What’s New in Pediatric Orthopedics?
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Disclosure

• I have no conflicts of interest regarding this presentation.

Objectives

• Understand recent trends for evaluation and management of pediatric orthopaedic conditions
• Improve knowledge of treatment of pediatric orthopaedic problems
• Understand when to refer to sub-specialist
My Background

- **Education**
  - Medical Education: Sanford School of Medicine at the University of South Dakota, 2006-2010, Vermillion, SD
  - Orthopaedic Residency: University of Iowa Hospitals and Clinics, 2010-2015, Iowa City, IA
  - Fellowship Training: The Hospital for Sick Children (SickKids), 2015-2016, Toronto, ON, Canada.
  - Board Eligible, American Board of Orthopaedic Surgery

- **Association**
  - American Academy of Orthopaedics Surgery, Member
  - Pediatric Orthopaedic Society of North America, Member
  - Alpha Omega Alpha Honor Medical Society, Lifetime Member

- **Interests**
  - Pediatric Orthopaedic trauma
  - Developmental Dysplasia of the Hip
  - Pediatric musculoskeletal infection
  - Scoliosis
  - Pediatric hip conditions
  - Limb foot reconstruction
  - Club foot
  - Neuromuscular disorder cerebral palsy
  - Pediatric Sports Medicine

History of Pediatric Orthopaedics

- **Origin of the word of Orthopaedics**
  - Nicholas Andry coined the word “orthopaedics”, derived from Greek words for “correct” or “straight” (“orthos”) and “child” (“paidion”), in 1741, when at the age of 81, he published Orthopaedia: or the Art of Correcting and Preventing Deformities in Children.

- **Early Modern History**
  - Jean-Andre Venel established the first orthopedic institute in 1780, which was the first hospital dedicated to the treatment of children’s skeletal deformities.
  - Antonius Mathysen, a Dutch military surgeon, invented the plaster of Paris cast in 1851.

Pediatric Orthopaedics

- **Broad field**
  - Spine
  - Trauma
  - Developmental Dysplasia of the Hip
  - Musculoskeletal infections
  - Oncology
  - Congenital anomalies
  - Foot and ankle
  - Limb length discrepancies
  - Sports
Spine

• Types of Scoliosis
  • Infantile (age 0-3)
  • Juvenile (3-10)
  • Adolescent (10+)
  • Congenital
    • Failure of segmentation
    • Failure of formation

Early-onset scoliosis

• Treatment goals
  • To maximize thoracic volume and function
  • Increase spine length
  • Maintain spine mobility
  • Minimize complications

• Advise early referral to pediatric orthopaedic spine surgeon
  • Early treatment is important to prevent progression
  • MRI is required for work-up

• Treatment options
  • Bracing or casting
  • Growing treatment
    • MAGEC rods (NuVasive)
    • Vertical Expandable Prosthetic Titanium Rib (VEPTR) (Depuy Synthes)
    • Tethers
    • Vertebral growth guidance (Medtronic)
  • Spinal fusion

Congenital Scoliosis

• Natural history of progression is dependent on the location and type of congenital abnormality.

• If spinal abnormality is present on prenatal ultrasound, would advise prenatal counseling with pediatric spine surgeon.

• Concern for VACTERL association
  • Additional work-up with renal ultrasound, cardiac echocardiogram, spinal MRI
Adolescent Idiopathic Scoliosis (AIS)

- Three-dimensional deformity of the spine with coronal curve magnitude greater than 10 degrees
- Affects 2-3% of children
- Risk of progression
  - Magnitude of deformity
  - Growth potential
- Treatment Goals
  - Minimize patient deformity
  - Maximize functional outcomes
- Treatments
  - Observation/Physical therapy
  - Bracing
  - Spinal fusion

AIS

- Cost versus benefit effectiveness of routine school-based screening programs is controversial
- However, with new understanding of bracing effectiveness, multiple societies (POSNA, SRS, AAP) have declared joint support for re-initiation in school programs
- Well-child screening with PCPs (pediatricians, family physicians, NP/PAs) remains an important tool for early diagnosis and referrals.
- If prominence is identified, advise x-ray acquisition and referral to pediatric spine specialist.

AIS - Bracing

- BRAIST study – Showed that bracing significantly decreased the progression of high-risk curves. Benefit increased with longer hours of brace wear. ¹
- Many types of braces available
  - TLSO
  - Nighttime bracing
  - Dynamic, flexible brace (SpineCor)
    - Prospective, randomized controlled study indicated a higher rate of progression in patients treated with SpineCor brace compared to rigid Bracing.²
- Bracing continues to growth is plateaued or stopped
  - Girls → 18-24 months after menarche or Risser 4
  - Boys → when height is plateaued
AIS - My treatment algorithm

- Skeletally immature (Risser 0-2, premenarchal or menarche <12 months)
  - 10-25 degrees → observation, physical therapy
  - 25-45 degrees → Rosenberger TLSO brace
  - 50 degrees or greater with progressive deformities → Consider candidate for surgery

- Skeletally mature (Risser 2+, post-menarchal)
  - 10-50 degrees → observation, physical therapy, yoga
  - 50 degrees or greater → Consider candidate for surgery

Developmental Dysplasia of the Hip (DDH)

- Spectrum
  - Ranging from dysplasia to dislocation

- Diagnosis
  - Clinical examination is essential for early detection
  - Barlow maneuver → hip is place at rest but dislocatable with stress
  - Ortolani maneuver → hip dislocated at rest but reducible with manipulation
  - Range of motion

- Surveillance
  - Evidence-based guidelines (endorsed by AAP, POSNA)
  - Universal ultrasound screening of all newborn infants is not supported
  - Recommendations regarding breech deliveries and ultrasound diagnostics (according to International Hip Dysplasia Institute)
    - Pavlik harness
    - Abnormal (unstable or dysplastic)
  - Follow-up Dysplasia
    - Year: 1, 2, 5
  - Dislocation
    - Year: 1, 2, 5, 8, 10, 12, 16 (maturity)

- Baby Hip Clinic Rules (SICKKIDS protocol)
  - Baby Age
  - Treatment

  0-6 weeks Dysplasia
    - Follow-up at 6 weeks of age with U/S
    - If normal U/S and no risk factors, then D/C
    - If normal with risk factors/breech, f/u at 1 year with x-rays
    - Clinically dislocated/dislocated or very unstable on U/S → Pavlik (follow weekly until stable)
    - Max: 3 weeks until stable, if not, then d/c Pavlik
    - Monitor for femoral nerve palsy

  6 weeks-6 months Abnormal (unstable or dysplastic)
    - Pavlik Post-Pavlik F/U
    - Dysplastic Year: 1, 2, 5
    - Dislocation Year: 1, 2, 5, 8, 10, 12, 16 (maturity)

  Once hip is stable for >5 weeks, then the harness can be removed for 1 hour per day
  - If abnormal at 12 weeks → continue Pavlik (max: 20 weeks)

  - If in Pavlik harness (once stable) follow-up at 2, 5, 8, 12 weeks with ultrasound
  - Every visit examine U/S and examine femoral nerve and harness
  - If abnormal at 12 weeks → continue Pavlik (max: 20 weeks)
Musculoskeletal Infections

- Pediatric MSK infections continue to present challenging problems for orthopaedic surgeons and other healthcare providers.
- Requires multi-disciplinary teams.
  - Orthopaedic surgeon, pediatricians/ED providers, hospitalists, infectious disease specialists, radiologists, and pathologist.
- Initial presentation can be highly variable and requires close physical examination, lab studies, and appropriate imaging to establish diagnosis and extent of disease.
  - Inclusion of orthopaedic surgeon is valuable. **Recommend early referral**
- Infections can be superficial (septic bursitis, cellulitis, abscess) or deep (osteomyelitis, septic arthritis, pyomyositis).
  - Isolated, multifocal, disseminated.
- **Goals of treatment**
  - Efficient diagnosis and early treatment.
  - Clinical Practice Guidelines are starting to be established at individual institutions to improve management of pediatric MSK infections.

MSK infections

- **Evaluation**
  - Plain radiographs are the mainstay of initial evaluation.
  - MRI is accurate and reliable imaging study for evaluating effusions and osteomyelitis.
    - Pros: non-invasive, high resolution.
    - Cons: cost, requiring sedation, logistically challenging.
  - Aspiration if effusion.
  - Clinical Practice Guideline – see example.
- **Determine severity of disease**
  - Recent comparative studies indicate that children with osteomyelitis caused by methicillin-resistant Staphylococcus aureus may be more ill than children with methicillin-sensitive Staphylococcus aureus.
- **Treatment**
  - Antibiotics are the mainstay.
    - Based on age, cultures, geographic considerations.
  - Surgical intervention.
  - Monitor inflammatory response.
    - If not improving within 72-96 hours, consider revision procedure.

Limb-length Discrepancy

- Limb length discrepancy (LLD) in the lower extremities is very common with studies estimating small limb-length inequality in more than half of the US population.
  - One study found LLD of 2cm or more was found in 7% of 8-12 year olds.
  - Gait patterns can start to be affected at 2cm or greater.
  - Long-term studies about the relationship between LLD and osteoarthritis do not exist.
- **Diagnosis**
  - Clinical examination, block testing.
  - CT scanogram.
  - Long-leg radiographs.
- **Treatment**
  - Observation.
  - Epiphysiodesis/Shortening.
  - Lengthening.
Limb-length Discrepancy

- My algorithm
  - 2 cm or less: observation or shoe modification
  - 2-5 cm: epiphysiodesis before maturity or femoral shortening at maturity (with symptoms)
  - 5 cm+: limb lengthening
    - PRECISE nail
    - Taylor Spatial Frame
- If greater than 20 cm or limb unable to be lengthened then consideration for amputation with prosthesis or rotationplasty.

Sports

- Overuse injuries in children and adolescents continue to command attention.
  - Four stages of overuse
    - Pain after activity
    - Pain during activity but without hindering performance
    - Pain during activity leading to detrimental effects on performance
    - Unrelenting pain, even with rest
- Risk Factors
  - Early specialization
  - Athletes in a large school are more likely to specialize
  - Train in a single sport >8 months per year
- Injury prevention, with regard to both sports injury and overuse, continues to be recommended.
  - A meta-analysis of injury prevention programs found that injury rates were reduced when such programs were implemented and that these reductions were significant compared with the injury rate of control groups without injury-prevention programs.3

Sports - Common Overuse Injuries in Pediatrics

### Upper Extremity
- Distal clavicle osteolysis
- Proximal humeral physeal separation
- Rotator cuff tendinitis
- Olecranon stress fracture
- Capitellar osteochondritis dissecans
- UCL strain/tear
- Medial epicondylar apophysitis/fracture
- Chronic exertional compartment syndrome

### Lower Extremity
- Femoral/shin/tibial stress fractures
- Femuracetabular impingement
- Medial tibial stress syndrome
- Chronic exertional compartment syndrome
- Patellar tendinitis
- Iliotibial band syndrome
- Osteochondritis dissecans
- Osgood-Schlatter disease
- Sinding-Larsen-Johansson disease
- Patellar tendinitis
- Sever disease
- Symptomatic accessory navicular

### Spine
- Postural-related back pain
- Spondylolysis and spondylolisthesis
Neuromuscular/Cerebral Palsy

• Goal setting with patient and family

• Hip Surveillance
  • Begin at age 2 years, the hips of children with CP should be monitored with annual pelvic radiograph up to age 5 in ambulatory patients (GMFCS level I thru III) and up to skeletal maturity in non-ambulatory patients (GMFCS level IV to V)
  • Important to identify hips at risk with serial Reimer migration index
  • Treatment strategies
    • Reactive
    • Proactive

Questions?

Reference

4. AAOS Orthopaedic Knowledge Update (OKU 5) – Pediatrics (2016)
6. The Hospital for Sick Children (SickKids)