Trends in Pediatric Orthopedics

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• I have no Conflicts of Interest to disclose.

• Disclaimer:
  • Final slides available
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Trends In Pediatric Orthopedics

1) Children are not just small adult
   Capitalizing on growth and remodeling potential
2) Own the bone.
   Overall bone health
3) Less is more
   Minimally invasive treatment options
4) Everything “old” is “new” again
Give it to me straight.....

- ORTHOPEDICS
- From the Greek:
  - Ortho= straight
  - Paideia = rearing of a child.
What we know and what is new....

• Scoliosis

• Lower Extremity Alignment

• Fractures
Scoliosis.... What we know.....

• Mild scoliosis is common
• Female more affected than males
  • Increases with magnitude of curve
• Often, a familial predisposition

• Greatest risk of curve progression:
  • Younger age, less mature
  • larger curves.
• Etiology not yet known
Scoliosis...... What we know

- Cobb Angle  Female:Male  Prevalence
- >10  1.4-2 :1  2 - 3 %
- >20  5:1  .3 - .5 %
- >30  10:1  .1 - .3 %
- >40  10:1  <0.1%

Scoliosis.... What we know

• **The risk of curve progression is related to:**
  - Growth Potential
    - age
      - Association of curve progression with adolescent growth spurt
    - menarchal status
      - Progression less common after onset of menarche
    - Risser sign
      - Prevalence of curve progression decreases as Risser sign increase

• **Specific Curve Factors**
  - pattern
    - Double curves progress more frequently than single curves; lowest progression seen in lumbar curves.
  - magnitude
    - Risk of curve progression increase with increasing curve magnitude
Scoliosis... What we know

• **RISK OF CURVE PROGRESSION**

• Age vs Curve magnitude

<table>
<thead>
<tr>
<th>Curve Magnitude at Detection</th>
<th>10-12 (%)</th>
<th>13-15 (%)</th>
<th>16 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 19°</td>
<td>25</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>20-29°</td>
<td>60</td>
<td>40</td>
<td>10</td>
</tr>
<tr>
<td>30-39°</td>
<td>90</td>
<td>70</td>
<td>30</td>
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<tr>
<td>60°</td>
<td>100</td>
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• **Risser stage vs curve magnitude**

  • Risser 0-1 5-19 deg 22%, 20-29 deg 68% progress
  • Risser 2-4 5-19 deg 1.6 %, 20-29 deg 23% progress
Scoliosis..... What we know

• **DIAGNOSIS**
  
  • History and physical exam
    • Adam’s forward bend

• **Xrays:** lateral curvature of the spine
  • Oversimplification of 3D deformity
  
  • minimum **10 degree** measurement on xrays to establish diagnosis of true scoliosis
Scoliosis.... What we know

• Scoliometer to measure angle of trunk rotation.
  • If 5 degrees -> repeat exam in 4-6 month
  • If >7 degrees -> consider xrays and referral

• A something new...
• Scoliometer app for phone

• Validation of a scoliometer smartphone app to assess scoliosis
  • Franko et al  JPO 2012 Dec  e72-75
Scoliosis.... What we know

• NATURAL HISTORY

• Adults with idiopathic scoliosis do not seem to be at increased risk for early death.
• Marked diminution in lung function (restrictive lung disease) seen when thoracic curves greater than 60 degrees and is more pronounced in curves > 100.
• Back pain seems to be more common in adults with scoliosis, but daily functioning seems to similar to general population
• Back pain is most common surgical indication for the adult with scoliosis. Estimate of 1% of pts with scoliosis will eventually require surgery for back pain.
• Cosmetic concerns: ? correlation of psychologic handicap and clinical deformity disputed by different authors but impact on self-image and self esteem should be respected.

Scoliosis.... What we know

• **GOALS OF TREATMENT**

• Prevent curve progression so that patients can enter adulthood with:
  • curves less than 50 degrees
  • a balanced spine
  • cosmetic acceptability.
Scoliosis....What we know

• TREATMENT

• Curves <30 degrees - **OBSERVATION** with serial radiographs 2-3x/yr.

• Curves 30-50 degrees in individuals who have significant growth (>2yr) remaining – **BRACE**

• Curves >50 degrees in child- **SPINAL FUSION**
Scoliosis..... What is New?

• **WHICH CURVES WILL PROGRESS?**
  • Which need to be monitored with xrays?
  • Which need to be braced?
  • Which need surgery?
• **SCOLISCORE** genetic test for predicting likelihood for curve progression.
  • DNA extracted from saliva.
  • Algorithm includes evaluation of 53 genetic markers: 28 progression and 25 protection associated markers
  • Scale from 1-200
    • 1-50 low risk
    • 51-180 intermediate risk
    • 181-200 high risk
Scoliosis... What is new?

• Scoliscore: genetic testing

• Less than 50% time high or low

• Caucasians only

• Indicated for predicting curves 10-25 degrees at presentation.

• Difficult for clinicians to gain confidence and know how to utilize information

• Limited impact
Scoliosis.... What is New?

- **Hueter-Volkman principle:** pressure on a growth plate make it grow slower while tension across a growth plate makes it grow faster.

- Fusionless surgery: **Growth modulation**
  - unilateral staples
  - anterior spinal tethers
  - Slows growth on the convexity, promotes growth on the concavity
  - Avoids fusion
  - Obviates need for brace
Scoliosis…. What is New?

• Fusionless surgery : still a work in progress.

• Stabilized segments may fuse
• ? Adequate correction
• Timing of procedure crucial
• Who would best benefit
• ? better than bracing
Scoliosis.... What is new?

- **Bracing**
- New data supporting efficacy of bracing
- **BrAIST study**
  - Treatment success as defined by preventing curve progression to surgical range
    - 72% success with bracing
    - 48% in non-braced group
      - Intention to treat, randomized groups 75% vs 42%
  - Positive association between hours of brace wear and rate of treatment success.
  - Of those patients who were treatment successes, 13 hours of brace wear/day resulted in 90-93% success.
Scoliosis.... What is New?

• Scoliosis specific Physical Therapy
  • Schroth Method
    • Autocorrection
    • Elongation
    • Chest wall expansion
    • Integration of corrected posture into daily life activities
  • Prevent curve progression
  • Aid in self esteem/self perception
  • Active intervention during “observation”

  • 74 pts, mean curve magnitude 15 degrees.
  • 35 scoliosis specific  39 standard PT
  • 6.1 % progressed to bracing in scoliosis specific
  • 25 % in standard PT
Scoliosis..... What is New?

• Scoliosis Specific Exercise Physical Therapy
  • May help to prevent curve progression
  • May enhance self esteem and self perception
  • Active intervention during “observation”

• However, although some evidence has shown superiority in comparison with non–specific exercises and/or controls, it is still too soon to make a general statement about their applicability. SRS statement May 2014

• Cost and insurance coverage
• Limited number of trained PT’s
Scoliosis... What is new?

• TAKE HOME MESSAGES

• Bracing is effective
• Trends toward less invasive surgery, capitalizing on growth modulation may be beneficial for some patients.
• Scoliosis specific physical therapy may be beneficial.
• Early identification of those patients who might benefit most from less invasive monitoring and interventions remains challenging.
Lower Extremity Alignment... What we know

• Bow legs/genu varus and knock knee/ genu valgum are common pediatric deformities
• Infant’s legs are varus/bowed at birth.
• Often looks worse as child starts to weightbear at around 1 year of age.
• Varus persists until age 2 when the legs straighten
• The legs overcorrect and become maximally valgus between ages 3 and 4 years.
• By 6-7 years of age, a mature knee alignment is achieved with 5-7 degrees of valgus.
• Physiologic varus and valgus resolve spontaneously.
Lower Extremity Alignment... What we know

- **Heath and Staheli.** Normal limits of knee angle in white children. JPO 1993, 13(2)259-262

- 196 **white** children 6 mos to 11 yrs clinical measurement of intercondylar and intermalleolar distances.
Lower Extremity Alignment... What we know

• If pathologic process is happening during varus phase -> progressive varus.
  • Infantile Blount’s disease

• If pathologic process happens during valgus phase -> progressive valgus.
  • 14 year old with renal osteodystrophy
Lower Extremity Alignment.. What we know

- By age 3 there should be no varus
- Valgus will peak 3-5 up to 15 degrees
- By age 10, no more than 10 degrees of valgus
Lower Extremity Alignment... What we know

• Would consider further evaluation with x-rays and/or labs if:
  • Worsening deformity
  • Unilateral deformity
  • Pain
  • Short statured

• Radiographs
  • Based on clinical exam
  • Standing alignment film, vs films of designated area of concern
Lower Extremity Alignment.. What we know

• DIFFERENTIAL DIAGNOSIS FOR PATHOLOGIC GENU VARUM/VALGUM

• Blount’s Disease
• Rickets- Vitamin D deficiency or hypophosphatemic
• Bone dysplasia (such as achondroplasia or metaphyseal dysplasia)
• Focal Fibrocartilaginous dysplasia
• Asymmetric growth arrest of medial distal femur or proximal tibia due to infection, fracture, or tumor
• Congenital longitudinal deficiency of tibia (with relative overgrowth of the fibula
• Lead or Fluoride Toxicity

• Tachdjian, MO. Clinical Pediatric Orthopedics p 125.
Lower Extremity Alignment...what we know

• BLOUNT’S DISEASE
• Pathologic genu varum, infantile tibia vara
• Develops between 1-3 years of age.
• Abnormality of proximal medial tibial physis.
• More common in infants who are heavy, early walkers, or African descent
Lower Extremity Alignment...What we know

• TREATMENT FOR BLOUNT’S

  • Bracing
    • Can be effective
      • Raney et al JPO 1998
      • Richards at al JPO 1998
    • Weightbearing use of braces best
    • Progressive deformity before age 3

  • Surgery: osteotomy
Lower Extremity Alignment... What we know

• ACCENTUATED GENU VALGUM

• Occurs when physiologic genu valgum fails to resolve
• These children are often obese, flat footed and ligamentously lax
• May cause anterior knee pain, patellofemoral instability, circumduction gait, and difficulty running.
• May cause lateral compartment arthritis in long term
• Bracing impractical

• White and Mencio  JAAOS 1995 (3) 275-82
Lower Extremity Alignment.. What is new?

- GUIDED GROWTH
- Less invasive surgery
- Able to weightbear
- No casting

- Reversible, once adequate correction obtained.
- Compared to classic hemi-epiphysseodesis
Lower Extremity Alignment.. What is new?

• **RICKETS**
  • Nutritional rickets is on the rise: 4 fold increase in last 10 years.
  
  • More frequently in
    • Children with dark skin
    • Breast fed and longer duration of breast feeding
    • Limited sun exposure
    • Limited milk intake
    • Predominantly vegetarian diet.

• Thacher et al. Increasing incidence of nutritional rickets: A population-based study
Lower Extremity Alignment.. What is new?

• **Rickets**  CONTRIBUTING FACTORS
  • Altered diets
  • Lack of sun exposure
    • northern latitudes may not allow adequate exposure
  • Use of sunscreen may interfere
  • Darker skinned people require more sun to make Vit D
  • Poor diet:
    • Children adopted from abroad may have had limited intake
    • Non varied diets, ie strictly vegetarian
    • Lactose intolerance

• **Recommendations for supplementation:**
  • Infants breast fed 400IU Vit D; 400 mg calcium
    • Mother’s need to supplement as well
  • Children and adolescents 1000-1500 IU Vit D: 1500-2000 mg calcium
Lower Extremity Alignment... What is new?

• TAKE HOME MESSAGES
• Majority of lower extremity alignment changes resolve spontaneously
• Further evaluation with xrays and/or labs warranted if
  • Progressive deformity
  • Unilateral deformity
  • Pain
• Attention to optimizing bone health for children with appropriate recommendations for Vit D and calcium supplementation, weightbearing activity and safe sunlight exposure.
Pediatric Fractures... what we know

• 40% of children will have a fracture during childhood
  • 20% may have more than 1

• Children heal fractures well.
• More quickly than adults
• Larger range of acceptable alignment given capacity for remodeling
• Most can be treated with cast immobilization
Pediatric Fractures... what we know

• Remodeling is less as children get older
  • greater than 10-12 years of age, remodeling becomes less predictable.

• Intra-articular fractures need to be anatomic

• Surgical stabilization of lower extremity fractures can aid in mobility and pain control
  • Ie femur fractures: avoiding spica cast immobilization
Pediatric Fractures... what we know

• Less invasive techniques can be used in children
  • Tolerance for less stable/rigid fixation
  • Tolerance for less than anatomic alignment
Pediatric Fractures... What is new?

• Closed treatment of Overriding Distal Radius Fractures without reduction in children
  • Crawford et al  JBJS 2012

• 51 children 3-10 yrs of age.
• Distal radius fracture with overriding and shortening.
• No sedation, no analgesia. Application of a short arm cast with gentle molding to address angular correction.
• All followed for at least 1 yr.
• Residual angulation averaged 2.2 degrees sagittal, and 0.8 degrees coronal.
• Cost analysis demonstrated closed reduction under conscious sedation or general anesthesia is nearly 5-6 x more expensive than this treatment. Pin fixation increases cost to 9 x
Pediatric Fractures.. What is new?

• Are NSAIDS a problem for fracture healing IN KIDS? **NO**!
• **NSAIDS effective in management of pediatric fracture pain.**
  • can be as effective as opioid.

• **Concerns of bone healing and delayed/non unions have not been seen in children.**

• 221 children, operative fracture care by single surgeon. 169 received ketorolac, 52 did not.
• No difference in transfusion rate 1.2%vs 1.9 %
• wound infection rate 1.9 vs 2.3 %
• No cases of delayed union or nonunion in either group.
Pediatric Fractures... What is new?

- **How many fractures are too many?**
  - Is Vitamin D deficiency an issue?

- Poor nutrition including a low calcium diet, low weight, and a sedentary life style, beginning in childhood are risk factors for osteoporosis.

- **When to be concerned about fractures:**
  - 3 fractures by end of high school
  - 2 fractures in a calendar year.
  - Stress fracture
  - Low energy mechanism of injury

  - AAOS ICL 2015  Owning osteoporosis in your practice

- Screen Vit D 25 OH
- Consideration for referral to endocrinology
Pediatric Fractures…. What is new?

• Every fracture is an opportunity to assess bone health and fracture risk and to educate.

• 3-4 servings of dairy/day
• 30 min outside arms/legs in sun 3x/week
• 1 hr of weightbearing play a day or 10 jumps 5x/day
Pediatric Fractures... What is new?

• TAKE HOME MESSAGES

• It is safe to use NSAIDS for pain control in children’s fractures
• Recurrent fractures may be indicator of sub- optimal bone health.
• Attention to optimizing bone health with appropriate Vit D and calcium supplementation and weightbearing exercise.
Trends in Pediatric Orthopedics

1) Capitalizing on growth and remodeling potential
   - Guided growth for spinal and lower extremity alignment
   - Fracture remodeling
2) Attention to overall bone health
   - Rickets, recurrent fractures
3) Minimally invasive treatment options
   - Fusionless scoliosis surgery
   - Guided growth of lower extremities
4) Everything “old” is “new” again
   - Bracing works for scoliosis
   - Fracture management with casting
Thank you for your attention.

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