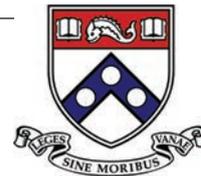




The Children's Hospital of Philadelphia

Ashley Trocle, BAS, John Dormans, MD, and John (Jack) Flynn, MD



The Division of Orthopedic Surgery at the Children's Hospital of Philadelphia enjoyed another year marked by change and growth. Our clinical and research programs have continued to expand in line with our goal of improving the quality of care we provide to patients. In 2014, CHOP was named the number one children's hospital by US News and World Report, a distinction we have held for 10 consecutive years.

In December, CHOP announced the selection of Dr John M. "Jack" Flynn, MD as the new division chief. Dr Flynn has previously served as associate chief of Orthopedics since 2005. Dr Flynn succeeded Dr John Dormans, MD FACS who led the division for over 18 years.

Next year will also mark the opening of two new state-of-the-art facilities. The new Specialty Center at King of Prussia (Figure 1) will open later this summer. The 115,000 square-foot facility will house an ambulatory surgery center to provide outpatient general and specialty surgical services. One of the many CHOP expansion projects in the region, the center acts to expand our reach into areas surrounding Philadelphia and to provide these communities with the best possible care. Construction of the Buerger Center for Advance Pediatric Care is on schedule, and the building will open in July 2015 (Figure 1b). The outpatient facility on CHOP's main campus features 12 floors of integrated clinical care facilities along with patient oriented features including 'wait, play, learn' areas for patients and siblings and a roof garden. The two facilities are exemplary of CHOP's commitment to being a world leader in patient care.

Clinical Program

Our orthopaedic faculty continues to expand and is currently comprised of twenty six total providers, including eighteen specially trained pediatric orthopaedic surgeons (twelve operative and four non-operative), four pediatricians with sports medicine training, and five transition to adult care faculty.

CHOP Orthopaedics is pleased to announce the addition of Dr Brian Vernau (Figure 2a), a pediatrician with sports medicine training. Dr Brian T Vernau joined the Division in fall 2014 after his completion of a sports medicine fellowship at CHOP. He is the team physician for Kennett High School and has provided medical care to the University of Pennsylvania and West Chester University. Dr Vernau obtained his medical degree from Pennsylvania State University College of Medicine in University Park, PA and completed his pediatrics residency at Nationwide Children's Hospital in Columbus, OH. Dr Apurva Shah, MD MBA (Figure 2b) will be joining the division



A



A

Figure 1. (A) CHOP's new Specialty Care Center in King of Prussia, PA will combine existing specialty care practices and expand regional ambulatory care and surgery services. (B) The Buerger Center for Advanced Pediatric Care will open in July 2015.

in August, 2015. Dr Shah is an orthopedic hand and upper extremity surgeon with interest in brachial plexus surgery, traumatic and congenital problems in the hand, and cost-effectiveness, outcomes, and economics of healthcare and orthopedics.

In the past year, the Division of Orthopedics has made a significant impact on the management of pediatric concussions at a local and national level. Five non-operative primary care sports physicians see concussion patients throughout the extensive CHOP Network in PA and NJ. Collaboration with CHOP's Center for Injury Research and Prevention continues



Figure 2. The division welcomed Dr Brian Vernau (A), a sports medicine pediatrician. Dr Apurva Shah (B) will be joining the division in August, 2015.

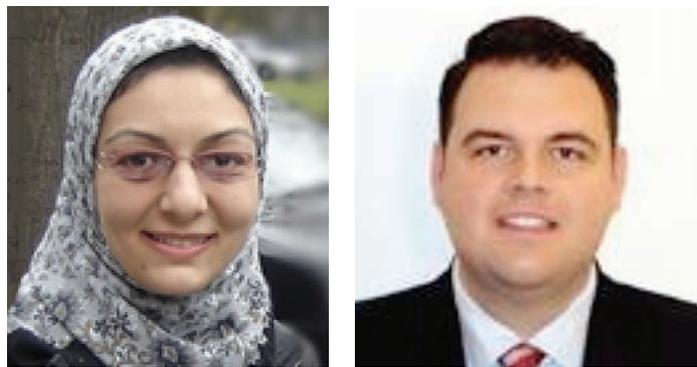


Figure 4. (A, B) From left to right, the CHOP Orthopaedic Research Fellows: Drs Nariman Abol Oyoum from Egypt and Emmanouil Grigoriou from Greece.

with funding from the CDC to study the epidemiology of pediatric concussion, as well as funding from the NIH CHOP/Penn Clinical Translation Science Award to study the genomics of concussion. In May, Dr Christina Master traveled to the Washington, DC with CHOP President and COO Madeline Bell to attend President Obama's White House Summit on Concussion. The work that CHOP is doing in developing a comprehensive pediatric concussion registry was highlighted in the White House press release on the summit. Overall, the Minds Matter research endeavor resulted in 5 publications in 2014, ranging from a review article in *Annals of Internal Medicine*, to studies describing visual and vestibular deficits in pediatric concussion, with 3 more in press already for 2015, including an article in the upcoming Special Issue of *Developmental Neuropsychology* highlighting concussion work within the Big 10-Ivy League consortium.

Teaching

CHOP Orthopaedics currently funds four one-year clinical fellowship positions, and three one-two year research fellowship positions. The 2014-2015 **clinical fellows** are Andrew Georgiadis, MD (Figure 3A); Aristides Cruz, MD (Figure 3B); Peter Fabricant, MD (Figure 3C); and Mark Seeley, MD (Figure 3D). Following completion of their clinical fellowships, Dr Georgiadis will be completing a fellowship at the Royal Children's Hospital in Melbourne, Australia, where he will train with international CP guru Kerr Graham. Dr Cruz will be

joining the faculty at Brown University Orthopedics, focusing on pediatric sports surgery. Dr Fabricant will be completing a sports medicine fellowship at Boston Children's Hospital, then plans to return to HSS. Dr Seeley will be an attending surgeon at Geisinger Health System in Wilkes-Barre, PA. This year's **research fellows** are Nariman Abol Oyoum, MD from Egypt (Figure 4A) and Emmanouil Grigoriou, MD from Greece (Figure 4B). After completing their research fellowship, Dr. Abol Oyoum will be returning to Assiut University in Egypt where she was an attending orthopedic surgeon, and Dr Grigoriou will be starting an orthopedic surgery residency program in the US.

Research Program

Basic Science

The past year has been productive, exciting and far-reaching for our Orthopaedic Basic Research Program, led by Maurizio Pacifici, Ph.D. (Figure 5) with new activities and research goals related to a number of skeletal pathologies. Our faculty members and their young associates continue to work diligently on the goals of our several current NIH



Figure 3. (A-D): From left to right, the CHOP Orthopaedic Clinical Fellows: Drs Andrew Georgiadis, Aristides Cruz, Peter Fabricant, and Mark Seeley.



Figure 5. The CHOP Orthopaedic Translational Research Team led by Maurizio Pacifici, Ph.D.

RO1 grants, one Department of Defense (DOD) grant and one Veterans Administration (VA) grant to understand basic fundamental aspects of skeletal formation and growth and in turn, pathogenic mechanisms that may subtend pediatric and adult conditions including Heterotopic Ossification (HO), Hereditary Multiple Exostoses (HME) and other musculoskeletal pathologies. Work supported by the Muscular Dystrophy Association (MDA) and led by one of our faculty members—Dr. Masahiro Iwamoto—continues to make progress using a novel pharmacological treatment to enhance muscle tissue repair after trauma or in congenital conditions such as muscular dystrophies. In a related development, our faculty member Dr. Eiki Koyama has joined forces with a faculty member in the CHOP Division of Plastic and Reconstructive Surgery—Dr. Hyun-Duck Nah—to understand the development and growth of the temporomandibular joint and to identify possible therapeutic means to treat TMJ osteoarthritis, a condition particularly common in women and quite debilitating. The data and insights stemming from their work have led to the publication of several important studies, and all their work and dedication have now been rewarded by a new 5 year NIH RO1 grant.

An equally important area of research led by another faculty member—Dr. Motomi Enomoto-Iwamoto—and supported by a R21 grant from the NIH focuses on tendon and ligament biology and aims to stimulate structural and functional repair in those essential structures when damaged by trauma or overuse. Dr. Enomoto-Iwamoto also received a grant from the Arthritis Foundation last year to study a cell membrane protein that affects the behavior and function of surface cells in articular cartilage, cells that are essential for the frictionless movement of the joints. The outcome of the work will shed new light on the biology of those cells and will suggest ways to maintain their function during aging or restore it in chronic conditions including osteoarthritis and acute joint injury in pediatric and adult patients. In a related development, Dr. Pacifici joined forces with Dr. Robert Mauck in the Department of Orthopaedic Surgery at Penn to study whether progenitor cells isolated from developing embryonic synovial joints may have articular cartilage regenerative capacity superior to that of currently used cells such as bone marrow-derived mesenchymal stem cells. Such highly innovative studies are supported by a new grant Drs. Pacifici and Mauck just received from the VA.

Our basic research work on HO has directly led to a phase 2 clinical trial to treat children affected by Fibrodysplasia Ossificans Progressiva (FOP), a congenital and very severe form of HO. Papers we published in 2010 and 2011 showed for the first time that synthetic agonist ligands for nuclear retinoic acid receptors are very potent inhibitors of HO in experimental animal models of the disease. The Canadian-based pharmaceutical company Clementia working closely with us and our colleagues at the UPenn FOP Foundation—Drs. Fred Kaplan, Bob Pignolo and Eileen Shore—launched the clinical trial in July of the past year.

Our clinical Division remains a major national and international center of diagnosis, care and surgical treatment

for children affected by hereditary multiple exostoses (HME). Our Basic Research Program is actively engaged in understanding the molecular pathogenesis of HME, using animal models and cells in vitro and funding from the NIH. To extend these basic research efforts and accelerate the pace of research toward translational medicine outcomes, a senior investigator—Dr. Paul Billings—joined our Division last year to create new cell-based bioassays to screen chemical libraries and identify drugs able to correct a specific polysaccharide deficiency that causes HME. Such pharmacological treatment could be used in combination with surgical interventions to provide a more effective and comprehensive therapy for HME patients in the future. This investment is paying off with new insights into the mechanisms of action of that polysaccharide in regulating cell function and into assays by which its function and production could be modulated by agents to elicit therapeutic outcomes.

Genetic Research

CHOP Orthopaedics is also working 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 obtained from patients and families with a variety of orthopaedic conditions, including targeting families with multiple individuals affected with adolescent idiopathic scoliosis (AIS), osteochondritis dissecans (OCD), and HME. A collaborative effort between the genetic, basic science and clinical teams indicated a putative genetic connection between the type 2 diabetes associated allele within TCF7L2 and EXT1 and EXT2, genes which are known to account for the primary genetic component of HME. The findings which published in *Bone* in early 2015, suggest a possible shared pathway between the two pathogeneses. Efforts to understand the genetic basis of adolescent idiopathic scoliosis also continue through efforts at CHOP and multi-center collaborations.

Biomechanical Research

Our division welcomed Saba Pasha, PhD to the research team in 2013. Dr Pasha is leading projects with a focus on orthopaedic biomechanics through extramural funding. In 2014, our research team integrated using EOS imaging with a pressure mat that permits association between skeletal deformities and patients' balance during the course of the skeletal deformity progression and after surgery. She also initiated a 3D data registry to better investigate the pathomechanisms associated with juvenile knee abnormalities.

Clinical Research

The CHOP Orthopaedic Surgery division is currently conducting 124 ongoing, IRB approved clinical research projects. This includes 49 prospective randomized clinical trials, observational studies or clinical databases on patient care. Investigators within the division have been awarded funding from both internal and external sources to conduct these studies. In 2014, the division produced 125 publications in major orthopedic journals including JBJS, Spine, JPO and CORR. Abstracts were presented at the major national and

international meeting in the field including AAOS, POSNA, SRS, and AAP. Several projects were nominated for best papers at national meetings, and Ben Fox Scholar Christine Goodbody, (Perelman Penn Med '15) won the Young Investigator in Training Award at AAP-Orthopaedics Section.

In 2009, our division initiated an annual Benjamin Fox Scholarship Award for current medical students who are interested in conducting a year of clinical research within Orthopaedics. In June, our department awarded Alex Gornitzky (Figure 6a) and Joseph Yellin (Figure 6b), both upcoming fourth year medical students at the Perelman School of Medicine at the University of Pennsylvania with this scholarship. While at CHOP, Alex has focused his research on the management and outcomes of development hip dysplasia (DDH), the genetics of osteochondritis dissecans, and Adolescent Idiopathic Scoliosis, including the psychosocial factors influencing bracing and postoperative management using the Rapid Recovery Pathway. Joe has concentrated his research on treatment of pediatric femur fractures and severe supracondylar humerus fractures, rehabilitation following ACL reconstruction, and neuromonitoring during spinal fusion in patients who may be neurologically compromised. He is also interested in examining infection rates and appropriate/efficient treatment surrounding VEPTR surgeries and osteomyelitis, respectively.

Recognitions and Achievements

Our Attendings have assumed several leadership roles within the pediatric orthopaedic community over the past year:

Keith Baldwin, MD is the director of clinical research in the Division of Orthopedics Surgery at CHOP. Dr Baldwin is also the Health Policy Chair of the Orthopedic Rehabilitation Association, Associate Editor for Rehabilitation of the Journal of Bone and Joint Surgery Reviews (JBJS), Editorial Board Member for World Journal of Orthopaedics, and Associate Editor for the Journal of Orthopaedic Trauma (JOT).

Robert Campbell, MD has continued to expand and develop the Center for Thoracic Insufficiency at CHOP. In August 2014, Dr Campbell co-directed the FDA Reviewers Pediatric Spine Course at CHOP. The course provided FDA reviewers with an understanding of surgical concepts, indications, and clinically important efficacy and safety parameters. The interactive

sessions allowed for discussion on the use and approval of current and future pediatric spinal devices. Additionally, the VEPTR/ VEPTR II received 510(k) clearance by the FDA in 2014. Dr Campbell, an inventor of the VEPTR, believes this will allow for increased availability of the device.

John P. Dormans, MD, FACS, Chief Emeritus of Orthopaedic Surgery at CHOP, is the current President of the Scoliosis Research Society (SRS) and will host the SRS's 50th Anniversary meeting in Minneapolis, Minnesota in September 2015. He is also the Secretary General of the SICOT Foundation, Treasurer of SICOT International, and President of SICOT's World Orthopaedic Concern (WOC).

Jack Flynn, MD, Chief of the Division of Orthopedics Surgery, served as the President of the Pediatric Orthopaedic Society of North America (POSNA) in 2013-2014 and hosted the 30th Annual meeting of POSNA in Hollywood, California in April, 2014. Dr. Flynn was elected to serve a 10 year term on the American Board of Orthopaedic Surgery and served as Burton Visiting Professor at Rochester and the Pediatric Orthopaedic Society of New Zealand visiting professor. He is one of the co-editors of *Rockwood's Fractures in Children*, 8th ed. published in 2014, and serves as co-Chair of the International Pediatric Orthopaedic Symposium and is the Chair of the AAOS CME Courses Committee. He continues his service on the Board of Directors of the Children's Spine Study Group, and is active in the Harms Study Group, a multi-center collaboration of researchers studying care improvements for pediatric spine deformity surgery.

Theodore J. Ganley, MD, is the Sports Medicine Director at CHOP supporting the clinical, research and outreach initiatives which continue to grow. Dr. Ganley recently collaborated on the creation of the new Penn/Children's Hospital of Philadelphia orthopedic sports medicine fellowship with Dr. Sennett. He was an advisory board member for the International Pediatric Orthopedic Symposium. Dr Ganley co-founded the Research in OCD of the Knee (ROCK) group and is on the board which developed the Pediatric Research in Sports Medicine (PRISM) group. He was also selected as a visiting Professor and invited lecturer this past year at Harvard Boston Children's, Case Western Reserve University, Union Memorial Hospital, and The Mexican Society of Pediatric Orthopedics.

B. David Horn, MD is the current chair of the AAOS Pediatric Evaluation Committee and is currently in the process of editing the 2016 Pediatric Self Assessment Examination. He also co-edited the textbook *Current Surgical Management of Fractures and Complications in Children*, published in 2014.

John Todd Lawrence, MD, Ph.D, through an OMEGa grant, recently completed the development of a distal radius fracture model (patent pending) which will improve resident performance in fracture reduction and casting techniques. The model is currently being validated in conjunction with a multicenter pediatric simulation group.

Dr Christina Master, MD, continues to work to expand Minds Matter: Concussion Care for Kids at CHOP and the clinical and research enterprise continues to grow, as described above. In addition, in the fall of 2014, Dr. Master became certified in the new ABMS subspecialty area of Brain Injury Medicine with the



Figure 6. (A, B) From left to right, the 2014-2015 Benjamin Fox Research Fellows: Alex Gornitzky and Joseph Yellin.

first administration of the exam cosponsored by the American Board of Psychiatry and Neurology, and the American Board of Physical Medicine and Rehabilitation.

Wudbhav Sankar, MD is the Director of the Young Adult Hip Preservation Program at CHOP. Dr Sankar is a member of the Board of Directors for the Pediatric Orthopaedic Society of North America (POSNA) and served as the program chair for the at the 2014 Annual Meeting. Dr Sankar was also a faculty presenter at International Pediatric Orthopaedic Symposium (IPOS) and the AAOS/AAHKS/POSNA Open and Arthroscopic Techniques for Adolescent and Young Adult Hip Preservation Course. He is the section editor of the spine section of *Operative Techniques and Orthopedics Surgery's* 2nd Edition, which will be published in 2015.

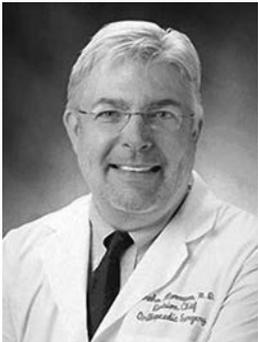
David Spiegel, MD, is the co-editor of the recently published textbook, *Global Orthopedics: Caring for Musculoskeletal*

Conditions and Injuries in Austere Settings. The textbook provides case-based information for surgeons in developing nations with limited resources in the context of public health, cultural differences, and historical precedents. In January 2014, Dr Spiegel was an invited lecturer at the inaugural Lancet Commission on Global Surgery Conference. He is also heading the AAOS International Scholar Program.

Lawrence Wells, MD became the Associate Director the Sports Medicine Performance Center at CHOP and Director of Quality, Safety, Value and Patient Experience in the Division of Orthopedic Surgery in 2014. He is the section editor for the orthopaedic section of *Nelson's Textbook of Pediatrics* 20th edition which will be published in 2015. Dr. Wells is the Vice President of the Philadelphia Orthopaedic Society and a member of the executive committee for the section on Orthopaedics for the American Academy of Pediatrics.

Tribute to Dr. John Dormans

Tyler R. Morris, MD, Alexander L. Neuwirth, MD, Jason A. Anari, MD, Ashley Trocle, BAS, John Dormans, MD, and John (Jack) Flynn, MD



After 18 years of distinguished leadership, Dr. John P. Dormans, MD, FACS will be stepping down as Chief of Orthopaedic Surgery at Children's Hospital of Philadelphia. In his tenure, Dr Dormans oversaw the division's significant expansion in faculty from five to 25 and facilitated a robust basic and clinical research program. He continued to develop the ACGME-approved pediatric orthopedic surgery fellowship, increasing the number of positions from one to four. As director of the fellowship program, he has trained 51 clinical fellows and 37 research fellows and provided the next generation of surgeons with the skill needed to be leaders in the field. Clinically, Dr Dormans is internationally recognized for his work in treating pediatric spinal deformities and musculoskeletal tumors, and promoting safety in spinal surgery. He oversaw the

development of the Spine Program, the Sports Medicine and Performance Center, the Center for Thoracic Insufficiency syndrome, the Neuromuscular Program, the Cerebral Palsy Program and the Young Adult Hip Preservation Program. In addition to his clinical appointments, Dr Dormans is active in a number of national and international organizations. He served as the President of the Pediatric Orthopedic Society of North America (POSNA), Scoliosis Research Society (SRS), and SICOT's World Orthopedic Concern, Treasurer of SICOT International and Secretary General of SICOT's Foundation during his tenure as division chief. He was also the president of the Medical Staff of CHOP (1999-2001) and Children's Surgical Associates (3 terms). He has published more than 340 peer reviewed articles, written or edited five textbooks, 140 abstracts and 150 editorials, reviews or chapters.

Dr Dormans was a driving force behind the division's growth for nearly two decades. His contributions to CHOP will continue to make a lasting impact on our staff and patients, and we will continue to celebrate his leadership.