CLINICAL REVIEW

Developmental Dysplasia of the Hip

Indexing Metadata/Description

› **Title/condition:** Developmental Dysplasia of the Hip

› **Synonyms:** Developmental dislocation of the hip joint; congenital dysplasia of the hip; congenital dislocation of the hip; dysplasia, hip (pediatric); dislocation of the hip joint, developmental; hip dysplasia, developmental; dysplasia of the hip, congenital; dislocation of the hip, congenital; CDH; DDH; dysplasia of the hip, developmental

› **Anatomical location/body part affected:** Hip joint, pediatric/femoral head and acetabulum

› **Area(s) of specialty:** Orthopedic Rehabilitation, Pediatric Rehabilitation

› **Description**

- Developmental dysplasia of the hip (DDH) encompasses a wide range of anatomic abnormalities in which the femoral head and acetabulum grow abnormally or are not aligned correctly, resulting in a subluxed or dislocated femoral head.[1,4] DDH is divided into four categories
  - Isolated dysplasia: Abnormal development of the proximal femoral head or acetabulum, either in the size or shape
  - Subluxable: Refers to a femoral head that is not centered within the acetabulum; usually due to ligamentous laxity.[9] The hip joint has increased mobility; however, at rest it is correctly located in the acetabulum
  - Dislocatable: Manual manipulation (i.e., provocation test) can dislocate the head of the femur from the acetabulum[8]
  - Dislocation: Refers to a femoral head that is positioned completely outside of the acetabulum. This is not the same as a dislocatable hip, in which the femoral head is easily dislocated but can be reduced during physical exam[9]
    - Dislocations that occur at 12 weeks' gestation are termed teratologic, which refers to irreversible malformation resulting in a fixed dislocated position. They are associated with a genetic, developmental, or neuromuscular disorder[1]
- The International Hip Dysplasia Institute (IHDI) came out with a new hip dysplasia classification in 2014 as the prior method (Tonnis, mentioned below) relied on the presence of an ossific nucleus, which was not always present in newborns. It is based on radiographic measures and has grades 1 (mild) to grade 4 (severe) and has been shown to be more reliable and accurate[15]
- The incidence of DDH varies greatly according to sex, age, and race. The incidence of DDH is 1 in 1,000 births[8]

› **ICD-10 codes**

- Q65 congenital deformities of hip
  - Q65.0 congenital dislocation of hip, unilateral
  - Q65.1 congenital dislocation of hip, bilateral
  - Q65.2 congenital dislocation of hip, unspecified
  - Q65.3 congenital subluxation of hip, unilateral
  - Q65.4 congenital subluxation of hip, bilateral
  - Q65.5 congenital subluxation of hip, unspecified
  - Q65.6 unstable hip

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– Q65.8 congenital subluxation of hip, unspecified
– Q65.9 congenital deformity of hip, unspecified

› (ICD codes are for the reader's reference, not for billing purposes)

• **Reimbursement:** No specific special agencies are applicable for this condition. In the United States, depending on geographical location individuals with DDH might be eligible for state government-funded therapy programs in the home or clinic setting. Evaluations to determine if a child qualifies for early intervention services through a state-funded program are free to recipients. Children under the age of 3 years are evaluated by local early-intervention services

• **Presentation/signs and symptoms**
– Decreased hip abduction on dislocated side
– Leg-length discrepancy;[2] shorter leg on the dislocated side (Allis or Galeazzi sign)[1]
– Asymmetrical leg position (affected leg is externally rotated)
– Positive Ortolani and/or Barlow test; "clunk" (not "click") when the hip is reduced[2]
– Decreased active and passive hip ROM
– Decreased hip and knee strength of the affected extremity, primarily hip abductors and hip extensors
– Abnormal gait (limp, toe-walking on affected side)

Causes, Pathogenesis, & Risk Factors

› **Causes**

• The exact etiology of DDH remains unknown; something prevents the femoral head from being positioned correctly within the acetabulum, resulting in a shallow acetabulum[9]

› **Pathogenesis**

• There are four critical periods of fetal hip development: at 12, 18, and 36–40weeks' gestation and the early postnatal period. During these critical periods of development, if the femur is not properly positioned in the acetabulum or if motion of the femoral head is decreased, normal bone modeling will not occur, resulting in a shallow acetabulum. As a result, the femoral head can slide either partially or completely out of the shallow acetabulum, resulting in hip subluxation or dislocation, respectively. Persistent dislocation of the hip results in flattening of the femoral head and a shallow acetabulum [1]

› **Risk factors**

• Risk factors for DDH
– Family history of DDH[2]
- Risk is increased 13% when a parent has hip dysplasia and 35% when a parent and a sibling have hip dysplasia[9]
– Female sex
- 6:1 female-to-male ratio[9]
– Race
- More common in Whites of European descent[9]
– Intrauterine factors
- Breech presentation/mode of delivery[2]
- Large for gestational age (LGA)[1]
- First-born child (mother's uterus has not yet been stretched and abdominal muscles are tight)[9]
– Congenital conditions such as arthrogryposis, lumbosacral agenesis, myelomeningocele, Marfan syndrome, fetal hydantoin syndrome, and Larsen syndrome. There is a high rate of coexistence of DDH and congenital muscular torticollis (20% coexistence) and DDH and metatarsus adductus (10% coexistence)[9]
– Researchers and physicians sometimes discuss DDH in terms of time of onset, with a late diagnosis occurring after 3 months of age. Using data from a large multicenter study, authors found that late diagnosis DDH was less associated with breech presentation and more associated with swaddling[16]

Overall Contraindications/Precautions

› Obtain written referral from attending pediatrician for specific treatment of DDH
› Obtain written consent from parent or legal caretaker

› If DDH has not been diagnosed and the initial examination suggests DDH, refer infant to a pediatric orthopedist for comprehensive assessment

› Recommendations/clinical practice guideline on universal ultrasound screening

• The American Academy of Orthopaedic Surgeons (AAOS) published 2014 clinical practice guidelines on detection and nonoperative management of pediatric DDH in infants up to 6 months of age. Based on a systematic review that included 31 studies, there is[12]

– moderate evidence to support not performing universal ultrasound screening of newborns
– moderate evidence to support performing an imaging study before 6 months of age in infants with one or more of the following risk factors: breech presentation, family history, or history of clinical instability
– limited evidence to support a practitioner obtaining an ultrasound in infants less than 6 weeks of age with a positive instability examination to guide the decision to initiate brace treatment
– limited evidence to support the use of an anteroposterior pelvis radiograph instead of an ultrasound to assess DDH in infants 4 months of age or greater

› See specific **Contraindications/precautions to examination** and **Contraindications/precautions** under **Assessment/ Plan of Care**

Examination

› **Contraindications/precautions to examination**

• The infant should be in a relaxed state during the examination. If the infant is distressed and crying, the examination will be difficult, as the infant will tend to tighten the muscles around the hip joint.[1] To facilitate relaxation, the baby should be fed prior to evaluation and the room should be warm and quiet

› **Special tests:** Only experienced and properly trained clinicians should perform provocative tests, such as the Ortolani and Barlow tests[1]

› **History**

• **History of present illness/injury**

– **General inquiry**
- Child's age?
- Active lower extremity ROM (per parent report)?
- Ease of diapering?
- Attainment of developmental milestones?
- Reason for current visit?

– **Course of treatment**
- **Medical management** (Also see *Intervention*, below)
- Given the high rate of spontaneous resolution, the orthopedist may simply monitor the infant for a few weeks
- Treatment of DDH depends on the persistence of the condition and can range from abduction therapy to closed or open reduction procedures
- The abduction angle ranges from 45° to 60° depending on the surgeon's preference. Increasing the abduction angle increases hip stability but can compromise the vascularity of the femoral head and increase risk for avascular necrosis of the femoral head
- Common forms of conservative treatment include the Pavlik harness, Craig splint, and von Rosen splint[1]
- **Surgical management:** Surgical interventions include the following: arthroscopic reduction, varus derotational osteotomy of the proximal femur, femoral shortening, and pelvic osteotomies (e.g., Salter, Pemberton, Dega, Triple, Chiari, and periacetabular). DDH may lead to early hip arthritis, necessitating a total hip arthroplasty at a young age[1]
- Open reduction and hip spica is the consensus management for children with DDH ages 18 to 24 months. Additional pelvic procedures may be necessary (e.g., Dega procedure) to achieve optimal results and prevent residual acetabular dysplasia and early osteoarthritis
- Authors of a Turkish retrospective study found that the addition of the Dega procedure to open reduction (n = 10) significantly improved the radiographic results of patients (mean age 25 months) with developmental hip dysplasia at a 5-year follow-up when compared to open reduction alone (n = 10)[17]

- **Diagnostic tests completed**
  - Ultrasound
    - Ultrasonography during the first 4 weeks of an infant's life will often reveal minor degrees of instability and acetabular immaturity in a normal hip; nearly all of these signs will resolve on follow-up[13]
    - The American Academy of Pediatrics (AAP) recommends hip imaging for female infants born in the breech position and optional hip imaging for male infants born in the breech position. Selective hip imaging has not been shown to significantly reduce the time to diagnosis[13]
  - Prior to the age of 6 months, X-rays are of limited use because the femoral head is composed entirely of cartilage[13]
  - Arthrography: This invasive test is performed to assess hip stability following a closed or open reduction[1]
- **Previous therapy:** Document whether patient has had occupational or physical therapy for this or other conditions and what specific treatments changed symptoms

– **Nature of symptoms:** Document nature of symptoms per parent report (can recommend FLACC or other scale to determine if baby is in pain)

– **Sleep disturbance:** Document number of wakings/night, if any

– **Barriers to learning**
- **Are there any barriers to learning? Yes__ No__**
- **If Yes, describe _____**

• **Medical history**

– **Past medical history**
- **General inquiry**
  - Child's gestational age
  - Presentation at birth (breech versus vertex)
  - Type of delivery (cesarean versus vaginal)
  - Birth order
  - Family history of DDH, ligamentous laxity, or myopathy[1]
- **Comorbid diagnoses:** Ask patient about other problems, including heart conditions, orthopedic disorders, etc. DDH is associated with congenital muscular torticollis and metatarsus adductus[9]
- **Medications previously prescribed:** Obtain a comprehensive list of medications prescribed and/or being taken (including OTC drugs)
- **Other symptoms:** Ask parent/caregiver about other symptoms child may be experiencing

• **Social/occupational history**

– **Patient's goals:** Document what the patient/caregiver hopes to accomplish with therapy and in general

– **Functional limitations/assistance with ADLs/adaptive equipment:** Document limitations

– **Living environment:** Stairs, number of floors in home, with whom patient lives, caregivers, etc. Identify if there are barriers to independence in the home; any modifications necessary? If child is positioned in an abduction device or cast, evaluate parents' ability to position child safely in a car seat and in the home. Positioning during sleep can be particularly problematic for the child. The therapist may want to observe positioning in crib/bassinet and provide recommendations to assist parent/caregiver

› **Relevant tests and measures: (While tests and measures are listed in alphabetical order, sequencing should be appropriate to patient medical condition, functional status, and setting)**

• **Anthropometric characteristics:** Document infant's height, weight, and head circumference and compare to age- and sex-matched norms. Assess child for leg-length discrepancy. An infant/child with DDH may present with an apparent leg-length discrepancy or an externally rotated leg on the affected side

• **Assistive and adaptive devices:** In the ambulatory child, determine if any assistive device is needed. Following surgical intervention, patients should be assessed for the need of any assistive devices to facilitate functional mobility

• **Balance:** In the ambulatory child, assess static and dynamic balance such as single limb stance and tandem stance with eyes open and closed. Use the balance section of the Peabody Developmental Motor Scales, Second Edition (PDMS-2)or the balance section of the Bruininks-Oseretsky Test of Motor Proficiency, Second Edition (BOT-2)

• **Cranial/peripheral nerve integrity:** In an infant who has undergone abduction therapy or casting, evaluate for brachial and femoral nerve palsies, which may result from improper harness application[3]

– Signs of femoral nerve palsy include muscle weakness, specifically decreased strength in the hip flexors and knee extensors, as well as decreased sensation along the anterior thigh and medial aspect of the lower leg and foot

– Signs of injury to the brachial plexus will vary depending on the portion of the plexus involved
  - Injury to the upper plexus will result in paralysis of the deltoid, biceps, brachioradialis, and brachialis. Due to paralysis, the arms will rest in adduction and internal rotation, with elbow extension and forearm pronation. Decreased sensation will be noted over the deltoid region and the radial surfaces of the forearm and hand
  - Injury to the lower plexus may result in a claw hand deformity. Paralysis will be noted in the intrinsic hand muscles. Weakness will be noted in the medial finger and wrist flexors and possibly the forearm extensors. Decreased sensation will occur on the ulnar side of the arm, forearm, and hand

- **Ergonomics/body mechanics:** If the child is positioned in an abduction orthosis or cast, evaluate caregiver's body mechanics during transfers/lifting
- **Functional mobility (including transfers, etc.):** Use the Pediatric Evaluation of Disability Inventory (PEDI) or the WeeFIM
- **Gait/locomotion:** In the ambulatory child, evaluate for gait deviations (e.g., limp or Trendelenburg gait). A Trendelenburg gait is a common gait deviation in the ambulatory child with DDH. Look for the pelvis to drop on the opposite side of dysfunction—i.e., in the case of right hip instability, the pelvis will drop on the left during stance on the right.[6] The child may compensate for hip abduction weakness by shifting weight over the affected limb. In cases of bilateral dysfunction, the child may ambulate with a waddling gait. In the case of unilateral dysfunction, the child may walk with a short-limbed gait or up on toes to compensate for a shorter leg
  – Trendelenburg sign: Ask child to stand on affected leg. If hip abductor weakness is present, the pelvis will drop on the opposite side and the trunk will lean over the affected leg to compensate[3]
- **Joint integrity and mobility:** Assess hip stability with the Ortolani and Barlow tests as detailed below
- **Motor function (motor control/tone/learning):** Assess bilateral extremity and trunk muscle tone. Note any asymmetry or abnormality. Use the Modified Ashworth Scale to assess spasticity, if indicated
- **Muscle strength:** In an infant, assess muscle strength via observation of developmental skills/active lower extremity and upper extremity movements in prone, supine, and side-lying. In older children who are able to follow multistep commands, assess strength with manual muscle testing (MMT). Children with DDH will likely present with weak hip abductors and extensors
- **Neuromotor development:** Use thePDMS-2 or the Alberta Infant Motor Scales (AIMS)
- **Observation/inspection/palpation (including skin assessment):** Examine the lower extremities for asymmetrical thigh or buttock skin folds.[5] Physical examination findings consistent with DDH in children under age 3 months include leg-length discrepancy, positive Barlow or Ortolani test, and asymmetrical gluteal skinfolds
  – In a child wearing an abduction orthosis, check skin integrity around the areas of the harness
  – Assess lower extremities for metatarsus adductus or clubfoot
- **Posture:** Assess child for congenital muscular torticollis. Note if the child presents with a postural head tilt and/or rotational head preference. In an ambulatory child, complete a full posture assessment, noting any asymmetry
- **Range of motion:** Assess bilateral lower extremity passive ROM, paying particular attention to hip abduction, which may be reduced in the dislocated hip. In a diapered baby, remove the child's diaper to accurately measure hip abduction. Hip abduction in an infant should measure 75° and hip adduction should measure 30°.[1]Screen bilateral lower extremity active ROM. Assess active upper and lower extremity ROM through observation
- **Reflex testing:** Assess infant reflexes such as Moro, asymmetrical tonic neck reflex (ATNR), Landau. Typically, an infant with DDH will not exhibit abnormal reflexes, unless associated with a neurological diagnosis
- **Special tests specific to diagnosis**
  – Each hip should be tested individually. The average examiner may exert as much as 3 times the necessary amount of force when performing this test. Excessive force may result in a false-positive test
  - Barlow test – Use to test infants less than 3–4 months of age.[5] This test is used to diagnose a dislocatable hip. Each hip should be tested individually, with the opposite hip held in maximum abduction to lock the pelvis. To perform test, place the infant in the supine position with the hips flexed to 90° and abducted. The thigh of the leg being tested is gently adducted while applying a gentle downward and lateral pressure. The test is positive given a palpable "clunk" or sensation of posterior movement, which indicates dislocation of the femoral head from the acetabulum. It is important to differentiate between a "click" and a "clunk." A "click" is elicited with range of motion and is likely due to the iliotibial band snapping over the greater trochanter. A "click" is not an indication of DDH.[5] Note: Barlow test will be negative in a hip that is dislocated[8]

- Ortolani test – Use to test infants less than 3–4 months of age.[5] The test is used to reduce a dislocated hip. As above, each hip should be tested individually, with the opposite hip held in maximum abduction to lock the pelvis. To perform test, place the infant in the supine position. Grasp the infant's thigh between your thumb and index finger. Flex the hips to 90°, holding the leg in neutral internal and external rotation. Next, using your 4th and 5th fingers, lift the greater trochanter while simultaneously abducting the hip of the leg being tested. The test is positive given a palpable "clunk," indicating that the femoral head has been relocated in the acetabulum. As above, differentiate between a "click" and a "clunk."[5] Note: Ortolani test may be negative in a dislocated hip[1]
- Allis or Galeazzi sign – This is the most reliable test for infants over 3 months of age.[1] Place the infant in supine, with the hips and knees flexed to 90° in neutral abduction. Evaluate the height of the knees. If one knee appears lower, this is likely due to posterior hip dislocation

Assessment/Plan of Care

› **Contraindications/precautions**

- Obtain written referral from attending pediatrician for specific treatment of DDH
- The treating therapist should have experience with congenital orthopedic conditions such as DDH
- The treating therapist should have experience with hip abduction therapy[1]
- Follow facility's protocols and physician's orders for treating DDH
- Unnecessary treatment may lead to complications, such as avascular necrosis, as well as cause parental psychosocial stress[1]

› **Diagnosis/need for treatment:** Following abduction therapy, patients can benefit from physical therapy to address the following impairments and impaired functional mobility: decreased active and passive ROM, decreased lower extremity and core strength, decreased age-appropriate functional mobility, delayed motor skills, antalgic gait, and decreased static and dynamic balance. Caregiver education plays an important role in the rehabilitation of DDH

› **Rule out**

- Congenital abduction contracture
- Slipped capital epiphysis
- Proximal focal femoral deficiency
- Congenital coxa vara
- Septic arthritis can result in a pathological dislocation[1]
- Traumatic hemarthrosis[1]
- Neurological conditions, such as cerebral palsy or myelomeningocele, can result in muscle imbalance, which can lead to hip dislocation[8]

› **Prognosis**

- Individuals with untreated hips that remain subluxed or dislocated are at risk for early degenerative joint disease and chronic disability[1]
- Early diagnosis is the key to effective treatment[9]
- Subluxable hips should be treated as soon as DDH is diagnosed because they often present as degenerative joint disease with clinical disability during the second decade of life[1]
- National newborn and infant screening programs, which allow for early detection of DDH, are in place worldwide. However, there are still children in whom DDH is diagnosed late (> 5 months of age). Closed reduction followed by a hip spica cast is most often prescribed for these children. In some cases, the Pavlik harness is recommended and used instead of surgical intervention
  - However, researchers who conducted a retrospective study in Turkey concluded that the use of the Pavlik harness was less effective when used in children over 4 months of age and also in children with complete dislocations and hips with severely deficient acetabular bony roofs[18]
- For adults with DDH who develop end-stage osteoarthritis, a cementless total hip arthroplasty is a safe procedure with good clinical outcomes[19]
  - Based on a Turkish study of 102 hips in 78 patients with end-stage arthritis secondary to DDH

› **Referral to other disciplines:** An ambulatory child with suspected DDH should be immediately referred to pediatric orthopedist

› **Other considerations**

• When fabricating and applying the spica cast for closed reduction of DDH, hip abduction and flexion needs to be aligned properly for achieving optimal outcomes

› **Treatment summary**

• Abduction therapy: Typically, this intervention will be carried out by a physician, nurse practitioner, or registered nurse. However, some clinics may utilize physical therapists

– There are many types of abduction therapy devices, including the Frejka pillow, Craig splint, van Rosen splint, Tübingen splint,[14] and the Pavlik harness

- Turkish researchers conducted a retrospective study to assess the functional outcomes of infants with DDH who were treated with the Tübingen hip flexion splint[14]

- The Tübingen hip flexion splint allows for reduction of the hip with abduction and flexion while allowing movement at the hip and knee joints. The hips remain abducted and flexed even when the child rolls to the side
- The overall treatment period was 17 weeks and median age at the start of treatment was 18 weeks. The median follow-up period was 13.5 months
- Researchers found that treatment was successful in 56/60 hips (93.3%). There were no complications in any of the patients

– The goal of abduction therapy is to position the hips in the "frog-leg"position of hip abduction and flexion, which promotes proper hip development by positioning the head of the femur in the acetabulum

– The most common abduction orthosis is the Pavlik harness, which is used to treat a "reducible" hip before the age of 6 months (preferably before crawling). The harness should position the hips in 100–110° of flexion and 70° of hip abduction, with the knees in 90° of flexion. The harness should be fitted and adjusted by a physician[1]

– Caregiver education[1]

- The Pavlik harness should be kept on at all times, even during diapering, during feeding, and while changing the infant's clothes. However, studies have revealed that most parents will remove the harness at some point in the treatment. It is vital to educate the parents regarding the importance of wearing the harness and how to don the harness correctly. The harness should also be marked so that the parent can reapply the harness in the correct position
- A disposable diaper can be placed under each harness to keep the harness clean. Clothes worn over the harness will also help to keep it clean
- Check the infant's skin several times per day, especially around the edges and under the straps, for skin abrasions or irritation. Keep the skin clean and dry. Avoid lotions, powders, and cream under the harness
- The infant can be positioned supine or prone, but not on side
- During transportation, infants should fit in a regular car seat while wearing the harness without difficulty
- Complications: Complications from abduction therapy can occur, most likely due to improper harness application, including avascular necrosis, femoral nerve palsy, knee subluxation, pressure sores, epiphysitis, inferior dislocation of the hip, medial knee instability, and tibial torsion[3]

– Clinical practice guidelines on nonoperative management of pediatric DDH in infants up to 6 months of age published by AAOS in 2014 are based on a systematic review of the literature that included 31 studies. The authors concluded there is limited evidence to support either immediate or delayed (2–9weeks) brace treatment for hips with a positive instability exam. There is also limited evidence to support serial physical examinations and periodic imaging assessments during brace management[12]

• Postsurgical rehabilitation

– Postoperative rehabilitation depends on the type of surgery and the surgeon's protocol[1]

• Functional rehabilitation: Research is lacking on physical therapy intervention for children and adolescents following medical management for DDH. There is also a lack of research on physical therapy intervention for children and adult patients with chronic DDH

Problem	Goal	Intervention	Expected Progression	Home Program

Decreased caregiver knowledge regarding DDH	The caregiver will be knowledgeable regarding DDH and will follow up with an orthopedist or pediatrician	**Referral to other disciplines** A child with suspected DDH should be immediately referred to his or her physician. Physical therapy typically will not have a role in the early treatment of DDH	N/A	N/A
Decreased caregiver knowledge regarding abduction therapy to prevent skin breakdown and ensure proper use of the harness	The caregiver will be independent with the use of the harness and care of the infant	**Caregiver education** If appropriate and in accordance with facility's protocols and physician's orders, educate caregiver on the care of the infant and use of the harness (see *Treatment summary*, above)	Caregiver will be independent with skin inspection	Provide caregiver with written instructions and diagrams
Hip joint arthritis, pain, and resulting functional deficits can occur if DDH is untreated or diagnosed late	Refer infant with suspected DDH to orthopedist or pediatrician for further evaluation	N/A	N/A	N/A
Decreased hip active ROM/passive ROM	Maximize hip active and passive ROM per physician guidelines	**Therapeutic exercises** Gentle active ROM and passive ROM for hip ROM. Follow physician's guidelines regarding any ROM restrictions **Manual therapy** Perform soft tissue mobilization and massage to hip muscles. Educate caregivers in massage techniques that can be performed at home	Progress child as indicated by response to treatment	Provide parents with written home exercise program

Antalgic gait	Ambulate without significant gait deviations or pain	**Gait training** Provide patient with an assistive device, if necessary, to achieve independence with gait and minimize any complaints of pain. Use a gait belt as needed. Facilitate equal weight bearing during stance phase and neutral stride and step length. Follow physician's guidelines for weight-bearing progression	Progress patient towards independence with gait without the use of an assistive device	Provide parent with instructions regarding the use of a gait belt, if needed, and any other safety measures. Instruct parent in use of assistive device

Decreased lower extremity strength Decreased tolerance to prone positioning Developmental delay	Increase bilateral lower extremity strength Attainment of age-appropriate gross motor milestones	**<u>Therapeutic exercise</u>** In infants and young children, strengthening and the acquisition of new motor skills is largely accomplished through play. It is crucial the clinician engage the child in play in order to gain active participation. All strengthening exercises should ideally be performed with 5–8 repetitions, 2–3 sets in a row, and 2–3x a day depending on the degree of involvement **<u>Functional training/ developmental skills progress</u>** Prone play is an important functional position for strengthening and developmental skill acquisition. Use toys and mirrors to encourage tolerance to this position. Facilitate prone on forearms to extended arms and reaching with either upper extremity. Strengthen gluteal muscles in prone with active hip extension. Use rolling to encourage active hip abduction and extension strength in addition to side-lying play. Facilitate independent sitting skills and core strengthening with reaching activities to both sides and across midline	Progress child as indicated by response to treatment and developmental readiness Progress child's developmental skills for prone, sitting, and transitional movements as appropriate	Provide patient and family/ caregivers with written instructions regarding functional activities that can be performed at home. Ask caregiver to demonstrate proper handling and positioning techniques

Desired Outcomes/Outcome Measures

› Reduction of the dislocated femoral head without major complications
  • Ortolani and Barlow tests
› Normal hip ROM and strength
  • MMT or functional strength testing depending on age
  • Goniometry
› Normal gross motor function for age[7]
  • PDMS-2
  • BOT-2
  • AIMS
  • PEDI
  • WeeFIM
› If appropriate and in accordance with facility's protocols and physician's orders, caregiver will be independent with the proper application of abduction therapy

Maintenance or Prevention

› Prevention of DDH is likely not possible. Early detection and closed reduction treatment are vital to prevent complications and improve overall outcome.[1] Following treatment intervention, patients need to be regularly monitored with ultrasound testing to ensure that optimal alignment is maintained. In some instances, the contralateral hip may be monitored in case of missed bilateral DDH[11]
› Caregivers and healthcare providers should be aware that children with DDH are at risk for developing psychosocial impairments as they age due to the long-term sequelae. Children report anxiety, depression, and poor self-esteem and self-image compared to their peers. During routine follow-ups, children should be screened for early identification[10]
› In families with a significant history of DDH, radiographic screening of siblings of patients with DDH may be advisable
  • In a study conducted in the United States, 27% of first-degree and second-degreerelatives of patients with DDH had unsuspected radiographic acetabular dysplasia and many became symptomatic after age 30[20]

Patient Education

› UCSF Benioff Children's Hospitals, "Developmental Dysplasia of the Hip,"https://www.ucsfbenioffchildrens.org/conditions/developmental_dysplasia_of_the_hip/index.html
› International Hip Dysplasia Institute website, https://hipdysplasia.org/developmental-dysplasia-of-the-hip/
› OrthoInfo, the website of the AAOS, https://orthoinfo.aaos.org/en/diseases--conditions/developmental-dislocation-dysplasia-of-the-hip-ddh

Coding Matrix

References are rated using the following codes, listed in order of strength:

M	Published meta-analysis	**RV**	Published review of the literature	**PP**	Policies, procedures, protocols
SR	Published systematic or integrative literature review	**RU**	Published research utilization report	**X**	Practice exemplars, stories, opinions
RCT	Published research (randomized controlled trial)	**QI**	Published quality improvement report	**GI**	General or background information/texts/reports
R	Published research (not randomized controlled trial)	**L**	Legislation	**U**	Unpublished research, reviews, poster presentations or other such materials
C	Case histories, case studies	**PGR**	Published government report		
G	Published guidelines	**PFR**	Published funded report	**CP**	Conference proceedings, abstracts, presentation

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