.

ADULT RECONSTRUCTIVE SURGERY

Curtis W. Hartman, M.D., is an associate professor in the Department of Orthopaedic Surgery and Rehabilitation. He received his medical degree at the University of Missouri in 2003, and completed his orthopaedic surgery residency at the University of Nebraska/Creighton University Medical Center Health Foundation in 2008. Following residency, Dr. Hartman completed a fellowship in adult reconstruction at the Rush University Medical Center and Central DuPage Hospital, in Chicago, Illinois, in 2009. He is board certified in orthopaedic surgery. He is a member of the American Academy of Orthopaedic Surgeons (member, Basic Science Exam Subcommittee, 2010-2014), the Mid-America Orthopaedic Association, the American Association of Hip and Knee Surgeons, the American Orthopaedic Association’s Emerging Leaders Program, the Nebraska Medical Society, the Nebraska Orthopaedic Society and the Metro Omaha Medical Society.

Current Research Grants:


Refereed Articles:


Book Chapters & Reviews:


Honors, Awards & Offices Held:


Surgeon, Operation Walk USA, Omaha, NE, December 7, 2012.

Event physician, 2012 U.S. Olympic Swimming Trials, Omaha, NE, June 2012.

Member, Membership Committee, Metro Omaha Medical Society, April 2012-present.


UNMC
- Member, UNMC Graduate Faculty, May 2013-present.
- Member, Dissertation Committee, Tyler Scherr, Ph.D. Student, Department of Pathology and Microbiology, UNMC College of Medicine, 2012-present
- Member, Dissertation Committee, Ke Ren, Ph.D. Student, Department of Pharmaceutical Sciences, UNMC College of Pharmacy, 2012-present
- Member, Surgical Services New Technology and Products Committee, 2011-present
- Member, Website Development Committee, 2011-present
- M2 ICE Course Instructor, College of Medicine September 2009-present
- M3 Course Instructor, College of Medicine September 2009-present
- Nebraska Orthopaedic Hospital
- Utilization Review Committee, 2013-present
- Finance Committee, 2012-present
BRIAN P. HASLEY, M.D.
PEDIATRIC ORTHOPAEDIC AND SPINE SURGERY

Brian P. Hasley, M.D., is an associate professor of Orthopaedic Surgery at the 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 in 1999 and completed his residency in orthopaedic surgery at the University of Nebraska Medical Center in 2004. 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 (2005). Dr. Hasley completed post fellowship spine research at the same facility. Dr. Hasley is board certified in orthopaedic surgery. He is a fellow of the American Academy of Orthopaedic Surgeons, and a member of the Scoliosis Research Society and the Pediatric Orthopaedic Society of North America (POSNA). Dr. Hasley has been selected as one of the Best Doctors in America from 2007-2014.

M. LAYNE JENSON, M.D.
PEDIATRIC ORTHOPAEDIC AND SPINE SURGERY

M. Layne Jenson, M.D., is an assistant professor in the Department of Orthopaedic Surgery and Rehabilitation. He received a master’s degree in Business Administration with a concentration in Health Organization Management from Texas Tech University in Lubbock in 2005. He completed his medical degree at Texas Tech University School of Medicine in Lubbock, also in 2005. Dr. Jenson completed his residency in orthopaedic surgery at the Texas Tech University Health Science Center in 2010. Following residency, he completed the Ryerson Fellowship in Pediatric Orthopaedic Surgery at the Northwestern School of Medicine at Children’s Memorial Hospital in Chicago in 2011. Dr. Jenson is a member of the American Academy of Orthopaedic Surgeons (AAOS) and a candidate member of the Pediatric Orthopaedic Society of North America (POSNA).

BEAU S. KONIGSBERG, M.D.
ADULT RECONSTRUCTIVE SURGERY

Beau S. Konigsberg, M.D., is an associate professor in the Department of Orthopaedic Surgery and Rehabilitation. Dr. Konigsberg received his medical degree from the University of Nebraska Medical Center in 2001, and completed his orthopaedic surgery residency at the University of Nebraska/Creighton University Health Foundation in 2007. Following residency, Dr. Konigsberg completed an adult reconstruction and arthroplasty fellowship at Midwest Orthopaedics at Rush/Rush University Medical Center in Chicago, Illinois (2008). He is board certified in orthopaedic surgery. He is a member of the Orthopaedic Research and Education Foundation, the American Academy of Orthopaedic Surgeons, the Mid-America Orthopaedic Association, the American Association of Hip and Knee Surgeons, the American Orthopaedic Association Emerging Leaders Program, the Nebraska Orthopaedic Society and the Metro Omaha Medical Society.

Refereed Articles:


SEAN V. MCGARRY, M.D.

MUSCULOSKELETAL ONCOLOGY

Sean V. McGarry, M.D., is an associate professor in the 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 cancer. Dr. McGarry is board certified in orthopaedic surgery. He is a member of the American Academy of Orthopaedic Surgeons, the Musculoskeletal Tumor Society, the Mid-America Orthopaedic Society, the Nebraska Orthopaedic Society and the Metro Omaha Medical Society.

Refereed Articles:


Book Chapters & Reviews:


Online Educational Materials:


Honors, Awards & Offices Held:

Elected to UNMC Faculty Senate, June 3, 2011-May 31, 2014.

Promoted to Associate Professor of Orthopaedic Surgery, Department of Orthopaedic Surgery and Rehabilitation, July 1, 2013.

University of Nebraska Medical Center

Faculty Senate, June 2013-May 2014

Continuing Education Committee, Member, October 2012-present

Tissue Bank Review Committee, Member, 2006-present

Musculoskeletal Tumor Lecture, February 2012

Honors, Awards & Offices Held:

ONE-Team (TNMC/UNMC/UNMC-P)

Member, Physician Engagement Group, July 2013-present

Member, Future Care Delivery Committee, July 2013-present

Member, Physician Compensation Committee, July 2013-present

Surgeon, Operation Walk USA, Omaha, NE, December 7, 2012

Member, Membership Committee, Metro Omaha Medical Society, April 2012-present.


Fellow, American Academy of Orthopaedic Surgeons, February 2012.

Consultant Reviewer, Journal of the American Geriatrics Society, September 2010-present.

Section Chief, Orthopaedics, VA Medical Center, January 2009-present.

Medical Board of Trustees, April 2006-present

Consultant Reviewer, Clinical Orthopaedics and Related Research, March 2011-present.

Consultant Reviewer, Orthopaedics, February 2011-present.

Tumor Module Editor, Orthopedics Hyperguide, February 2011-2012.

Children’s Hospital of Omaha Bylaws Committee, Member, January 2008-present.

National Comprehensive Cancer Network (NCCN)

Metastatic Osteosarcoma of Bone Sub-committee, February-July 2012

Soft Tissue Sarcoma Panel, July 2007-present

Bone Cancer Panel, May 2006-present

Editorial Board, Orthopaedics, January 2011-present.

Section Editor, Online Oncology Module, Orthopaedic Hyperguide, January 2011-2012.
MATTHEW A. MORMINO, M.D.
ORTHOPAEDIC TRAUMATOLOGY AND LOWER EXTREMITY

Matthew A. Mormino, M.D., is professor and residency program director, as well as the Herman Frank Johnson, M.D., Professor of Orthopaedic Surgery and Rehabilitation in the Department of Orthopaedic Surgery and Rehabilitation. He received his medical degree from the University of Illinois College of Medicine (1991) and completed his orthopaedic surgery residency at Creighton University/University of Nebraska Medical Center Health Foundation (1996). He also completed a trauma fellowship at the University of Washington in 1997. 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. Dr. Mormino has been selected as one of the Best Doctors in America from 2005-2014, and as one of Castle Connolly’s Regional Top Doctors from 2012-2014.

Refereed Articles:


Honors, Awards & Offices Held:


Award for Faculty Excellence in Teaching, Nebraska Orthopaedic Surgery Residency Program, June 2013.

Promoted to Professor of Orthopaedic Surgery, Department of Orthopaedic Surgery and Rehabilitation, July 1, 2012.

Award for Faculty Excellence in Teaching, Nebraska Orthopaedic Surgery Residency Program, June 2012.

AO North America
- Fellowship Advisory Board, 2011-present
- Faculty, 1997-present
- At-large Member to the UNMC Physicians Board of Directors, UNMC Physicians, July 2010-2013.
- Board Member, Mid America Orthopaedic Society, 2006-2012.
- ABOS certified through 2019.
- 15 Years of Service Award, The Nebraska Medical Center, 2012.
FERYDOON NAMAVAR, SC.D.
DIRECTOR, NANO-BIOTECHNOLOGY LABORATORY

Ferydoon Namavar, Sc.D., is a professor emeritus in the 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. One of his primary research interests is to understand how cells attach to a nanostructured surface. By mimicking the cell behavior, he is designing and fabricating nanostructured surfaces that exhibit or simulate the effects of a cell in cell-cell interactions. Presently, he is also 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 (i) friction and wear reduction, (ii) substrates for tissue engineering and enhancement of bone growth, and (iii) 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 over 50 grants and contracts from a variety of corporations and government agencies, including DOE, DOD, NIH, NASA and NSF. He has authored or co-authored over 230 scientific papers throughout his career. He collaborates with scientists around the world and holds seven patents, including US patent 7,048,767, entitled “Nano-crystalline, homo-metallic, protective coatings” for reducing the wear of artificial orthopaedics implants. Dr. Namavar was awarded professor emeritus status on January 1, 2014.

Current Research Grants:
Namavar, F.: Material Science Smart Coatings, Department of Energy, Principal Investigator, September 2010-September 2013.

Refereed Articles:


Honors, Awards & Offices Held:
10 Years of Service, UNMC, 2012.
LORI K. REED, M.D.
FOOT & ANKLE AND GENERAL ORTHOPAEDIC SURGERY

Lori K. Reed, M.D., is an associate professor in the Department of Orthopaedic Surgery and Rehabilitation. Dr. Reed received her 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 in 2004. She then went on to complete her Foot and Ankle/Lower Extremity Reconstruction Fellowship at the Florida Orthopaedic Institute in Tampa (2005). Dr. Reed is board certified in orthopaedic surgery. She is a member of the American Academy of Orthopaedic Surgeons, American Orthopaedic Foot and Ankle Society, Orthopaedic Trauma Association, AO Trauma, Mid-America Orthopaedic Association, Nebraska Orthopaedic Society, Nebraska Chapter of the American College of Surgeons, and the Emerging Leader Program of the American Orthopaedic Association.

SUSAN A. SCHERL, M.D.
PEDIATRIC ORTHOPAEDIC SURGERY

Susan A. Scherl, M.D., is a professor in the Department of Orthopaedic Surgery and Rehabilitation. She earned her medical degree from the Boston University School of Medicine in 1987. Dr. Scherl completed two years of a general surgery residency at St. Luke’s/Roosevelt Hospital Center in New York (1989) and a five-year orthopaedic residency at State University of New York Health Science Center in Brooklyn (1994). She completed a pediatric orthopaedic fellowship at Case Western Reserve University in Cleveland in 1995. She is board certified in orthopaedic surgery. Dr. Scherl is a member of the Pediatric Orthopaedic Society of North America (POSNA) Annual Meeting Program Committee, as well as the POSNA Advocacy Committee. She serves on the American Orthopaedic Association Traveling Fellowship Committee. Dr. Scherl was selected as one of the Best Doctors in America for 2003-2005, and 2007-2014. She has edited two textbooks on musculoskeletal medicine and authored numerous book chapters and article reviews.

Refereed Articles:

Book Chapters & Reviews:

Honors, Awards & Offices Held:
Member, American Medical Association, 2014.
Promoted to Associate Professor of Orthopaedic Surgery, Department of Orthopaedic Surgery and Rehabilitation, July 1, 2013.
Member, Ruth Jackson Orthopaedic Society, 2013-present.
Member, Public Relations Committee, Orthopaedic Trauma Association, 2009-present.
MATTHEW J. TEUSINK, M.D.
SHOULDER AND ELBOW SURGERY

Matthew J. Teusink, M.D., joined the Department of Orthopaedic Surgery and Rehabilitation as an assistant professor in August 2013, and specializes in shoulder and elbow surgery.

Dr. Teusink was born and raised in Fremont, Michigan. He received his medical degree from the University of Iowa Carver College of Medicine in Iowa City, Iowa, (2003-2007). He then completed a five-year orthopaedic residency at the University of Iowa Hospitals and Clinics, also in Iowa City, (2007-2012). Following residency, Dr. Teusink completed a shoulder and elbow fellowship at the Florida Orthopaedic Institute in Tampa, Florida (2012-2013).

He is a reviewer for the Journal of Shoulder and Elbow Surgery and Orthopaedics. He is a candidate member of the American Academy of Orthopaedic Surgeons and the Mid-America Orthopaedic Association, and is a member of the Nebraska Orthopaedic Society.

Dr. Teusink and his wife, Jennifer, have one son. His interests and hobbies include triathlons and golf.

Referred Articles:

Honors, Awards & Offices Held:

Member, Nebraska Orthopaedic Society, January 2014.
Candidate Member, American Academy of Orthopaedic Surgeons, November 2013.
Journal Reviewer, Orthopaedics, 2013-present.

JUSTIN C. SIEBLER, M.D.
ORTHOPAEDIC TRAUMATOLOGY

Justin C. Siebler, M.D., joined the Department of Orthopaedic Surgery and Rehabilitation’s full-time faculty as an assistant professor in August 2014. A board-certified orthopaedic surgeon, Dr. Siebler specializes in orthopaedic traumatology.

Dr. Siebler grew up in Lincoln, Nebraska. He received his medical degree at the University Nebraska Medical Center (2000-2004) and attended orthopaedic residency at the Creighton University/University of Nebraska Health Foundation Orthopaedic Surgery Residency Program (2004-2009), both in Omaha, Nebraska. Following residency, he completed an orthopaedic traumatology fellowship at the Florida Orthopaedic Institute in Tampa, Florida (2009-2010).

Prior to joining the department, Dr. Siebler was an assistant clinical professor at Creighton University (2010-present).

He is a fellow of the American Academy of Orthopaedic Surgeons and the American Board of Orthopaedic Surgery, and a member of the Orthopaedic Trauma Association and the Mid-America Orthopaedic Association. He is also a member of the AO Trauma North America Musculoskeletal Trauma Faculty (2012-present).

Dr. Siebler and his wife, Erin, have three children. His interests and hobbies revolve around being outdoors with his family.

Clinical Expertise & Research Interests:
Dr. Siebler’s clinical interests are in orthopaedic fractures, injury and trauma.

Conditions & Surgical Specialties:
Fractures in and around joints (periarticular fractures)
Fractures of the pelvis and hip socket
Fragility fractures
PHILIPP N. STREUEBEL, M.D.
HAND AND UPPER EXTREMITY SURGERY

Philipp N. Streubel, M.D., joined the Department of Orthopaedic Surgery and Rehabilitation’s full-time faculty as an assistant professor in August 2014. Dr. Streubel grew up in Colombia, South America, as the son of German immigrants. He received his medical degree at Pontificia Universidad Javeriana (1996-2002) and completed his orthopaedic residency at the Universidad del Rosario in his hometown of Bogotá (2004-2008).

In 2008, Dr. Streubel moved to the U.S. and completed three surgical fellowships: Orthopaedic Trauma, Vanderbilt Medical Center, Nashville, TN (2010-2011); Shoulder and Elbow Surgery, Mayo Clinic, Rochester, MN (2011-2012); Hand Surgery, Rush Medical Center, Chicago, IL (2013-2014).

Prior to joining the department, Dr. Streubel was an upper extremity surgeon and assistant professor of orthopaedics at the Mayo Clinic in Minnesota (2012-2013).

Dr. Streubel has extensive research experience: Research Coordinator, Fundacion Santa Fe de Bogota, Bogota, Colombia (2002-2004); Research Fellow, Center of Investigation and Documentation, AO Foundation in Zurich, Switzerland (2007); Research Fellow, Orthopaedic Trauma Service, Washington University School of Medicine, St. Louis, MO (2008 – 2010). He has written over 30 peer-reviewed papers and book chapters, and given over 40 oral and poster presentations at national and international meetings. He serves as a reviewer for the Journal of Shoulder and Elbow Surgery and is a member of the American Society for Surgery of the Hand (ASSH-Candidate), Orthopaedic Trauma Association (OTA-Candidate), Colombian Society of Orthopedic Surgery and Traumatology (SCCOT), AO Foundation Alumni Association, Mid-America Orthopaedic Association, the Mayo Clinic Alumni Association and the Vanderbilt Orthopedic Society.

Dr. Streubel is fluent in English, Spanish and German. He and his wife, Catalina, have one daughter. His interests and hobbies include tennis, photography and traveling.

Clinical Expertise & Research Interests:
Dr. Streubel specializes in the comprehensive care of the upper extremity. His clinical interest focuses on degenerative conditions and traumatic and overuse injuries of the shoulder, elbow, wrist and hand.

His research interests include shoulder arthroplasty and the treatment of elbow stiffness and instability, as well as management of thumb arthritis, wrist fractures, and trauma of the proximal and distal humerus.

Conditions & Surgical Specialties:
Arthritis, arthroscopic surgery, deformity, joint replacement, sports medicine, trauma/fractures, dislocations, tumor/ oncology, wrist, elbow, hand, shoulder, carpal tunnel syndrome, cubital tunnel syndrome, rotator cuff tears, tendon injuries, joint stiffness, trigger finger, de Quervain’s disease, tennis elbow

OTHER FACULTY

GLEN M. GINSBURG, M.D.

Glen Ginsburg, M.D., is a volunteer associate professor of Orthopaedic Surgery at the University of Nebraska Medical Center. He received his M.D. from the School of Medicine and Biological Sciences at the State University of New York at Buffalo, where he also completed a general surgery residency, as well as his orthopaedic residency training. Dr. Ginsburg completed a pediatric orthopaedic fellowship at the Children’s Hospital Los Angeles at the University of Southern California Department of Orthopaedic Surgery. He is a board-certified orthopaedic surgeon. Dr. Ginsburg is the clinical director of the Motion Analysis Laboratory at UNMC’s Munroe-Meyer Institute, and serves as an academic advisor to orthopaedic residents in the Department of Orthopaedic Surgery and Rehabilitation. Dr. Ginsburg retired to volunteer associate professor status on March 15, 2011.

WALTER W. HUURMAN, M.D.

Walter W. Huurman, M.D., is a professor emeritus of Orthopaedic Surgery and Pediatrics at the University of Nebraska Medical Center. He received his M.D. from Northwestern University and completed his orthopaedic residency at the U.S. Naval Medical Center in Oakland, California, and the University of California, San Francisco. He 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. Dr. Huurman served as an oral examiner for the American Board of Orthopaedic Surgery (1982, 1986-87, 1990-92, and 1994-2003). He is 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.
Background
Distal humerus fractures have an estimated incidence of 5.7 per 100,000 persons per year and account for 10% of distal humerus fractures. A bimodal distribution has been noted with young males involved in high-energy trauma, and elderly females as a result of falls. The main goal of treatment of extra-articular distal humerus fractures is to gain an appropriate and stable alignment, which will allow for early elbow range of motion. Stability that allows early range of motion has been shown to be important for good functional outcome. Dual-plating has been advocated for distal humerus fractures, as it has been shown in biomechanical studies to be stiffer when bending forces are applied. However, no statistically significant differences were noted in axial compression, torsional loading, or load to failure between single- and dual-plating. Dual-plating also requires more extensive tissue dissection, as well as increased implant cost. Advantages to the single-plate technique include decreased dissection and soft tissue destruction, as well as decreased manipulation of the ulnar nerve. Ulnar neuropathy has been noted in up to 50% of patients with a distal humerus fracture undergoing fixation. The approach to the distal humerus is also variable. A number of techniques have been described, including: olecranon osteotomy, triceps-reflecting, triceps-splitting, and paratricipital approaches, among others.

Materials and Methods
Thirty-five patients were treated for distal humerus fractures at the participating institutions with a single lateral plate. Of those 35 patients, 6 were excluded from this study, as they had a triceps-splitting approach. At the time of this study, 29 patients had been followed to union or failure. Union was described as painless range of motion with radiographic evidence of bridging callus as evaluated by a staff physician.

The mean age at the time of surgery was 37 (range, 16-85 years). Ten (10) injuries were in males, and 19 were in females. The mechanism of injury included motor-vehicle collision in 15, fall in 7, altercation in 3, gunshot wound in 2, and sporting injury in an additional 2 patients. The fractures were classified according to the AO/ASIF classification. Twenty patients suffered type A3 fractures, while the remaining 9 suffered type A2 fractures.

Surgical Technique
A consistent surgical technique was utilized in all patients. Patients were placed in the lateral decubitus position. A slightly lateral to midline posterior approach was utilized. Full-thickness fasciocutaneous flaps were then developed. The lateral border of the triceps muscle was identified and then elevated from the intramuscular septum. Once this had been achieved, the radial nerve was identified. The lateral dissection was continued distally and anterior to the anconeus muscle. Extensive and meticulous neurolysis was then performed. This allowed the nerve to be elevated along with the triceps, preserving its neurovascular supply. The triceps was freed from the posterior aspect of the humerus in an extraperiosteal fashion. The fracture was then...
reduced anatomically with direct visualization and indirectly with fluoroscopy. Kirschner wires were used for provisional fixation of the fracture and the reduction was confirmed with fluoroscopy. Definitive fixation was then performed with a single Synthes (DePuy/Synthes, Warsaw, IN) 3.5-mm LCP plate placed on the lateral column (Figures 1 and 2). A minimum of 4 screws were used, both proximally and distally, in order to prevent loss of reduction or catastrophic failure. Prior to closure of the wound, the elbow was taken through a range of motion in order to ensure stability of the construct as well as determining the motion arc. The wound was then closed in a layered fashion and a drain was placed when necessary.

Postoperatively, the patients were placed into a splint for two weeks. At the first postoperative visit (2 weeks), the splint was removed and the patient was started with range of motion activities. Radiographs were obtained at regular intervals to assess for fracture union.

**Results**
Twenty-eight (28) of the 29 fractures (96.6%) treated with a single lateral plate healed primarily. A single patient suffered catastrophic failure of fixation, which required repeat open reduction and internal fixation with dual plates. For those that went on to union, the average time to union (radiographic and clinical) was 2.9 months. All patients exhibited full active and passive range of motion about the elbow. No patients complained of elbow weakness. No cases of ulnar neuritis were noted postoperatively.

**Discussion**
In our study, a single lateral-column plate using the lateral aspect of the paratricipital approach led to a union rate of 96.6%. A single failure of fixation occurred after a fall. The optimal surgical approach and fixation technique for extra-articular distal humerus fractures has not been determined. Many different surgical approaches have been described in the literature, each with their own inherent advantages and complications.1-6 Dual-plating has the advantage of increased stiffness to bending stresses, but the disadvantage of added soft tissue injury and possible ulnar neuritis associated with medial dissection. The nonunion rate for distal humerus fractures has noted to be as high as 11%.1 Stripping the bone of soft tissue may increase this complication. The lateral window to the paratricipital approach avoids exposure of the ulnar nerve and the possibility of iatrogenic injury, as well as preserving any medial blood supply to the periosteum, without sacrificing fixation strength.

**Conclusion**
A single lateral-column plate applied through the lateral window of the paratricipital approach is a viable solution to extra-articular (AO A2-3) distal humerus fractures. The lateral window and lateral-based plate allows for decreased soft tissue damage surrounding the fracture, especially decreasing complications associated with exposure of the ulnar nerve. In addition, the decreased soft tissue damage and lack of periosteal stripping may decrease the risk of nonunion, as the blood supply to the humerus is better preserved.

**References**
WEAR ANALYSIS OF THREE DIFFERENT BEARING COMBINATIONS IN THA

Hartman, CW; Hedgecock, J; Konigsberg, BS; Martell, JM,* Garvin, KL
University of Nebraska Medical Center, Omaha, NE
*University of Chicago Medical Center, Chicago, IL

Introduction
The early and midterm clinical outcomes of total hip arthroplasty (THA) using highly crosslinked polyethylene (HXLPE) have been outstanding (Table 1). Reported wear rates with HXLPE have been very low. Alternative hard bearings (monolithic ceramics and oxidized zirconium) are commonly used to further improve the wear of HXLPE, although published results with these combinations are rare. The purpose of this study was to analyze the wear rates of three different bearing combinations in THA.

Methods
We evaluated 230 THAs with a minimum follow-up of five years (range 60-122 months) and a mean follow-up of 75.4 months. Hips were assigned to three groups based on the bearing couple. The bearing couple used in Group 1 was cobalt chrome (CoCr) on HXLPE, Group 2 was CoCr on standard polyethylene, and Group 3 was oxidized zirconium on HXLPE. We measured the linear wear for each group using the Martell Method. Median wear rates for Groups 1 and 2 and Groups 1 and 3 were compared using the Mann-Whitney test for statistical significance.

Results
The median true linear wear rate for Group 1 was 7.5 μm/yr (± 75 μm/yr), Group 2 was 52 μm/yr (± 98 μm/yr), and Group 3 was 24 μm/yr (± 98 μm/yr). The wear rate for Group 1 was significantly less than the wear rate for Group 2 (p = 0.001) (Figure 1). The wear rate for Group 1 was not significantly different than the wear rate for Group 3 (p = 0.144) (Figure 2). The Harris Hip scores improved from 51 (range 26-75) pre-operatively to 97 (range 66-100) at follow-up. There was no radiographic evidence of implant loosening or osteolysis.

Conclusion
We found the wear rate of HXLPE was significantly less than the wear rate of standard polyethylene at an average follow-up of 6 years. The use of oxidized zirconium did not improve wear rates of HXLPE when compared to CoCr. Our data would suggest that any benefit to alternative bearings is dwarfed by the significant effect of crosslinking polyethylene.

Table 1

<table>
<thead>
<tr>
<th>Authors</th>
<th>Polyethylene</th>
<th>Hips (#)</th>
<th>Mean Age (yrs)</th>
<th>F/U (yrs)</th>
<th>Linear Wear Rate (μm/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>McCalden 2005</td>
<td>Longevity (CoCr)</td>
<td>50</td>
<td>72.3</td>
<td>6.6</td>
<td>30</td>
</tr>
<tr>
<td>Thomas 2011</td>
<td>Longevity (CoCr)</td>
<td>27</td>
<td>68</td>
<td>7-7.8</td>
<td>30</td>
</tr>
<tr>
<td>Garcia-Rey 2008</td>
<td>Durasul (CoCr)</td>
<td>45</td>
<td>62.5</td>
<td>5.5</td>
<td>6</td>
</tr>
<tr>
<td>Triclot 2007</td>
<td>Durasul (CoCr)</td>
<td>51</td>
<td>70.6</td>
<td>4.9</td>
<td>25</td>
</tr>
<tr>
<td>Geerdink 2009</td>
<td>Duration (CoCr)</td>
<td>22</td>
<td>64</td>
<td>8</td>
<td>88</td>
</tr>
<tr>
<td>Engh 2006</td>
<td>Marathon (CoCr)</td>
<td>116</td>
<td>62.5</td>
<td>5.7</td>
<td>10</td>
</tr>
<tr>
<td>Kurtz 2011</td>
<td>HXLPE</td>
<td>1503</td>
<td>NA</td>
<td>Min 5 yr</td>
<td>42</td>
</tr>
<tr>
<td>Ranawat 2012</td>
<td>Crossfire (HXLPE)</td>
<td>112</td>
<td>52</td>
<td>5.7</td>
<td>14/43</td>
</tr>
<tr>
<td>Garvin 2013</td>
<td>Longevity (CoCo/Oxidized Zr)</td>
<td>179</td>
<td>57</td>
<td>6.3</td>
<td>7.5/24</td>
</tr>
</tbody>
</table>
Figure 1

True Linear Wear Rates (start >= 1 yr)

- **COCR-STANDARD**
  - $y = 0.0359x + 0.0341$
  - $R^2 = 0.0662$

- **COCR-LONGEVITY**
  - $y = 0.0152x - 0.0399$
  - $R^2 = 0.0093$

- Linear (COCR-STANDARD)
- Linear (COCR-LONGEVITY)

Figure 2

True Linear Wear Rates (start >= 1 yr)

- **COCR-LONGEVITY**
  - $y = 0.0152x - 0.0399$
  - $R^2 = 0.0093$

- **OXINIUM-LONGEVITY**
  - $y = 0.0066x + 0.0597$
  - $R^2 = 0.0022$

- Linear (COCR-LONGEVITY)
- Linear (OXINIUM-LONGEVITY)
Background
Revision hip surgery of the femur for patients with substantial bone loss is challenging. We previously reported 41 patients (44 hips) treated with femoral impaction grafting followed for a minimum of 2 years. The survivorship, using femoral reoperation for symptomatic aseptic loosening as the end point, was 97% at 8 years. However, data on longer term survival are crucial to adequately compare this surgical technique with other types of revision hip arthroplasty procedures.

Questions/Purposes
We therefore asked what the survivorship of impaction bone grafting was at longer followup, if the severity of bone loss was associated with failure, and finally, if longer length stems had improved survival compared with shorter stems.

Methods
Between 1993 and 2002, 78 femoral revisions were performed in 71 patients using impaction grafting. The average age of the patients was 67 years (range, 33–84 years). Sixty-nine of the 71 patients were available for followup evaluation. We obtained Harris hip scores preoperatively and postoperatively. Radiographs were measured for radiolucent lines. Patients were followed a minimum of 2 years (average, 10.6 years; range, 2–19 years).

Results
Survival of the femoral component without revision for any cause was 93% (confidence interval [CI], 83%–97%) at 19 years (Figure 1). Neither severity of bone loss nor the length of the stem predicted failure.

Conclusions
Impaction bone grafting has a high survival of 93% at the 19-year followup for patients with severe bone loss of their femur (Table 1). The survival compares favorably with previous investigations on impaction allografting for revision hip surgery.

Figure 1: The graph shows the survival of the femoral component without revision for any cause was 93% (95% CI: 83%, 97%) at 19 years.
### Table 1: Impaction Bone Grafting Results

<table>
<thead>
<tr>
<th>Study</th>
<th>#Pts/Hips</th>
<th>Demographics</th>
<th>Defects/Classifications</th>
<th>Implant Selection</th>
<th>Length of F/U (years)</th>
<th>Complications</th>
<th>Survivorship</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ornstein et al JBJS(Br) 2009</td>
<td>1188 Pts/1305 Hips</td>
<td>650 F 538 M 71 yrs</td>
<td>Not stated (NS)</td>
<td>1081 Std stems 145 Long stems</td>
<td>8.1 (5-18)</td>
<td>33 Fracture/Infection Loosening Dislocation</td>
<td>99% for aseptic loosening 74% for any reason</td>
</tr>
<tr>
<td>Halliday et al JBJS(Br) 2003</td>
<td>207 Pts/226 Hips</td>
<td>NS</td>
<td>12 Grade 1 106 Grade 2 106 Grade 3 62 Grade 4</td>
<td>Std Stems</td>
<td>10.4 (5-11)</td>
<td>5% Fracture Infection Loosening Dislocation</td>
<td>99% for aseptic loosening 90.5% for any reason</td>
</tr>
<tr>
<td>Garcia-Cimbrelo et al JBJS(Br) 2011</td>
<td>79 Pts/81 Hips</td>
<td>48 F 33 M 64 yrs</td>
<td>20 Grade 2 40 Grade 3 21 Grade 4</td>
<td>69 Std stem 12 Long stem</td>
<td>10.4 (5-17)</td>
<td>7.5% Fracture Infection Loosening</td>
<td>100% Grade 2 81% Grade 3 at 10yrs 70.8% Grade 4</td>
</tr>
<tr>
<td>Schreurs et al JBJS(Am) 2005</td>
<td>33 Pts/33 Hips</td>
<td>24 F 9 M 63 yrs</td>
<td>3 Grade 1 14 Grade 2 13 Grade 3 4 Grade 4</td>
<td>Std Stems</td>
<td>10.4 yrs (8-13)</td>
<td>11% Fracture Infection Loosening Dislocation</td>
<td>100% for aseptic loosening 85% for any reason</td>
</tr>
<tr>
<td>Wraighte et al JBJS(Br) 2008</td>
<td>75 Pts/75 Hips</td>
<td>35 F 40 M 68 yrs</td>
<td>2 Grade 1 19 Grade 2 50 Grade 3 4 Grade 4</td>
<td>Std Stems</td>
<td>10.5 (6.3-14.1)</td>
<td>6.7% Fracture Infection Loosening Dislocation</td>
<td>92%</td>
</tr>
<tr>
<td>ten Have et al JBJS(Br) 2012</td>
<td>29 Pts/31 Hips</td>
<td>23 F 6 M 65 yrs</td>
<td>1 Grade 1 11 Grade 2 9 Grade 3 11 Grade 4</td>
<td>Std Stems</td>
<td>12.6 (10-14.7)</td>
<td>12% Fracture Infection Loosening Dislocation</td>
<td>77.4%</td>
</tr>
<tr>
<td>Sierra et al JBJS(A) 2008</td>
<td>40 Pts/42 Hips</td>
<td>26 F 14 M 73.8 yrs</td>
<td>2 Grade 1 4 Grade 2 23 Grade 3 9 Grade 4</td>
<td>All Long stems</td>
<td>7.5</td>
<td>29% Complications</td>
<td>90%</td>
</tr>
<tr>
<td>Garvin et al Current study</td>
<td>71 Pts/78 Hips</td>
<td>32 F 39 M 67 yrs</td>
<td>0 Grade 1 22 Grade 2 42 Grade 3 14 Grade 4</td>
<td>51 Std stems 27 Long stems</td>
<td>12.8 (10-18.8)</td>
<td>6% Fracture Infection Loosening Dislocation</td>
<td>98% for aseptic loosening 93% for any reason</td>
</tr>
</tbody>
</table>
Introduction

Some well-known rotating platform total knee replacement (TKR) and unicompartmental designs have had truly excellent long-term clinical results. These include the LCS TKR (DePuy) and the Oxford Unicompartmental Knee (Biomet). The lower constraint from a mobile bearing is forgiving of some surgical rotational misalignments, helps patellar tracking, and helps reduce the shear forces and torques transmitted to the prosthesis-bone interface reducing the risk of implant loosening. It is frequently argued that because mobile bearings reduce contact stress, they have been typically expected to reduce fatigue and wear. In a rotating platform TKR, wear is also expected to be less, because the rolling/sliding motion is separated from the transverse rotational motion onto two separate articulating surfaces, thus presenting less cross-paths, less cross-shear and therefore less wear. Such wear reduction has not however been categorically proven clinically.

Fixed-bearing TKRs have, in general, had comparable success in kinematic ability, wear, osteolysis and loosening, with survival typically reaching >96% for 10 or even up to 20 years for some designs. We therefore question here if there was actually a difference between fixed-bearing and mobile-bearing TKRs with regards to wear, especially since some studies struggle to find evidence of superiority of either design at long-term clinical follow-up.

In a previous study, [1] we answered the above question regarding a known, highly successful mobile-bearing TKR and compared its wear in vitro with a fixed-bearing counterpart of the same femoral component design. With >97% statistical power, no significance difference was found (p = 0.298) between the polyethylene wear rates of the mobile- and fixed-bearing designs. The above case study [1] was conclusive, but it could not be generalized. In that clinically proven TKR design, the mobile bearing was neither significantly better nor worse in wear than its corresponding fixed-bearing version.

In this article, we ask the more ambitious and general question, whether wear of mobile-bearing knees is necessarily less than that of fixed bearings, from in vitro test results in our lab across a wide range of knee designs.

Materials and Methods

We amalgamated in vitro wear test data from our lab, spanning across a wide variety of fixed- and mobile-bearing TKR designs, materials and sizes. TKR wear depends on the combination of joint forces and motions between the implant articulating surfaces. Two principal test methods have been standardized to experimentally simulate wear in the knee; force-controlled testing and displacement-controlled testing (see [2] for a comprehensive description of both methods, contrasting the pros and cons of each). The test methodology employed for all the TKR wear results presented in this paper was the force-control method. We utilized knee simulators (Figure 1), which were originally produced by the first author in England, then redesigned and upgraded in Nebraska, and upon which an international standard ISO 14243-1 was written. The results presented here were from our laboratory tests from a period spanning 2000-2011, all done in exactly the same way with the aforementioned ISO standard method.

Each simulator test of a group of TKRs involved 2-4 identical TKR samples representing a combination of design, size and materials. Each test involved was run for at least 5 million simulated walking cycles. Wear was measured gravimetrically according to the cleaning and weighing protocols of ISO 14243-1 and 2, with weight measurements conducted at the start, and at frequent intervals throughout the test.

Twenty-two groups were tested, 16 groups of fixed bearings and 4 groups of mobile bearings, of various types and sizes. The bearing materials were all ultra-high molecular weight polyethylene (UHMWPE) of two basic resins (mostly GUR 1020 or GUR 1050). The processing of those resins and manufacturing of the final bearings ranged from what is typically loosely termed “conventional UHMWPE” without any deliberate crosslinking beyond what had occurred during radiation sterilization, to the deliberately highly crosslinked varieties (e.g., up to 10MRad dose of radiation). Some of the highly crosslinked bearing materials even had modern oxidation stabilization techniques applied, such as with Vitamin E and/or various combinations and sequences of re-melting, annealing, radiation and even artificial aging for some harsh cases.
Results

The results are shown in Figure 2. The fixed-bearing TKRs with highly crosslinked UHMWPE (FB10, FB14 and FB16) showed lower wear than conventional poly implants of the same design and size (from the rest of Figure 2). The highly crosslinked fixed-bearing TKRs of various designs, sizes and types, lumped together, averaged 80% lower wear than the conventional UHMWPE fixed bearings (p<0.005).

This showed that the force-control test methodology employed was highly discriminating for wear when such differences in wear existed between TKR designs or materials and at clinically significant levels.

If the 4 groups (n=16 samples total) of mobile-bearing TKRs from (Figure 2) were compared as a whole to the 16 fixed-bearing TKR groups/types (n=50 samples), the wear rate of the mobile-bearing knees of all averaged 7.80 mg/MC (s. dev. ±4.40 mg/MC). This was lower than for fixed bearings (of all types) (12.7±7.23 mg/MC), not statistically significant, (two tailed p=0.21).

Figure 1: One of the three knee simulators at the University of Nebraska Medical Center. Each simulator has 4 test stations. Loaded-soak controls are implemented on a separate dedicated external machine.

Figure 2: TKR wear results from the University of Nebraska Medical Center.
Discussion

TKR wear depends on the combination of joint forces and motions between the implant’s articulating surfaces. In vivo, the kinematic motion of knees with TKRs can be highly dependent on the design of the knee implant. In the force-control wear testing method employed here, the TKR kinematics (as well as wear) were dependent variables and formed the results of testing rather than its inputs. Considering the method used, and the test inputs to all knees being the same and with appropriate soft tissue simulation across all tests, no statistically significant difference resulted to characterize mobile bearings as having lower wear than fixed bearings. Yet, such differences did clearly feature with the example shown in the previous section, of significantly lower wear for highly crosslinked UHMWPE (from the results of Figure 2) compared to the conventional UHMWPE bearings.

By close examination of the charts of Figure 2, especially the standard deviations and min/max extremes, depending on the TKR design and materials, the ranges in wear of mobile-bearing knees clearly overlapped those of fixed bearings. This alone was categorical enough to shed doubt on any claim that mobile-bearing knees should simply wear less than fixed bearings. It also confirms the need for all TKR systems, mobile as well as fixed, to be tested for their individual detailed design as well as materials.

If the question was modified to speculate on which would generally have less wear, mobile-bearing designs or fixed-bearing TKR designs; then the answer becomes more complex. From the results shown here, there appears to be a tendency for mobile-bearing knees to wear less, but our results do not support this difference to be statistically significant with sufficient power across all the TKR types we tested. The above implies two things: Mobility of the TKR bearing versus a fixed bearing is one of many variables which are all influential, and it is the combination of mobility and good design and materials that can bring lesser wear, not mobility alone. It also means that the effectiveness of a mobile-bearing design can more usefully be assessed and compared to a fixed bearing when the same TKR is tested in two versions (fixed and mobile) with materials and all other design details except those which provide the bearing mobility are kept the same. As mentioned in the introduction section, a previous dedicated study [1] did precisely that, and showed no significant difference in wear on one well-known design frequently used as an example of the superiority of mobile-bearing knees.

Among the limitations of our data is that our testing was limited to the simulation of human walking gait, without more demanding daily activities such as turning while walking, stair climbing or higher-flexion squatting. It is questionable how less frequent activities like these would add to the wear assessed for walking. It is even less clear which way the trends found here would turn if such activities were simulated. Simulation of more severe daily activities to measure TKR wear has not been standardized, and it is rare to find such data that could be compared across TKR designs.

Another limitation of our data is inherent in the scope of the study presented. The question addressed wear as an isolated variable. However, efficacy of an implant would include its functional ‘performance’ and this may indeed sway the overall answer differently. It is clear that mobile bearings would be expected to show less constraint against either rotation or translation or both. Although the overall knee joint laxity would result from the combination of the implant constraint and the soft-tissue constraint as tuned in surgery, a less constrained implant clearly should be at less risk for loosening and better survival as mentioned earlier. It is important to note, however, that the implant constraint can also be too little, risking instability and demanding more exacting soft tissue tuning and surgical technique.

In the same way, our data are limited by not addressing the (debated) potential new risks with mobile bearings such as intermittent sticking due to edge loading, or the small reported risks of subluxation, and the possibility of introducing more adhesive and even abrasive backside wear. The latter can be induced by trapped bone/cement debris. Just like fixed bearings, any benefits and risks of mobile bearings should be considered multi-factorial and should be addressed, and tested, preferably one factor/variable at a time.

Our data and conclusions do not show wear of mobile-bearing TKRs to be necessarily less than fixed bearings. The wear of both will depend more on the detailed design and materials of the TKR than on the mobility of the bearing. With the high ability of the force-control test method to discriminate and thus predict wear, all TKR implant designs, fixed and mobile, should be tested in vitro for preclinical screening against the potential risk of excessive wear.

References


This article presents an abridged version of a larger study published as reference [3] above.
LESS THAN 100% BONE SUPPORT MAY NOT BE ASSOCIATED WITH RADIOLUCENCIES WITH A PARTIALLY CEMENTED GLENOID COMPONENT

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Presented at the 2011 Closed Meeting of the American Shoulder and Elbow Surgeons.

Introduction
Glenoid component seating as well as glenoid bone support are important to component survival. It is unclear if 100% bone support is necessary to prevent radiolucencies and, ultimately, loosening of the prosthesis. The primary goal of this study was to evaluate glenoid component radiolucency lines and seating of a partially cemented glenoid component. The secondary purpose was to evaluate the reliability of currently described scoring systems for glenoid radiolucency lines and seating.

Methods
A prospective cohort study of 48 total shoulder arthroplasties (TSAs) was performed by the senior surgeon (EVF) from July 2003-July 2007. All TSAs were performed by the senior surgeon utilizing the Depuy Global Advantage Anchor Peg Glenoid (Warsaw, IN). The pre-operative diagnosis was primary glenohumeral osteoarthritis in all shoulders. A total of 35 shoulders underwent standardized radiographs and CT scans (0.625 mm cuts) with coronal and sagittal reconstructions at minimum two-year follow-up. Glenoid seating and radiolucency lines were evaluated by three fellowship-trained musculoskeletal radiologists according to the criteria of Lazarus. Additionally, bone incorporation between the central peg’s radial fins was evaluated on CT scan according to the criteria of Yian. We tested the association between glenoid seating and radiolucency line scores, as well as the association between glenoid seating scores and bone incorporation between the central peg’s radial fins. Intra- and inter-observer reliability was tested for the various scoring systems.

Results
At a mean of 43 months post-surgery, 91% of shoulders had Lazarus grade 0, 1, or 2 radiolucency lines. Similarly 99% of shoulders were graded Lazarus A, B, or C, meaning better seating. Neither the Lazarus plain film radiolucency score (p=0.78), nor Yian CT radiolucency scores (p=0.68), were associated with Lazarus plain film seating scores. Additionally, neither Lazarus plain film radiolucency scores (p=0.25), nor Yian CT radiolucency scores (p=0.68), were associated with modified Lazarus CT scan seating scores. Bone incorporation between the radial fins of the central peg was not associated with plain film seating scores (p=0.19) or with modified Lazarus CT scan seating scores (p=0.80). CT allowed for better intra- and inter-observer reliability in all categories.

Conclusion
Excellent seating and low rates of radiolucent lines were obtained with the use of a partially cemented anchor peg glenoid component. Radiolucent lines were not associated with seating scores. Intra- and inter-observer reliability of partially cemented glenoid component radiolucencies and seating improves with the use of thin cut CT scans and reconstruction images.

Figure 1: AP radiograph of left shoulder with Lazarus seating score B and radiolucent line score 0

Figure 2: Axial cut CT showing bony incorporation between radial fins of central peg
Introduction
Damage to metallic femoral heads can occur in vivo. Increasingly, regulatory agencies are requiring testing of hip prostheses under high demand or even “abrasive conditions.” Abrasion likely increases both wear and friction at the head/liner interface. In this study, we investigated if our novel friction measurement technique can detect damage to femoral heads during extended wear testing of metal-on-plastic (MOP) THR s of various material combinations using both scratched and as-new femoral heads.

Materials and Methods
Friction was measured based on equilibrium of forces and moments measured by a 6-DOF load cell on each test station of an AMTI hip simulator. The force and moment data was utilized to calculate the frictional torque about each of three rotational axes (flexion/extension, abduction/adduction and internal/external rotation). The frictional torques were transformed to account for the offset in load cell position from the hip center and were then vector summed to yield an overall frictional torque about the femoral head. The friction factor was then computed by dividing the overall frictional torque by the applied compressive load and the femoral head radius. The waveforms specified in ISO-14242-1 representing normal human walking gait were used. Diluted bovine serum at 37ºC lubricated the specimens during testing.

Twelve UHMWPE liners (40mm I.D.) were tested against CoCrMo femoral heads. Liners were of three materials:

- Three conventional (GUR1020, gamma-sterilized 3.5Mrad),
- Three highly cross-linked (HXL) (GUR1020, 10Mrad, annealed, EtO-sterilized, artificially aged), and
- Six HXL w/vitamin-E (GUR1020, 12Mrad, annealed, EtO-sterilized, aged).

The test comprised three different phases:

**Phase – 1:** Standard clean test for 5 million walking cycles (Mc);

**Phase – 2:** Pulverized PMMA was added to serum at 700 mg/L (introducing somewhat abrasive conditions); this testing phase lasted 2Mc (taking the test to 7Mc total);

**Phase – 3:** Femoral heads were then deliberately scratched in the lab using a technique developed in house to create random latitudinal and longitudinal scratches similar to what is seen on retrievals. The scratching technique involved pressing femoral hip heads into abrasive beads under a known load (712N, one body weight) to create longitudinal scratches. Latitudinal scratches were generated by rotating the femoral heads 90º about their polar axis while still under load.

This process was repeated 10 times on each femoral head which resulted in random scratch patterns, but repeatable severity and similar visually to retrievals. Phase – 3 lasted for 1Mc, for a total of 8Mc.
Results

Phase – 1: (Clean test with no 3rd body particles or abrasion) went as expected, with the HXL and vitamin E HXL wearing much less than the conventional bearings (Figure 4). Friction factors of three THR types were similar during this phase (0.062±0.0084, Figure 4).

Phase – 2: Addition of the PMMA powder only slightly increased the wear and friction factor (0.066±0.0066) of the bearings, because it did not significantly scratch the heads. The PMMA failed to create sufficiently abrasive conditions.

Phase – 3: Wear was double that of Phase – 1, a statistically significant increase for all material types (p < 0.05). The friction factors also increased once the heads were scratched (Conventional: 0.11±0.0077, HXL: 0.082±0.0049, Vitamin E HXL: 0.087±0.022). Our scratching procedure not only successfully created the appearance of abrasive conditions through femoral head surfaces which were similar to a typical implant retrieval, but they produced a quantitatively higher friction as measured here.

Discussion and Conclusions

This friction technique successfully detected when femoral head damage had occurred. Higher friction was clearly observed after femoral heads had been scratched and high wear was occurring. The initially decreasing friction factor observed on most THRs coincided with a possible “bedding-in” period where the UHMWPE liner conformed to the femoral head.

THR friction measured during these hip simulation wear studies was shown here to depend on, and it may therefore be predictive of, the level of abrasive damage (scratching) of the femoral heads. This could save time and cost of lengthy wear studies.
TOTAL KNEE ARTHROPLASTY WITH A COMPUTER-NAVIGATED SAW
A PILOT STUDY

Garvin, K; Barrera, A; Mahoney, C; Hartman, C; Haider, H

With kind permission from Springer Science+Business Media: Clinical Orthopaedics and Related Research®, Total Knee Arthroplasty With a Computer-navigated Saw. A Pilot Study. Vol. 471 (1) 155-61, January 2013, Authors: Garvin, K; Barrera, A; Mahoney, C; Hartman, C; Haider, H; Figures 1-7; Table 1. Symposium: Papers presented at the Annual Meetings of the Knee Society

Background
Computer-aided surgery aims to improve implant alignment in TKA but has only been adopted by a minority for routine use. A novel approach, navigated freehand bone cutting (NFC), is intended to achieve wider acceptance by eliminating the need for cumbersome, implant-specific mechanical jigs and avoiding the expense of navigation.

Questions/Purposes
We determined cutting time, surface quality, implant fit, and implant alignment after NFC of synthetic femoral specimens and the feasibility and alignment of a complete TKA performed with NFC technology in cadaveric specimens.

Methods
Seven surgeons prepared six synthetic femoral specimens each, using our custom NFC system. Cutting times, quality of bone cuts, and implant fit and alignment were assessed quantitatively by CT surface scanning and computational measurements. Additionally, a single surgeon performed a complete TKA on two cadaveric specimens using the NFC system, with cutting time and implant alignment analyzed through plain radiographs and CT.

Results
For the synthetic specimens, femoral coronal alignment was within ± 2º of neutral in 94% of the specimens (Figure 1). Sagittal alignment was within 0º to 5º of flexion in all specimens (Figure 2). Rotation was within ± 1º of the epicondylar axis in 97% of the specimens (Figure 3). The mean time to make cuts improved from 13 minutes for the first specimen to 9 minutes for the fourth specimen (Figure 4). TKA was performed in two cadaveric specimens without complications and implants were well aligned.

Conclusions
TKA is feasible with NFC, which eliminates the need for implant-specific instruments. We observed a fast learning curve.

Clinical Relevance
NFC has the potential to improve TKA alignment, reduce operative time, and reduce the number of instruments in surgery. Fewer instruments and less sterilization could reduce costs associated with TKA.
Figure 1: A graph shows the frequency and magnitude of errors in coronal alignment. The errors never exceeded 4° in either direction.

Figure 2: A graph shows the frequency and magnitude of errors in sagittal alignment. The error in more than 90% of the cases was less than 3°. The skew in the data showed all the surgeons were conservative and tried to avoid excessive cutting that might cause anterior notch.

Figure 3: A graph shows the frequency and magnitude of errors in rotational alignment. The errors never exceeded 2° in either direction. ER = external rotation; IR = internal rotation.

Figure 4: A graph shows times of bone cutting for all surgeons, broken down and averaged according to the order in which the bones were cut. Values are expressed as mean and SD. A clear and steep learning curve is evident.
INTER- AND INTRA-OBSERVER RELIABILITY OF TWO-DIMENSIONAL CT SCAN FOR TOTAL KNEE ARTHROPLASTY COMPONENT MALROTATION

Konigsberg, B; Hess, R; Hartman, C; Smith, L; Garvin, K

Background
Rotational malalignment of total knee arthroplasty (TKA) has been correlated with patellofemoral maltracking, knee instability, and stiffness. CT is the most accurate method to assess rotational alignment of prosthetic components after TKA, but inter- and intraobserver reliability of CT scans for this use has not been well documented.

Questions/Purposes
The objective of this study was to determine the inter- and intraobserver reliability and the repeatability of the measurement of TKA component rotation using two-dimensional CT scans.

Methods
Fifty-two CT scans of TKAs being evaluated for revision surgery were measured by three different physicians. An orthopaedic resident and attending measured the same scans twice (more than 2 weeks apart) and a musculoskeletal radiologist measured them once. To assess interobserver reliability, intraclass correlation coefficients (ICCs) with two-way mixed-effects analysis of variance models, as well as 95% confidence intervals for each were done. The repeatability coefficient was calculated as well, which is defined as the difference in measurements that include 95% of the values. This indicates the magnitude of variability among measurements in the same scale, which in this study is degrees.

Results
The interobserver ICC measurement for the femoral component was 0.386 (poor), and it was 0.670 (good) for the tibial component. The interobserver ICC for the combined rotation measurements was 0.617 (good). The intraobserver ICC for the femoral component was 0.606 (good), and it was 0.809 (very good) for the tibial component. The intraobserver ICC for combined rotation was 0.751 (good). The intraobserver repeatability coefficient for the femoral component was 0.49°, 10.64° for the tibial component, and 12.29° for combined rotation.

The intraobserver overall ± 5° margin of equivalency for the femoral component was 95%; for the tibial component, it was 69%; and for the combined rotation, there was a 54% chance that all the measurements taken would fall within 5° of each other.

Conclusions
In this study, the inter- and intraobserver reliability, and the repeatability, of TKA component rotation were variable. This raises concern about whether CT scan is diagnostic in the assessment of component malrotation after TKA.
Figure 1: The CT scan is an image at the level of the femoral medial and lateral epicondyles. Line A represents the epicondylar axis of the femur and Line B represents the femoral component posterior condylar surface and the component rotational axis. In this patient, the femoral component is 1.03° internally rotated.

Figure 2: The intersection of the lines shown on the tibia represents the geometric center of the knee (GC).

Figure 3: The line is to the center of the tibial tubercle (T).

Figure 4: Line “TR” represents the tibial anatomic axis for rotation and line “CR” represents the tibial component axis for rotation. The angle formed by the intersection of these lines represents the component rotation. In this patient, the tibial component is internally rotated 27°.
OUTCOMES FOLLOWING DISTAL HUMERAL FRACTURE FIXATION WITH AN EXTENSOR MECHANISM-ON APPROACH

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Investigation performed at the Department of Orthopaedic Surgery and Rehabilitation, University of Nebraska Medical Center, Omaha, Nebraska

With kind permission from Rockwood Water, Inc.: Journal of Bone and Joint Surgery American, Outcomes Following Distal Humeral Fracture Fixation with an Extensor Mechanism-On Approach, 94(6), 548-553, March 2012, Authors: Erpelding, J; Mailander, A; High, R; Mormino, M; Fehringer, E.

Background
Distal humeral fractures (Figures 1a and 1b) have traditionally been managed with surgical approaches that disrupt the extensor mechanism. We hypothesized that an extensor mechanism-on approach for operative fixation of distal humeral fractures (Figure 2) with parallel or orthogonal plate constructs (Figures 3a and 3b) would allow excellent healing, a motion arc of the elbow exceeding 100º, and maintenance of extensor mechanism strength.

Methods
Distal humeral open reduction and internal fixation (ORIF) was performed with either orthogonal or parallel plate constructs in seventy-nine elbows. Thirty-seven elbows were fixed via an extensor mechanism-on surgical approach, and twenty-four of them were available for additional evaluation. Radiographs as well as MEPI (Mayo Elbow Performance Index), DASH (Disabilities of the Arm, Shoulder and Hand), and SF-36 (Short Form-36) scores were obtained.

Results
All thirty-seven fractures healed primarily. Three elbows underwent later release because of stiffness. The median arc of elbow motion was 126º (range, 60º to 141º). The mean MEPI was 91.5 points and the mean DASH score was 15.9 points, indicating excellent scores with mild impairment. The median percent loss of triceps strength was 10% (range, 0% to 49%) compared with the contralateral, normal elbow.

Conclusions
Open treatment of distal humeral fractures with an extensor mechanism-on approach results in excellent healing, a mean elbow flexion-extension arc exceeding 100º, and maintenance of 90% of elbow extension strength compared with that of the contralateral, normal elbow.

Figure 1a: Initial injury lateral radiograph of a 54-year-old man with a displaced distal humeral fracture

Figure 1b: Anteroposterior radiograph
Figure 2: Medial dissection and arthrotomy posterior to the humeroulnar ligaments. A = ulnar nerve, B = medial epicondyle, C = trochlea, and D = olecranon tip. (Reproduced, with permission, from: Schildhauer TA, Nork SE, Mills WJ, Henley MB. Extensor mechanism-sparing paratricipital posterior approach to the distal humerus. J Orthop Trauma. 2003;17:374-8.)

Figure 3a: Lateral radiograph made 10 months after fixation of the fracture shown in Figures 1a and 1b

Figure 3b: Anteroposterior radiograph
This paper addresses the application of engineered nanocrystalline ultra-hydrophilic titanium oxide films to artificial orthopaedic implants. Titanium (Ti) is the material of choice for orthopaedic applications and has been used for over fifty years because of its known biocompatibility. Recently it was shown that biocompatibility of Ti metal is due to the presence of a thin native sub-stoichiometric titanium oxide layer which enhances the adsorption of mediating proteins on the surface, thus enhancing cell adhesion and growth. Improving the quality of surface oxide, i.e., fabricating stoichiometric oxides, as well as nanoengineering the surface topology that matches the dimensions of adhesive proteins, is crucial for the increase of protein adsorption and, as a result, the biocompatibility of Ti implant materials. We have fabricated ultra-hydrophilic nanocrystalline transparent films of anatase phase of titanium (TiO$_2$) by ion beam assisted deposition (IBAD) processes in an ultrahigh vacuum system. Source material was 99.9% pure rutile TiO$_2$. Various ion beam conditions were used to produce these coatings with different grain sizes (4 to 70 nm) that affect the wettability, roughness, and the mechanical and optical properties of the coating. Our biological experiments have shown that biocompatibility of these ultra-hydrophilic nanoengineered TiO$_2$ coatings are superior to commonly used orthopaedic titanium.

**Introduction**

Orthopaedic and dental implants have used various coatings, such as hydroxyapatite, to encourage osseointegration. However, concerns have been raised about the mechanical strength, debonding, and bioabsorption of these layers. We have designed and engineered novel, hard, mechanically and chemically stable, ultra-hydrophilic, nanocrystalline TiO$_2$ coatings to support bone ingrowth.

We have demonstrated fabrication of thin film of amorphous, rutile, brookite, and anatase phases of TiO$_2$ by IBAD processes. Comparing the IBAD nanocrystalline transparent anatase TiO$_2$ films with the orthopaedic materials indicates that IBAD TiO$_2$ is superior in supporting growth, adhesion, and proliferation of the bone marrow stromal cell line.

Historically, Ti and its Ti alloy were considered biocompatible because of their excellent corrosion resistance, which substantially limits the amount of ions released into the tissue under most conditions. It is not known if trace amounts of the titanium metal released influence any part of the tissues. The corrosion-resistance of titanium was believed to be due to instantaneous oxide formation on its surface. Our recent studies of orthopaedic-grade titanium indicated that titanium possess a 2 to 3 nm TiO$_2$ layer which not only protects the metal, but also enhances the adsorption of mediating proteins on the surface, which then influences cell adhesion and growth. Below we will briefly discuss the roles and benefits of nanocrystalline TiO$_2$ coatings for artificial orthopaedic implants.

**Experiments**

Nanocrystalline TiO$_2$ is produced by IBAD in the Nanotechnology Laboratory at the University of Nebraska Medical Center. Energetic ions (oxygen, nitrogen, and argon) are employed to produce engineered nanocrystals “stitched” to a metallic substrate by ion bombardment using an “ionic hammer.” This is a unique approach, which can produce single and multi-layer films with desired surface properties that are not possible through conventional techniques. IBAD can be applied to deposited films with less built-in stress than other techniques and excellent adhesion. We have applied IBAD to TiO$_2$ films deposited at room temperature to 600°C onto silicon (Si), glass, and orthopaedic-grade titanium substrates.

The thin film characteristic and surface morphology of IBAD TiO$_2$ films produced at different deposition conditions and their relationship to their hydrophilicity were studied by transmission microscopy (TEM), atomic force microscopy (AFM), and contact angle measurements. The wetting characteristic of TiO$_2$ was observed by measuring the contact angle of a deionized (DI) water droplet on the surfaces of various samples using a computer-controlled video contact angle (VCA) instrument.

SAOS-2 human osteoblast-like cell line was used for the tests. Cells were grown in McCoy’s 5A medium with 15% Fetal Bovine Serum and 1% gentamycin. Cell morphology was visualized by microscopy at 40x after staining with actin (5:200, Invitrogen, Alexa Fluor 546 Phalloidin) and DAPI (300 nM, Invitrogen, 6-diamidino-2-phenylindole).

**Results**

Atomic force microscopy (AFM) was employed to investigate the surface morphology of the as-deposited TiO$_2$ thin films (Figure 1). It should also be noted that we have produced TiO$_2$ films with roughness ranging from 1 to 70 nm by varying IBAD conditions. The surface morphology of TiO$_2$ samples was studied by AFM where the presence of semi-pyramidal nanostructures was observed.
Figure 2: Comparing visualization of the morphology and adherence of SAOS-2 cells on nanocrystalline TiO₂ (a) and biomedical-grade titanium (b and c) by fluorescence microscopy at 400x at the same growing conditions and 48 hours of incubation. Most of the adherent cells on the nanocrystalline TiO₂ are spread and actin filaments (red) are evident, as compared to titanium, which some cells are rounded up and their nucleus (blue) are fragmented.

Figure 2 shows there are greater numbers of cells on nanocrystalline anatase TiO₂ compared to microcrystalline Ti. In addition, most of the adherent cells on the nanocrystalline TiO₂ are spread and the actin filaments are evident. Although there was variability in different areas of the biomedical-grade Ti, overall, fewer cells on the microcrystalline Ti are adhered and spread, some cells are rounded up, and some have nucleus fragmentation indicating apoptosis and cell death. Overall, cell survival, adhesion, and morphology indicated that the cells growing on the nanocrystalline TiO₂ are healthier than those growing on biomedical grade Ti.¹⁵

Discussion

Our as-deposited nanostructured coatings exhibited contact angle of 0 degrees. A few weeks later contact value increase slightly. After one year, one of our samples has shown contact angle of 14 degrees, which is considerably lower than previously observed.

Surface wettability and morphology affect the adhesion of cells to a surface. In cell-cell adhesion, one of the extracellular matrix (ECM) proteins, fibronectin (FN), mediates the interactions between cells by insoluble FN matrix. The FN absorption is considered in the literature as one of the most essential events in cell adhesion and bone formation on the implant surface.¹⁴ Together with other adhesive proteins and proteins incorporated into ECM,¹⁵ FN dimer mediates the cell adhesion to the implant surface.

Particularly, FN dimer plays the role of specific anchor and signal factor for cells on the implant surface and provides focal or cell–matrix adhesion. Thus, the FN adsorption is a key factor in cell adhesion and bone formation at an implant surface.¹⁶ We have demonstrated that FN may adhere stronger to the nanostructured surface than to the planar smooth surfaces due to the roughness, fitting to the size of FN and electrostatically to the protein (due to the locally charged patches originated by nanostructuring).² This may facilitate faster cell adhesion to the surfaces and their proliferation.

Conclusion

Our results indicate that nanoeengineering TiO₂ coatings with grain sizes ranging from 2 to 10 nm, which is comparable with the dimension of adhesive protein, will enhance cell adhesion and growth. Nanocrystalline ceramics such as TiO₂ and zirconium oxide (ZrO₂) possess unique properties that alter cell adhesion by direct (cell–surface interactions) and indirect (affecting protein–surface interactions) mechanisms.² This result is consistent with our recent animal studies⁸ that show faster and better quality bone growth on a titanium implant coated with the nanostructure ceramics.

Acknowledgment

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References

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