merc RESEARCH

MUSCULOSKELETAL EDUCATION
AND RESEARCH CENTER


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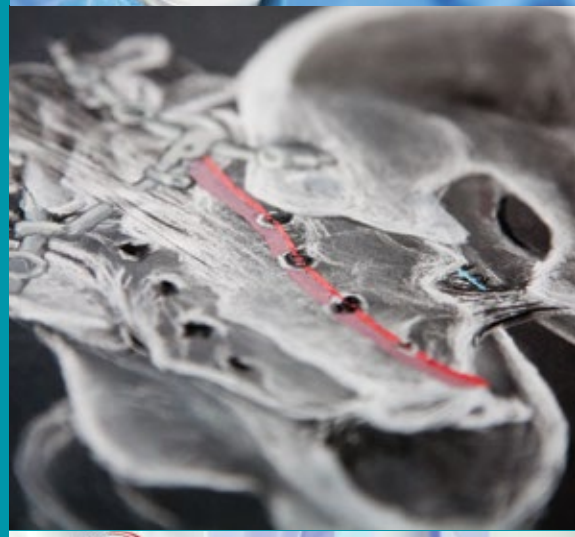
On behalf of Globus Medical, I am delighted to share with you the mission of the Musculoskeletal Education and Research Center (MERC), which is defined by integration, development, and expansion, to create a multidisciplinary research center with core areas of research excellence across a broad spectrum of scientific disciplines. The purpose of this endeavor is to establish and maintain a premier musculoskeletal research and teaching center while developing a collaborative worldwide network of research colleagues dedicated to the treatment of patients with musculoskeletal disorders. It is our fundamental motivation that steadfast, concerted research efforts by clinicians, research staff, and fellows builds upon the scientific and clinical knowledge base of musculoskeletal disorders, improving surgical care and quality of life for patients.

Dave Demski

Chief Executive Officer



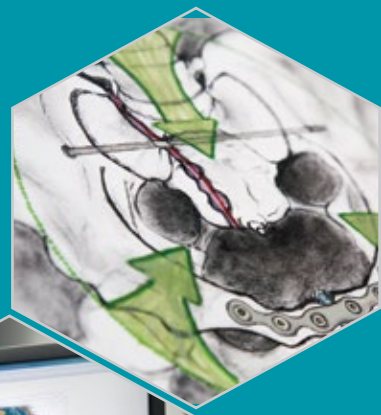
MUSCULOSKELETAL EDUCATION AND RESEARCH CENTER

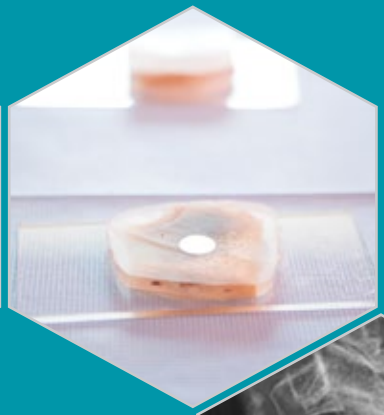
OVERVIEW

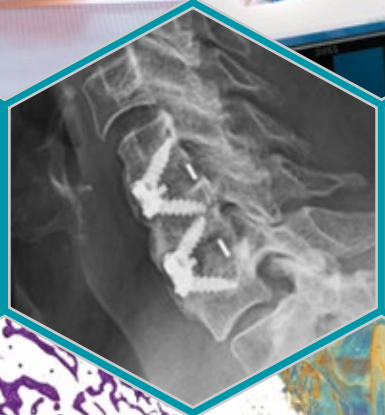
The Musculoskeletal Education and Research Center (MERC) serves as the educational and research division of Globus Medical. In keeping with the mission of MERC, staff members endeavor to maintain a multidisciplinary research center with core areas of research excellence across a broad spectrum of scientific disciplines. These include biomechanical testing, computational modeling, histology and histomorphometry, radiography, scanning electron microscopy and particle analysis, *in vivo* biological modeling, and clinical research. Of high collateral importance is the Bohlman-Cushing-Dandy Memorial Library and Archives, which has been entrusted to MERC for the benefit of staff and fellowship researchers. MERC adheres to Good Laboratory Practices (GLP) and provides a basic scientific, biomechanical, and clinical research facility at which researchers and clinicians can pursue their musculoskeletal research interests and goals.

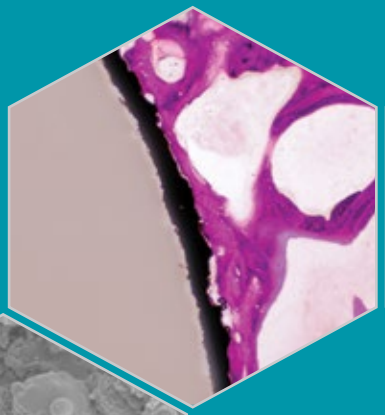
Trained investigators and educational professionals at MERC collaborate with nationally and internationally recognized orthopaedic surgeons and neurosurgeons to conduct research and provide training programs. Our focus is to educate surgeons from all over the world on the safe and effective use of Globus Medical products while providing general education on musculoskeletal disorders and treatment.

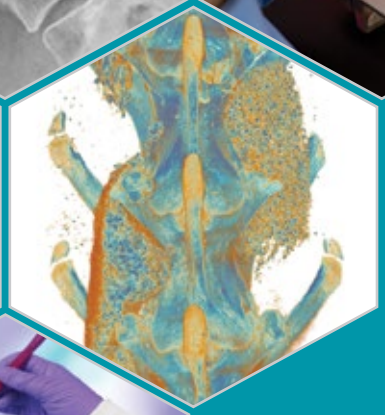
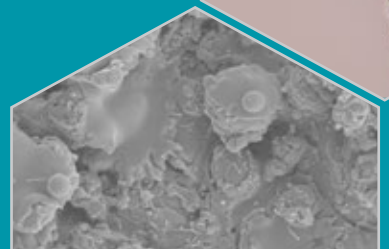






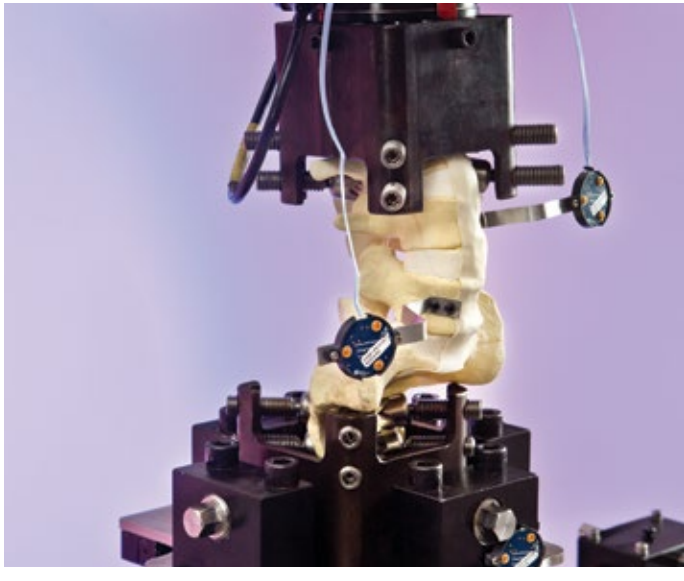



CORE AREAS OF RESEARCH

BIOMECHANICAL TESTING

The foundation of the biomechanical testing laboratory is the six-degrees-of-freedom motion simulator, designed to apply controlled multidirectional motions—flexion/extension, lateral bending, and axial rotation—to musculoskeletal structures. Biomechanical testing platforms are configured with highly accurate optoelectronic motion analysis systems that enable researchers to quantify and compare segmental spinal kinematics following destabilization or reconstruction techniques. The testing platform is designed for a variety of transducers which can be interfaced to measure parameters such as intervertebral disc pressure and strain within osseous structures or spinal constructs. The laboratory is also equipped with MTS units for static and fatigue testing of specimens, a dual-energy x-ray (DEXA) scanner for quantification of bone mineral density, an O-arm surgical navigation system, and fluoroscopic image intensifiers.

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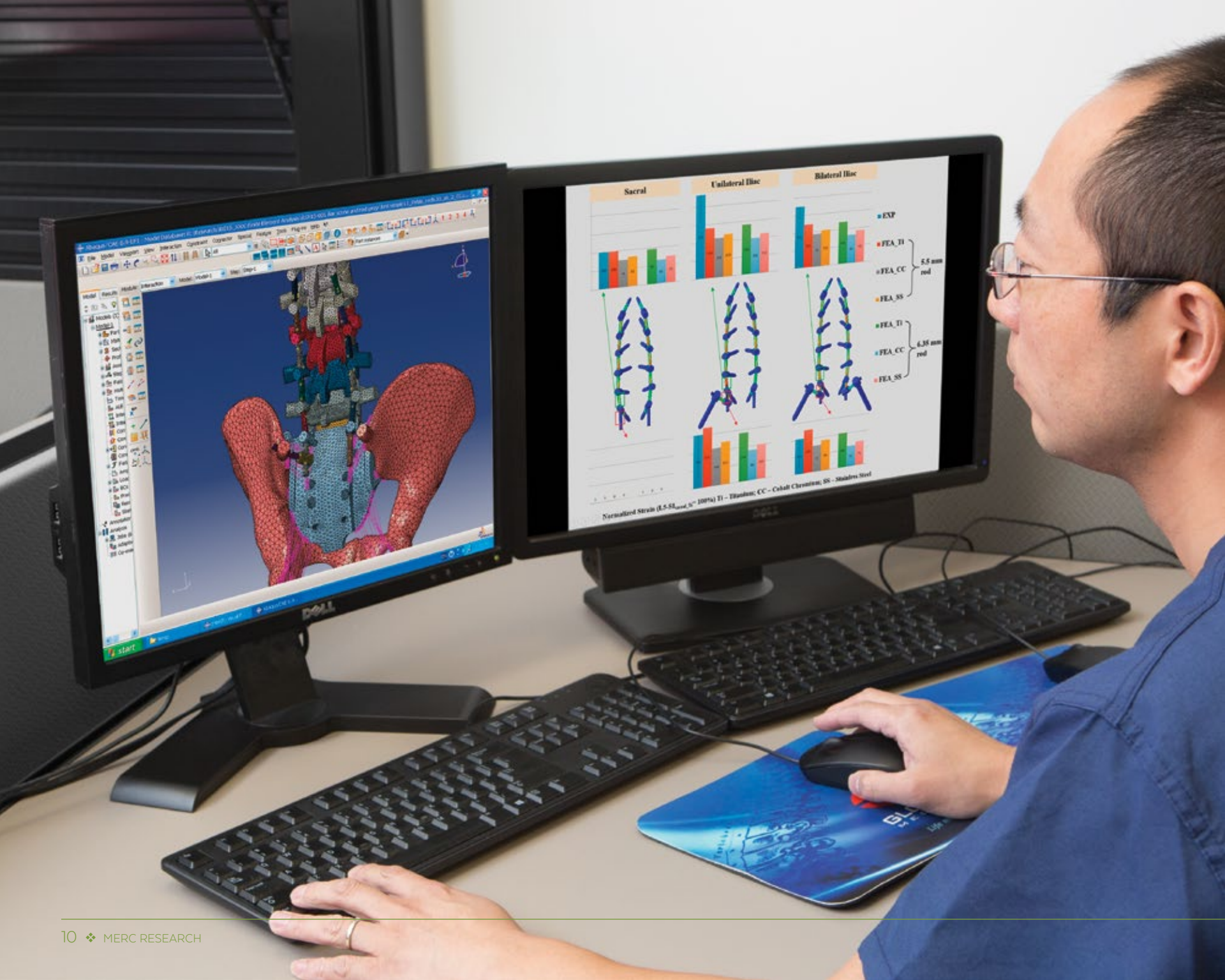
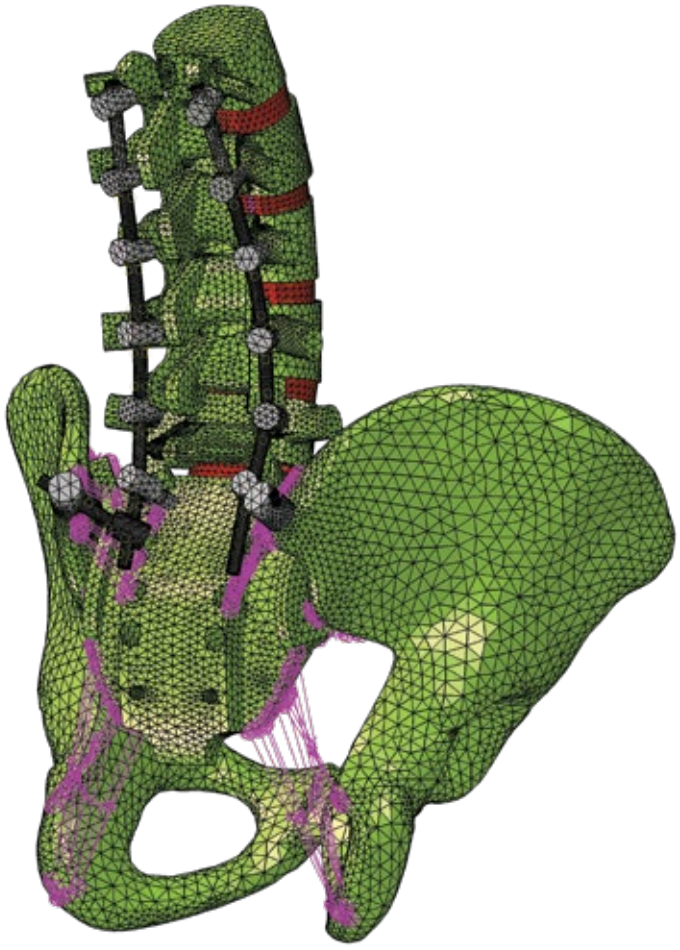
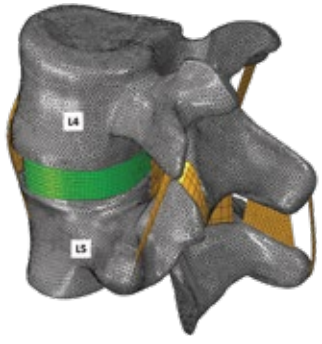
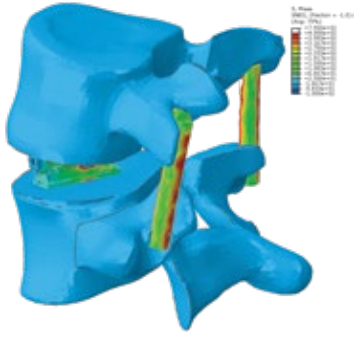

Sacral
Unilateral Iliac
Bilateral Iliac
EXP
FEA_Ti
FEA_CC
FEA_SS
5.5 mm rod
FEA_Ti
FEA_CC
FEA_SS
6.35 mm rod
Normalized Strain (LS-SS$_{rod}$ = 100%) Ti – Titanium; CC – Cobalt Chromium; SS – Stainless Steel

COMPUTATIONAL MODELING

Along with biomechanical testing equipment, the MERC facility features a computer-aided design and computational analysis software suite. Researchers conduct stress analysis simulations of the spine and applied implant constructs as part of the research and development process. Finite element models of fully anatomic L4-L5 lumbar motion segments and lumbopelvic anatomies generate accurate, experimentally validated data sets. These models allow physiologic simulation of standard decompression, disc replacement, and fusion reconstruction techniques, and enable researchers to investigate stress and strain patterns within implants or biological structures. Computational modeling provides the opportunity for surgeons and engineers to improve implants designed for fusion or non-fusion technologies, streamline the product development life cycle, and conduct exploratory analysis of the anatomy.

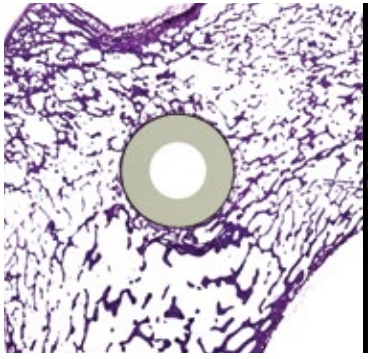


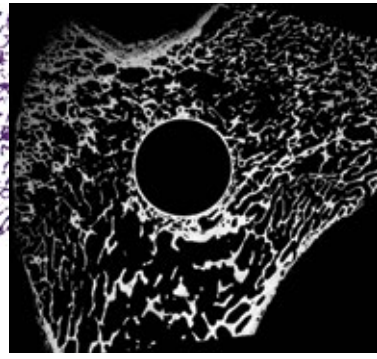


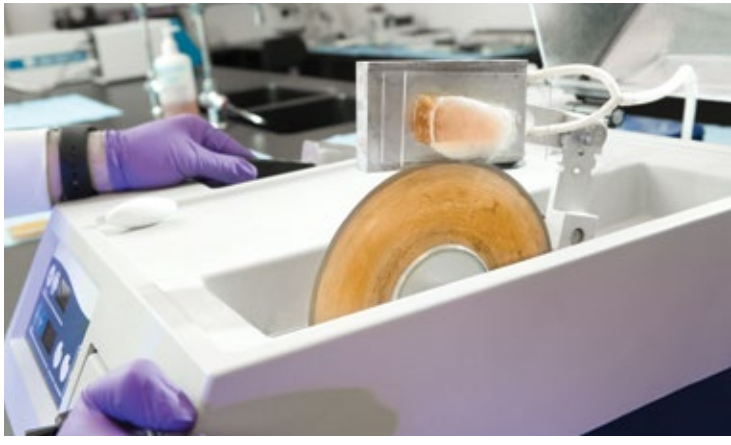


HISTOLOGY & HISTOMORPHOMETRY

The histology laboratory is capable of processing a wide variety of tissue samples that include operative fusion segments, intervertebral arthroplasty devices, osseous defects, and implants, through un-decalcified and decalcified techniques. The laboratory is uniquely equipped for examination of oversized osseous specimens using micro-grinding technology, microtomes, and diamond cutting blades. Histologic slides of varied thickness can be produced for highly accurate assessment of bone remodeling, wear debris, inflammatory reactions, degenerative changes, and osseointegration at the implant interface. Immunohistochemical macrophage and cytokine assays can be performed to further delineate cellular mediators in inflammatory reactions. Histomorphometric image analysis permits quantitative calculations of osseous and soft tissue parameters.

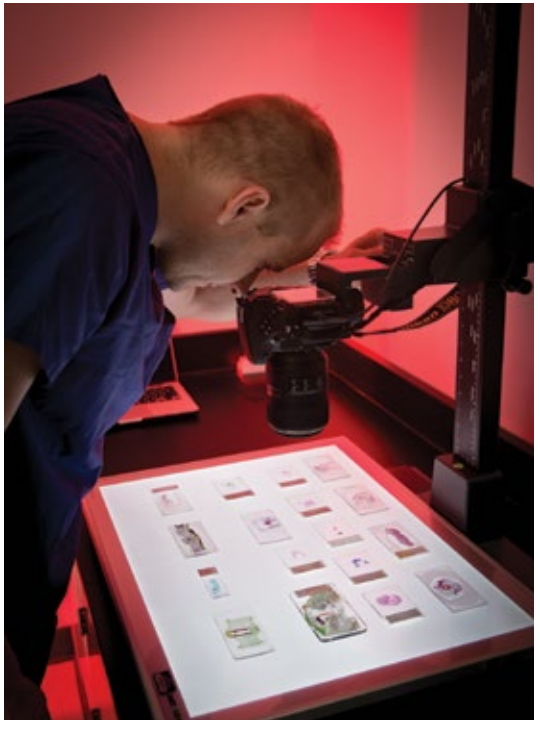






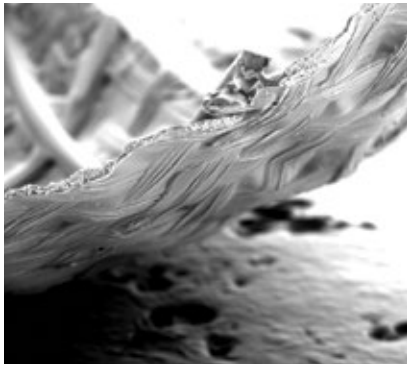
RADIOGRAPHY

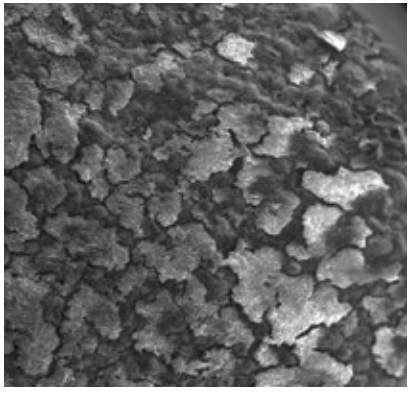
A comprehensive suite dedicated to visualization and quantitative assessment of radiographic plain films, high resolution microradiographs, computed tomography (CT), micro computed tomography (MicroCT) scans, and magnetic resonance imaging (MRI), is available. The MicroCT core facility houses a high-energy desktop scanner with the flexibility to image large and small objects of variable density. MicroCT offers greatly enhanced resolution, which approaches tens of microns, and provides a method of conducting 3D microscopy that can be applied in analysis of spinal implants and biological materials. Biological tissue samples can be imaged in combination with implants and virtually delineated with the use of image registration and segmentation software. Moreover, 3D slicing algorithms can be used to quantify bone volume in multiple planes and orientations as observed on CT/MRI and MicroCT scans. Applications include measurement of bone formation and implant resorption, quantification of bone volume, and overall morphologic assessment.

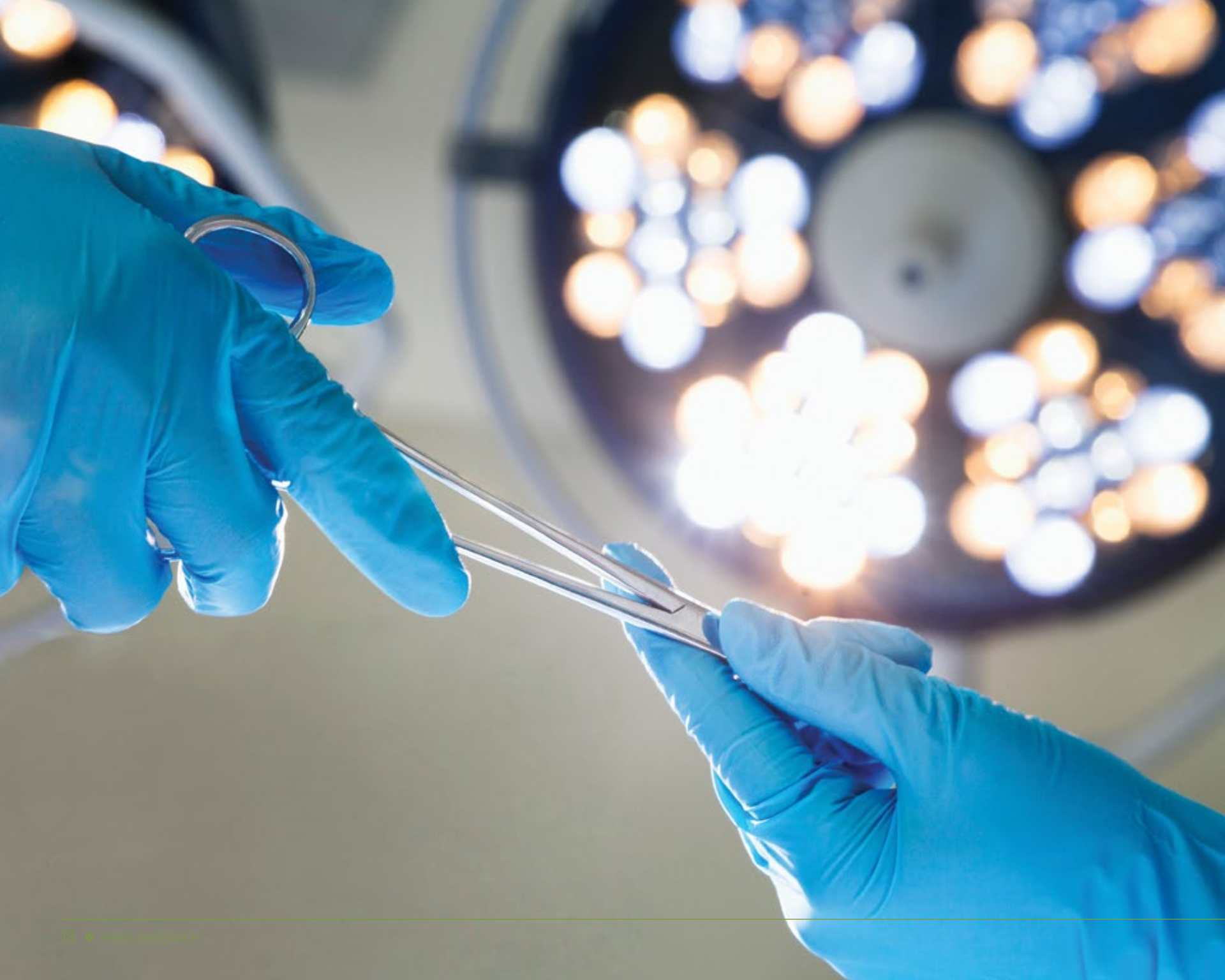


SCANNING ELECTRON MICROSCOPY AND PARTICLE ANALYSIS

The scanning electron microscopy and particle analysis laboratory at MERC permits researchers to evaluate implant surface topography and perform particle analysis—processes that are paramount for fusion and non-fusion technologies. The scanning electron microscope (SEM) is capable of analyzing wear particulates and surface topography at magnifications greater than 100,000. The SEM can be used in combination with computational modeling techniques to determine how corrosion, pitting, surface erosion, cracks, and particulate are related to stress under *in vivo* conditions. Results of surface particulate analysis can be combined with SEM topographic images for complete characterization of the surface environment. Energy dispersive x-ray spectroscopy can be performed to identify unknown materials by elemental composition.





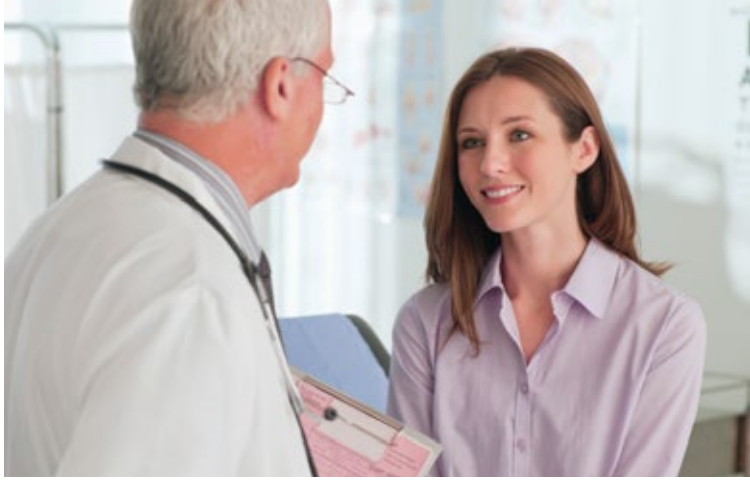


IN VIVO BIOLOGICAL MODELING

MERC conducts a wide variety of pre-clinical *in vivo* modeling studies to assess safety and efficacy of implant materials and devices. Strict adherence to all applicable guidelines as outlined by the Code of Federal Regulations (CFR, Title 21, part 58) and the USDA Animal Welfare Act is of utmost importance in these studies. All facilities interacting with MERC are accredited by the Association for Assessment and Accreditation of Laboratory Animal Care, compliant with the National Institutes of Health Office of Laboratory Animal Welfare, licensed by the US Department of Agriculture, and inspected by the Food and Drug Administration. Research projects are approved and closely monitored by the Institutional Animal Care and Use Committee, and strictly adhere to all applicable stipulations of the most recent version of the USDA Animal Welfare Act and Good Laboratory Practices. MERC has extensive experience with *in vivo* biological modeling for spinal arthrodesis, bone graft substitutes, motion preservation-based surgical reconstruction techniques, and neurotoxicity models.

CLINICAL RESEARCH

MERC conducts clinical research studies of scientific merit and interest, to assess the safety and effectiveness of products or techniques used to treat patients with spinal disorders. The MERC clinical research group collaborates with surgeons and clinical research coordinators to develop and conduct single or multicenter, prospective or retrospective, post-marketing research projects within the United States and in other countries. Clinical research group members, in collaboration with surgeons and clinical site staff, define outcome measures and manage de-identified patient data.



NON-CLINICAL RESEARCH FELLOWSHIP PROGRAM

The MERC Non-Clinical Research Fellowship Program enables young health care professionals to gain additional knowledge and research training in applied musculoskeletal research. The program is open to all recipients of an accredited medical doctorate (MD), doctorate of osteopathic medicine (DO), or Fellowship of the Royal College of Surgeons (FRCS) degree, who are currently enrolled in an accredited residency program for orthopaedics or neurosurgery. The non-clinical research fellowship program at MERC is designed to provide national and international clinicians the opportunity to participate in musculoskeletal research. This program assists fellows to become proficient in the methodological aspects of conducting basic scientific or clinical research while generating scientific manuscripts suitable for publication in peer-reviewed journals. The program is designed for candidates with commitment, a pioneering and teachable spirit, and a strong desire to succeed. As developed by a multidisciplinary organization, the MERC program offers rigorous and highly competitive research training within an intellectually challenging, innovative, and supportive environment, providing a strong foundation for future musculoskeletal research endeavors.

Dr. Henry H. Bohlman

Dr. Harvey W. Cushing

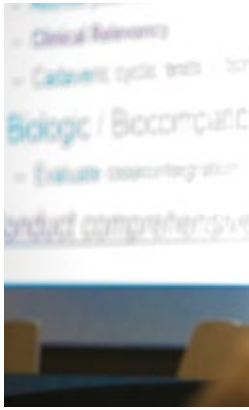
Dr. Walter E. Dandy

BOHLMAN-CUSHING-DANDY MEMORIAL LIBRARY AND ARCHIVES

World renowned neurosurgeons Dr. Harvey W. Cushing (April 8, 1869–October 7, 1939) and Dr. Walter E. Dandy (April 6, 1886–April 19, 1946) and orthopaedic spine surgeon Dr. Henry H. Bohlman (July 22, 1937–May 27, 2010) dedicated their lives to the training and education of surgeons. Through the enormous generosity of Ms. Amanda Prescott, Dr. Bohlman's widow, the Bohlman family, and Dr. Bohlman's close friends, Dr. Henry H. Bohlman's career-long collection of radiographic archives, 35mm slides, personal library, and memorabilia have been left in the care of MERC. As caretakers and stewards of Dr. Bohlman's work, MERC appreciates the importance of this role in bringing his wishes to fruition—creating a living digital archived database dedicated to the education and training of future generations of spine surgeons. Dr. Bohlman was the consummate educator, and his collection is dedicated to all devoted spine surgeons, of all countries, for the benefit of patients suffering from spinal deformity and neurologic compression. The Bohlman-Cushing-Dandy Memorial Library and Archives includes more than 60,000 x-rays and slides, along with Dr. Bohlman's personal library and memorabilia.

"The digitization of my 30+ year career. These images, radiographs, and pathology slides will be digitized with the clinical findings into a searchable database. The digital transformation will give clinical researchers unparalleled access to data regarding outcomes of surgical procedures performed to correct for various injuries and deformities of the spine. For spine surgeons, this database will be a goldmine of information that I hope will lead to new understandings of the spine and its surgical treatments."

– Dr. Henry H. Bohlman

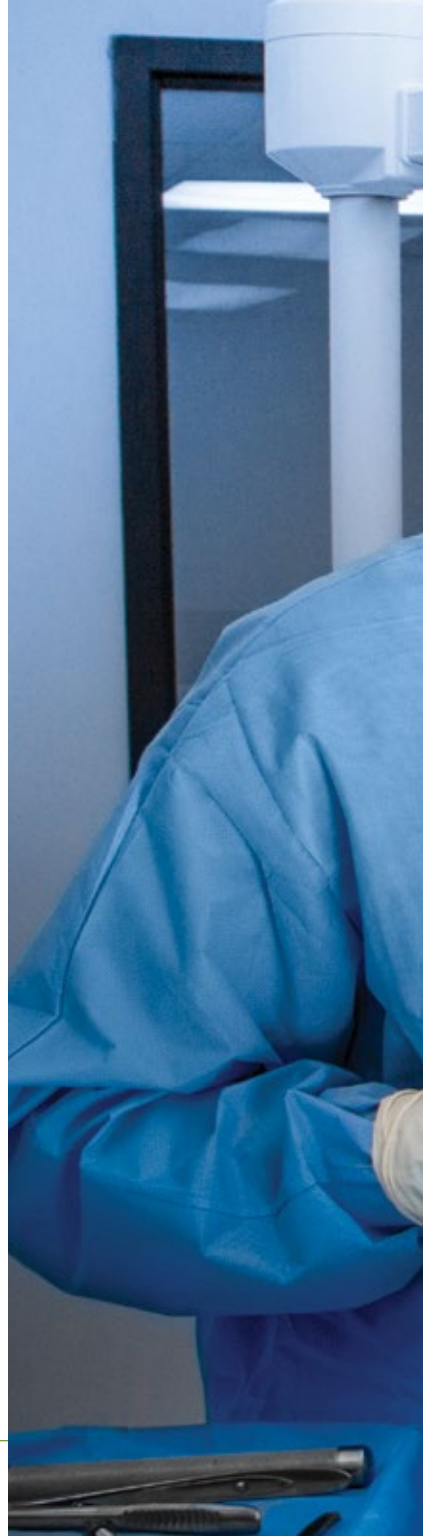


ANNUAL MERC SYMPOSIUM

The Annual MERC Symposium, held in Audubon, Pennsylvania, brings together internationally recognized researchers and surgeon faculty from a variety of multidisciplinary subspecialties on a single platform to discuss current concepts in spinal surgery and facilitate the exchange of scientific and clinical scientific perspectives, with the goal of improving care and treatment of patients with spinal pathology. The mission of the MERC Symposium is fourfold: (1) to provide education on current concepts and challenges in spinal surgery, (2) to showcase innovative research conducted over the past year, (3) to highlight new technologies and next generation advances in material science and device design, and (4) to enrich the aforementioned goals by infusing them with the scientific perspectives of esteemed thought leaders. Symposium proceedings are published in the journal *Spine* as a Supplement edition.

RESEARCH PROPOSALS AND GRANTS

MERC is committed to advancing spinal technology and improving patient care, and provides research grant support for basic scientific studies that explore new surgical techniques, expand our understanding of spinal biomechanics and disc biochemistry, and lead to the development of novel and effective treatments for patients with spinal disorders. MERC has developed a robust research and development program that enables research staff to work with care providers within the medical community. Further, MERC funds a variety of clinical research studies designed to improve patient care through well-designed protocols of scientific merit and interest in the use of implant devices as indicated and cleared by the FDA. Funding for basic scientific and clinical research proposals is decided by the MERC Research Steering Committee. For more information, visit www.globusmedical.com/research.

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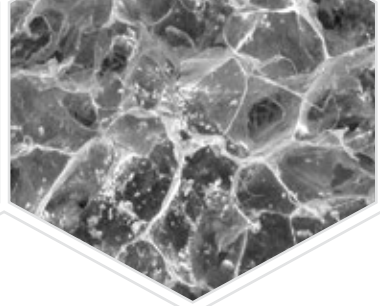

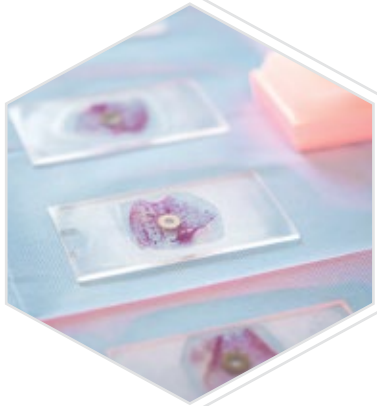

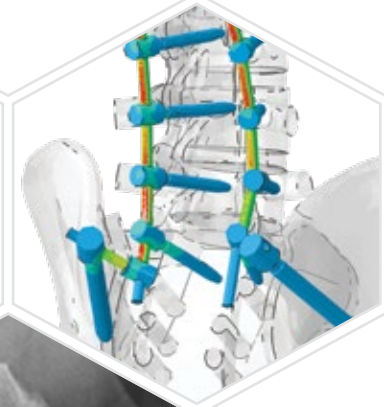

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