Management of the Non-Ambulatory Child with Hip Pathology

AACPDM 2018 Orthopedic Day

Tuesday October 9th

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Epidemiology:

- Spastic hip displacement is the second most common deformity seen in children with cerebral palsy (CP) after equinus deformity.
- Incidence of spastic hip displacement is related to severity of involvement, varying from 1% in children with spastic hemiplegia to approximately 75% in children with spastic quadriplegia.[1,2]
- Two large population based studies have reported the overall incidence of hip displacement to be approximately 35% across all children with CP.[3,4]
- The most useful development in the classification of CP in recent years has been the creation of the Gross Motor Function Classification System (GMFCS).[5]
- The risk of progression from hip displacement to dislocation is related to severity of neurologic involvement[6,7] and walking ability[2,8] and is directly related to gross motor function as graded by the GMFCS.[3]
- Soo etal[3] demonstrated a linear relationship between rate of hip displacement and GMFCS level
  - GMFCS I = no cases of hip displacement
  - GMFCS IV/V = 69-90% of cases had hip displacement (MP>30%) and relative risk of hip displacement in this cohort was between 4.6 to 5.9 compared to ambulant (GMFCS II) children.

Pathophysiology of Spastic Hip Displacement:

- Children with cerebral palsy are born with “anatomically” normal hips without the evidence of hip displacement or dislocation.[9]
- The natural history of spastic hip disease is one of “silent lateral subluxation”, as children are often not symptomatic until the hip has dislocated and become painful.[10]
- Asymmetric muscle spasticity has long been felt to be a major contributor to hip instability in children with CP. Progressive limitation of abduction, often associated with flexion deformity, is believed to be an early indicator of hip instability.[11]
- Two critical elements of pathologic proximal femoral anatomy in spastic hip displacement are:
  - Increased anteversion of the femoral neck in the transverse plane
  - Increased femoral neck-shaft angle in the coronal plane. [12,13]
- Robin etal[14] demonstrated that these two deformities are closely related to a child’s GMFCS level.
  - Both increased deformities are caused by persistent fetal alignment secondary to delayed walking and limitations in gross motor function.
The combination of elevated femoral neck anteversion and neck-shaft angle contributes to the increased risk of hip displacement.

- Traditionally, great emphasis has been placed on adductor spasticity or contracture “pulling” hips out of the socket by increased forces[15]. However, hypotonic GMFCS IV and V children have the same risk of hip displacement as similar children with hypertonia[3].
- Hip displacement has been demonstrated to contribute to high rates of pain and impaired health related quality of life (HRQOL) in non-ambulant children with CP[16-18].

**Imaging**

- A well-taken anteroposterior (AP) radiograph of the pelvis/hip joint (supine) guides decisions for treatment regarding spastic hip displacement[19,20].
- Reimer’s migration percentage (MP) is a measure of femoral head containment within the acetabulum[21] and is currently the most common and reproducible measurement for spastic hip displacement in children with CP[22,23].
- To calculate MP, one first identifies Perkin’s and Hilgenreiner’s line and then calculates the percentage of ossified femoral head which lies lateral to Perkin’s line. The lateral acetabular margin can be challenging to identify in scenarios where severe displacement exists and a “gothic-arch” has been created. In these scenarios, the midpoint of the lateral acetabular margin is selected for Perkin’s line[23]. The continuous measurement of the MP has proven to be valid, reliable and useful in measuring hip displacement in children with cerebral palsy[24,25,22,26].
- The definition of a hip “at-risk” of instability is defined as having an MP of >30%[22]. Miller and Bagg[25], found that children (2-18 years) whose MP was greater than 60% progressed to dislocation (MP>90%) during childhood. Furthermore, those children (2-18 years) with a MP between 30-60% had equal rates of hip displacement (25%) and recommended close surveillance and operative intervention to prevent hip dislocation.
- Recently Difazio et al.[27] reported on the relationship between MP and HRQOL as measured by the Caregiver Priorities and Child Health Index of Life with Disabilities (CPCHILD) in GMFCS IV and V children undergoing hip reconstruction surgery. The authors identified a negative correlation between preoperative MP and CPCHILD scores and found that those children whose preoperative MP was higher than 50% had worse CPCHILD scores postoperatively.

**Treatment**

- The primary goals for treating hip displacement in non-ambulant children (GMFCS IV/V) with CP are to maintain painless, flexible and well-located, hips with a symmetric range of motion to facilitate standing, transfers and seating in a wheelchair[8].
- The principal aims are to prevent pain and to maintain limited function such as standing transfers and comfortable sitting[28,8,17].
- Non-operative interventions, including bracing, standing programs and injections of botulinum toxin A, do not prevent hip displacement in non-ambulatory children with
cerebral palsy, although they may have other tone related benefits[29]. Neurosurgical interventions for generalized hypertonia such as selective dorsal rhizotomy or intrathecal baclofen do not prevent hip displacement but may ameliorate painful spasms and other associated symptoms[28,30].

- Three operative categories (preventative, reconstructive and salvage) exist for the treatment of hip displacement in patients with cerebral palsy and are stratified according to symptoms, functional impairment, migration percentage, acetabular dysplasia, and severity of muscle spasticity[8].

  - **Preventative** hip surgery for the non-ambulant child with CP applies to interventions associated with lengthening a portion of the hip adductors and possibly hip flexors with occasional phenolization of the anterior branch of the obturator nerve or anterior-branch obturator nerve neurectomy[31-33]. Children with an MP >40%, or those who demonstrate an increase in MP of >10% in under 1 year and hip abduction <30° are candidates for preventative surgery[8,34,25].

  - Substantial outcome variability exists after adductor surgery in children with CP, with good results ranging from 32%[35] to 90%[36]. According to GMFCS, adductor surgery in non-ambulant children, the success rate decreased to 27% and 14% respectively (GMFCS IV and GMFCS V)[35].

  - **Reconstructive** hip surgery for the non-ambulant child with CP applies to preventative procedures coupled with bony reconstruction of the femur and/or pelvis.

  - Once an MP exceeds 50% and there is presence of hip subluxation/dislocation without degenerative changes to the femoral head, reconstructive hip surgery is recommended[37].

  - For correction of osseous hip deformity, VDRO is a proven, effective technique to improve hip-joint reduction, redirect the femoral neck and correct excessive anteversion commonly present in non-ambulant GMFCS IV and V children with hip subluxation[38-41].

  - Several authors have suggested that combined proximal femoral and acetabular procedures for spastic hip displacement have been shown to yield positive results[41-44], but it is not clear whether a pelvic osteotomy is needed in all non-ambulatory cerebral palsy patients[8,37].

  - In general, most surgeons employ a step-wise approach to the reconstruction for subluxated or dislocated hips in non-ambulatory children with cerebral palsy[45].

  - Mubarak et al.[41] and McNerney et al.[44] described their modification of the Dega as the “San-Deigo Acetabuloplasty”, where the semi-circular osteotomy extends from the anterior inferior iliac spine to the sciatic notch. The osteotomy extends from the lateral cortex to, but not through, the medial wall of the pelvis[41].

  - **Salvage** hip surgery for the non-ambulant child with CP applies to those children and adolescents who present with degenerative, painful dislocated hips or when reconstruction has failed, resulting in significant femoral head deformity, articular cartilage loss and pain[46].

  - Salvage procedures include: hip arthrodesis, valgus osteotomy with femoral head resection, proximal femoral resection with soft tissue interposition, replacement arthroplasty with mixed results and each carrying their own set of risks and potential complications[47-53,16].
List of References:


