



Children's Hospital of Philadelphia

John (Jack) Flynn, MD



Pediatric Faculty



John Flynn, MD



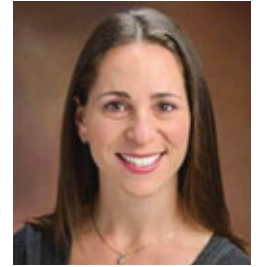
Jason Anari, MD



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



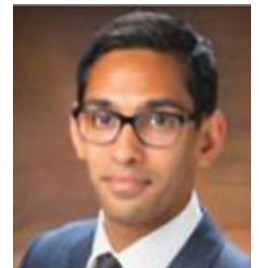
Christina Master, MD, FAAP, CAQSM, FACS



Christopher Renjilian, MD



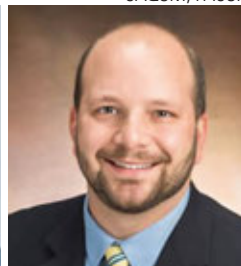
Wudbhav Sankar, MD



Apurva Shah, MD, MBA



David Spiegel, MD



Brian Vernau, MD, FAAP, CAQSM



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 pediatric musculoskeletal care in the nation/world, we have continued to expand our clinical, research, and teaching programs despite challenges due to COVID-19 pandemic. Again in 2021, *US News and World Report* ranked CHOP Orthopaedic Surgery 1st in the nation in pediatric orthopaedic surgery.

In 2021, CHOP Orthopaedics welcomed a new sports medicine pediatrician to our team, participated virtually and in person at national and international conferences, maintained enrollment of three FDA Phase IIIb investigational drug trials and a feasibility device trial, published more than 200 articles, and obtained significant extramural funding from major funding agencies such as National Institutes of Health (NIH), Department of Defense (DoD), and National Science Foundation (NSF).

Clinical Program

Our Orthopaedic faculty continues to expand and is currently comprised of thirty members: eighteen specially trained pediatric orthopaedic surgeons (including three transition-to-adult care faculty), four non-operative physicians, six sports medicine-trained pediatricians, and two collaborating plastic surgeons. In March 2022, we welcome Dr. Chrissy Goodbody (Figure 1), who will join us as an Attending Surgeon in pediatric limb deformity, foot/ankle and neuromuscular disorders. She completed her medical degree at the University of Pennsylvania, her residency at the Hospital of Special Surgery, her Pediatric Orthopaedic Fellowship at CHOP, then a subspecialty fellowship at the Baltimore Limb Deformity Center. Our division also welcomed faculty member, Dr. Edward Re (Figure 2). He earned his medical degree at Brown University in Providence, Rhode Island. Dr. Re completed an internship in Emergency Medicine at the Hospital of the University of Pennsylvania before joining CHOP as a pediatric resident, then a primary care sports medicine fellow. He joins our program as a new sports medicine pediatrician.



Figure 1. Chrissy Goodbody, MD



Figure 2. Edward Re, MD

Education Program

CHOP Orthopaedics currently funds four one-year clinical fellowships. The 2021-2022 clinical fellows are Brett Lullo, MD

(Figure 3); Joseph Yellin, MD (Figure 4); Raghav Badrinath, MD (Figure 5); and Alex Gornitzky, MD (Figure 6). The 2020-21 research fellow was Dr. Soroush Baghdadi, MD from Iran (Figure 7). While at CHOP, Dr. Baghdadi focused his research efforts on basic science projects related to cartilage regeneration and clinical research focused on pediatric trauma, neuromuscular conditions, and sports injuries. We are excited to have Dr. Baghdadi join our team as a clinical fellow in August 2022.



Figure 3. Brett Lullo, MD



Figure 4. Joseph Yellin, MD

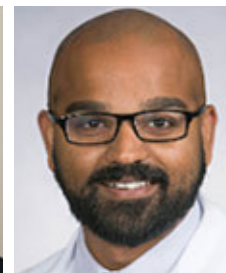


Figure 5. Raghav Badrinath, MD



Figure 6. Alex Gornitzky, MD



Figure 7. Soroush Baghdadi, MD

To celebrate the graduation of the 2020-2021 clinical fellows, the Division hosted the Nicholson Visiting Professor Program and Fellows Graduation & Reunion in June 2021. This year's Visiting Professor was Dr. Steve Frick, Professor of Orthopaedic Surgery and Vice Chairman—Education at Stanford University School of Medicine Department of Orthopaedic Surgery, and Chief of Pediatric Orthopaedics at Stanford Children's Health. He is a nationally recognized expert in clubfoot and foot/ankle disorders, trauma, osteogenesis imperfecta, hip dysplasia, growth, leadership, professionalism, and graduate medical education.

The 2021 Drummond Rising Star Visiting Professor was Ben Shore, MD, MPH. Dr. Shore is an Associate Professor of Orthopaedic Surgery at Harvard Medical School and Boston Children's Hospital. He serves as the Director of the Orthopaedic Fellowship Program at Boston Children's Hospital and Co-Director of the Cerebral Palsy and Spasticity Center. He gave excellent talks on hip surveillance in cerebral palsy, Legg-Calve-Perthes disease, and all things related to trauma. 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. They focused on pediatric pathologies including Multiple Hereditary Exostoses (MHE), Fibrodysplasia Ossificans Progressiva (FOP), Temporomandibular Joint dysfunction, Lamb-Shaffer syndrome, Hjadu-Cheney syndrome, and spondyloarthritis. The research program is currently supported by 14 R01 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 a 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, Tibial Spine fractures (TSF) 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.

Clinical Research

The Division of Orthopaedic Surgery is currently conducting more than 236 IRB-approved clinical research projects. This includes more than 100 prospective and observational studies. CHOP Ortho faculty are also members of a number of multicenter study groups, including the Harms Study Group (HSG), the Pediatric Spine Study Group (PSSG), Research in Osteochondritis Dissecans of the Knee (ROCK), SCFE Longitudinal International Prospective Registry (SLIP), Tibial Spine Prospective Cohort (TSF-PC), 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), Children's Orthopedic Trauma and Infection Consortium for Evidence based Studies (CORTICES), Congenital Upper Limb Differences Registry (CoULD), Research in Osteochondritis of the Elbow (ROCKET), Sports Cohort Outcomes Registry (SCORE), and International Perthes Study Group (IPSG). Investigators within the division have been awarded funding from both internal and external sources to conduct these studies. In 2021, the Division published over 226 articles in major orthopaedic journals, including *JAMA*, *JBJS*, *Lancet*, *JPO*, and *CORR*. Members across our division presented more than 140 presentations at international and national conferences last year alone.

Our Benjamin Fox Research Fellowship for medical students between 3rd and 4th years welcomed Patrick England (Washington University School of Medicine in St. Louis.), Sara Kiani (Icahn School of Medicine at Mount Sinai) and Nathan Houlihan (Sidney Kimmel Medical College at Thomas Jefferson University) (Figure 8-10).



Figure 8. Patrick England



Figure 9. Sara Kiani

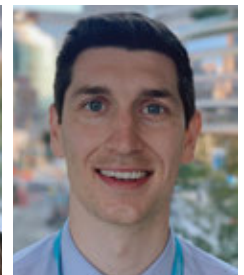


Figure 10. Nathan Houlihan

Recognition and Achievements

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

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 PI from Pediatric Orthopaedics Society of North America (POSNA) titled, “*Managing failure to lengthen in MCGR: Best practice guidelines*”.

Alexandre Arkader, MD was the Vice Chair for the Pediatric Orthopaedic Society of North America (POSNA) Educational Course Committee. 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 continues to serve as Co-PI on RSNA Research & Education Foundation Seed 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 several 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. He also received the prestigious *Standard Research Grant* from Scoliosis Research Society.

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 Scoliosis Research Society titled, “*New Strategies for Pulmonary Assessment in Spinal and Chest Wall Deformity*”. 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 Orthopedics 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, completed his term as the Vice President of the American Board of Orthopaedic Surgery and began serving as President of the Pediatric Spine Study Group/Pediatric Spine Foundation. He also was selected to serve on the JBJS Board of Trustees. Dr. Flynn is a co-editor of *Lovell and Winter's Pediatric Orthopaedics*, *Rockwood's Fractures in Children*, *Operative Techniques in Pediatric Orthopaedics*. Dr. Flynn serves on the Editorial Board of *Journal of Spinal Deformity*. He is a site leader for *Hospital-Based Cluster Stratified Randomization Control Trial* where 21 national sites are participating to compare 6-week lengthening interval compared to a 16-week lengthening interval on spinal growth in EOS patients undergoing treatment via Magnetically Controlled Growing Rods.

Theodore Ganley, MD is the Sports Medicine Director at CHOP was the second VP of the Pediatric Research in Sports Medicine (PRISM) group, co-founder and executive board member as well as President 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 and it was funded by *Arthur H. Huene Memorial Award* from POSNA. 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). Dr. Ganley also serves as the site PI for recently NIH funded grant “*IMPACCT: Infrastructure for Musculoskeletal Pediatric Acute Care Clinical Trials*”.

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 MEMO, which is the largest group studying medial epicondyle fractures and injuries. 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 continues to serve as a co-PI from NIH titled “*A Low-Cost, Collaborative Tool for the Tracking of Youth Activities to Reduce Risk of Physical Injury*” and site Co-PI

for recently NIH funded grant “*IMPACCT: Infrastructure for Musculoskeletal Pediatric Acute Care Clinical Trials*”.

Kathleen Maguire, MD is our new faculty member continuing her work at our Sports Medicine Performance Center. She is an active member of AAOS Emerging Leaders Program.

Wudbhav Sankar, MD is the Director of the Young Adult Hip Preservation Program at CHOP. Dr. Sankar currently serves as 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*.

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 continues 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 continues to serve as the PI for Angela S.M. Kuo Memorial Award from POSNA for his research project “*Opioid vs. Non-Opioid Analgesia in Pediatric Supracondylar Humerus Fractures*.” He also serves as the site Co-PI for recently NIH funded grant “*IMPACCT: Infrastructure for Musculoskeletal Pediatric Acute Care Clinical Trials*”.

David Spiegel, MD continued his work with the Children’s Hospital of Philadelphia Global Health Pilot Grant. He currently is the chair for the International Scholars Program at AAOS. 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. Dr. Wells currently serves as the President of Board of Directors for the Philadelphia Orthopaedic Society and as Vice Chair for Inclusion, Diversity and Equity at the Perelman School of Medicine.

Brendan Williams, MD continued his work at our Sports Medicine Performance Center. Dr. Williams serves on POSNA Educational Courses Committee and AAOS Emerging Leaders Program. He continued his tenure as Board of Directors for Children Beyond Our Borders.