

HIP Dysplasia In Children: Physiotherapy Management

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Abstract: Developmental dysplasia of the hip (DDH) comprises of a wide spectrum of clinical severity, ranging from mild developmental abnormalities to dislocation. Hip dysplasia into adolescence and adulthood may result in abnormal gait, decreased strength and increased rate of degenerative hip and knee joint disease. There are different screening programs for DDH, the suspicion is raised based on a physical examination immediately after birth. Radiography and ultrasonography are used to confirm the diagnosis.

Treatment depends solely on the age of the patient and the reducibility of the hip joint. Early age up to 6months, the main treatment is an abduction brace like the pavlik harness if it fails, closed reduction and Spica casting is done .After the age of 18months, treatment usually consist of open reduction and hip reconstruction surgery. Various treatment and physiotherapy management protocol have been proposed thus the purpose of this review was to provide literature based on the current practice for detection of the abnormality and physiotherapy management of DDH. With emphasis on recent updates in screening and management.

Abbreviations: DDH – Developmental Dysplasia of hip

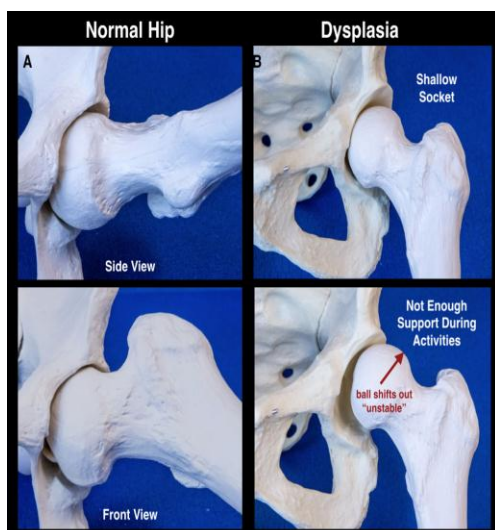


Figure 1: Normal hip and Dysplastic hip

TERMINOLOGIES IN HIP DYSPLASIA

- ✓ **DYSPLASIA** - Any abnormality of development

- ✓ **SUBLUXATION** - Incomplete loss of contact between the articular surfaces of the femoral head and acetabulum.
- ✓ **DISLOCATION** - Complete loss of contact between the articular surface of the femoral head and acetabulum
- ✓ **DISLOCATEABLE** - Tendency of the femoral head to be push out of the socket
- ✓ **REDUCIBLE DISLOCATION** - Ability of the dislocated femoral head to be able to be push back into the socket
- ✓ **IRREDUCIBLE DISLOCATION** - The femoral head remain stuck in the dislocated position
- ✓ **ACETABULAR DYSPLASIA** - Specifically refers to incomplete or insufficient development of the hip socket
- ✓ **INSTABILITY** - Ability to subluxate or dislocate the hip with passive manipulation (Junich T, etal., 2018).

I. INTRODUCTION

Hip dysplasia also known as DDH is an anatomical abnormalities of the hip joint in which the femoral head has an abnormal relationship with the acetabulum (Shahryar etal, 2010).

The designation DDH has been officially endorsed by the AAOS, AAP and POSNA because it is not restricted to congenital dislocation of the hip and includes developmental problems of the hip (Gullie et al, 2000).

Over the years, DDH has been ascertained to be a condition that evolves over time emerging during the period before and even after birth (Chen Stain No et al. , 2008).

DDH includes femoral head subluxation or dislocation and /or acetabular dysplasia (Nguyen et al., 2018).

Hip Dysplasia threatens long-term function by increasing the chance of early degenerative diseases (Malvitz, Weinstein, Sl., 1994).

Early diagnosis and treatment of DDH is of greatest importance to get a more favourable prognosis (Nguyen Hung., 2013).

Teratologic hip dysplasia refers to the more severe, fixed dislocation that occur prenatally, usually in those with genetic or neuromuscular disorders (Stephen, David, 2006).

Persistence of hip dysplasia into adolescence and adulthood may result in abnormal gait, decreased strength and increased rate of degenerative hip and knee joint disease (Pavel, et al., 2015).

PREVALENCE/EPIDEMIOLOGY

The exact incidence of DDH is difficult to determine because of a discrepancy

PREVALENCE/EPIDEMIOLOGY

In definition of the condition, type of examination used and different levels of skills of clinicians (Shahryar N, et al., 2010).

1 in 1,000 children is born with a dislocated hip and 10 in 1,000 children are born with hip subluxation (James, TG et al, 2000)

DDH is extremely rare in Chinese & black population and common among native Americans and eastern Europeans (Hosalka, et al., 2016)

However, in a review of 284 children with congenital orthopaedic malformation in an African Teaching Hospital (Ibadan, Nigeria) DDH accounted for only 2.2% of all congenital malformations (Omololu, Ogunlade, Alonge, T.O., 2005).

The immunity of the African infant from DDH may be due to deeper acetabulum, genetic factors and the absence of swaddling in African cultures (Randall, TL., Elaine, NS., 2011).

A study by Ali-Gombe A, et al (1996), at the University of Maiduguri Teaching Hospital, Nigeria, shows that the prevalence of acetabular dysplasia in the Nigerian population based on centre-edge angle & acetabular depth were 3.3% and 2.9% respectively.

- ✓ The left hip is affected in 60% of children, the right hip in 20% & both hips in 20%.
- ✓ The left hip is more commonly involved because it is adducted against the mother lumbosacral spine in the most common intrauterine position with limited space for abduction (Dunn PM, 2002).

II. CAUSES/RISK FACTORS

Factors contributing to DDH includes:

✓ BREECH PRESENTATION

It is believe that in utero, knee extension of the infant in the breech position results in sustained hamstring forces around the hip and contribute to subsequent hip instability (Salter RB, 1998).

Breech presentation results in extreme flexion and limitation of hip motion causing capsular stretching and acetabular dysplasia.

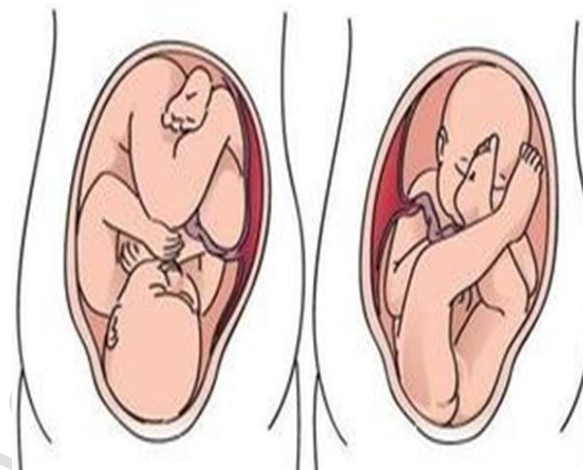


Figure 1: Normal and Breech presentation

✓ FEMALE SEX

80% of children with DDH are females. This is as a result of the effect of additional estrogen produced by the female foetus & circulating maternal hormones (Relaxin) which passes freely via the placenta into the newborn during childbirth thus increasing ligamentous laxity.(Wilkinson JA, 1999)

✓ POSITIVE FAMILY HISTORY (GENETICS)

A family history positive for DDH may be found in 12 – 33% of affected patients. The risks of DDH for a child has been documented at 6% in one affected sibling, 12% in one affected parent & 36% if a parent and a sibling are affected (Haasbeck JF, Wright JG, Hadden DM, 2005).

✓ FIRSTBORN STATUS (PRIMPARITY)

Firstborn children are affected twice as often as subsequent siblings presumably because of an unstretched uterus & tight abdominal structures in the mother which may compress the uterine contents (Stephen KS, David LS, 2006).

✓ OLIGOHYDRAMNIOS

A deficit of amniotic fluid in the amniotic sac can limits intrauterine space & uterine volume and this is associated with

a lot of congenital abnormalities including DDH (David DA, etal 2004).

✓ POSTNATAL POSITIONING (SWADDLING)

There is a high incidence of DDH in communities where new-borns are positioned on a cradled board with the hips swaddled in extension & adduction.(Kutlu etal, 2013)



Figure 3: Swaddling position



Figure 4: 2- way swaddle

III. BRIEF EMBRYOLOGY OF THE HUMAN HIP

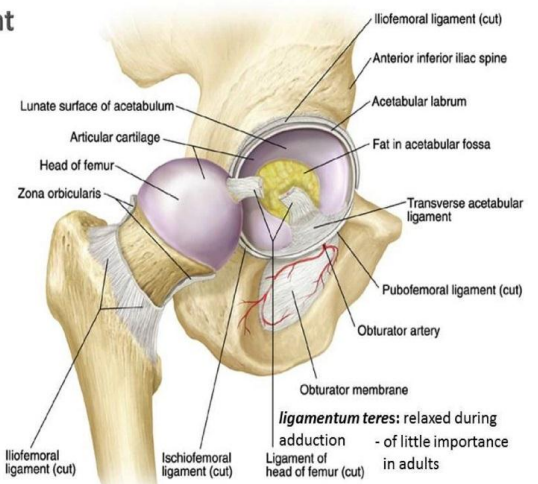
- ✓ The limb bud appear first at 4 weeks gestation. the hip joint begins to develop at 8weeks gestation when a cleft occurs btw the acetabulum and the femoral head & development is usually completed by 11weeks (Watanabe RS, 2007).
- ✓ As a result, the hip is always located early in the embryonic stage because its form from the pelvis.
- ✓ Hip dysplasia or dislocation may then occur in utero, perinatally or subsequently with development.

IV. CLINICALLY RELEVANT ANATOMY OF THE HIP JOINT

- ✓ *The hip joint* is a ball and socket synovial joint formed by an articulation between the pelvic acetabulum and the head of femur (Oliver Jones, 2018).

- ✓ It forms a connection from the lower limb to the pelvic girdle and thus is designed for stability & weight bearing rather than a large range of motion.
- ✓ The *acetabulum* is a cup- like depression located on the inferolateral aspect of the pelvis. Its concavity is deepened by the presence of a fibro cartilaginous collar- the acetabular labrum.

Hip Joint



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Plate 3-55

Figure 6: Hip Joint

- ✓ The *acetabular labrum* is a circular layer of cartilage which surrounds the outer part of the acetabulum effectively making the socket deeper and so helping provide more stability (Ferguson etal, 2003).
- ✓ The *head of femur* is hemispherical and fits completely into the concavity of the acetabulum.
- ✓ *The ligaments* of the hip joint act to increase stability.
- ✓ *Intracapsular Ligament:* The ligament of head of femur
- ✓ *Extracapsular Ligaments:* Iliofemoral, Pubofemoral & Ischiofemoral ligaments.
- ✓ *Iliofemoral Ligament:* Strongest, Y- shaped, & prevent hyperextension of the hip joint.
- ✓ *Pubofemoral Ligament:* Triangular in shape, prevent excessive abduction and extension.
- ✓ *Ischiofemoral Ligament:* Prevents hyperextension and holds the femoral head in the acetabulum.



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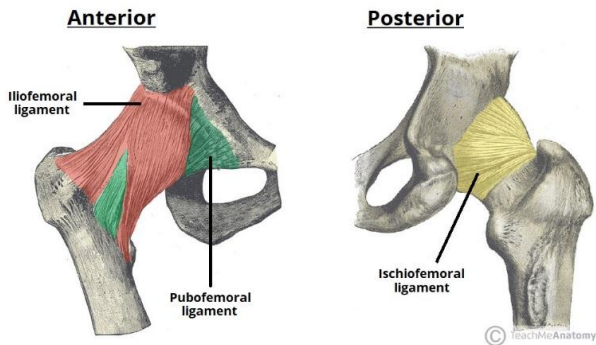


Figure 7: Ligaments of hip joint

V. ARTERIAL SUPPLY OF THE HIP JOINT

- ✓ Largely by the medial and lateral circumflex femoral arteries (branches of the profunda/deep femoral artery).

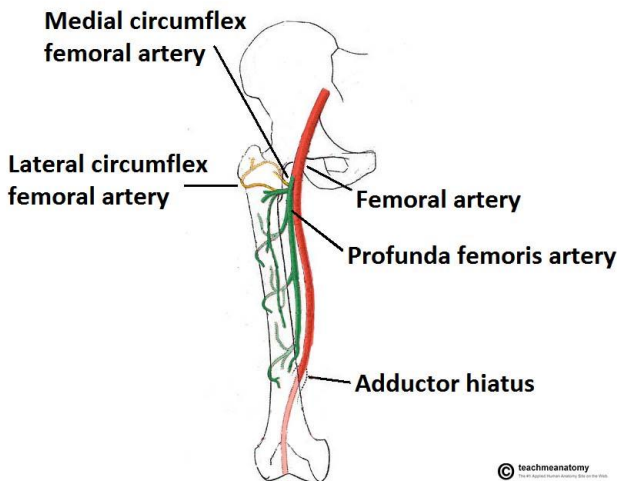


Figure 8: Arterial supply of the hip joint

VI. NERVE SUPPLY

- ✓ Innervated by the Sciatic, Femoral and Obturator nerves.

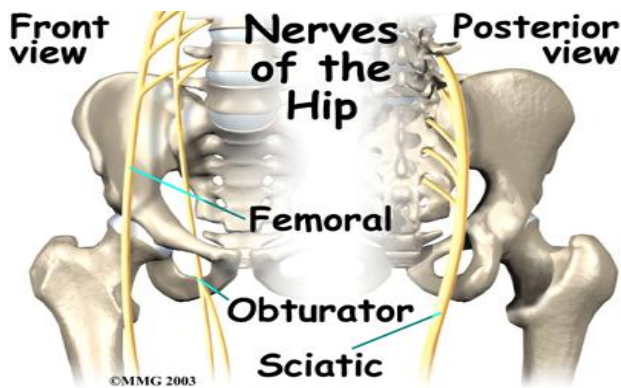


Figure 9: Nerve supply of the hip joint

Anterior Views of the Muscles of the Hip Joint—Deep Views

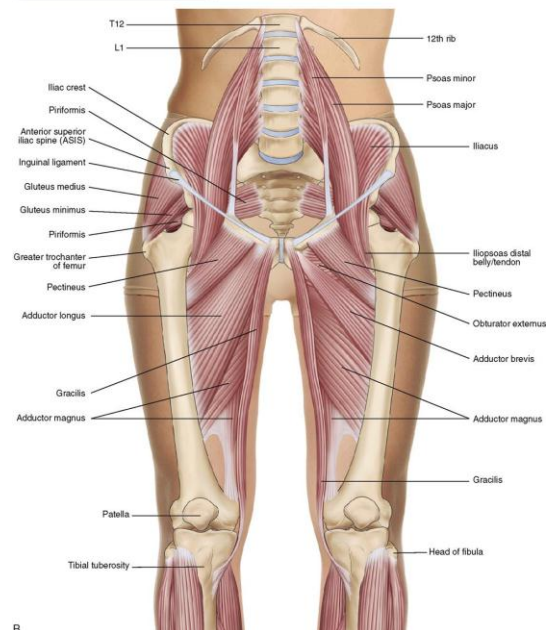


Figure 10: anterior muscles of the hip joint

- ✓ **FLEXION:** Iliopsoas, Rectus femoris, Sartorius, Pectineus
- ✓ **EXTENSION:** Gluteus maximus, Hamstrings
- ✓ **ABDUCTION:** Gluteus medius, Minimus, Piriformis & TFL.
- ✓ **ADDUCTION:** Adductor longus, Brevis & Magnus, Pectineus and Gracilis.
- ✓ **LATERAL ROTATION:** Biceps femoris, Gluteus maximus, Piriformis, Obturators, Gemelli and Quadratus femoris.
- ✓ **MEDIAL ROTATION:** Anterior fibres of Gluteus medius & Minimus, TFL.

Posterior Views of the Muscles of the Hip Joint—Superficial and Intermediate Views

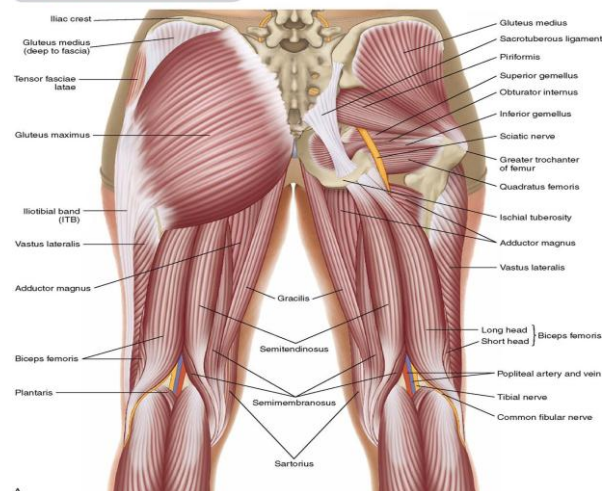


Figure 11: Posterior muscles of the hip joint

VII. PATHOLOGIC ANATOMY OF A DYSPLASTIC HIP

- ✓ The following structures or conditions may be a block to concentric reduction in a patient with DDH:

- Inverted Labrum
- Presence of a Limbus
- Hypertrophied ligamentum teres
- Pulvinar
- Contracted capsule
- Contracted TAL
- Contracted Iliopsoas

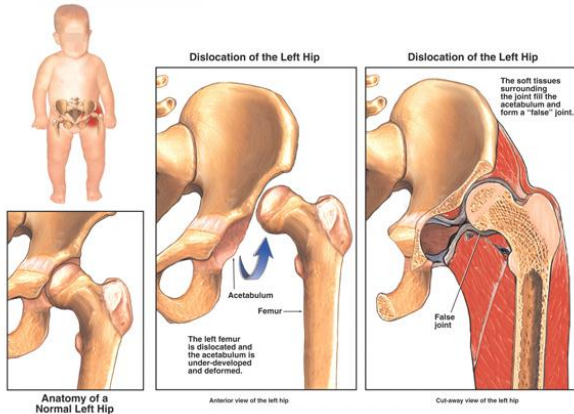


Figure 12: Anatomy of a dysplastic hip

- ✓ Persistent subluxation of the hips results in progressive deformation of both the acetabulum and the femoral head (James TG, et al., 2000)
- ✓ The most consistent finding in DDH is a shallow acetabulum with persistent femoral anteversion.
- ✓ If a subluxation or dislocation persists, the *fibrocartilagenous labrum* hypertrophies and inverted and may mechanically block concentric reduction of the hip.
- ✓ *The limbus* represent a pathologic response of the acetabulum to abnormal pressures in the hip. It is the labrum that is hypertrophied with fibrous and fibrocartilaginous overgrowth, and is a potential block to concentric reduction of a dysplastic hip.
- ✓ With superior migration of the femoral head, the *Labrum* is gradually everted with capsular tissue interposed btw it and the outer wall of the acetabulum.
- ✓ The space btw the acetabulum and the femoral head is filled with fibro fatty tissue (*Pulvinar*) that develops in the base of the acetabulum and a thickened *Ligamentum teres* thus preventing the reduction of the femoral head within the acetabulum.
- ✓ The *iliopsoas tendon* that crosses the anterior capsule constricts it anteriorly. Once the *capsular constriction* becomes narrower than the diameter of the femoral head, non-operative reduction becomes impossible.



- ✓ The fascia and muscles around the hip joint respond to the superior displacement of the femoral head by becoming shortened and constricted. The tight adductor muscles resist abduction and the flexor muscles hold the femoral head in the superior position thus making reduction difficult (David DA, et al., 2012).
- ✓ The *TAL* located at the caudal perimeter of the acetabulum contracts in patient with persistent hip dislocation and is a major block to concentric reduction of the hip.

VIII. SIGNS AND CLINICAL PRESENTATIONS

- ✓ Asymmetrical thigh and gluteal skin folds
- ✓ Limited abduction of the affected hip
- ✓ Apparent femoral shortening of the affected hip (Geleazzi sign)
- ✓ > 18months old:
- ✓ Hip pain
- ✓ Waddling/Trendelenburg gait

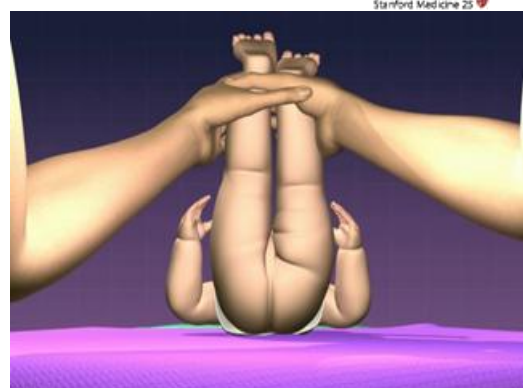
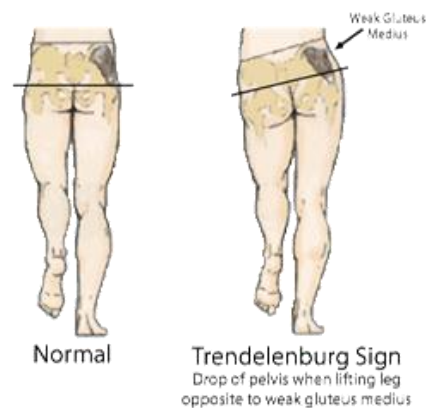
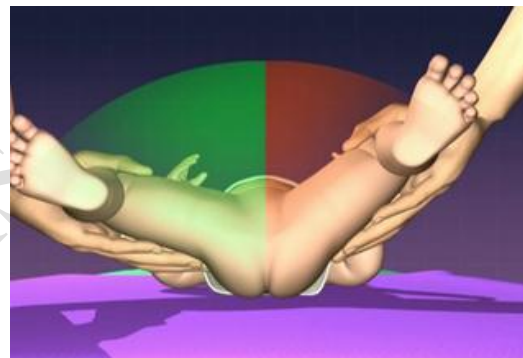




Figure 13: Galeazzi test

LEG LENGTH DISCREPANCY/TOE WALKING

- ✓ NB: Leg length discrepancy and /or asymmetrical gluteal/thigh folds will be absent in patients with bilateral DDH. Hence early diagnosis (in newborn screening) is essential as prognosis worsens with increasing age.(IHDI, 2015)

IX. COMPLICATIONS

- ✓ Residual Acetabular dysplasia, subluxation and /or re-dislocation despite treatment.
- ✓ Early Osteoarthritis of the hip joint
- ✓ Leg length discrepancy---LBP, functional scoliosis and knee pain.
- ✓ Avascular necrosis of the femoral epiphysis.

X. DIFFERENTIAL DIAGNOSIS

- ✓ Plagiocephaly
- ✓ Torticollis
- ✓ Scoliosis
- ✓ Spina bifida
- ✓ Hyperextended knee
- ✓ Legg calve-perthes dxs LCPD
- ✓ Calcaneovalgus
- ✓ Metatarsus Adductus
- ✓ Clubfoot
- ✓ Arthrogryposis
- ✓ Larsen syndrome

XI. DIAGNOSIS/SCREENING

PHYSICAL EXAMINATION

- ✓ For the examination of DDH in infant, the baby should be relaxed and examined in a warm, quiet environment with removal of the diaper.
- ✓ General inspection
- ✓ Assessment for asymmetry
- ✓ Testing for hip instability

XII. GELEAZZI/ ALLIS SIGN

- ✓ Unequal knee height is a positive test.
- ✓ Any asymmetry of the gluteal/thigh folds will be apparent.



Figure 14: Galeazzi/Allis sign

XIII. BARLOW'S MANEUVERS

Provocative test used to identify hip instability
The hip is flex to 90 degree and adducted and a gentle force is apply downward in an attempt to subluxate or dislocate an unstable hip.

A gliding sensation is felt if there's presence of hip instability.

The barlow's test should be repeated a number of times on each sides to ensure that it is performed in a relaxed infant.



- ✓ NB:
The barlow and ortolani maneuvers are effective for children <_3 months old because after the age of 3, soft- tissue contractures limit the motion of the hip.

Hence the detection of asymmetry is more important in older infants.

XIV. IMAGING

✓ HIP ULTRASOUND (ULTRASONOGRAPHY)

Infants <4months old.

Real time ultrasonography has been established as an accurate method for imaging of the hip during the first few months of life when the ossification centre of the femoral head is yet to appear (Pavel Kotlansky et al.,2015)

✓ HIP X-RAY

Imaging of choice in infants > 4months when the femoral ossification centre is visible

✓ CT- Scan is useful for assessment of quality reduction after closed/open reduction & fixation with spica cast.

XV. SURGICAL MANAGEMENT OF HIP DYSPLASIA

✓ The treatment of DDH is age- related and the goal is to achieve and maintain concentric reduction of the femoral head into the acetabulum.

The best outcome can be expected only if there's early diagnosis of the condition.

✓ The surgical interventions for children with DDH are:
6-18 months old; closed reduction followed by immobilization with a hip spica cast

>18 months or failure of closed reduction; Surgical Therapy- Open reduction possibly with a Pelvic/Femoral Osteotomy followed by immobilization with a spica cast.

Older adolescents or adults: THA

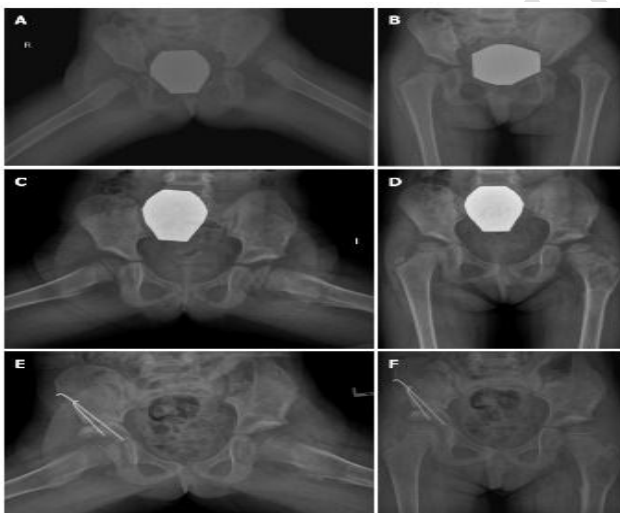


Figure 15: Xray of the hip

XVI. PHYSIOTHERAPY MANAGEMENT OF DDH IN CHILDREN

Assessment; proper history taking
.Patient's education

✓ PAVLIK HARNESS;

Effective for children < 6months old

Is a dynamic positioning device that allows the child to move freely within the confines of its restraints. Maintain the hips in 90-100 degree of flexion & 50 degree of abduction.

It consists of a circumferential chest trap with shoulder straps that provides sites of attachment for lower extremity straps.

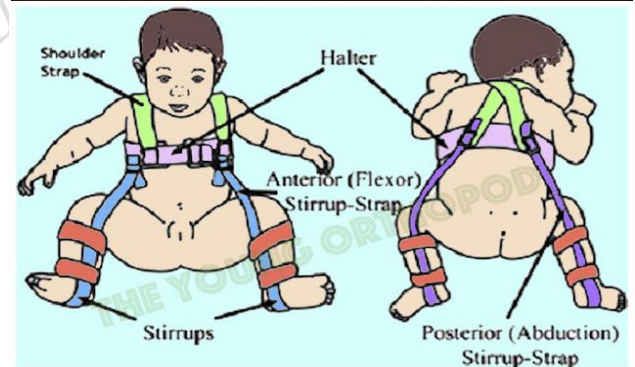
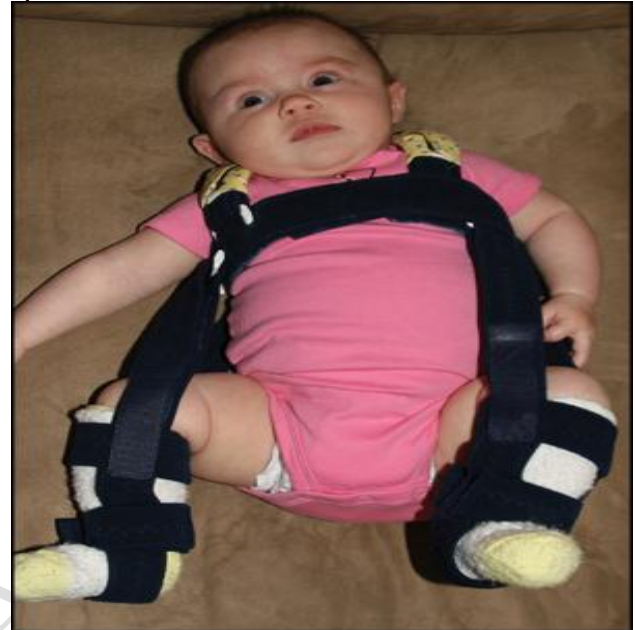


Figure 16: Pavlik harness

✓ The function of the anterior lower extremity strap is to flex the hips whereas the posterior lower extremity straps prevents adduction of the hips which is associated with avascular Necrosis.

XVII. INDICATIONS

✓ Presence of a reducible hip in an infant who is not yet making attempt to stand.

✓ The child's family must be able to follow instructions and be available for frequent evaluations and harness adjustments to prevent complications.

✓ NB;

✓ Positioning of the hips in flexion and limitation of adduction will permit stretching of the adductors with

gradual “docking” of the femoral head within the acetabulum.

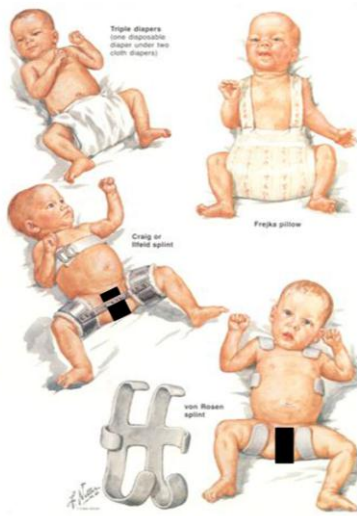
- ✓ Evaluation is done on a weekly basis and a radiograph or sonogram of the hips in the harness is obtained when there’s full range of motion.

XVIII. HIP ABDUCTION BRACES

- ✓ Usually worn after the pavlik harness i.e after 4-6weeks of introduction of the harness.
- ✓ The HAB keeps the hip in abduction and limit hip movement, thus help in realignment of the femoral head into the socket for normal development of hip joint.
- ✓ The HAB is usually worn for about 6-12 weeks.
- ✓ After the hips becomes stable, the brace is normally worn part time usually at night for another 4-6weeks.

Abduction Pillows and Braces

- Intuitive for parents to use
- Useful for hips that are reduced and stable in abduction
- Limited usefulness of ultrasound in the pillow or brace



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Figure 17: hip abduction brace

✓ TRACTION

Sometimes a few weeks of traction is used to stretch the ligaments before attempting a surgical treatment though it’s said to be controversial (IHDI, 2015)

✓ CONVENTIONAL THERAPY (FOLLOW-UP APPROACH)

- Strengthening & Range of motion exercises
- Gait training
- Exercise program for weight reduction

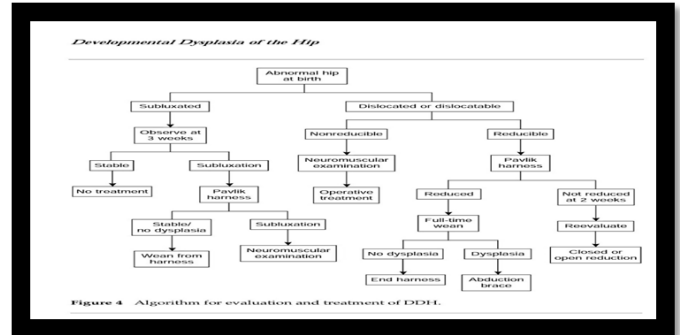


Table 1: Developmental dysplasia of the hip

XIX. LITERATURES

- ✓ Ramsey et al (1996) reported the results of treatment of 27 dislocated hips in 23 children who were less than 6 months old. The clinical and radiographic criteria for use of pavlik harness included the ability to direct the femoral head toward the triradiate cartilage. 24 dislocations were successfully reduced, and all were clinically and radiographically normal at follow up with no evidence of avascular necrosis.
- ✓ Kalamchi and MacFarlane (1998) also reported on 21 patients with hip dislocation and 101 patients with hip dysplasia who were treated at an average age of 5 months. Reduction with the use of pavlik harness was successful in 97% of patients with no cases of avascular necrosis. Five dislocated hips in 3 children required closed or open reduction for successful treatment of hip instability; concentric reduction was achieved in all cases. At an average follow-up of 5 years, all hips were clinically and radiographically normal.
- ✓ Harding et al 2007 reported on 47 children with 55 dislocated hips who were monitored with ultrasonography during the course of their treatment with the pavlik harness. Diagnosis and initiation of treatment before the age of 3 weeks increased the chance of a successful result; 63% of children treated with pavlik harness before the age of 3 weeks achieved reduction compared with 20% of children treated after the age of 3 weeks. If reduction was not obtained after 3 weeks of harness use, the harness was abandoned.

XX. CONCLUSION

Hip dysplasia threatens long-term function by increasing the chance of early degenerative disease, thus early diagnosis

& treatment of DDH is critical to provide the best possible functional outcome. The role of ultrasonography was established as the best imaging modality for screening and follow up of infants suspected for DDH up to the age when the proximal ossific nucleus appears. Successful treatment with splinting device requires careful counselling of parents. Surgical management requires careful pre-operative planning and adequate follow up to ensure the best clinical outcomes.

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