Developmental Hip Dysplasia

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Definition

It is an abnormal in utero development of the hip joint – the spectrum includes instability, dysplasia, subluxation, and frank dislocation.

Embryology

- Origin – mesenchymal cells.
- Cleft at 7 weeks
- Complete development at 11 weeks.
- The acetabulum develops from the triradiate cartilage.
- The proximal femoral ossification center appears between the fourth and seventh weeks.
- The key factor in normal hip development is *acetabular growth around a spherical, centrally located femoral head.*

Etiology

- Genetics – familial preponderance
- Intrauterine position – packaging
  - Breech
  - Oligohydramnios
- Neuromuscular
  - Myelomeningocele
- Postnatal factors – swaddling

N.B. *Ligamentous laxity* – not a causal relationship. Children have documented ligamentous laxity without hip instability. DDH is not a hallmark of systemic hyper laxity syndromes – Marfan, Down, Ehlers-Danlos.

Epidemiology/Risk Factors

- Incidence: 1–2/1000 live births. Variable with ethnicity/geographical location
- Ethnicity
  - Highest – Laplanders
  - Lowest – African Americans
- Female sex
- First born
- Breech
- Positive family history
- Oligohydramnios
- Metatarsus adductus
- Torticollis

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Pathology

- *Shallow acetabulum with insufficient anterior and lateral coverage*
- Coxa valga
- Redundant capsule
- Inverted labrum
- Elongated ligament teres
- Tight iliopsoas tendon
- Redundant fibrous tissue in the joint – pulvinar

The normal development of the hip joint is dependent on the uninterrupted contact of the acetabulum with a spherical and centrally located femoral head. The consequences of dysplasia and the response to treatment are directly related to the time allowed for the abnormal relationship to persist. This means that the clinical presentation, the investigation, the treatment, and the outcome will depend on the time of diagnosis and stage of child development at the time of diagnosis.

Clinical Presentation (See Above)

- Newborn to 6 months
  - Barlow maneuver – the located hip is dislocated.
  - Ortolani – the dislocated hip is relocated.
  - They are usually performed concomitantly, are interchangeable, and have equal diagnostic value.
  - They become ineluctable after 3 months.

An irreducible hip in the nursery with limited abduction is the hallmark of teratological DDH, usually present in systemic conditions – 2% of all nursery diagnosed DDH.

The "hip click" has no diagnostic significance.

- Six months to walking age
  - Limited hip abduction – hallmark
  - Galeazzi sign – apparent femoral shortening
  - Asymmetrical gluteal folds
  - Limb length inequality

Bilateral DDH – more difficult to diagnose especially after 3–6 months (Barlow/Ortolani are absent); the findings are symmetrical.

- After walking age
  - Limited abduction
  - Limp – due to abductor weakness (relative shortening, Trendelenburg)
  - Waddling gait – bilateral DDH, bilateral Trendelenburg gait
  - Lumbar hyperlordosis

Imaging Studies

- Ultrasound
  - Noninvasive and operator dependent
  - Evaluates
    - Hip anatomy – see (Fig. 113.1)
    - Location of the femoral head.
    - Degree of femoral head coverage.
    - Above in static and dynamic modes.
  - High false positive rate (over diagnosis)/ low false negative rate
  - Critical information
    - Alpha and beta angles (alpha angle >60° is normal)
    - Percentage of femoral head coverage (>50% is normal)
  - Indications in the United States
    - Screening for high-risk newborns
    - Follow-up while treatment in brace
    - After age 3 weeks
- *X-rays – pelvis (AP and frog lateral)*
  - Timing – after 3 months of age/when the proximal epiphyses are present
  - Landmarks – see (Fig. 113.1)
  - Normal hip parameters
    - The proximal femur/epiphysis projects in the inferomedial quadrant.
    - Acetabular index <30°.
    - Continuous Shenton line.

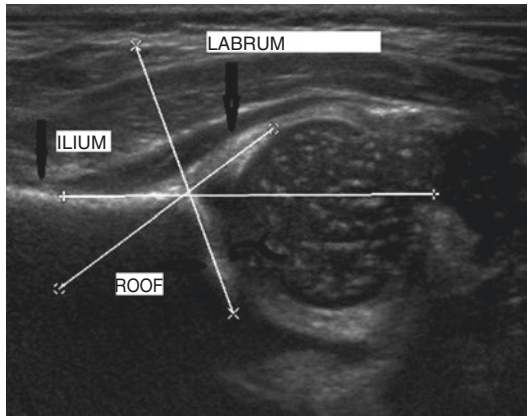

Fig. 113.1 Bilateral hip dysplasia: the femoral epiphyses are outside the inferior medial quadrant, the Shenton lines are broken

    - Symmetrically developed proximal epiphyses.
    - Symmetrical hip abduction with the femoral epiphyses projecting centrally in relationship with the triradiate cartilage on the frog view.
  - Arthrogram – used to assess the adequacy of closed reduction in the operating room
  - CT scan – same indications as the arthrogram
  - MRI scan – limited indications, need for general anesthesia
- Natural history – degenerative joint disease
  - Dysplasia without subluxation – the progression and severity of DJD is not related to the radiograph's findings.
  - Dysplasia with subluxation – severity related to the degree of subluxation.

Treatment – Age Dependent

- Zero to 6 months – Pavlik harness
  - Prevents hip adduction and extension
  - Allows abduction and flexion/promotes reduction/stabilization
  - Duration: until hip stabilizes. If Ortolani positive: 6–12 weeks
  - 95% successful
  - Contraindications
    - Neuromuscular etiology
    - Syndromic generalized ligamentous laxity – Ehlers-Danlos
    - Teratological DDH, i.e., arthrogryposis
    - Age >6 months – child too active, 50% failure
  - Complications – secondary to
    - Persistent use despite failure – persistent dislocation/subluxation
    - Inappropriate application
    - Consequences – femoral head and acetabular damage, femoral nerve palsy.
- 6 months to 2 years
  - Closed reduction and spica application
    - Under general anesthesia
    - Well-molded spica
    - Arthrogram documentation of reduction before spica application
    - CT scan documentation of reduction after spica application and follow-up
    - Duration – 6–12 weeks
    - Postcasting – hip abduction orthosis until age 18–24 months
  - Open reduction and spica application
    - Indications: failed/lost reduction/irreducible dislocation
    - Spica for 12 weeks
    - Hip abduction orthosis postcasting
  - Additional procedures
    - Femoral shortening – if reduction not possible intraoperatively
    - Periacetabular osteotomy – to increase anterior coverage/deepen the acetabulum
    - Varus/derotation femoral osteotomy – in conjunction with the above (will allow centralization of the femoral head – the essential condition of normal hip development).

Complications: Proximal Femoral Growth Disturbance

- Usually iatrogenic
- Avascular necrosis of the femoral head
  - Injury to the medial circumflex femoral artery

  - Indirect – excessive abduction during closed/open reduction
  - Direct injury during open reduction.
  - Possibly prevented by femoral shortening during open reduction
- Persistent malreduction – abnormal pressure on the femoral head

Conclusions

- DDH is a complex entity.
- Natural history is uniformly bad with lifelong disability.
- Early diagnosis is imperative – mandatory screening.
- Screening in the United States is by clinical evaluation with ultrasound recommended for high-risk/ambiguous cases.
- The outcome depends on early diagnosis and treatment.
- Successful treatment means a hip that at maturity has:
  - Full coverage of the femoral head
  - Shenton lines in continuity
  - Normal tear drop