ORTHOPAEDIC SURGERY FOR THE LOWER LIMBS IN CHILDREN WITH CEREBRAL PALSY

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I. GENERAL
  A. Treatment Goals
     i. Maximize function
     ii. Delay/avoid surgery when possible
  B. Optimizing outcome requires optimizing biomechanical alignment
     i. Remember: all joints affect all other joints in all planes
  C. Non-surgical treatments
     i. Bracing
     ii. Stretching
     iii. Physical therapy
     iv. Botulinum toxin (off label indication)
  D. Operative intervention
     i. “The decision is more important than the incision” -- Mercer Rang
     ii. Typical indications
        1. Age: 7 – 10 years
        2. Wait until child has plateaued for 6-8 months
        3. Non-operative interventions will not suffice
     iii. Single event multilevel surgery (SEMLS), addressing all bone and soft tissue issues at one time, is the standard of care
        1. Gait analysis is performed pre-op, when available
           a. Optimizes outcome
           b. Decreases rate of reoperation

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1. All significantly affected planes and levels should be addressed with SEMLS.
2. Pre-operative decision-making is the most important determinant of surgical outcome.
3. Pre-operative gait analysis decreases rates of reoperation and cost in children with CP.

II. HIP PROBLEMS
  A. Hip flexion contractures
     1. As with other contractures, static and dynamic measures often not well-correlated
        i. 50% with HFC > 10°, do not walk with excessive hip flexion (Rethlefsen et al. J Pediatr Orthop 2010)
ii. Main problem is crouch, though crouch is often seen in the absence of hip flexion contracture (HFC)

2. Consider surgery (psoas recession) if HFC >10 degrees and significant hip flexion in stance
   i. May do this through adductor incision if adductors require lengthening

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1. Many patients who walk with excessive hip flexion do not have HFC.
2. Many with HFC do not have severe hip flexion during gait.

B. Hip adduction contractures
1. Problems
   i. Scissoring
   ii. Troubles with diapering & hygiene
2. Differentiate between dynamic scissoring and fixed contracture
   i. When surgery necessary, the adductor longus is typically tightest.
      a. Gracilis often needs lengthening
      b. Try to avoid lengthening brevis and magnus. (These rarely need lengthening, especially in GMFCS I-III)
      c. Obturator neurectomy should be avoided (to avoid “frog” positioning of hips)

© PEARL: Obturator neurectomy has risk of causing abduction contractures, and does not decrease the risk of recurrent subluxation when combined with bony procedures

III. KNEE PROBLEMS
A. Hamstring contracture/knee contractures
1. Flexion contractures are much more common than extension contractures (exception: near drowning survivors)
2. Problems
   i. Crouch
   ii. Difficulty sitting is rare for knee flexion contracture < 90°, but common with knee extension contractures
3. Treatment
   i. Conservative: stretching, knee immobilizers, botulinum toxin (off label indication)
   ii. Surgery
      a. Hamstring lengthening (HSL)
         i. Avoid overlengthening (results in recurvatum)
         ii. Recurvatum much more common with medial/lateral lengthening
         iii. Do not check a popliteal angle intra-op (due to increased risk of neuropraxia)
      b. Guided growth (anterior hemiepiphysiodesis of distal femur) – for knee contractures if > ~ 2 years of remaining growth
         i. May use plate/screw construct or just screws
ii. May be combined with patella tendon advancement (PTA)
c. Distal femoral extension osteotomy (for more severe
deformities and/or less growth remaining)
i. Shortening of femur decreases risk of neurovascular injury
   ii. Better results when combined with PTA

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1. Overlengthening of hamstrings is an under-appreciated problem and results in genu recurvatum and stiff-knee gait.
2. Lateral hamstrings often do not require lengthening, particularly before adolescence.
3. Consider bone surgery for recurrent and/or severe contractures

B. Stiff-knee gait
   1. Interferes with foot clearance in swing phase
   2. Often due to rectus spasticity
   3. Consider surgery (distal rectus femoris transfer) if following criteria are ALL met:
      i. Excursion from stance to swing < 50°
      ii. EMG shows rectus is overactive in swing phase
      iii. GMFCS I or II function

IV. Ankle/Foot problems
A. Equinus
   1. Important to make sure:
      i. Whether equinus is dynamic or due to static contracture
   2. Be sure that toe-walking is due to equinus and not knee and/or hip flexion
      i. Toe-walking in AFO’s is a tip-off that knee/hip are issues rather than heelcord
   3. Avoid surgery whenever possible (by using stretching, braces, serial casting...)
      i. Heelcords are better a little tight than a little loose
      ii. Calcaneus gait more common with age (even without previous surgery)
      iii. Calcaneus reported in up to 30-40% of patients following heelcord surgery
         a. Rate much lower with gastroc recession than TAL

© PEARLS:
1. Toe-walking in AFO’s is usually due to the hamstrings.
2. Heelcords are better a little too tight than too loose.

B. Varus
   1. Contributors
      i. Anterior tibialis ~ 1/3 of cases
      ii. Posterior tibialis ~ 1/3
iii. Anterior & Posterior tibialis ~ 1/3
2. Differentiate between flexible and rigid deformities
3. Surgery
   i. Balance soft tissues
   ii. Bony surgery also needed for rigid deformity

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1. Anterior tibialis is a significant contributor to varus feet in children with CP, contrary to traditional teaching.
2. Always balance soft tissues, regardless of whether deformity is flexible or rigid

C. Valgus
1. Differentiate pes valgus from ankle valgus
   i. Clinical exam – lateral malleolus should be distal to medial malleolus
   ii. AP ankle x-ray – if clinical exam suspicious for ankle valgus
      a. If “normal” ankle, distal fibular physis is at level of ankle joint
2. Often associated with tight gastrocnemius and peroneals
3. If surgery is needed, calcaneal osteotomies help preserve hindfoot motion
4. Talonavicular fusion may be needed for severe midfoot break

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1. Make sure that valgus is from the foot and not the ankle (standing AP ankle x-ray may be needed).
2. If the valgus is from the ankle, address the tibia with hemiepiphysiodesis or osteotomy.

V. LEVER ARM DYSFUNCTION
A. General
1. Problematic due to abnormalities in balance, strength and coordination
2. Surgery may be needed to address lever arm dysfunction due to torsional deformity, foot deformity and/or hip subluxation

B. Long bone torsion (femur and/or tibia)
1. Consider osteotomy if torsion persists and interferes with function
2. Femoral osteotomy
   i. Comparable results for proximal and distal osteotomies
   ii. Proximal osteotomy indicated if:
      1. Coxa valga, and/or
      2. Hip subluxation
   ii. Surgical correction should be 1.5 – 2:1 of what is deemed clinically
3. Tibial osteotomy
   i. Distal osteotomy is much safer than proximal osteotomy
   ii. Fibular osteotomy is not needed for rotational correction
   iii. Surgical correction should be 1:1
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1. Bony malalignment is more problematic in children with CP due to limitations in balance, strength and coordination.
2. Proximal and distal femoral osteotomies have equivalent results.
3. Tibial osteotomies are best done distally.
4. Surgical correction should be 1.5 – 2:1 for femoral osteotomies and 1:1 for tibial osteotomies.

REFERENCES (1-25)
