



Children's Hospital of Philadelphia Update

Divya Talwar, PhD, MPH and John Flynn, MD



Pediatric Faculty



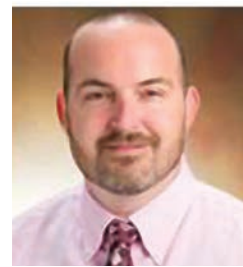
John Flynn, MD



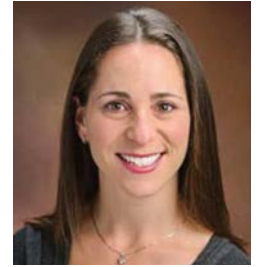
Jason Anari, MD



Alexandre Arkader, MD



Keith Baldwin, MD, MPH, MSPT



Naomi Brown, MD, FAAP,
CAQSM



Patrick Cahill, MD



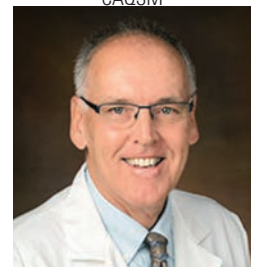
Robert Carrigan, MD



Benjamin Chang, MD, FACS



Richard Davidson, MD



Vincent Deeney, MD



Malcom Ecker, MD



Theodore Ganley, MD



B. David Horn, MD



J. Todd Lawrence, MD, PhD



Ines Lin, MD



Kathleen Maguire, MD



Christina Master, MD, FAAP,
CAQSM, FACS



Christopher Renjilian, MD



Wudbhav Sankar, MD



Apurva Shah, MD, MBA



David Spiegel, MD



Brian Vernau, MD, FAAP,
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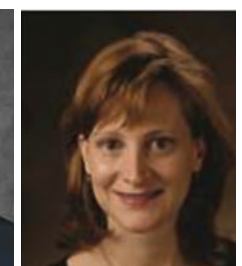
Kristy Weber, MD, FACS



Lawrence Wells, MD



Brendan Williams, MD



Jennifer Winell, MD

Introduction

The Division of Orthopaedic Surgery at the Children's Hospital of Philadelphia (CHOP) had another successful and productive year of significant growth, accomplishment, and innovation. Upholding our mission and vision to provide the most comprehensive care to our patients, we have continued to expand our clinical, research, and teaching programs.

In 2019, CHOP Orthopaedics continued the Nicholson Visiting Professorship, welcomed two pediatric orthopaedic surgeons on our team, hosted major conference meetings for Food and Drug Administration (FDA) reviewers, maintained enrollment of FDA Phase IIIb investigational drug trial and a feasibility device trial, expanded our research coordinator team, obtained significant extramural funding from major funding agencies such as National Institutes of Health (NIH), Centers for Disease Control and Prevention (CDC), and National Science Foundation (NSF).

Clinical Program

Our orthopaedics faculty continues to expand and is currently comprised of twenty-nine Faculty, nineteen specially trained pediatric orthopaedic surgeons (fifteen operative and four non-operative), five sports medicine-trained pediatricians, two active plastic surgeons, and three transition-to-adult care faculty. Our division welcomed two new faculty members, Dr. Brendan Williams, MD (Figure 1) and Dr. Katherine Maguire, MD (Figure 2). Both Drs. Williams and Maguire joins our program as new Attending Orthopaedic Surgeon with specialization in sports medicine.



Figure 1. Brendan Williams, MD **Figure 2.** Katherine Maguire, MD

Education Program

CHOP Orthopaedics currently funds four one-year clinical fellowships and one one-year research fellowship. The 2019-2020 clinical fellows are Alexa Karkenny, MD (Figure 3); Matthew Landrum, MD (Figure 4); Brian Piazza, MD (Figure 5); and Margaret Wright, MD (Figure 6). This year's research fellow is Dr. Soroush Baghdadi, MD from Iran (Figure 7). While at CHOP Dr. Baghdadi has focused his research efforts on between basic science projects related to cartilage regeneration and clinical research focused on pediatric trauma, neuromuscular conditions, and sports injuries.

To celebrate the graduation of the 2018-2019 clinical fellows, the Division hosted the Nicholson Visiting Professor Program and Fellows Graduation & Reunion in June 2018. This year's Visiting Professor was Dr. David Skaggs, of Orthopedic Surgery at the Keck School of Medicine of the University



Figure 3. Alexa Karkenny, MD **Figure 4.** Matthew Landrum, MD **Figure 5.** Brian Piazza, MD



Figure 6. Margaret Wright, MD **Figure 7.** Soroush Baghdadi, MD

of Southern California and Chief of Orthopaedic Surgery at Children's Hospital Los Angeles. He is a nationally recognized expert in pediatric spinal deformity and trauma and currently holds the Associates Endowed Chair of Pediatric Spinal Disorders at Children's Hospital Los Angeles. The program consisted of a mix of short lectures and discussions, a cocktail reception, and research and end-of-the-year remarks from the four fellows.

The 2018 Drummond Rising Star Visiting Professor was Raymond Liu, MD. Dr. Liu, an Associate Professor of Pediatric Orthopaedics at Rainbow Babies and Children's Hospital in Cleveland, Ohio, with a specialization in complex hip and limb deformity and holds the Victor M. Goldberg Endowed Chair in Orthopaedics. He gave excellent talks on maturity and predicting growth—critical to most areas of pediatric orthopaedics. The Division also continued to host visiting scholars to provide them with an opportunity to observe clinical care of pediatric patients in a high volume, academic setting.

Research Program

Basic Science and Translational Research

This past year, our basic and translational medicine researchers led by Maurizio Pacifici, Ph.D. have made impressive progress and generated novel, exciting, and far-reaching insights on key aspects of skeletal biology and growth and pediatric musculoskeletal pathologies. Our pediatric musculoskeletal research lab continues to solidify its standing with research work from Dr. Fanxin Long and Dr. Veronique Lefebvre. Our faculty members and their associates, including postdoctoral fellows, visiting scientists and research technicians, continued to tackle and fulfill the goals of several current NIH R01 grants and one Department of Defense (DOD) grant. These biomedical research projects aim to

advance current understanding of basic cellular, biochemical and genetic mechanisms that regulate the behavior and function of skeletal forming cells. These basic and key insights and observations are used to predict what may subtend and lead to pediatric pathologies including Multiple Hereditary Exostoses (MHE), Fibrodysplasia Ossificans Progressiva (FOP), Temporo-mandibular Joint dysfunction, Lamb-Shaffer syndrome, Hjadu-Cheney syndrome, and spondyloarthritis. The research Program is currently supported by 11 RO1 grants from the National Institutes of Health and generous donations from private foundations.

Center for Thoracic Insufficiency Syndrome (CTIS) Frontier Translational Research Program

Through funding from the Frontier Program, the Division's Center for Thoracic Insufficiency Syndrome (CTIS) continued developing innovative projects in translational research. The CTIS program strives to develop novel imaging techniques, construct new metrics for clinical outcomes, and establish reliable evidence to support innovative surgical strategies and devices through its research. These efforts are made possible by the collaboration of a multidisciplinary team of specialists from clinical research, image processing, informatics, and basic sciences/biomechanics. Currently, the CTIS Basic Science Lab is developing an animal model of TIS that will provide a platform for testing novel devices. The animal surgeries and biomechanics testing will be performed at Penn Vet's New Bolton Center. In addition, the CTIS team in collaboration with Medical Image Processing Group were awarded NIH R01 grant to develop novel dynamic functional metrics for TIS patients by establishing a comprehensive normative database of dMRI images and anatomic and functional models and metrics, and to translate these to develop biomarkers of TIS and of its corrective-surgery outcomes.

With the generous philanthropic support, Dr. Campbell's legacy was strengthened with the establishment of *Wyss/Campbell Center for Thoracic Insufficiency Syndrome*, enabling CHOP to discover countless more breakthroughs in research and care for TIS children.

Genetic Research

CHOP Orthopaedics continues to work in collaboration with the Center for Applied Genomics (CAG), led by Dr. Hakon Hakonarson and Dr. Struan Grant, to compile a registry of DNA and RNA samples. These samples are obtained from patients and families with a variety of orthopaedic conditions including adolescent idiopathic scoliosis (AIS), osteochondritis dissecans (OCD) of the knee, and multiple hereditary exostoses (MHE). The team is investigating further genetic characterizations of the EXT1/EXT2 mutations harbored by each exostosis and identify second hit(s) across exostoses from the same patient. This pilot project represents the first biomedical research focused on MHE and will provide novel and broadly relevant information. The goal is to translate the findings to prognostic tools based on the severity of the disease and to identify therapeutic means to counter the effects of EXT1/EXT2 plus "second hit" mutations.

Orthopaedic Engineering

Dr. Saba Pasha, Director of Orthopedic Engineering, continues her research on the application of 3D imaging and computer simulation in surgical planning, use of predictive models in surgical decision-making, and the exploration of gait and motion analysis for a more personalized treatment. For her research, Dr. Pasha is supported by grants from POSNA and SRS.

With new emerging technology, such as the EOS x-ray imaging system, comprehensive information about a patient's condition is now readily available. Dr. Pasha's work utilizes advanced imaging and motion analysis to collect data on a range of conditions and patient populations.

Clinical Research

The Division of Orthopaedic Surgery is currently conducting more than 200 IRB-approved clinical research projects. This includes 80 prospective and observational studies. CHOP Ortho faculty are also members of a number of multicenter study groups, including the Harms Study Group (HSG), Research in Osteochondritis Dissecans of the Knee (ROCK), SCFE Longitudinal International Prospective Registry (SLIP), The Fox Pediatric Spinal Deformity Study (Fox PSDS), Pediatric ACL: Understanding Treatment Operations (PLUTO), Medial Epicondyle Outcomes Multicenter (MEMO) study and International Hip Dysplasia Institute (IHDI). Investigators within the division have been awarded funding from both internal and external sources to conduct these studies. In 2018, the Division published over 150 articles in major orthopaedic journals, including *JBJS*, *Lancet Neurology*, *JPO*, and *CORR*. Members across our division presented more than 150 presentations at international and national conferences last year alone.

The Division successfully continues to award the annual Benjamin Fox Fellowship Award for medical students who are interested in conducting a year of clinical research within orthopaedics. In July, Joshua Bram (Perelman School of Medicine at the University of Pennsylvania), Lacey Magee (Rutgers-Robert Wood Johnson Medical School) and Nishank Mehta (Rutgers New Jersey Medical School, Newark), were awarded with the fellowship (Figure 8-10).

Recognition and Achievements

Our faculty have assumed several leadership roles within the pediatric orthopaedic community over the past year.

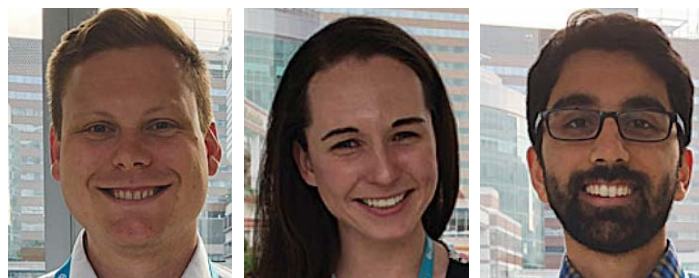


Figure 8. Joshua Bram

Figure 9. Lacey Magee

Figure 10. Nishank Mehta

Jason Anari, MD served as international faculty member at the Salzburg Medical Seminar in Pediatric Orthopedics in Salzburg, Austria. Dr. Anari also received a new grant as co-PI from Penn Institute for Translational Medicine and Therapeutics (ITMAT) titled, “*Development and testing of deep learning algorithms for segmentation on 4D MRI to understand changes in normal thoracic dynamics during childhood maturation*”.

Alexandre Arkader, MD was the Vice Chair for the Pediatric Orthopaedic Society of North America (POSNA) Educational Course Committee and faculty member for *XITROIA Congresso Brasileiro de Trauma Ortopedico Pediatrico* in Brazil. He also serves as sub-committee chair for Global Courses. Dr. Arkader continues to serve as a reviewer for *Journal of American Academy of Orthopaedic Surgeons*, *Journal of Bone and Joint Surgery Essential Surgical Techniques*, *BMC Musculoskeletal Disorders*, *Journal of Pediatric Orthopaedics B* and *Journal of Children's Orthopaedics*. He received funding from RSNA Research & Education Foundation Seed Grant as a Co-PI for grant titled “*Osteosarcoma Imaging with UTE MRI: Validation and Optimization with CT and Histopathology Correlation*.” Dr. Arkader is an active member of CORTICES study group.

Keith Baldwin, MD, MSPT, MPH is the Associate Director of Orthopaedic Trauma in the Division of Orthopedic Surgery. He currently serves as a reviewer for a number of journals including the *BMC Medical Education*, *BMC Musculoskeletal Disorders*, *BMJ Open*, *Journal of Pediatric Orthopaedics*, *Annals of Internal Medicine*, *Journal of Bone and Joint Surgery—American*, and the *American Academy of Pediatrics*. He also serves as an associate editor for *Journal of Orthopedic Trauma* and an editorial board member of the *American Journal of Orthopedics*, *Current Orthopaedic Practice* and *World Journal of Orthopedics*. Dr. Baldwin is an active member of CORTICES study group and CORTICES Research Committee.

Patrick Cahill, MD started his term as Board of Director for Pediatric Cervical Spine Study Group. He serves as Chair for Health Policy Committee and member of Governance Council at Scoliosis Research Society. He is also a member of POSNA's Quality, Safety, Value Initiative Committee. He continues to serve as an Associate Editor for *Spine Deformity Journal* and as a reviewer for the *Journal of Bone and Joint Surgery – American* and the Thrasher Research Fund. Dr. Cahill is an active member in the Harms Study Group, Pediatric Spine Study Group, and Fox Pediatric Spine Deformity study group, which are multi-center groups prospectively researching care improvements for complex pediatric spine deformities. Dr. Cahill received a new grant as co-PI from Penn Institute for Translational Medicine and Therapeutics (ITMAT) titled, “*Development and testing of deep learning algorithms for segmentation on 4D MRI to understand changes in normal thoracic dynamics during childhood maturation*”. He is the Director for *Wyss/Campbell Center for Thoracic Insufficiency Syndrome*.

Robert Carrigan, MD continues to serve on the ASSH Fellows Conference Committee, AAOS Appropriate Use

Committee, and POSNA Resident Newsletter Committee. He also serves as a reviewer for *Journal of Hand Surgery* and *Clinical Orthopaedics and Related Research*.

Richard Davidson, MD has continued to serve as an associate editor for Foot & Ankle, International. He also serves as a reviewer for *Clinical Orthopaedics and Related Research* and *Advances in Orthopaedic Society*.

B. David Horn, MD continues to serve as a reviewer for journals, such as *Clinical Orthopaedics and Related Research (CORR)*, *Pediatric Emergency Medicine*, and *Pediatrics*.

Jack Flynn, MD, Chief of the Division of Orthopaedics, continues to serve his 10-year term as a Director of the American Board of Orthopaedic Surgery. Dr. Flynn is a co-editor of *Lovell and Winter's Pediatric Orthopaedics*, *Rockwood's Fractures in Children*, *Operative Techniques in Pediatric Orthopaedics*. He is a core member of Pediatric Spine Study Group and Harms Study Group, a multicenter collaboration of researchers studying care improvements for pediatric spine deformity surgery, and serves on the Board for the Children's Spine Foundation. He also received *William Pottsic Mentoring Award* from the Department of Surgery. In the past year, Dr. Flynn was also invited as the visiting professor at Northwell/LIJ Medical Center, St. Justine/University of Montreal, University of Alabama Birmingham, Vanderbilt University and Hospital for Special Surgery. He was invited as Visiting Lecturer for the Silver Anniversary of POSICON, Mumbai, India.

Theodore Ganley, MD is the Sports Medicine Director at CHOP, continued growth of clinical, research initiatives. Dr. Ganley has continued in several leadership roles with national organizations, such as the chairman for the POSNA Evidence Based Practice Committee, second vice president of the Pediatric Research in Sports Medicine (PRISM) group, co-founder and executive board member for the Research in Osteochondritis Dissecans of the Knee (ROCK) group, executive committee member for the American Academy of Pediatrics, advisory board member for the International Pediatric Orthopaedic Symposium, and program chair for the Philadelphia Orthopaedic Society. Along with his leadership roles, he continues to be actively involved in biomechanical studies utilizing cadaver specimens in collaboration with the *Biedermann Lab for Orthopaedic Research* and *Human Motion Lab*. He is leading a nationwide initiative on Tibial Spine prospective study group with 14 sites currently participating. Dr. Ganley was invited as a Visiting Lecturer for Silver Anniversary of POSICON, Mumbai, India. Additionally, he is the site leader for the FDA clinical trial for studying the efficacy and safety of autologous cultured chondrocytes on porcine collagen membrane (MACI).

John Todd Lawrence, MD, PhD continued his collaborative work with Dr. Leo Han at Drexel University. Funded by the National Science Foundation, the project focused on conducting in vitro studies for a novel cartilage repair strategy. Dr. Lawrence is an active member of sports medicine multicenter research groups such as PLUTO and he leads a 12-site study group called MEMO. He continues to serve as a reviewer for the *American Journal of Sports Medicine (AJSM)* and *Journal of Shoulder and Elbow Surgery (JSES)*.

Dr. Lawrence received a new grant as co-PI from NIH titled “A Low-Cost, Collaborative Tool for the Tracking of Youth Activities to Reduce Risk of Physical Injury”.

Wudbhav Sankar, MD is the Director of the Young Adult Hip Preservation Program at CHOP. Dr. Sankar currently serves as the chair of the POSNA Fellowship committee and co-director of the International Hip Dysplasia Institute. He remains active in several study groups including Academic Network of Conservational Hip Outcomes Research (ANCHOR), SCFE Longitudinal International Prospective Registry (SLIP) and International Perthes Study Group (IPSG). Dr. Sankar is currently a reviewer for the *Journal of Bone and Joint Surgery*, *Journal of Pediatric Orthopaedics*, and an Editorial Board Reviewer of *Techniques in Orthopaedics*. Dr. Sankar was also the recipient of POSNA *Special Effort and Excellence Award*.

Apurva Shah, MD, MBA continues his tenure as the Director of Clinical Research. He continued to serve as co-PI on the grant from Orthopaedic Trauma Association titled, “*Opioid*

utilization after rotational ankle fractures”. He continued to serve as the team leader and traveled to Sigua Tepeque, Honduras for a pediatric hand surgery medical mission. Dr. Shah is currently a reviewer for the *Journal of Bone and Joint Surgery* and *Journal of Pediatric Orthopaedics*. Dr. Shah served as international faculty member at the Salzburg Medical Seminar in Pediatric Orthopedics in Salzburg, Austria.

David Spiegel, MD continued his work with the Children's Hospital of Philadelphia Global Health Pilot Grant. He currently is the chair for International Scholars Program at the American Academy of Orthopaedic Surgeons (AAOS). He served as a visiting lecturer at McGill University. Dr. Spiegel continued to be an active academic internationally, giving lectures in Iraq, Nepal and Pakistan.

Lawrence Wells, MD is the Associate Director of the Sports Medicine Performance Center at CHOP and Director of Quality, Safety, Value, and Patient Experience in the Division of Orthopaedic Surgery. Dr. Wells currently serves as the President of Board of Directors for the Philadelphia Orthopaedic Society.