RESEARCH REPORT (2006 –2009)
Engineering Center for Orthopaedic Research Excellence (E-CORE)
Departments of Bioengineering and Orthopaedic Surgery
Colleges of Engineering and Medicine
University of Toledo, Toledo, OH 43606

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ACKNOWLEDGEMENTS

Through research we increase our understanding of the causes of various joint abnormalities and the associated pain and reduction in quality of life. This can in turn lead us to new and effective conservative and surgical procedures to restore the normal life style. It is with such aspects in mind that the University established the Engineering Center for Orthopaedic Research Excellence (E-CORE) in July 2006. We are grateful to the Administration for their foresight. The E-CORE has enabled us to attract scientists from within the campus and outside to pursue state-of-the-art research.

The Center has well equipped labs for research at the cellular level, bench and cadaver tests, analytical modeling, and clinical and patient follow up following surgery or rehabilitation. At present the research efforts encompass basic, preventive, interventional and translational, and deal in the area of lower extremity, spine and upper extremities, muscles and various physical therapy regimens. The Center staff is looking at ways to regenerate bone tissue.

The research efforts, besides peer reviewed publications, conference presentation and world-wide recognition of the work thus far accomplished, have led to several devices (translational research). The Center’s staff has filed patents for an exercise machine for the elderly golfers, a number of spinal devices, and a sensor for predicting micro cracks in lower extremities of the military recruits. We are looking at ways to improve the physical therapy approaches used for low back pain patients. We have also developed a laser based therapeutic device to enhance wound healing. Through the NSF funded grant on assistive devices for the disabled, a wheel chair that could be used on the beach was conceived.

The Center was able to attract project/research sponsorship from industry, foundations, and federal agencies like the NSF and NIH. The group has been extremely successful in securing funding from the State of Ohio under its Third Frontier Initiatives. McMaster and Gardner families jointly established an endowed Chair in Orthopaedic Bioengineering. Departments of Bioengineering and Orthopaedic Surgery have provided stipends for students and fellows.

The research activities described in the following pages would have not been possible without the support and hard work of staff, residents, fellows and students. Department of Radiology provided imaging support for the projects. John Jaegly and his staff from the College of Engineering Mechanical Shop helped with the machining/fabrication needs.

It is with pleasure we acknowledge everyone’s contributions to the success of the Center and hope that you all will continue to support us in the coming years.

Toledo, Ohio
July 1, 2009

Vijay K. Goel, PhD
Nabil Ebraheim, MD
MISSION

The Colleges of Engineering and Medicine (formerly known as Medical College of Ohio), the University of Toledo, in July 2006, formally established an Engineering Center for Orthopaedic Research Excellence (E-CORE). Drs. Vijay K. Goel, PhD and Nabil Ebraheim, MD were appointed the founding co-directors. The Center includes an interdisciplinary team of investigators from diverse fields such as medicine (e.g., orthopedics, anatomy, radiology), engineering (bioengineering, mechanical, chemical), bone metabolic diseases (e.g. endocrinology, bone biology, bone marrow stem cells) and allied health care professionals such as kinesiology and physical therapy. The Center provides an opportunity for the group to work together to understand the complex nature of the human skeletal system, like the hip, knee and spine.

E-CORE has three primary goals.

- Create new knowledge in basic and applied areas of orthopaedic research and become a nationally and internationally recognized center of excellence
- Educate the students, post-docs, residents, fellows, and the UT community in the area of the orthopaedic research and enable them to fulfill their intellectual and career objectives
- Improve the human condition by developing and applying new knowledge which will ultimately help patients suffering from various orthopaedic disorders

E-CORE thus fulfills the University’s broad mission by serving as a model for partnerships across the main and health science campuses of UT. E-CORE also provides contemporary education and research in orthopaedics and other related fields in medicine and engineering (e.g., biomechanics/ergonomics). The state-of-the-art clinical and engineering facilities enables faculty, staff, post-docs, residents, fellows and students (graduate and undergraduate) to work individually and collectively at the forefront of the field thus attracting national and international reputation for excellence.

More specifically, the objectives to fulfill the mission/goals are as follows:

- Undertake state-of-the-art research in the areas that are funded by external agencies
- Develop collaborative research/educational projects with faculty and staff from other units on our campus (e.g., neurosurgery, biology, physics, human health sciences, etc.)
- Initiate collaborative research efforts with units off campus within Ohio, the United States, and other countries
- Create incentives for the faculty and staff, especially the junior faculty from other units (on and off campus) to foster interdisciplinary research in accordance with E-CORE’s goals
- Train engineers, ergonomists, medical students, post-docs, residents and fellows
- Provide a state-of-the-art research facility for the education students
- Provide a state-of-the-art research facility for industry for the development and evaluation of products
- Serve as a laboratory for the evaluation of ergonomics-tasks on the UT campus.
PERSONNEL

Main Campus—The University of Toledo

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PERTINENT CURRENT PROJECTS AND RESEARCH AREAS

The members are currently pursuing externally funded applied and clinical research in the following areas:

- Orthopaedic Biomechanics (Spine, Knee, Assistive Technology)
- Biomaterials and Tissue Engineering
- Bone Biology
- Product Development/Translational Research

Spine: In the area of the spine, the primary investigators are Drs. Vijay Goel, Ashok Biyani, Hossein Elgafy and Nabil Ebraheim. Over the past two years, we have recruited a post-doc in the area of spine research. We also seek help from other faculty on and off campus. With their support we have secured substantial funding from industry and Ohio Research Scholar Program from the State of Ohio. We collectively, with help from fellows, residents and graduate students, undertake research involving spinal implant design and development (bench type tests, cadaver tests, finite element modeling), in vivo animal investigations, etc.

Dr. Elahinia (and Dr. Goel) is currently developing pedicle screw that will compensate for bone loss due to osteoporosis. This novel bio-inspired SMA device compensates for osteoporosis-induced adverse effects on spinal implants. To this end the device grows in the areas of bone loss to maintain continuous mechanical contact and desired total stiffness. This is a transformative departure from the existing spinal implants.

More recently, Dr. Azad, in collaboration with Drs. Goel, Biyani and Ebraheim, has initiated a project to develop antimicrobial titania nanomats for wound disinfection, and antimicrobial nanoscale coating of titania on implants for spinal wound healing. The project is funded by industry.
Under the ORSP funded grant, we will recruit a senior faculty in the area of spine and have adequate funds to acquire additional equipment and operational funds for the scholar’s use. We have also established a formal collaboration with Cleveland Clinic Foundation under the umbrella of the Ohio Research Scholar Grant. Complementing this cluster, we are strategically located next to a world-renowned animal testing and manufacturing facilities, (NAMSA, Toledo, Ohio, and Hammill Manufacturing Inc., Maumee, Ohio, respectively). Hammill manufactures orthopaedic implants, including spinal implants, for a large number of companies. We have sought their expertise for the design, development and in vivo evaluation of spinal implants.

Knee: This is the most researched area at the University of Toledo. For the last 20+ years, Dr. Mohamed S. Hefzy has been investigating the knee mechanics (in vitro testing, modeling, etc). Dr. Goel, very recently, has recruited Dr. Constantine Demetropoulos as Research Associate Professor, and a post-doc, Ali Kiapour on an NIH grant. Dr. Jason Levine, MD and Carmen Quatman, PhD, are interested in the knee mechanics and its correlation with biology in male and female athletes. They serve as co-investigators on the grant, along with the Cincinnati group (PI). Dr. Nabil Ebraheim and his staff are very active in pursuing research in the area of elbow, wrist, hip, knee and ankle joints as well.

Assistive Technology: Dr. Mohamed S. Hefzy designs and develops assistive devices for the physically challenged people in the society. More recently, Dr. Mohammad Elahinia as PI, with Drs. Hefzy and Armstrong as Co-PI, are working on the design and development of an ankle orthosis under their NSF funded grant.

Biomaterials and Tissue Engineering: Dr. Sarit Bhaduri is pursuing several externally funded research projects in this area, like the innovative approaches to the treatment of osteoporotic bone. Dr. A. Champa Jayasuriya has a Tissue Engineering/Regenerative Medicine background and is currently investigating biomimetic strategies for bone tissue engineering. She has/had funding from NSF and NIH. The main goal of Dr. Jayasuriya’s research is to develop new approaches for regeneration of damaged or diseased human bone tissues. Therefore, she is continuously working to develop novel methods to apply in bone regeneration.

Bone Biology: Dr. Beata Lecka-Czernik conducts her research under the umbrella of Center for Diabetes and Endocrine Research (CeDER) and has several grants in the area related to Diabetes, Obesity and Osteoporosis. These are major public health concerns due to their prevalence in our increasingly sedentary and aging society. The peroxisome proliferator-activated receptor-gamma (PPARγ) transcription factor is a protein that regulates glucose metabolism and energy expenditure. This protein also regulates lineage commitment of bone marrow mesenchymal stem cells (MSC). PPARγ protein is a target for a class of anti-diabetic drugs TZDs, which decrease glucose levels and increase insulin sensitivity. Although their beneficial anti-diabetic profile, prolonged treatment with these drugs leads to the bone loss and increased number of bone fractures in diabetic patients. Dr. Lecka-Czernik’s research has demonstrated that TZDs affect bone mass by changing lineage commitment of MSC toward formation of fat cells (adipocytes) and away from formation of bone forming cells (osteoblast). As a result, TZD administration to animals, as well as to humans, leads to the bone loss and the gain of fat in the bone marrow. Her research also demonstrated that the similar mechanism involving PPARγ protein is responsible for bone loss with aging.
Product Development/Translational Research: Some of the research activities have led to the development of products/concepts, primarily in the area of spine (artificial disc, motion preservation system, a golf exercise machine, and several other devices). Patents have been filed for some of these concepts and a few have been licensed to industry, like the Golf exercise machine (see the website http://turningpointeffect.com for details). Details for other patents are provided on Page 15.

Graduate and undergraduate students, residents and fellows assist the group with the research projects. They in turn get training and obtain their degrees.

RESEARCH FACILITIES

These are described below reflecting the research activities of various faculty/staff.

Orthopaedic Biomechanics Facilities (Faculty – Goel, Hefzy and staff from Orthopaedics, PL 1045 and 1050, NE 0650, NE 0630, and HEB 011 JKL): We have the equipment needed to undertake a typical biomechanical study as follows: Various still cameras; Panasonic Palm Corder (small) video camera; Active EMG electrodes with amplifiers; MTS programmable bi-axial tension/compression-torsion testing machine (Floor model); MTS programmable bi-axial tension/compression-torsion testing machine (Table top model); Two 3-D Optotrak Motion Measurement Systems; Enduratec microtester (tissue and cell level mechanical tests); Six Station MTS Wear tester for Spinal Implants like the artificial discs; Force Plates; Acoustic emission data acquisition system; Raman microscope with 633 nm and 785 nm laser excitations for Physico-chemical materials characterization; Fume hood equipped with air pressure, water supply, vacuum system, etc; Fracture producing drop apparatus; Computers and work stations; Other instrumentation, jigs and fixtures; Small workshop

At the College of Engineering, we have computing facilities and the software like ABAQUS, Solid Works, AutoCAD, etc for everyone’s use.

The Department of Radiology has the CT and MRI scanners, and other imaging equipment for use.

Dynamic and Smart Systems Facility (Dr. Mohammad Elahinia, NE 2045): The laboratory is a state-of-the-art facility for the development and characterization of smart material systems. A range of experimental devices provides the capability to perform comparative testing for shape memory alloy actuators. The devices are: dSPACE hardware-in-the-loop controllers for open and closed-loop data collection and experiments; A BOSE Electro-Force instrument with environmental chamber for assessing thermo-mechanical properties of the SMA medical devices; A non-contact laser transducers for measuring displacement and deformation with micrometer resolution; Polytec laser vibrometer for whole system noncontact deformation measurements; A variety of sensors and power supplies.

Materials Processing Facilities (Dr. Sarit Bhaduri, NE): The materials laboratory is equipped for powder and pellet processing. The instruments available include a 3 KW microwave furnace (MMT), cold iso-static press (50ksi pressure), a high temperature dilatometer, a reaction hot
press, a hot iso-static press (1500C and 30ksi pressure), a high temperature furnace (1800C) and powder pelletizers. Additionally, the materials characterization center comprises of characterization equipment including X-ray diffractrometer, SEM (Hitachi S4800), environmental SEM, FT-IR (Digilab Excalibur Series FTS 4000), AFM (Veeco instruments) with nano-indentation capability etc.

Dr. Azad has electrospinning equipment, an autoclave and other relevant equipment for the project listed above under the Spine research.

**Bone Biology Lab (Dr. Beata Lecka-Czernik, HSB 141):** The major equipment in this lab is as follows: Scanco mCT35 scanner, StepOnePlus Real-Time PCR System (Applied Biosystems), plate reader spectrophotometer, plate reader luminometer, class II biological safety cabinets (tissue culture), carbon dioxide incubators (Heraeus), Olympus CK40 inverted microscope, electrophoresis equipment, Geiger counter, hybridization oven, 3 microcentrifuges, 1 refrigerated microcentrifuge, microwave, 2 refrigerators, one –80°C and two –20°C freezers, temperature-controlled water baths, tissue homogenizer, analytical balance, pH meter, 2 thermocyclers.

**Tissue Engineering and Regenerative Laboratory (Dr. A. Jayasuriya, HEB 213):** The laboratory is equipped with an analytical balance, pH meter, several stirrer hot plates, spec freezer mill, UV spectrophotometer, general incubator, refrigeration with freezer, ultrasonicator and dessicator, stirred-type spinner flasks, stir table, centrifuge, microcentrifuge, CO₂ incubator, Class II biological safety cabinet, water bath, lyophilizer, and an inverted microscope.

**PROJECT SPONSORS**

The research projects have been sponsored from a wide range of groups as follows:

**Industry**

Abbott Spine  
Advanced Spine System  
Aesculap, Inc.  
Alphatec Tech, Inc.  
Altiva, Inc.  
Applied Spine Technologies, Inc.  
Biocure, Inc.  
Bionix Implant, Inc.  
Calcitec, Inc.  
DePuy Spine, Inc.  
Disc Dynamics, Inc.  
Disc Motion Technologies  
EBI, Inc.  
Encore Orthopedics, Inc.

Facet Solutions, Inc.  
Globus Medical, Inc.  
Graham Medical Technologies  
Innovative Spinal Technologies, Inc.  
Interventional Spine  
Japan Medical Manufacturing, Inc.  
LANX, Inc.  
Laurimed, LLC  
Medicine Lodge, Inc.  
Medicrea, Inc.  
Medtronic  
Maegellant Spine Technologies, Inc.  
NAMSA  
Nexgen Spine
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Projects sponsored by these companies primarily dealt with the evaluation of their innovative products. Because of the confidential nature of the projects, details are not listed.

**Foundations**

**NUCCRA Foundation**
2007-2009 $150,000 Biomechanics of Chiropractic Adjustments  
UT Investigators - Palmer and Goel

**American College of Sports Medicine Foundation**
2008-2009 $5,000 Research Award to Carmen Quatman, MD-PhD student

**American Diabetes Association**
2009-2012 $300,000 Prevention of TZD-induced bone loss and improvement of TZD-affected bone fracture healing  
Principal Investigator - Lecka-Czernik

**State of Ohio**

2005-2007 $866,606 Northern Ohio Center of Excellence in Product Development  
In collaboration with Camp, Inc. and Valtronic USA  
UT Investigators: Cameron, Goel, Biyani, Molitor, and Relue

2009-2014 $4,800,000 Research Cluster for Development and Evaluation of Spinal Implants  
Ohio Research Scholar Program  
Investigators (Goel—PI, Hefzy, Bhaduri, Elahinia, Azad, Nadarajah ,Armstrong, Pincivero, Palmer, Biyani, Ebraheim, Elgafy, Lecka-Czernik, Jayasuriya from University of Toledo) and (Gilbertson—Co-PI and Benzel from Cleveland Clinic Foundation, Cleveland, OH)
2009-2011  $3,000,000  Third Frontier Wright Project --Nitinol Commercialization  
Accelerator-Develop and commercialize products made from nitinol  
In collaboration with the Cleveland Clinic Foundation, Norman Noble, Inc., Case 
Western Reserve University, and NASA Glenn Research Center  
UT Investigators: M. Elahinia – PI, Sarit Bhaduri, Vijay Goel and Ashok Biyani  
(approved for funding)

**Federal**

**National Science Foundation (NSF)**

2006-2010  $450,000  Bioengineering/Bioinformatics Summer Institute at Clemson  
Co-Principal Investigator - Bhaduri

2007-2010  $310,616  A new approach to regenerate bone using microparticles seeded with  
mesenchymal stem cells and macrophages  
Principal Investigator - AC Jayasuriya

2007-2010  $270,000  Evaluation of Bisphosphonate Coated Ti Implants for Osteoporosis  
Treatment  
Principal Investigator - Bhaduri

2008-2010  $247,995  Shape Memory Alloy Actuated Active Ankle Foot Orthosis  
Investigators - Elahinia – PI; Hefzy and Armstrong - -Co-PI’s

2006-2014  $200,000  Engineering Senior Design Projects to Aid Persons with Disabilitis  
Co-Principal Investigators – Hefzy and Pourazady

2007-2010  $260,000  Processing and Evaluation of HA Nanocomposites  
Principal Investigator – Bhaduri

**National Institutes of Health (NIH/NIA/NIAMS)**

2006-2011  $296,006  Bone loss with aging occurs due to increased PPAR-y activity in  
marrow stem cells Principal Investigator - Lecka-Czernik

2007-2011  $136,046  Vertebral Displacements and Ligament Strains During Simulated Spinal  
Manipulation, Project-Developmental Centers for Research on Complementary  
and Alternative Medicine, Phase II  
In collaboration with Gudvalli, Palmer College of Chiropractic,  
Davenport, IA, Qin, S.U.N.Y., Stony Brook, New York  
UT Investigator/Co-Principal Investigator - Goel

2008- 2012  $800,000  Development and Validation of Instrumented Synthetic  
Mechanical Analogue Lumbar Spine Model, SBIR–Phase, II  
In Collaboration with Pacific Research Labs, and Friis, Kansas University, KS  
UT  Principal Investigator - Goel

2009- 2013  $2,850,000 Multi-faceted Approach Modeling ACL Injury Mechanisms  
In collaboration with Hewett—PI, Cincinnati Children’s Hospital Medical Center,  
Cincinnati, OH  
UT Investigators: Goel, Demetropoulos, Levine and Quatman
PATENTS (Product Development)

2. Vijay K. Goel, and Aaron Matyas, Self-Distracting Joint Replacement Assembly, Ser. No. 60/781,916, filed March 13, 2006, Our File No.: 1-27723
7. Vijay K. Goel, and Aaron Matyas, Anchoring Pedicle Screw, Ser. No. 61/159,910, filed March 13, 2009, Our File No.: 1-50795
8. Vijay K. Goel, Ahmad Faizan, Hossein Elgafy, Cervical Dynamic System in Conjunction with Artificial Disc to Treat Whiplash Injury Patients, Ser. No. 61/159112, filed March 11, 2009, Our File No.: 1-50794
PROFESSIONAL ACTIVITIES, AWARDS & HONORS

VIJAY K. GOEL, PhD

Meeting Chair, American Society of Mechanical Engineering – Bioengineering Division, Summer Meeting, Amelia Island, FL, 2006; Invited Talks, 3rd Spinal Instructional Course, Durban, South Africa, Feb 9-11, 2006; Invited Talks (2), Preservation of the Motion in the Spine, Hawk’s Cay, Duck Key, FL, April 5-8, 2006; Moderator, First Session, Spine Arthroplasty Society Meeting, Montreal, Canada, May 9-13, 2006; ABET Mock Reviewer Department of Biomedical Engineering, Rutgers University, June 11-12, 2006; Conference Chair, ASME-BED Summer Bioengineering Conference, Amelia Island, FL., June 21-25, 2006; Co-Chair, BioMEMS Session, ASME-BED Summer Bioengineering, Conference, Amelia Island, FL, June 21-25, 2006; Co-Chair, Spine Arthroplasty Workshop, ASME-BED Summer Bioengineering Conference, Amelia Island, FL, June 21-25, 2006; Program Chair, Spine Arthroplasty Society (SAS7), Berlin, Germany; April 30 – May 3, 2007; Program Leader, Pick the 10 most important biomechanics papers from SPINE – Pod cast, 2008 (Invited on behalf of the Journal by the Publisher and Synthes Spine, Inc); Basic Science Program Member, Spine Arthroplasty Society (SAS9), London, England, April 27 – May 2, 2009; Best Basic Science Paper Award Committee, Spine Arthroplasty Society (SAS9), London, England, April 27 – May 2, 2009; Invited Seminar Speaker, Department of Bioengineering, Kansas University, Lawrence, KS, March 27, 2009; Invited Talk, 107th Biannual Meeting of the Central Association of Orthopaedic Surgery and Traumatology, Kobe, Japan, Oct 6 and 7th, 2006; Invited Talk8th International Congress of Physiological Anthropology Kamakura, Japan, Oct 9-14, 2006; Invited Member Working Group of Japanese Spine Industry Meeting, Kobe, Japan, Oct 8, 2006; Invited Talks, 2nd Annual Meeting, WENMISS, London, UK, Jan 12-14, 2008; Invited Talks and Course Faculty, ISSLS Instructional Course, Ganga Hospital, Coimbatore, India, Jan 17-18, 2008; Invited talks (Faculty), 10th International Spine Congress, Alexandria, Egypt, March 19-21, 2008; Invited Talks (2), Disc Motion Technologies (DMT), Spine Week, Geneva, Switzerland, May 27-June 1, 2008; Reviewer, Hong Kong Science and Technology Proposals, 2009; Invited Speaker Annual Conference of the World Society for Endoscopic Navigated and Minimal Invasive Spine Surgery"(WENMISS), May 21st -23rd, 2009, Kota Kinabalu, Malaysia; Invited Speaker, SAS 9th Annual Meeting, London, UK, April 28-May 2, 2009; 3 Invited Talks, Combined Meeting of Malaysia Orthopaedic Association and WENMISS, May 22-24, 2009; 3 Invited Talks, The International Masters Spine Symposium and Cadaver Workshop, The Royal College of Surgeons of England, London, May 28-30, 2009; The 2006 Research Award, University of Toledo; The 2006 NASS Henry Farfan award for contributing to the art and science of spinal disorder management through service to NASS (North American Spine Society); Student Award-2007, Carmen Quatman, MD-PhD student, Ruth Jackson Orthopaedic Society Medical Student Scholarship (Co-advisor – V K Goel);
Student Award-2009, Ali Kiapour, PhD student, ASME Summer Bioengineering Conference, PhD Competition – Honorable Mention (Advisor – V K Goel)

ASHOK BIYANI, MD


MOHAMMAD ELAHINIA, PhD

Symposium Chair: Symposium on Nonlinear Modeling and Control of Smart Material Systems, The International Nonlinear Science and Complexity Conference, Beijing, China, August 7-12 2006; Symposium Chair: Symposium on Smart Material Systems at the ASME


A. CHAMPA JAYASURIYA, PhD

NSF panel reviewer, 2006-present; Moderator –Biomaterials Session Midwestern Tissue Engineering Consortium, 2007

BEATA LECKA-CZERNIK, PhD

Presentations: PPARγ nuclear receptor as a key component of bone loss due to aging and anti-diabetic TZD therapies, Medical College of Georgia, Augusta, GA, January 4, 2007; Bone loss with aging occurs due to increased PPARγ activity in marrow stem cells National Institute on Aging, workshop of Biology of Aging Program, San Antonio, TX, May 31, 2007; Bone, Fat and Aging: PPAR-γ as key component of bone loss due to aging and anti-diabetic glitazones Indiana University, Indianapolis, IN, November 13, 2007; Mechanism of bone loss and impairment of bone healing due to anti-diabetic TZD therapy Orthopaedic Research Seminar, Case Western Reserve University, Cleveland, OH, May 19, 2009; PPARs, nutrients and bone, Invited speaker for the plenary symposium of 34th European Symposium on Calcified Tissues, Copenhagen, Denmark, May 8, 2007; Mechanism of TZD-induced bone loss, Invited speaker, The Endocrine Society Annual Meeting, San Francisco, CA, May 15, 2008; Local and systemic functions of bone fat and its contribution to the energy metabolism: The effect of diabetes and obesity on bone, Invited speaker, 38th Sun Valley Workshop on Skeletal Tissue Biology, Sun Valley, Iowa, August 6, 2008; PPAR gamma effect on bone and fat, Invited speaker, Obesity Symposia, Phoenix AZ,


American Society for Bone and Mineral Research, Career Enhancement Awards, Primary Reviewer 2007

**SARIT B. BHADURI, PhD**

**Reviewer:** Journal of Materials Research; Metallurgical and Materials Transactions; Scripta Materialia; Acta Materialia; Acta Biomaterialia; Journal of The American Ceramic Society; Materials Synthesis & Processing; Materials Processing and Fabrication; Journal of Materials Science; Materials Science and Engineering; Applied Physics Letters (APS); Journal of the American Ceramic Society (ACerS); Journal of Biomechanical Engineering (ASME); Journal of Medical Devices (ASME); Journal of Biomedical Materials Research; Directorate of Engineering (CTS, CMS, DMII, EEC, and ECS (Previously), CBET, CMMI (Currently)); Directorate of Mathematical & Physical Science (DMR); Directorate of Human Resources; Served as a panelist (Advanced ceramics, MMC, Manufacturing, electronic/ photonic devices) for reviewing SBIR/STTR (both Phase I and Phase II) proposals; Reviewer of SBIR/STTR (both Phase I and Phase II) proposals from DOE/BES; Reviewer of proposals from AFOSR/NRC; Reviewer of proposals from ARO; Served as panelist in NASA (Code U); Panelist in NIH ZRG1 study–section.


34. Liu JY, Ebraheim NA, Hartman RG, Sanford Jr. CG, Muzumdar AM, Yeasting RA, Goel VK: Morphological changes of the cervical intervertebral foramen during unilateral facet dislocation. The Spine J, 6 (S) Supplement, 2007


40. McGowan DP, Goel VK: Aching backs get support from FDA, but not payors. AAOS-Now, Vol 1, #7, Sep 2007


42. Goel, VK: A commentary on the manuscript titled “Hybrid testing of lumbar Charite discs versus fusions by Panjabi et al”. Spine, 32, 967, 2007


http://lapress.com/journals.php?pa=toc&journal_id=17
http://www.springerlink.com/content/n76n835541325223/?p=5149d7fbed74e42ad6a00d856953b41&pi=0
63. Jayasuriya, AC, Shad C: Controlled release of insulin like growth factor-1 and bone marrow stromal cell function of bone-like mineral layers coated PLGA scaffolds. J of Tissue Engineering and Regenerative Medicine, 2(1): 43-49, 2008
76. Pare PE, Chan FW, Bhattacharya S, Goel VK: Surface slide track mapping of implants for total disc arthroplasty. J. Biomech, 42, 131-139, 2009


82. Lecka-Czernik B: Bone is a target for type 2 diabetes treatment (invited review). Current Opinion in Investigational Drugs (accepted)

83. Huang S, Kaw M, Harris MT, Ebraheim, NA, McNerney MF, Najjar SM, Lecka-Czernik, B: Decreased Osteoclastogenesis and High Bone Mass in Mice with Impaired Insulin Clearance Due to Liver-Specific Inactivation to CEACAM1. Bone (submitted)


85. Tarkesh, Esfahani E, Elahinia MH: Control of a Shape Memory Alloy Walking Assistive Device, Journal of Vibration and Control, accepted for publication

PUBLICATIONS – Book Chapters


2. Goel VK, Faizan A, Felon L, Biyani A, McGowan D, Wang S-T: Biomechanical aspects of the spine motion preservation systems. In Innovations in Spinal Reconstruction – Clinical Examples of Basic Science, Biomechanics, and Engineering. Kai-Uwe Lewandrowski, MD; Iain H. Kalfas, MD; Robert F. McLain, MD; Paul Park, MD; Debra J. Trantolo, PhD; Michael J. Yaszembiski, MD, PhD (Co-Editors), 2006. http://books.google.com/books?id=7FehnLKEdIgC&pg=PA279&dq=Biomechanical+Aspects+of+the+Spine+Motion+Preservation+Systems&ei=HrHbScHyBYWqiQSlgMHIAg#PPA279,M1


5. Sairyo K, Goel VK, Biyani A, Ebraheim NA. Biomechanics of Spondylolysis with


5. Faizan A, Goel VK, Bergeron B: The anterior longitudinal ligament is essential to restore disc biomechanics following artificial disc replacement. 52nd Annual Meeting, Orthopedic Research Society, Chicago, IL, March 19-22, 2006


21. Faizan A, Goel VK, Bergeron B: The anterior longitudinal ligament is essential to restore disc biomechanics following artificial disc replacement. SAS6, Montreal, Canada, May 9-13, 2006


28. Sairyo K, Biyani, A, Goel VK, Leaman D, Booth R, Thomas J, Ebraheim N, Cowgill I, Mohan S: Lumbar ligamentum flavum hypertrophy is due to accumulation of inflammation
related scar tissue. A histological and biological assessment. ISSLS 33rd Annual Meeting, Bergen, Norway, June 13-17, 2006


40. Tarkesh ET, Elahinia MH, Hefzy MS: Sliding Mode Controller for a Knee Prosthesis Actuated by Shape Memory Alloys. Eleventh Conference on Nonlinear Vibrations, Stability, and Dynamics of Structures, Blacksburg, VA, August, 13-17, 2006,


81. Tarkesh E, Elahinia M, Hefzy MS: Developing an Active Ankle Foot Orthosis Based on Shape Memory Alloy Actuator, ASME Summer Bioengineering Conference, Keystone, CO, June 20-24, 2007


88. Liu, J, Ebraheim NA, Harman RG, Sanford CG, Jr, Muzumdar AM, Yeasting RA, Goel VK: Morphological changes of the cervical intervertebral foramen during unilateral facet dislocation. 22nd Annual Meeting NASS, Austin, TX, Oct 23-27, 2007


106 Hanson M, Goel V: Biomechanical evaluation of a direct lateral procedure: What are the effects when paired with pedicle screw or posterior interspinous fixation. Annual Meeting AANS/CNS Section on Disorders of the Spine and Peripheral Nerves, and Orlando, FL February 27 - March 1, 2008


120. Faizan A, Goel VK: Finite element analysis of cervical spine following bilevel fusion, bilevel total disc replacement and fusion plus total disc replacement at adjacent levels. 8th SAS Annual Meeting, Miami, FL, May 6-9, 2008
121. Faizan A, Goel VK: A finite element study to evaluate the biomechanical effects of the artificial disc components’ shape on the cervical spine. 8th SAS Annual Meeting, Miami, FL, May 6-9, 2008

122. Biyani A, Chinthakunta, S, Goel V: Characterizing MRI distortion associated with cervical artificial disc replacement devices made of titanium and cobalt chrome. SAS8, Global Symposium on Motion Preservation Technology, Miami Beach, FL, May 6-9, 2008

123. Parepalli B, Goel VK: The effects on motion and intra discal pressure after adding a dynamic stabilization device to an injured spine: A finite element based study. SAS8, Global Symposium on Motion Preservation Technology, Miami Beach, FL, May 6-9, 2008


125. Faizan A, Goel V., Biyani A., Garfin S., Bono C., Maguire P, Serhan H: A Finite element study to evaluate the biomechanical effects of the artificial disc components’ shape on the cervical spine. SAS8, Global Symposium on Motion Preservation Technology, Miami Beach, FL, May 6-9, 2008

126. Kiapour A, Mehta A, Goel V, Hoy B, Fauth AR: A biomechanical comparison of different spinal implants: Motion preventing (fusion) motion preserving (anatomic facet replacement) and dynamic stabilization (DYNESYS). SAS8, Global Symposium on Motion Preservation Technology, Miami Beach, FL, May 6-9, 2008


174. Chikka A, Terai T, Kodigudla M, Ambati D, Goel VK, Ferrara, L, Vaccarro A, Susprasinuous ligament transaction does not alter the biomechanical efficacy of the SuperionTM


186. Tabesh M, Elahinia MH: Primary design of a shape memory alloy expandable insert to enhance pedicle screw performance. ASME Summer Bioengineering Conference, June 2009, Lake Tahoe, CA


188. Kiapour A, Goel VK, Krishna M, Koruprolu S, Parikh R, Mhatre, D: A computational and experimental investigation in to biomechanics of lumbar spine stabilized with a novel posterior dynamic stabilization system. Summer Bioengineering Conference, Resort at Squaw Creek, Lake Tahoe, CA, June 17-21, 2009


