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# Developmental Dysplasia of the Hip

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Developmental dysplasia of the hip (DDH) is a spectrum of anatomical abnormalities of the hip joint in which the femoral head has an abnormal relationship to the acetabulum. The true incidence of DDH can only be estimated because there is no “gold standard” for diagnosis. Most developed countries report an incidence of 1.5 to 20 cases of DDH per 1000 births, depending in part on the methods of screening used (Shipman, Helfand, Moyer, & Yawn, 2006). The incidence varies by race: it is increased in the Sami people and Native Americans and decreased in populations of African descent (Phillips, 2007).

Although in most affected infants the problem resolves spontaneously in the first several months of life, persistent DDH may result

29% of those in people aged 60 years and younger (Dezateux & Rosendahl).

**DEFINITION**

The spectrum of DDH includes hips that are:

- **Dysplastic:** The hips have inadequate acetabulum formation. This disorder may not be clinically apparent but causes various radiographic abnormalities.
- **Subluxated:** The femoral head can be partially displaced outside of the acetabulum.
- **Dislocatable:** The femoral head is located within the acetabulum but can be displaced by stress maneuvers.
- **Dislocated:** The femoral head is completely outside the acetabulum. Dislocations are divided into two types:

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in chronic pain, gait abnormalities, and degenerative arthritis (Dezateux & Rosendahl, 2007). In its severest form, DDH is one of the most common congenital malformations and is an important cause of childhood disability. This disorder underlies up to 9% of all primary hip replacements and up to

— Teratologic dislocations: Teratologic dislocations occur early *in utero* and often are associated with other problems, such as Larsen syndrome, arthrogryposis, or spina bifida. These dislocations are extremely rare and usually require surgical treatment.

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J Pediatr Health Care. (2008). 22, 318-322.

Note: Figures 1, 2, and 3 can be viewed in color online at [www.jpeds.org](http://www.jpeds.org).

0891-5245/\$34.00

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doi:10.1016/j.pedhc.2008.05.005

— Typical dislocations: Typical dislocations usually occur in healthy infants and may develop prenatally or postnatally (American Association of Pediatrics [AAP], 2000).

## ETIOLOGY

DDH has multifactorial causes. Ligamentous laxity plays an important role, predisposing the developing hip to mechanical forces that cause the femoral head to move outside of the acetabulum. Dysplasia appears to be the result of this process rather than the cause (Phillips, 2007).

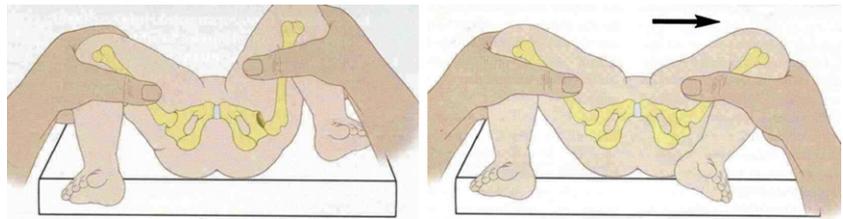
## RISK FACTORS

In case control and observational studies, female gender, breech positioning at delivery, family history of DDH, and increased birth weight (>4000 g) have been most consistently shown to have an association with the diagnosis of DDH (Patel, 2001). Most of the infants diagnosed with DDH have no identifiable risk factors (Bache, Clegg, & Herron, 2002).

## CLINICAL SYMPTOMS

Clinical presentations of DDH depend on the age of the child. Newborns present with hip instability; infants have limited hip ab-

**FIGURE 1. Ortolani test.** This figure is available in color online at [www.jpedhc.org](http://www.jpedhc.org). Reprinted with permission from SLACK Incorporated: Cady, R. B. (2006). Developmental dysplasia of the hip: Definition, recognition, and prevention of late sequelae. *Pediatric Annals*, 35, 92-101.



duction throughout the first year of life until a child begins walking (AAP, 2000).

Provocative testing includes the Barlow and Ortolani maneuvers. The Barlow test attempts to identify a dislocatable hip, while the Ortolani maneuver attempts to relocate a dislocated hip. A dislocatable hip has a distinctive “clunk”—a feeling of instability. Both tests have been shown to have a high degree of operator dependence. Separating true dislocations (palpable clunks) from benign sounds (clicks) takes practice and experience.

The examination must be performed with the diaper off, and one hip is tested at a time. Very little force is required, because forceful, repeated examinations

the thigh. The hip is gently abducted while lifting the leg anteriorly (Figure 1).

The Barlow test is the reverse maneuver. The leg is gently adducted with light pressure on the inside of the thigh with the thumb (Figure 2).

High-pitched clicks are often palpable or audible during the examinations. These clicks are benign and resolve with time. By 8 to 12 weeks of age, the Ortolani and Barlow tests are no longer reliable because of increased muscle tightness and decreased capsule laxity (Shipman et al., 2006). After 3 months of age, limitation of abduction is the most reliable sign associated with DDH (Patel, 2001). Both hips are examined at the same time with the hips and knees flexed and the legs gently abducted. Any asymmetry of abduction may represent abnormality (Figure 3).

Other signs such as shortness of the femur with the hips and knees flexed (Galeazzi sign), asymmetry of the thigh or gluteal folds, and discrepancy of leg lengths may raise suspicion but are not specific findings for DDH. Fold asymmetry can be present in up to 24% of all children (Phillips, 2007).

## Radiographic Evaluation

- All imaging methods are subjective and operator dependent.
- In the first 4 to 6 months of life, ultrasound is more sensitive than radiography because of

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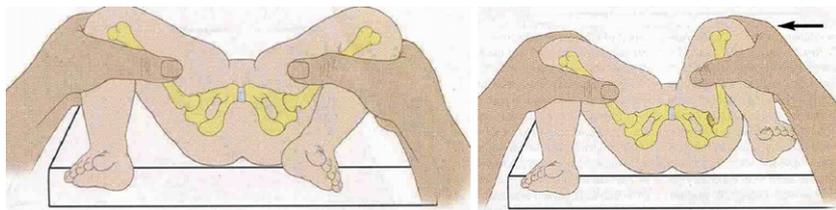
## DIAGNOSIS

The cornerstone of early detection is repeated, careful examination of all infants from birth and

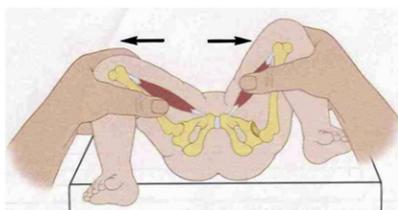
can disrupt the vacuum in the capsule and cause the hip to become readily dislocatable (AAP, 2000).

In the Ortolani maneuver, the newborn is supine, and the hip is flexed to 90 degrees. The examiner's index and middle fingers are placed over the greater trochanter and the thumb on the inside of

**FIGURE 2. Barlow test.** This figure is available in color online at [www.jpedhc.org](http://www.jpedhc.org). Reprinted with permission from SLACK Incorporated: Cady, R. B. (2006). *Developmental dysplasia of the hip: Definition, recognition, and prevention of late sequelae. Pediatric Annals, 35, 92-101.*



**FIGURE 3. Examination for abduction contracture.** This figure is available in color online at [www.jpedhc.org](http://www.jpedhc.org). Reprinted with permission from SLACK Incorporated: Cady, R. B. (2006). *Developmental dysplasia of the hip: Definition, recognition, and prevention of late sequelae. Pediatric Annals, 35, 92-101.*



incomplete ossification of the femoral head in early infancy.

- Ultrasound findings during the first month of life often can reveal minor degrees of instability or acetabular immaturity that usually resolve spontaneously without any treatment (AAP, 2000; Bache et al., 2002).
- Computed tomography and magnetic resonance imaging may be useful in the preoperative assessment of complicated DDH.

### SCREENING FOR DDH

The method of screening and the choice of population to be screened are controversial. Three methods of DDH screening have been described:

- Clinical screening via universal physical examination during the first year of life by properly trained medical providers. Fol-

low-up ultrasounds for abnormal or questionable examinations can be considered.

- Universal clinical (physical examination) screening with additional selective ultrasound or radiographic screening for children with risk factors. The risk factors proposed include female gender, breech presentation at delivery, positive family history, and, some data suggest torticollis and congenital foot deformity as well. The practitioner must remember that the majority of children with DDH have no identifiable risk factors; thus, this method of screening cannot be expected to detect all cases of DDH. Ultrasound or radiographic examination is an adjunct, not a replacement, for clinical examination.

The benefit of universal screening has not been demonstrated, and this practice would increase the identification of “abnormalities” that would resolve without intervention (AAP, 2000).

Two respected authorities, the AAP and the U.S. Preventive Services Task Force (USPSTF), have developed different recommendations on screening for DDH. The AAP Subcommittee on Developmental Dysplasia of the Hip recommends careful clinical examination of all babies at birth and at all well-child examinations during the first year of life. If the results of newborn examination are negative or equivocally positive, risk factors may be considered. In addition to physical examination, selective ultrasound at age 4 to 6 weeks (or radiography at 4 months if ultrasound is not available) is recommended for babies with risk factors or questionable physical examination. Because female infants with a positive family history of DDH and females born in breech presentation have the highest risks of DDH (about 44/1000 and 120/1000, respectively), imaging with an ultrasound or radiography is recommended for these infants. Some studies show a high

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- Universal screening of all babies with ultrasound or radiography in addition to physical examination. This practice would be expensive and would require significant additional resources.

incidence of hip abnormalities detected in all infants born breech, so this imaging strategy remains an option for infants of either sex who are born breech (AAP, 2000).

The USPSTF also reviewed the published literature on screening for DDH (Shipman et al., 2006). The USPSTF guideline is more recent, and some of the original research they considered was not published at the time the AAP guideline was written. The USPSTF determined that the quality of evidence supporting different screening approaches was variable and that evidence is insufficient to recommend routine screening for developmental dysplasia of the hip in infants as a means to prevent adverse outcomes (Shipman et al.). Published studies did not link any screening approach to improved functional outcomes. Three major randomized controlled trials that compared treatment rates and outcomes between clinical examination screening, selective ultrasound, and universal ultrasound screenings did not show clear benefit from any ultrasound screening. The use of ultrasound may reduce the rate of unnecessary treatment but also may identify many more children with mildly dysplastic hips, leading to higher rates of follow-up and treatment for hips that will spontaneously normalize (Elbourne, Dezateux, & Arthur, 2002; Holen, Tegnander, & Bredland, 2002; Rosendahl, Markestad, & Lie, 1994). Very few studies looked at functional outcomes of patients who received treatment for DDH. Because of the high rate of spontaneous resolution of DDH, the true effectiveness of intervention is not known. It should be recognized that all interventions for DDH, surgical or nonsurgical, have been associated with avascular necrosis of the femoral head, the most harmful complication of DDH treatment. In conclusion, the USPSTF stated that screening with clinical examination or ultrasound has the potential to identify newborns at increased risk for DDH, but benefits of screening are not clear because of very high rate of spontaneous resolution of the condition (Shipman et al.). It is important to point out

that the USPSTF follows very stringent policies regarding the incorporation of carefully critiqued evidence into its guidelines (Guirguis-Blake, Calonge, & Miller, 2007; Harris, Helfand, & Woolf, 2001). In contrast, the AAP did not adopt a policy for appraisal and incorporation of evidence until after its guidelines were written (Classifying recommendations for clinical practice guidelines, 2004).

#### INDICATIONS FOR ORTHOPEDIC REFERRAL

- Referral to an orthopedic surgeon is indicated when unstable (dislocatable with palpable clunks) hips are detected during examination at any age. Ordering ultrasonographic examination or an x-ray prior to referral is not recommended (AAP, 2000).
- If the results of the physical examination at birth are equivocal, a primary care provider should

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### *Multiple observational studies report high rates of DDH resolution without intervention in the newborn period.*

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re-examine the hips in 2 weeks before making a referral to an orthopedist. Most hip clicks resolve by 2 weeks of age and do not lead to hip dysplasia (AAP, 2000).

- If the physical findings at the 2-week examination raise suspicion for DDH, consider referral to an orthopedist at age 3 to 4 weeks (AAP, 2000).

#### TREATMENT OPTIONS

- Multiple observational studies report high rates of DDH resolution without intervention in the newborn period. The high rates are believed to be due to ongoing growth and development of the femur and the acetabular cartilage (Patel, 2001).

- The majority of pediatric orthopedic surgeons recommend immediate treatment of infants with unstable hips on examination. Some pediatric orthopedists will allow a few weeks of close observation and will only treat babies with an abnormality that persists at 3 to 4 weeks (Cady, 2006).
- The Pavlik harness is now considered the treatment of choice for DDH in infants younger than 6 months. It is a dynamic splint that prevents hip extension and adduction.
- The Pavlik harness treatment is usually safe, but complications have been described. The most serious complications are avascular necrosis of the femoral head, femoral nerve compression, delayed acetabular development, and knee subluxation. These risks of treatment have prompted caution in expanding

screening criteria such that infants with benign abnormalities might be subjected to potentially harmful treatment.

- The use of triple diapers during the newborn period is no longer recommended (AAP, 2000).
- The duration of therapy depends on the child's age and severity of DDH.
- For children older than 6 months, open or closed reduction is usually necessary.

#### SUMMARY

Diagnosing DDH can be very challenging. The prevention of late detection is the goal for all practitioners. Multiple studies show that use of current diagnostic techniques can minimize the number

of late diagnoses but not eliminate them. The key to early diagnosis remains repeated, careful physical examination of infants during the first year of life. Practitioners should become as skilled and experienced as possible in performing the examination, and they should maintain their skill throughout their careers. Whether ultrasonography or radiography should be used as supplemental studies for at-risk infants with normal physical examination remains controversial.

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