



Pediatric Orthopaedic Fellowship Curriculum

The Fellowship Pediatric Orthopaedic Curriculum is designed for the fellow to spend three months each in four content areas. There are five content areas comprising the program, which allows the fellow the latitude to determine his or her individual educational experience. There will be overlap in most of these content areas, and in particular pediatric fracture / trauma care and general primary care pediatric orthopaedic disorders. Each of the faculty has specific areas of clinical and research interest, which is the primary content area that will be covered as the fellow rotates on the different services. Many of the faculty will see patients with musculoskeletal conditions across a wide spectrum of disorders. However, the division is not compartmentalized into defined services based on subject (i.e. there is no defined Cerebral Palsy service). The fellow will be assigned to a group of one or two physicians at any one time with whom he or she will be working in clinic and in surgery for three month periods.

Each of the five content areas has listed the competency - based Goals and Objectives. Many of these goals and objectives will also have overlap in each of the five content areas, and are similar to those listed for the 6 ACGME Core Competencies outlined under “Learning Objectives” in this Fellow manual. For each of the content areas, only the Medical Knowledge and Patient Care core competency goals are listed, as the Goals and Objectives for the other competencies are the same across all five content areas.

These five content areas include:

1. Spinal deformity, pediatric bone and joint infection
2. Cerebral palsy and other neuromuscular disorders
3. Hip and lower extremity deformities
4. Sports medicine
5. Pediatric trauma, foot and ankle disorders

Content Areas

Spinal deformity, pediatric bone and joint infection

Rotation description: This three month rotation is directed by Greg White MD as the primary faculty staff. The fellow will encounter various types of spinal deformity patients during this rotation including early onset and idiopathic scoliosis, neuromuscular and syndromic scoliosis, congenital scoliosis and kyphosis, Scheuermann’s kyphosis, and spondylolisthesis. Other pediatric spinal disorders such as infection, tumors, and traumatic spine fractures will be discussed during didactic conferences if not directly observed and cared for by the fellow in patients during this three month rotation or during the rest of the fellowship year. The fellow will also evaluate and treat pediatric bone and joint infections throughout the fellowship year.

Competency - based Goals and Objectives:

1. Medical knowledge – The fellow will:
 - a. Demonstrate knowledge of the natural history of congenital scoliosis, early-onset and adolescent idiopathic scoliosis as well as neuromuscular scoliosis.
 - b. Understand the role and effectiveness of nonoperative treatment (bracing) for idiopathic and neuromuscular scoliosis.
 - c. Prescribe a spinal orthosis, using the proper terminology and descriptive information necessary to communicate effectively with the orthotist.
 - d. Formulate an algorithm for surgical treatment decision making, including the role for posterior spinal fusion, anterior spinal fusion and combined anterior/posterior spinal fusion and appropriate fusion levels for each.

- e. Participate in a sufficient number of surgical cases in order to become competent in the surgical techniques used in the operative treatment of scoliosis including exposure, instrumentation and bone-grafting for anterior and posterior spinal fusions.
 - f. Understand the natural history of other forms of pediatric spine disorders including spondylolysis and spondylolisthesis.
 - g. Evaluate patients with these disorders.
 - h. Order appropriate imaging studies in order to investigate the status of these disorders.
 - i. Describe an algorithm for formulating treatment decisions of patients with spondylolysis/spondylolisthesis.
 - j. Discuss the role of nonoperative (brace) treatment for these conditions and be able to properly prescribe an appropriate orthosis.
 - k. Be aware of and familiar with the surgical treatment of these disorders, the different techniques available and the risks associated with each.
 - l. Participate in the evaluation of patients with acute problems or acute care needs, such as limping, refusing to walk, joint pain in the setting of a fever or other illness.
 - m. Learn the appropriate laboratory studies to order in the evaluation of a patient with acute joint pain or swelling, differentiate septic arthritis vs inflammatory process based on physical exam, diagnostic studies, etc. (Kocher criteria).
 - n. Produce an appropriate differential diagnosis for a child with acute joint pain and swelling and be able explain how to include or exclude possible diagnoses on the list.
 - o. Understand the presentation of potentially life-threatening infections such as MRSA, and the need for continual surveillance for these infections.
2. Patient Care – The fellow will:
- a. Understand the care of the patient with a spinal deformity begins in the initial evaluation and assessment of the patient.
 - b. Demonstrate an understanding of the impact of conservative and operative methods of treatment of the patient and the family.
 - c. Determine what appropriate diagnostic and imaging studies for specific spinal deformities and other spine-related disorders, and their interpretation.
 - d. Prepare and manage the post-operative care of spine patients in the PICU and on the surgical patient floor, as well as prepare comprehensive discharge plans.
 - e. Perform an appropriate physical exam of a patient with hip pain.
 - f. Discuss the role of different imaging modalities of the patient with joint pain or illness including: plain radiographs, ultrasound, nuclear medicine scans and MRI scans.
 - g. Understand the management of patients with bone and joint infection in coordination with other services including infectious disease, pediatrics, and radiology.

Cerebral Palsy and other Neuromuscular disorders

Rotation description: The Fellowship Director, Michael Wade Shrader, MD will direct the neuromuscular disorder rotation, with an emphasis on the comprehensive care of the child with cerebral palsy and other spasticity related conditions. The fellow will learn how to work in a multi-disciplinary outpatient setting with other pediatric specialists. The fellow will participate in the motion analysis / gait lab, understanding the indications and interpretations of gait studies for clinical decision-making. The fellow will gain an understanding of both upper and lower extremity procedures, single event multi-level (SEML) procedures, tendon transfers, salvage hip procedures, and newer techniques for crouch gait in ambulatory patients. There will be overlap with the spine rotation in the care of neuromuscular spinal deformities.

Competency - based Goals and Objectives:

- 1. Medical knowledge – The fellow will:
 - a. Become familiar with classifications of cerebral palsy, including different types of motor disorders (spasticity, mixed tone, dystonia, ataxia, etc.) as well as different physical patterns: hemiplegia, triplegia, diplegia, quadriplegia.
 - b. Be able to describe different physical features associated with each pattern of involvement.
 - c. Evaluate patients across a wide spectrum of neurologic and musculoskeletal involvement, ranging from mildly involved to profoundly handicapped, with particular attention to the different physical

exam findings that one should look for or anticipate finding with patients from a large spectrum of disease involvement.

- d. Learn the natural history of cerebral palsy and other related conditions
 - e. Learn the basic components of gait analysis in the evaluation of ambulatory patients with cerebral palsy and other neuromuscular disorders.
 - f. Be able to listen to and to communicate with the physical therapist who performs the initial gait analysis.
 - g. Interpret gait analysis studies with specific attention to kinematic and kinetic plots, electromyograms, muscle length graphs, pedobarographs and energy expenditure measurements.
 - h. Explain gait analysis findings to a patient's parents and/or the referring physician.
 - i. Use this information to formulate a problem list as well as a list of treatment solutions to correct the problems.
 - j. Interact with the other members of the healthcare team to be aware of the role of adjunctive therapies in the treatment of patients with spasticity. This includes the role of Botulinum toxin and phenol for localized tone reduction by the physical medicine and rehabilitation physicians as well as neurosurgical procedures to address abnormal tone such as selective dorsal rhizotomy and intrathecal baclofen pump therapy.
 - k. Understand the role of soft-tissue surgery and bony procedures for surgical treatment of the patient with a neurologic hip subluxation/dislocation.
 - l. Become experienced and competent in the surgical treatment of the deformities or conditions associated with cerebral palsy. Specifically, be able to perform the following procedures: a femoral osteotomy, a pelvic osteotomy, tibial osteotomy, calcaneal osteotomy, psoas intramuscular lengthening, hamstring lengthening, rectus femoris transfer, patellar tendon advancement, gastrocnemius lengthening and muscle transfer procedures about the foot.
 - m. Participate in the postoperative care and management of patients following multiple lower extremity procedural surgery.
 - n. Understand the relative merits and considerations of using gait analysis in the evaluation and treatment of patients with neuromuscular disorders. This includes understanding which patients are appropriate candidates for gait analysis, discussion within the pediatric orthopaedic community regarding the validity of gait analysis, issues pertinent to healthcare systems, insurance companies and third party payors regarding the usefulness and expense of gait analysis.
 - o. Demonstrate an understanding of the different types of orthoses that are prescribed for patients with neurologic conditions.
 - p. Develop the appropriate clinical sensitivity for interacting with and dealing with patients with specialized needs and their families
 - q. The use and application of outcome measures for cerebral palsy
2. Patient Care – the fellow will:
- a. Gain an understanding of the importance of a global assessment of the child in a multi-disciplinary setting.
 - b. Understand the impact on the family, the resources available for the ongoing care of child such as physical therapy, orthotics, social work, etc.
 - c. Learn the appropriate decision-making for the child with cerebral palsy; indications, timing of surgery, planning post-operative care
 - d. Manage the post-operative care of patients with cerebral palsy and prepare comprehensive discharge plans.

Hip and Lower Extremity Disorders

Rotation description: This three month rotation will be directed by Judson Karlen, MD. There will be an emphasis on the spectrum of hip disorders from infancy to early adulthood. The fellow will learn the natural history and treatment of various pediatric hip disorders such as Developmental Dysplasia of the Hip (DDH), Slipped Capital Femoral Epiphysis (SCFE), and Legg-Calve-Perthes Disease (LCP). Indications and technical aspects of newer techniques for femoral acetabular impingement such as hip preservation procedures (peri-acetabular pelvic osteotomies, surgical hip dislocation) are an important part of the rotation. Complex lower extremity disorders and deformities will be cared for by the fellow, gaining an understanding of the principles and concepts of deformity

correction, as well as modern techniques of external fixation, such as the use of the Taylor-Spatial Frame, Ilizarov, and the Multi-Axial Correction (MAC) Frame.

Competency - based Goals and Objectives:

1. Medical knowledge- The fellow will:
 - a. Understand the risk factors, pathology and natural history of developmental dysplasia of the hip (DDH).
 - b. Understand the role of DDH with regard to the risk of potential future osteoarthritis of the hip in adulthood.
 - c. Communicate with primary care providers including pediatricians, family physicians and nurse practitioners regarding the role of screening for DDH in newborn children.
 - d. Examine the newborn child for features of developmental dysplasia of the hip.
 - e. Understand the role of ultrasound in the infant and be able to interpret ultrasound images of the infant hip.
 - f. Evaluate the older child for clinical evidence of developmental dislocation of the hip.
 - g. Describe the radiographic findings associated with DDH at different stages of development, including untreated as well as treated patients.
 - h. Explain the different treatment options available for patients of different ages and how treatment decisions are made.
 - i. Classify the different types of pelvic osteotomies available to address hip dysplasia and explain the important differences between them.
 - j. Exhibit knowledge of the various risk factors or possible complications associated with the different treatments available.
 - k. Perform the most frequently performed procedures for developmental hip dysplasia including an open reduction of the hip (anterior and medial), as well as the following pelvic osteotomies: Salter Innominate, Dega or Pemberton, triple innominate (Steele, Tonnis, etc.), periacetabular osteotomy (Ganz) and salvage type procedures such as a Staheli shelf procedure or Chiari procedure.
 - l. Exhibit the clinical judgment to decide which of the above procedures is appropriate and be able to discuss with patient's parents the relative merits and recommendations of each.
 - m. Review a radiograph for findings suggestive of Legg-Calve-Perthes (Perthes) disease, and discuss the radiographic stages of Perthes and describe the different classification systems used in Perthes.
 - n. Display an understanding of the treatment principles for Perthes, including maintaining range-of-motion and achieving containment of the femoral head, and be able to apply these principles to clinical decision making in patients with Perthes at different ages.
 - o. Demonstrate the surgical ability to perform a femoral osteotomy, pelvic osteotomy or combined femoral and pelvic osteotomy in the treatment of Perthes.
 - p. Identify clinical symptoms and signs suggestive of a Slipped Capital Femoral Epiphysis (SCFE), including stable and unstable SCFE.
 - q. Explain treatment options available for the treatment of stable and unstable SCFE.
 - r. Understand and be able to explain the role of proximal femoral osteotomy for realignment after previous SCFE, and the evolving role of surgical hip dislocation for unstable SCFE.
 - s. Discuss the risks associated with SCFE and its treatment, including the risk of avascular necrosis, chondrolysis, and future hip disorders
 - t. Understand and be able to explain the normal alignment for children at different ages and different stages of development.
 - u. Evaluate patient for rotational alignment deformities including performing a rotational or torsional profile; and evaluate alignment deformities in the coronal plane including congenital, acquired and post-traumatic deformities.
 - v. Understand the principles of limb deformity analysis and correction, perform the radiographic evaluation of lower extremity deformities including measuring the mechanical axis, the distal lateral femoral mechanical angle, and the proximal medial tibial mechanical angle.
 - w. Assess the patient both clinically and radiographically for limb length inequalities.
 - x. Be familiar with different methods of correcting rotational deformities, angular deformities and limb length differences.
 - y. Participate in surgeries addressing deformities or limb length differences including: hemiepiphyseodeses, epiphyseodeses, acute corrections using osteotomies as well as different

methods of performing gradual corrections including Ilizarov and Taylor-Spatial Frame methodology.

- z. Gain exposure to and become familiar with such congenital conditions as: congenital pseudarthrosis of the tibia, congenital short femur, proximal femoral focal deficiency, infantile and adolescent tibia vara, fibular hemimelia and tibial hemimelia.
2. Patient Care – the fellow will:
- a. Manage the pre-operative and post-operative needs of the patient with a limb deformity or complex hip disorder in a graduated manner. This includes helping to plan out the deformity with the surgical team, anticipating the potential risks and complications that can occur with limb deformity correction, and understanding the timing of appropriate frame corrections when using computer assisted programs for deformity correction.
 - b. Develop appropriate clinical sensitivity for interacting with and dealing with patients and their families with congenital LLD and hip deformities
 - c. Determining appropriate diagnostic studies and their interpretation in the evaluation and planning of complex hip disorders and limb deformities
 - d. Be expected to perform the surgical procedures in their entirety by the completion of their fellowship year.

Sports Medicine

Rotation description: The sports medicine rotation is directed by Jeff Vaughn DO and Kristina Wilson MD. The emphasis on the rotation is on the care of pediatric and adolescent patients sustaining sports related injuries. Dr. Wilson directs the primary care component of the program, and Dr. Vaughn heads the orthopaedic part of the sports medicine program. Opportunities are provided to the fellow to cover a high school team during the football season. Pediatric and pre-adolescent anterior cruciate ligament (ACL) reconstructive procedures, arthroscopic procedures of the hip for labral tears, impingement (FAI), and loose bodies, and arthroscopic treatment for patients with osteochondritis dissecans (OCD) of the knee and ankle will be frequently encountered during the fellow's rotation. The fellow will also evaluate and care for patients with primary care conditions such as concussions and overuse injuries in the skeletally immature athlete.

Competency - based Goals and Objectives:

1. Medical knowledge- The fellow will:
 - a. Understand the natural history of specific injuries to the pediatric athlete
 - b. Be expected to identify the surgical indications and propose appropriate surgical interventions for the pediatric athlete when necessary
 - c. Understand the conservative and operative methods of treatment for sports-related injuries
 - d. Learn the indications, techniques, and approaches for arthroscopic procedures of the knee, hip, shoulder, and ankle.
 - e. Be able to perform arthrocentesis/ injections of the knee and shoulder.
 - f. Gain an understanding of the diagnosis and treatment of complex knee problems such as multiple ligament injuries and recurrent patellar instability.
 - g. Be able to differentiate complex problems of the shoulder such as instability vs. impingement in the throwing athlete, multi-directional instability, labral tears, shoulder subluxation.
 - h. Determine the diagnosis and treatment of complex problems of the ankle, such as post-traumatic impingement syndrome, osteochondral injuries and chronic instability.
 - i. Gain a complete understanding of post-operative rehabilitation guidelines and restrictions for knee ligament reconstructions and repairs and shoulder instability reconstructions.
 - j. Understand rationale and techniques for ACL reconstruction in the skeletally immature athlete.
 - k. Develop the skills in a graduated approach to perform complex arthroscopic surgical procedures such as meniscectomy, meniscal repair, multiple ligament repair/reconstruction in the knee, labral repair/debridement, and the treatment of articular cartilage lesions such as osteochondritis dissecans of the knee, ankle, and elbow.
 - l. Gain understanding of indications for hip arthroscopy and skills to perform procedures for femoral acetabular impingement (FAI), loose bodies, and labral tears.

- m. Rehabilitative techniques for sports-related injuries
2. Patient Care – The fellow will:
- a. Understand that the care of the pediatric athlete can be quite different from that of the adult sports medicine patients. The fellow will gain an understanding of these important differences, and specifically how they impact on the evaluation, treatment, and return of the pediatric athlete back to the playing field.
 - b. Evaluate sports-related injuries in the acute setting
 - c. Perform a detailed clinical examination of the shoulder, elbow, knee and ankle.
 - d. Order appropriate diagnostic tests and imaging studies to assist with diagnosis and accurate assessment of the level/severity of the injury.
 - e. Interpret diagnostic test and imaging studies (X-rays, CT scan, MRI) to assist with diagnosis and accurate assessment of the level/severity.
 - f. Plan and execute surgical procedures for these sports-related conditions.
 - g. Manage the pre-surgical and post-surgical needs by the completion of the rotation and/or fellowship year

Pediatric Orthopaedic Trauma, Foot and Ankle

Rotation description: Mohan Belthur, MD, oversees/directs this rotation. The fellow will learn the concepts and techniques to care for patients with pediatric and adolescent foot and ankle disorders such as the Ponseti method for clubfeet, cavus foot, and tarsal coalition. The fellow will gain an understanding of the care of the child with myelomeningocele and muscular dystrophies in multi-disciplinary settings. The fellow will gain experience with a variety of genetic disorders and skeletal dysplasia conditions during the rotation. The fellow will also have the opportunity to spend 1-2 weeks in a 3rd world/limited resource setting in Honduras with the program director. Throughout the entire academic year, the fellow will have an ongoing trauma experience during all four rotation blocks. The fellow will take call from home an average of 6x/month (every 5th night).

Competency - based Goals and Objectives:

1. Medical knowledge – The fellow will:
- a. Describe and identify the most common foot deformities in the newborn child, including clubfoot, congenital vertical talus, metatarsus adductus and congenital calcaneovalgus foot deformities.
 - b. Understand the incidence, etiology and pathoanatomy of the clubfoot deformity.
 - c. Understand and demonstrate the Ponseti method of clubfoot correction, casting techniques, and operative care; approaches for the untreated clubfoot
 - d. Participate in a percutaneous heel cord tenotomy procedure for treatment of equinus contracture associated with clubfoot deformity.
 - e. Recognize the difference between an idiopathic clubfoot and the teratologic clubfoot associated with myelomeningocele or arthrogryposis.
 - f. Discuss the role of complete subtalar release type surgery in the treatment of clubfeet and its current role in the treatment of rigid clubfoot deformities.
 - g. Describe and identify features associated with congenital vertical talus (CVT) deformity of the foot. Become familiar with casting treatment for CVT. Be able to describe the different surgical approaches to CVT.
 - h. Physically exam a pediatric patient with a flatfoot deformity and determine the difference between a flexible flatfoot and a rigid flatfoot; list the potential causes of a rigid flatfoot deformity.
 - i. Discuss the different types of tarsal coalition and the appropriate treatment options relative to each.
 - j. Identify and discuss the underlying causes associated with cavovarus foot deformities in pediatric patients.
 - k. Understand the treatment options and the need for long-term follow-up of patients with residual deformity of pediatric foot deformities
 - l. Perform in a graduated manner complex reconstructive procedures for neuromuscular foot deformities such as midfoot osteotomies, calcaneal lengthening, calcaneal osteotomies, and arthrodesis of the foot.

- m. Safely and satisfactorily perform a closed reduction and application of a well-fitting cast for the following injuries: forearm fractures, distal radius fractures, pediatric femur fractures, and tibia fractures.
 - n. Describe the indications and technique for operative treatment of the following: supracondylar elbow fractures, lateral condyle fractures, Monteggia fractures, unstable forearm fractures, completely displaced distal radius fractures, pediatric femur fractures, tibia fractures and distal tibia fractures involving the articular surface (transitional fractures)..
 - o. Safely perform a closed reduction and pinning of a displaced supracondylar elbow fracture.
 - p. Discuss the treatment options and the relative merits of each option in the surgical treatment of pediatric femur fractures.
 - q. Discuss the evaluation and stabilization of patients with multi-trauma related injuries.
 - r. Explain the evaluation and treatment of patients with open fractures.
 - s. Discuss the symptoms and signs of compartment syndromes in the pediatric patient, including the upper extremity and the lower extremity. Explain how to evaluate and treat the patient with possible compartment syndrome
 - t. Attend multi-disciplinary clinics and to become familiar with other neuromuscular disorders such as Spina Bifida and Muscular Dystrophy (Duchenne's, Spinal Muscle Atrophy, etc).
 - u. Exhibit knowledge of the orthopaedic and associated medical problems associated with these conditions including neuromuscular scoliosis.
 - v. Discuss the role and timing of posterior spinal fusion in the treatment of neuromuscular scoliosis including the need for appropriate cardiology and pulmonary evaluations for patients with specific neuromuscular disorders such as Duchenne's muscular dystrophy.
 - w. Understand the role of nonoperative and operative care in the management of hip, knee and foot deformities in patients with Spina Bifida and with different levels of involvement.
2. Patient Care – The fellow will:
- a. Gain an understanding of the care of the pediatric patient in a number of multi-disciplinary settings during this rotation. Patients with myelomeningocele, muscular dystrophy, and trauma patients all require the expertise from several members of the health care team. The fellow will understand the role of and work with other members of the health-care team in caring for these patients, including but not limited to: pediatricians, Physical Medicine and Rehabilitation physicians, neurologists, urologists, physical and occupational therapists, nurses, orthotists and social workers.
 - b. Understand the implications of these conditions on the health-care system and the delivery of health care for these patients.
 - c. Understand the natural history, evaluation, orthopaedic issues, and care of the myelomeningocele patient in a multi-disciplinary setting.
 - d. Understand the natural history, evaluation, orthopaedic issues, and care of the muscular dystrophy patient in a multi-disciplinary setting.
 - e. Demonstrate graduated responsibilities in the care of these complex patients. This includes learning the operative skills for complex reconstructive procedures, and managing the post-operative care of the patient. The fellow will be involved in the planning of these procedures, as well as formulate comprehensive short term and long-term discharge plans.
 - f. Participate in the evaluation and treatment of children with trauma-related injuries of the musculoskeletal system.
 - g. Demonstrate the ability to be able to perform a thorough musculoskeletal examination including a detailed neurologic exam of a patient with an orthopaedic injury including: an upper extremity fracture, a lower extremity fracture, suspected spine trauma or possible pelvic injury or fracture.
 - h. Know what appropriate imaging studies to order to evaluate the patient with a rigid flatfoot deformity, cavovarus feet, and tarsal coalitions.