Stanford

Sandip Biswal, MD

Associate Professor of Radiology (Musculoskeletal Imaging)

CLINICAL OFFICES

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Bio

BIO

As a Musculoskeletal Radiologist, I try to identify the cause of one's pain, discomfort, inflammation or other related musculoskeletal symptom(s) using clinical imaging approaches such as magnetic resonance imaging (MRI), computed tomography, digital radiography & ultrasound. However, these current approaches have limitations in accurately identify pain generators. Accordingly, my group along with my collaborators have been developing clinical imaging methods that would objectively pinpoint the site of pain generation using novel agents that specifically seek out molecular and cellular pain markers to highlight hypersensitive pain-sensing nerves. Successful validation of this approach will aid in the diagnosis of pain generators but also facilitate more intelligent management of chronic pain, minimize unnecessary surgeries, improve outcomes, aid in the development of novel analgesics and potentially reduce healthcare costs associated with the management of chronic pain.

CLINICAL FOCUS

- Diagnostic Radiology
- Radiology
- Musculoskeletal Imaging
- Musculoskeletal Interventional Procedures
- Clinical Trials
- Positron Emission Tomography/Magnetic Resonance Imaging (PET/MRI)
- Pain Imaging Diagnostics

ACADEMIC APPOINTMENTS

- Associate Professor - University Medical Line, Radiology
- Member, Bio-X
- Member, Cardiovascular Institute
- Member, Wu Tsai Neurosciences Institute

ADMINISTRATIVE APPOINTMENTS

- Co-Section Chief Musculoskeletal Imaging, Department of Radiology, (2018- present)
- Director, Musculoskeletal Imaging Fellowship, Department of Radiology, (2009- present)

HONORS AND AWARDS

- Donald E. and Delia B. Baxter Foundation Research Scholar Award., Donald E. and Delia B. Baxter Foundation (2004)
- 2005 Resident Teaching Award - Junior Faculty of the Year, Stanford University, Department of Radiology, Stanford University School of Medicine (June 2005)
- Top Scientific Abstract Award, Academy of Molecular Imaging (March 2006)
- 2006 Resident Teaching Award - Junior Faculty of the Year, Department of Radiology, Stanford University School of Medicine (June 2006)
- Moncada Award, Society of Computed Body Tomography and Magnetic Resonance (April 2008)
- 2010 Resident Teaching Award - Junior Faculty of the Year, Department of Radiology, Stanford University School of Medicine (June 2010)

PROFESSIONAL EDUCATION

- Fellowship: UCSD Musculoskeletal Radiology Fellowship (2002) CA
- Residency: Stanford University Radiology Residency (2001) CA
- Internship: Columbia University Medical Center (1997) NY
- Medical Education: Harvard Medical School (1996) MA
- Board Certification: Diagnostic Radiology, American Board of Radiology (2001)
- MD, Harvard Medical School-M.I.T. , Medicine (1996)
- BS, California Inst. of Technology , Biology (1990)

LINKS

- My Lab Website: https://www.biswalpainimaging.com
- LinkedIn: www.linkedin.com/in/sandip-biswal-220523aa

Research & Scholarship

CURRENT RESEARCH AND SCHOLARLY INTERESTS

The management of individuals suffering from chronic pain is unfortunately limited by poor diagnostic tests and therapies. Our research group is interested in 'imaging pain' by using novel imaging techniques to study peripheral nociception and inflammation with the goal of accurately identifying the location of pain generators. We are developing new approaches with positron emission tomography (PET) and magnetic resonance imaging (MRI) (PET/MRI) and are currently in clinical trials.

CLINICAL TRIALS

- PET/MRI in the Diagnosis of Chronic Pain, Recruiting
- Use of PET/MR Imaging in Chronic Pain, Recruiting
- [18F]FTC-146 PET/MRI in Healthy Volunteers and in CRPS and Sciatica, Not Recruiting
- Combined F-18 NaF and F-18 FDG PET/CT for Evaluation of Malignancy, Not Recruiting

- F18PET/CT Versus TC-MDP Scanning to Detect Bone Mets, Not Recruiting

Publications

PUBLICATIONS

- **Machine-learning Approach to Differentiation of Benign and Malignant Peripheral Nerve Sheath Tumors: A Multicenter Study**
  Zhang, M., Tong, E., Hamrick, F., Pendleton, C., Smith, B., Hug, N., Mattonen, S., Napel, S., Spinner, R., Yeom, K., Wilson, T., Mahan, M.
  AMER ASSOC NEUROLOGICAL SURGEONS.2021

- **Machine-Learning Approach to Differentiation of Benign and Malignant Peripheral Nerve Sheath Tumors: A Multicenter Study.** *Neurosurgery*
  Zhang, M., Tong, E., Hamrick, F., Lee, E. H., Tam, L. T., Pendleton, C., Smith, B. W., Hug, N. F., Biswal, S., Seekins, J., Mattonen, S. A., Napel, S., Campen, et al
  2021

- **Abnormal [18F]FDG PET/MRI findings in paraspinal structures of patients with suspected cerebrospinal fluid leak.** *Scientific reports*
  Yoon, D., Cipriano, P. W., Penticuff, R., Castillo, J. B., Xu, Y., Carroll, I. R., Biswal, S.
  2021; 11 (1): 15926

- **Abnormal [18F]FDG PET/MRI Findings In Paraspinal Muscles of Patients with Suspected Cerebrospinal Fluid Leak.**
  Cipriano, P., Yoon, D., Xu, Y., Carroll, I., Biswal, S.
  SOC NUCLEAR MEDICINE INC.2020

- **Sigma-1 receptor PET/MRI for identifying nociceptive sources of radiating low back pain**
  Yoon, D., Cipriano, P., Carroll, I., Curtin, C., Roh, E., Wilson, T., Biswal, S.
  SOC NUCLEAR MEDICINE INC.2020

- **PET/MR imaging of sigma-1 receptor pinpoints previously undetectable abnormalities in chronic pelvic pain**
  Yoon, D., Fast, A., Shen, B., James, M. L., Lum, D., Biswal, S.
  SOC NUCLEAR MEDICINE INC.2020

- **18F-FDG PET/MRI of patients with chronic pain alters management.**
  Cipriano, P., Yoon, D., Carroll, I., Curtin, C., Tawfik, V., Xu, Y., Biswal, S.
  SOC NUCLEAR MEDICINE INC.2020

- **Imaging of Damaged Nerves.** *Clinics in plastic surgery*
  Purger, D. A., Sakamuri, S., Hug, N. F., Biswal, S., Wilson, T. J.
  2020; 47 (2): 245–59

- **Identifying Musculoskeletal Pain Generators Using Clinical PET.** *Seminars in musculoskeletal radiology*
  Yoon, D. n., Kogan, F. n., Gold, G. E., Biswal, S. n.
  2020; 24 (4): 441–50

- **Diagnosis and Successful Management of an Unusual Presentation of Chronic Foot Pain Using Positron Emission Tomography/Magnetic Resonance Imaging and a Simple Surgical Procedure** *CLINICAL JOURNAL OF SPORT MEDICINE*
  Cipriano, P., Yoon, D., Holley, D., Hargreaves, B., Carroll, I., Curtin, C., Biswal, S.
  2020; 30 (1): E11–E14

- **18F-FDG PET/MRI of patients with chronic pain alters management.**
  Cipriano, P., Yoon, D., Carroll, I., Curtin, C., Tawfik, V., Xu, Y., Biswal, S.
  SOC NUCLEAR MEDICINE INC.2019

- **Abnormal [18F]FDG PET MRI Findings in Paraspmal Muscles of Patients with Suspected Cerebrospinal Fluid Leak**
  Cipriano, P., Yoon, D., Carroll, I., Penticuff, R., Xu, Y., Biswal, S.
  SOC NUCLEAR MEDICINE INC.2019

- **Musculoskeletal changes on [18F]FDG PET/MRI from complex regional pain syndrome in foot**
  Yoon, D., Xu, Y., Cipriano, P., Tawfik, V., Curtin, C., Carroll, I., Biswal, S.
  SOC NUCLEAR MEDICINE INC.2019

- **Diagnosis and Successful Management of an Unusual Presentation of Chronic Foot Pain Using Positron Emission Tomography/Magnetic Resonance Imaging and a Simple Surgical Procedure.** *Clinical journal of sport medicine : official journal of the Canadian Academy of Sport Medicine*

Cipriano, P. W., Yoon, D., Holley, D., Hargreaves, B. A., Carroll, I. R., Curtin, C. M., Biswal, S.

2019

- **[F-18] FSPG-PET reveals increased cystine/glutamate antiporter (xc-) activity in a mouse model of multiple sclerosis** *JOURNAL OF NEUROINFLAMMATION*

  Hoehne, A., James, M. L., Alam, I. S., Ronald, J. A., Schneider, B., D'Souza, A., Witney, T. H., Andrews, L. E., Cropper, H. C., Behera, D., Gowrishankar, G., Ding, Z., Wyss-Coray, et al

  2018; 15

- **Combined PET/MRI: Global Warming-Summary Report of the 6th International Workshop on PET/MRI, March 27-29, 2017, Tübingen, Germany.** *Molecular imaging and biology : MIB : the official publication of the Academy of Molecular Imaging*

  Bailey, D. L., Pichler, B. J., Gückel, B. n., Antoch, G. n., Barthel, H. n., Bhujwalla, Z. M., Biskup, S. n., Biswal, S. n., Bitzer, M. n., Boellaard, R. n., Braren, R. F., Brendle, C. n., Brindle, et al

  2018; 20 (1): 4–20

- **[18F]FSPG-PET reveals increased cystine/glutamate antiporter (xc-) activity in a mouse model of multiple sclerosis.** *Journal of neuroinflammation*

  Hoehne, A. n., James, M. L., Alam, I. S., Ronald, J. A., Schneider, B. n., D'Souza, A. n., Witney, T. H., Andrews, L. E., Cropper, H. C., Behera, D. n., Gowrishankar, G. n., Ding, Z. n., Wyss-Coray, et al

  2018; 15 (1): 55

- **Successful treatment of chronic knee pain following localization by a sigma-1 receptor radioligand and PET/MRI: a case report** *JOURNAL OF PAIN RESEARCH*

  Cipriano, P., Lee, S., Yoon, D., Shen, B., Tawfik, V., Curtin, C., Dragoo, J. L., James, M., Mccurdy, C., Chin, F., Biswal, S.

  2018; 11: 2353–56

- **F-FTC-146 in humans.** *Journal of nuclear medicine*

  Hjørnevik, T., Cipriano, P. W., Shen, B., Hyung Park, J., Gulaka, P., Holley, D., Gandhi, H., Yoon, D., Mittra, E. S., Zaharchuk, G., Gambhir, S. S., McCurdy, C. R., Chin, et al

  2017

- **F]FTC-146.** *Molecular imaging and biology*

  Shen, B., Park, J. H., Hjørnevik, T., Cipriano, P. W., Yoon, D., Gulaka, P. K., Holly, D., Behera, D., Avery, B. A., Gambhir, S. S., McCurdy, C. R., Biswal, S., Chin, et al

  2017

- **18F-FDG PET/MRI in Chronic Sciatica: Early Results Revealing Spinal and Non-spinal Abnormalities.** *Journal of nuclear medicine : official publication, Society of Nuclear Medicine*

  Cipriano, P. n., Yoon, D. n., Gandhi, H. n., Holley, D. n., Thakur, D. n., Ith, M. n., Hargreaves, B. n., Kennedy, D. n., Smuck, M. n., Cheng, I. n., Biswal, S. n.

  2017

- **Feasibility of 7T MRI for Imaging Fascicular Structures of Peripheral Nerves.** *Muscle & nerve*

  Yoon, D. n., Biswal, S. n., Rutt, B. n., Lutz, A. n., Hargreaves, B. n.

  2017

- **Visualizing Nerve Injury in a Neuropathic Pain Model with [(18)F]FTC-146 PET/MRI.** *Theranostics*

  Shen, B. n., Behera, D. n., James, M. L., Reyes, S. T., Andrews, L. n., Cipriano, P. W., Klukinov, M. n., Lutz, A. B., Mavlyutov, T. n., Rosenberg, J. n., Ruoho, A. E., McCurdy, C. R., Gambhir, et al

  2017; 7 (11): 2794–2805

- **Detection of nociceptive-related metabolic activity in the spinal cord of low back pain patients using (18)F-FDG PET/CT.** *Scandinavian journal of pain*

  Zhou, X. n., Cipriano, P. n., Kim, B. n., Dhatt, H. n., Rosenberg, J. n., Mittra, E. n., Do, B. n., Graves, E. n., Biswal, S. n.

  2017; 15: 53–57

- **[18F]FDG PET/MRI of patients with chronic pain alters management: early experience.** *EJNMMI physics*

  Biswal, S., Behera, D., Yoon, D. H., Holley, D., Ith, M. A., Carroll, I., Smuck, M., Hargreaves, B.

  2015; 2: A84-?

- **Novel Noxipoint Therapy versus Conventional Physical Therapy for Chronic Neck and Shoulder Pain: Multicentre Randomised Controlled Trials** *SCIENTIFIC REPORTS*

  Koo, C. C., Lin, R. S., Wang, T., Tsauo, J., Yang, P., Yen, C., Biswal, S.

  2015; 5

- **Combined F-18-NaF and F-18-FDG PET/CT in the Evaluation of Sarcoma Patients** *CLINICAL NUCLEAR MEDICINE*
  Jackson, T., Mosci, C., von Eyben, R., Mittra, E., Ganjoo, K., Biswal, S., Gambhir, S. S., Iagaru, A.
  2015; 40 (9): 720-724

- **Fracture Healing Effects of Locally-Administered Adipose Tissue-Derived Cells** *YONSEI MEDICAL JOURNAL*
  Lee, S., Jeon, T. J., Biswal, S.
  2015; 56 (4): 1106-1113

- **Neuropathic Pain Mechanisms and Imaging** *SEMINARS IN MUSCULOSKELETAL RADIOLOGY*
  Tung, K., Behera, D., Biswal, S.
  2015; 19 (2): 103-111

- **Effect of local treatment with adipose tissue-derived mesenchymal stem cells in the early tumorigenesis of osteosarcoma.** *Oncology reports*
  Lee, S., Jeon, T. J., Biswal, S.
  2015; 33 (3): 1381-1387

- **Factors associated with repetitive strain, and strategies to reduce injury among breast-imaging radiologists.** *Journal of the American College of Radiology*
  Thompson, A. C., Kremer Prill, M. J., Biswal, S., Rebner, M., Rebner, R. E., Thomas, W. R., Edwards, S. D., Thompson, M. O., Ikeda, D. M.
  2014; 11 (11): 1074-1079

- **Evaluation of s-1 Receptor Radioligand 18F-FTC-146 in Rats and Squirrel Monkeys Using PET.** *Journal of nuclear medicine : official publication, Society of Nuclear Medicine*
  James, M. L., Shen, B., Nielsen, C. H., Behera, D., Buckmaster, C. L., Mesangeau, C., Zavaleta, C., Vuppala, P. K., Jamalapuram, S., Avery, B. A., Lyons, D. M., McCurdy, C. R., Biswal, et al
  2014; 55 (1): 147-153

- **A F-18-Labeled Saxitoxin Derivative for in Vivo PET-MR Imaging of Voltage-Gated Sodium Channel Expression Following Nerve Injury** *JOURNAL OF THE AMERICAN CHEMICAL SOCIETY*
  Hoehne, A., Behera, D., Parsons, W. H., James, M. L., Shen, B., Borgohain, P., Bodapati, D., Prabhakar, A., Gambhir, S. S., Yeomans, D. C., Biswal, S., Chin, F. T., Du Bois, et al
  2013; 135 (48): 18012-18015

- **A (18)F-Labeled Saxitoxin Derivative for in Vivo PET-MR Imaging of Voltage-Gated Sodium Channel Expression Following Nerve Injury.** *Journal of the American Chemical Society*
  Hoehne, A., Behera, D., Parsons, W. H., James, M. L., Shen, B., Borgohain, P., Bodapati, D., Prabhakar, A., Gambhir, S. S., Yeomans, D. C., Biswal, S., Chin, F. T., Bois, et al
  2013; 135 (48): 18012-18015

- **Molecular Imaging: An Innovative Force in Musculoskeletal Radiology** *AMERICAN JOURNAL OF ROENTGENOLOGY*
  Wilmot, A., Gieschler, S., Behera, D., Gade, T. P., Reumann, M. K., Biswal, S., Mayer-Kuckuk, P.
  2013; 201 (2): 264-277

- **Automatic Retrieval of Bone Fracture Knowledge Using Natural Language Processing** *JOURNAL OF DIGITAL IMAGING*
  Do, B. H., Wu, A. S., Maley, J., Biswal, S.
  2013; 26 (4): 709-713

- **Bilateral peripheral neural activity observed in vivo following unilateral nerve injury.** *American journal of nuclear medicine and molecular imaging*
  Behera, D., Behera, S., Jacobs, K. E., Biswal, S.
  2013; 3 (3): 282-290

- **Exogenous MC3T3 Preosteoblasts Migrate Systemically and Mitigate the Adverse Effects of Wear Particles** *TISSUE ENGINEERING PART A*
  Fritton, K., Ren, P., Gibon, E., Rao, A. J., Ma, T., Biswal, S., Gambhir, S. S., Goodman, S. B.
  2012; 18 (23-24): 2559-2567

- **Rotator cuff tears: association with acromion angulation on MRI** *Annual Meeting of the American-Roentgen-Ray-Society (ARRS)*
  McGinley, J. C., Agrawal, S., Biswal, S.
  ELSEVIER SCIENCE INC.2012: 791–96

- **Assessment of Collagen-Induced Arthritis Using Cyanine 5.5 Conjugated with Hydrophobically Modified Glycol Chitosan Nanoparticles: Correlation with F-18-Fluorodeoxyglucose Positron Emission Tomography Data** *KOREAN JOURNAL OF RADIOLOGY*
  Cha, J. H., Lee, S. H., Lee, S., Park, K., Moon, D. H., Kim, K., Biswal, S.

2012; 13 (4): 450-461

- **In vivo USPIO magnetic resonance imaging shows that minocycline mitigates macrophage recruitment to a peripheral nerve injury** *MOLECULAR PAIN*
  Ghanouni, P., Behera, D., Xie, J., Chen, X., Moseley, M., Biswal, S.
  2012; 8
- **Effect of a CCR1 receptor antagonist on systemic trafficking of MSCs and polyethylene particle-associated bone loss** *BIOMATERIALS*
  Gibon, E., Yao, Z., Rao, A. J., Zwingenberger, S., Batke, B., Valladares, R., Smith, R. L., Biswal, S., Gambhir, S. S., Goodman, S. B.
  2012; 33 (14): 3632-3638
- **MC3T3-E1 Osteoprogenitor Cells Systemically Migrate to a Bone Defect and Enhance Bone Healing** *TISSUE ENGINEERING PART A*
  Gibon, E., Batke, B., Jawad, M. U., Fritton, K., Rao, A., Yao, Z., Biswal, S., Gambhir, S. S., Goodman, S. B.
  2012; 18 (9-10): 968-973
- **Selective inhibition of the MCP-1-CCR2 ligand-receptor axis decreases systemic trafficking of macrophages in the presence of UHMWPE particles** *JOURNAL OF ORTHOPAEDIC RESEARCH*
  Gibon, E., Ma, T., Ren, P., Fritton, K., Biswal, S., Yao, Z., Smith, L., Goodman, S. B.
  2012; 30 (4): 547-553
- **Oral manganese as an MRI contrast agent for the detection of nociceptive activity** *NMR IN BIOMEDICINE*
  Jacobs, K. E., Behera, D., Rosenberg, J., Gold, G., Moseley, M., Yeomans, D., Biswal, S.
  2012; 25 (4): 563-569
- **Magnetic Resonance Reporter Gene Imaging** *THERANOSTICS*
  Lee, S., Lee, S., Biswal, S.
  2012; 2 (4): 403-412
- **Pattern of 18F-FDG Uptake in the Spinal Cord in Patients With Non-Central Nervous System Malignancy** *SPINE*
  Do, B. H., Mari, C., Tseng, J. R., Quon, A., Rosenberg, J., Biswal, S.
  2011; 36 (21): E1395-E1401
- **F-18-FDG PET/MRI Can Be Used to Identify Injured Peripheral Nerves in a Model of Neuropathic Pain** *JOURNAL OF NUCLEAR MEDICINE*
  Behera, D., Jacobs, K. E., Behera, S., Rosenberg, J., Biswal, S.
  2011; 52 (8): 1308-1312
- **Continuous Infusion of UHMWPE Particles Induces Increased Bone Macrophages and Osteolysis** *Annual Scientific Meeting of the Knee-Society*
  Ren, P., Irani, A., Huang, Z., Ma, T., Biswal, S., Goodman, S. B.
  SPRINGER.2011: 113–22
- **Radiolabeling of a Saxitoxin derivative for PET-MRI imaging of pain**
  Hoehne, A., Parsons, W. H., Behera, D., Shen, B., Gambhir, S. S., Du Bois, J., Biswal, S., Chin, F. T.
  WILEY-BLACKWELL.2011: S2–S2
- **Informatics in Radiology RADTF: A Semantic Search-enabled, Natural Language Processor-generated Radiology Teaching File** *RADIOGRAPHICS*
  Do, B. H., Wu, A., Biswal, S., Kamaya, A., Rubin, D. L.
  2010; 30 (7): 2039-2048
- **Surveillance of systemic trafficking of macrophages induced by UHMWPE particles in nude mice by noninvasive imaging.** *Journal of biomedical materials research. Part A*
  Ren, P., Huang, Z., Ma, T., Biswal, S., Smith, R. L., Goodman, S. B.
  2010; 94 (3): 706-711
- **Surveillance of systemic trafficking of macrophages induced by UHMWPE particles in nude mice by noninvasive imaging** *JOURNAL OF BIOMEDICAL MATERIALS RESEARCH PART A*
  Ren, P., Huang, Z., Ma, T., Biswal, S., Smith, R. L., Goodman, S. B.
  2010; 94A (3): 706-711
- **Indirect imaging of cardiac-specific transgene expression using a bidirectional two-step transcriptional amplification strategy** *GENE THERAPY*
  Chen, I. Y., Gheysens, O., Ray, S., Wang, Q., Padmanabhan, P., Paulmurugan, R., Loening, A. M., Rodriguez-Porcel, M., Willmann, J. K., Sheikh, A. Y., Nielsen, C. H., Hoyt, G., Contag, et al
  2010; 17 (7): 827-838

- **Triblock copolymer coated iron oxide nanoparticle conjugate for tumor integrin targeting** *BIOMATERIALS*
  Chen, K., Xie, J., Xu, H., Behera, D., Michalski, M. H., Biswal, S., Wang, A., Chen, X.
  2009; 30 (36): 6912-6919

- **A Novel Estrogen Receptor Intramolecular Folding-based Titratable Transgene Expression System** *MOLECULAR THERAPY*
  Paulmurugan, R., Padmanabhan, P., Ahn, B., Ray, S., Willmann, J. K., Massoud, T. F., Biswal, S., Gambhir, S. S.
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- **Analysis of Bone Mineral Density and Bone Turnover in the Presence of Polymethylmethacrylate Particles** *JOURNAL OF BIOMEDICAL MATERIALS RESEARCH PART B-APPLIED BIOMATERIALS*
  Zilber, S., Lee, S. W., Smith, R. L., Biswal, S., Goodman, S. B.
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  Liu, X., Xiong, Z., Lee, S., Levi, J., Yaghoubi, S., Biswal, S., Gambhir, S. S., Cheng, Z.
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- **Stem Cell-Mediated Accelerated Bone Healing Observed with in Vivo Molecular and Small Animal Imaging Technologies in a Model of Skeletal Injury** *JOURNAL OF ORTHOPAEDIC RESEARCH*
  Lee, S., Padmanabhan, P., Ray, P., Gambhir, S. S., Doyle, T., Contag, C., Goodman, S. B., Biswal, S.
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- **Erdheim-Chester disease: case report with unique postmortem magnetic resonance imaging, high-resolution radiography, and pathologic correlation** *CLINICAL IMAGING*
  de Abreu, M. R., Castro, M. O., Chung, C., Trudell, D., Biswal, S., Wesselly, M., Resnick, D.
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- **Systemic trafficking of macrophages induced by bone cement particles in nude mice** *BIOMATERIALS*
  Ren, P., Lee, S., Biswal, S., Goodman, S. B.
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- **Tibial aperture bone disruption after retrograde versus antegrade tibial tunnel drilling: a cadaveric study** *KNEE SURGERY SPORTS TRAUMATOLOGY ARTHROSCOPY*
  McAdams, T. R., Biswal, S., Stevens, K. J., Beaulieu, C. F., Mandelbaum, B. R.
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- **Early findings of small-animal MRI and small-animal computed tomography correlate with histological changes in a rat model of rheumatoid arthritis** *NMR IN BIOMEDICINE*
  Lee, S., Greve, J. M., Leaffer, D., Lollini, L., Bailey, P., Gold, G. E., Biswal, S.
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- **Stress-related injuries around the lesser trochanter in long-distance runners** *AMERICAN JOURNAL OF ROENTGENOLOGY*
  Nguyen, J. T., Peterson, J. S., Biswal, S., Beaulieu, C. F., Fredericson, M.
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- **Synthesis and characterization of PVP-coated large core iron oxide nanoparticles as an MRI contrast agent** *NANOTECHNOLOGY*
  Lee, H., Lee, S., Xu, C., Xie, J., Lee, J., Wu, B., Koh, A. L., Wang, X., Sinclair, R., Xwang, S., Nishimura, D. G., Biswal, S., Sun, et al
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- **Mouse femoral intramedullary injection model: technique and microCT scan validation.** *Journal of biomedical materials research. Part B, Applied biomaterials*
  Zilber, S., Epstein, N. J., Lee, S., Larsen, M., Ma, T., Smith, R. L., Biswal, S., Goodman, S. B.
  2008; 84 (1): 286-290

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  Zilber, S., Epstein, N., Lee, S., Larsen, M., Ma, T., Smith, R. L., Biswal, S., Goodman, S. B.
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- **Synthesis and characterization of PVP-coated large core iron oxide nanoparticles as an MRI contrast agent.** *Nanotechnology*

Lee, H. Y., Lee, S. H., Xu, C. n., Xie, J. n., Lee, J. H., Wu, B. n., Koh, A. L., Wang, X. n., Sinclair, R. n., Wang, S. X., Nishimura, D. G., Biswal, S. n., Sun, et al
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  Biswal, S., Resnick, D. L., Hoffman, J. M., Gambhir, S. S.
  2007; 244 (3): 651-671
- **Sacral stress fractures: Magnetic resonance imaging not always definitive for early stage injuries - A report of 2 cases** *AMERICAN JOURNAL OF SPORTS MEDICINE*
  Fredericson, M., Moore, W., Biswal, S.
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- **Diagnosis of aseptic deep venous thrombosis of the upper extremity in a cancer patient using fluorine-18 fluorodeoxyglucose positron emission tomography/computerized tomography (FDG PET/CT)** *ANNALS OF NUCLEAR MEDICINE*
  Do, B., Mari, C., Biswal, S., Kalinyak, J., Quon, A., Gambhir, S. S.
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- **Visualization of telomerase reverse transcriptase (hTERT) promoter activity using a trimodality fusion reporter construct** *JOURNAL OF NUCLEAR MEDICINE*
  Padmanabhan, P., Otero, J., Ray, P., Paulmurugan, R., Hoffman, A. R., Gambhir, S. S., Biswal, S., Ulaner, G. A.
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- **Erdheim-Chester disease: MR imaging, anatomic, and histopathologic correlation of orbital involvement** *AMERICAN JOURNAL OF NEURORADIOLOGY*
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