NEONATAL SCREENING OF DEVELOPMENTAL DYSPLASTIC OF HIP (DDH) IN BREECH DELIVERED BABIES

By

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Specially Dedicated To

My wife

Suziani binti Mohd Rani

&

My Children

Nur Fatin Husna
Muhammad Ishkandar
Nur Fatin Syazwani

For Their Patience, Love and Support

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ABSTRAK

Bahasa Melayu

Pendahuluan: *Developmental dysplasia of hip* (DDH) adalah satu penyakit yang dijumpai pada bayi dimana berlaku keabnormalan pada pertumbuhan tulang pinggul dan menyebabkan ia terkeluar dari sendinya. Data menunjukkan kadar penyakit ini dikesan pada bayi di Malaysia adalah rendah tetapi masih tiada lagi data yang dikeluarkan bagi bayi yang dilahirkan songsang. Pemeriksaan rutin Ortolani dan Barlow dilakukan pada semua bayi sebelum keluar dari wad postnatal oleh Pegawai Perubatan yang kurang berpengalaman. Diketahui kadar ketepatan kaedah ini bertambah dengan pengalaman Pegawai Perubatan tersebut.

Tujuan kajian ini dijalankan adalah untuk mendapatkan kadar insiden bayi dilahirkan songsang mempunyai penyakit DDH dan juga membandingkan keputusan pemeriksaan Ortolani dan Barlow antara kumpulan pegawai khusus(Dedicated examiner) dengan pegawai umum(Routine examiner).

Kaedah: Ini adalah satu *cross-sectional study* yang bermula pada Oktober 2005 sehingga Disember 2006 di Hospital Raja Perempuan Zainab II, Kota Bharu, Kelantan. dan di Hospital Universiti Sains Malaysia. Dalam julat masa yang ditentukan ini seramai 180 bayi kelahiran songsang telah diperiksa oleh pegawai khusus dan ia merangkumi 66.9% jumlah kelahiran bayi songsang di kedua-dua hospital. Antaranya tiga-puluh bayi telah dipilih untuk perbandingan antara pegawai khusus dengan pegawai umum berdasarkan pemeriksaan ultrasound sebagai rujukan asas (gold

standard). Pemilihan tersebut berdasarkan persetujuan ibubapa pesakit untuk menjalani pemeriksaan *ultrasound.*

Keputusan : Dari 180 subjek, seramai 6 bayi (3.3%), empat bayi perempuan dan dua bayi lelaki dikesan positif Ortolani dan Barlow. Kesemuanya dilahirkan secara pembedahan(LSCS). Daripada 30 subjek, pegawai khusus telah dapat mengesan sebanyak lima bayi positif Ortolani dan Barlow berbanding dengan pegawai umum yang tidak langsung berupaya mengesan bayi positif. Berdasarkan penyiasatan ultrasound pegawai khusus mendapat sensitiviti 0.67 dan spesefisiti 0.97.

Kesimpulan: Insiden Ortolani dan Barlow positif dikalangan bayi kelahiran songsang pada kadar 3.3% menunjukkan mereka memerlukan pemerhatian khusus. Pegawai yang ditugaskan khusus untuk melakukan pemeriksaan Ortolani dan Barlow akan dapat mengesan penyakit ini dengan lebih baik lagi.

ABSTRACT

Introduction: Developmental dysplasia of the hip (DDH) is a disorder that represents abnormal development or dislocation of the hip secondary to capsular laxity and mechanical factor. It was reported that incidence of DDH in life born babies was very low in Malaysia. However there is no reported study on breech babies in Malaysia. Neonatal screening using Ortolani and Barlow is known to have poor sensitivity which will become better with the experience of examiner. In the current practice, this test is done by medical officer as part of other neonatal screen. We conducted this study to determine the incidence of DDH in breech babies using Ortolani and Barlow test. We also compared the finding of examination result between dedicated examiner and routine examiner.

Method: This was a cross-sectional study, conducted from October 2005 to December 2006 at Hospital Raja Perempuan Zainab II, Kota Bharu, Kelantan and at Hospital Universiti Sains Malaysia. In the period of the study, 180 babies were examined by dedicated examiner and it is equivalent to 66.9 % of breech deliveries in both hospitals. Out of this, 30 babies were selected to be examined by routine examiner and dedicated examiner which later confirm with ultrasound examinations as the gold standard. The selection was made based on parents consent for ultrasound examination.

Result: Out of 180 breech babies, six babies (3.3 %) had positive Ortolani and Barlow test. All 6 babies were among 127 babies delivered through Lower Segment Caesarean Section. Four out of six babies were female and two are male. From 30 selected samples, dedicated examiner detected five babies with positive Ortolani and Barlow test. However routine examiner did not detect any positive Ortolani and Barlow test. Based on ultrasound as gold standard, the dedicated examiner has sensitivity of 0.67 and specificity of 0.97.

Conclusion: High incidence (3.3%) of positive Ortolani and Barlow test among breech babies supports the need for special attention to this population of patients. A dedicated hip screener for neonatal examination has the ability to detect DDH better than the routine examiner.

CHAPTER ONE

INTRODUCTION

1.0 INTRODUCTION

Developmental dysplasia of the hip (DDH) was previously called congenital dysplasia of the hip. This disorder represents abnormal development or dislocation of the hip secondary to capsular laxity and mechanical factor e.g., intrauterine positioning (Raymond M Stefko –Miller, 2000). DDH is also used to describe the condition where the femoral head has an abnormal relationship with the acetabulum (Homer et al., 2000). DDH is presently the preferred term since the acetabulum continues to develop postnatally. Furthermore, not all dysplasia present at birth. It is a dynamic condition that can occur prenatally and postnatally. The acronym DDH includes hips that are unstable, subluxated, dislocated (luxated) and/or have malformed acetabulum (Homer et al., 2000).

DDH is an evolving process, and the physical findings change on clinical examination. The clinical tests of Barlow and Ortolani are conventionally used as screening examination to detect DDH in the neonate. However it is known that this test has a low sensitivity (Burger, 1990). In our current practice, this test is conducted routinely as part of neonatal screening. Most of the time it is performed by junior members of the team. They do not have proper training. Study has shown that the more experience the examiner, the better chance for him to detect DDH through Ortolani and Barlow test(Burger, 1990). Thus, some author proposed dedicated hip screener for neonatal examination. Many authors proposed additional ultrasound as part of neonatal screening for DDH (Harck.H.T.1990). However, it is not cost effective in doing on all babies (Hensinger,R.N. 1995). Others proposed ultrasound on selected high risk babies

(Clarke, N.M.P., 1989). However, this is still not possible in some centers due to financial or availability of expert radiologist.

Thus we propose this study to see whether a dedicated examiner is needed for a better neonatal hip screening using Ortolani and Barlow test. It is known that the incidence of DDH is 8.6 to 25 in one thousand life birth and the incidence of DDH in breech babies is much higher,29 to 133 one thousand life birth (A.A.P.,2005). We took breech babies as sample of the study in order to meet the objective with achievable sample size. This opportunity was also taken to study the pattern of DDH occurring in breech babies in our population.

CHAPTER TWO

LITERATURE REVIEW

2.0 LITERATURE REVIEW

Keyword Defination

1. **Developmental dysplastic hip(DDH)** – previously called congenital dysplasia of the hip, this disorder represents abnormal development or dislocation of the hip secondary to capsular laxity and mechanical factor e.g. intrauterine positioning (Raymond M Stefko –Miller 2000)

2. **Ortolani's test-** adduction and depression of femur relocates a dislocated hip (Raymond M Stefko)

3. **Barlow' test** - adduction and depression of femur dislocates a dislocatable hip (Raymond M. Stefko).

4. **Galeazzi sign** –demonstrated by clinical appearance of foreshortening of the femur on the affected side. This test is performed with the hip held together and the knees flexed.

5. **Risk baby** –by American academy of Family Physicians –baby with breech presentation, first born, oligohydramnios, postnatally positioning of infant, positive family history and presence of other congenital abnormality eg metatarsus adductus.

6. **Breech delivery** – buttock presentation first during delivery (Obstetric,Ten Teachers).

7. **Dedicated Examiner** - the researcher (Dr Zakaria Yusoff).

8. **Routine Examiner** – the pediatric medical officer.

9. **Radiologist** – trained pediatric radiologist with experience in DDH ultrasound.

2.1 Terminology of DDH

Developmental dysplasia of the hip (DDH) has been recognized from the time of Hippocrates. It is a common condition which remains controversial and confusing despite diagnostic and treatment advances. The terminology can be unclear and inconsistent, diagnosis can be subtle and there can be long-term sequelae even in patients given optimal treatment. For example, despite DDH having been documented to occur in patients who did not have dysplasia at birth, there is still an erroneous belief that all cases of DDH are present at birth and, if diagnosed later, represent a ''missed'' diagnosis. The value of screening methods is still commonly debated. Thus it is unsurprising that DDH is commonly associated with malpractice suits, even though results of treatment are generally quite good.

DDH was formerly called `congenital dislocation of the hip` (CDH) as it used to be thought that infants were born with this problem. Though true in some instances, most infants developed hip dysplasia after birth (Teo, 2002).

In recent years various medical organisations have suggested this change in nomenclature to more accurately describe the pathogenesis of hip dysplasia. The term developmental dysplasia or dislocation of the hip (DDH) refers to the complete spectrum of abnormalities involving the growing hip, with varied expression from dysplasia to subluxation to dislocation of the hip joint. It indicates a dynamic condition, occurring prenatally or postnatally and is potentially capable of getting better or worse. Unlike the

traditional term congenital dysplasia or dislocation of the hip, DDH should thus be considered the more appropriate terminology (Takao Yamamuro, 2005).

The designation DDH has been officially endorsed by the American Academy of Orthopaedic Surgeons, the American Academy of Pediatrics, and the Pediatric Orthopaedic Society of North America because it is not restricted to congenital dislocation of the hip and includes developmental problems of the hip (Guidera KJ, 1990).

These changes helped to eliminate the blame placed on pediatricians/neonatologists who performed the initial neonatal hip examination of a child and later found to have DDH (Donaldson *et al.*, 1997)

The term dysplasia denotes an abnormality in development, such as an alteration in size, shape, or organization that leads to a shallow saucer-shaped acetabulum that is not congruent with the femoral head. It is difficult to assess dyslpasia of the baby femoral head before 4 month of age due to lack of radiological evidence until ultrasound appears. Dysplasia has an anatomic definition, which is inadequate development of the femoral head and/or acetabulum. The radiographic definition is determined by the presence or absence of an intact Shenton line. Radiographically, a patient with dysplasia has anatomic abnormalities of the femoral head and/or acetabulum (anatomic dysplasia) with an intact Shenton line, whereas a patient with subluxation has anatomic abnormalities of the femoral head and/or acetabulum (anatomic dysplasia) and a disrupted Shenton line.

The term dislocated hip indicates that the femoral head has been displaced from the confines of the acetabulum. A dislocated hip may be reducible or irreducible. A dislocatable hip is one in which the femoral head is located within the acetabulum but can be completely displaced from it by the gentle application of posteriorly directed forces to the hip positioned in adduction. When a similar maneuver is performed with resultant gliding of the femoral head, which remains within the confines of the acetabulum, the hip joint is unstable and is thus termed subluxatable.

There are two maneuvers for assessing hip stability in the newborn adopted for clinical screening purposes. They are the Ortolani and Barlow tests. The Ortolani elicits the sensation of the dislocated hip reducing, and the Barlow detects the unstable hip dislocating from the acetabulum. The Ortolani is performed with the newborn supine and the examiner's index and middle fingers placed along the greater trochanter with the thumb placed along the inner thigh. The hip is flexed to 90° but not more, and the leg is held in neutral rotation. The hip is gently abducted while lifting the leg anteriorly. With this maneuver, a "clunk" is felt as the dislocated femoral head reduces into the acetabulum. This is a positive Ortolani sign. The Barlow provocative test is performed with the newborn positioned supine and the hips flexed to 90°. The leg is then gently adducted while posteriorly directed pressure is placed on the knee. A palpable clunk or sensation of movement is felt as the femoral head exits the acetabulum posteriorly. This is a positive Barlow sign. The Ortolani and Barlow maneuvers are performed 1 hip at a time. Little force is required for the performance of either of these tests. The goal is not to prove that the hip can be dislocated. Forceful and repeated examinations can break the

seal between the labrum and the femoral head. These strongly positive signs of Ortolani and Barlow test are distinguished from a large array of soft or equivocal physical findings present during the newborn period. High-pitched clicks are commonly elicited with flexion and extension.

2.2 Natural history and Pathoanatomy of DDH

In the normal hip at birth, there is a tight fit between the femoral head and the acetabulum. The femoral head is held in the acetabulum by the surface tension created by the synovial fluid. In postmortem specimens, even after the capsule is sectioned, it is very difficult to dislocate a normal infant's hip. In DDH, this tight fit is lost and the femoral head can be made to glide in and out of the acetabulum with a palpable sensation, which feels almost as if the head is gliding in and out over a ridge; this is known as the Ortolani sign (Ponseti IV, 1978).

The typical dysplastic hip has a ridge in the superior-posterior and inferior aspectsof the acetabulum. This ridge, or neolimbus, as described by Ortolani is composed of very cellular hyaline cartilage (Ponseti IV, 1978). It is over this ridge that the femoral head glides in and out of the acetabulum, producing the palpable sensation known as the Ortolani sign. In most newborns with developmental hip dysplasia or dislocation, the labrum is everted. There is empiric evidence (such as the 95% success rate of devices like a Pavlik harness) that these pathological changes are reversible.

The majority of the abnormalities in developmental hip dysplasia or dislocation are on the acetabular side. Changes on the femoral side are secondary to anteversion and pressure changes on the head from the acetabulum or ilium associated with the subluxation or dislocation. With growth and development, however, acetabular growth is affected by the primary disease (abnormal acetabular cartilage either primary or

secondary to pressure changes from the femoral head and neck) and any growth alterations incurred from secondary acetabular procedures. Proximal femoral anatomic abnormalities are generally secondary to growth disturbances incurred from treatment. At birth, the pathological findings in developmental hip dysplasia or dislocation range from mild capsular laxity to severe dysplastic changes .(Ponseti IV. 1978)

Understanding the developmental nature of the DDH and subsequent spectrum of hip abnormalities requires knowledge of the normal growth and development of the hip joint (Arronson *et al.,* 1994). Embryologically, the femoral head and acetabulum developed from the same block of primitive mesenchymal cells. A cleft developed to separate them at 7-8 weeks` gestational period. By 11 weeks` of gestation, the hip development was complete (Homer *et al.,* 2000). The shape of acetabulum varied during gestational development and affected by genetic and hereditary factors (Donaldson *et al.*, 1997).

The femoral head grew disproportionately faster than the surrounding cartilage, so at birth the femoral head was less than 50% covered. Therefore, during late gestation and the first few months after birth, the femoral head had the least structural support from the acetabulum. The hip was at highest risk to subluxate or dislocate during this period (Donaldson *et al.,* 1997). Within a few weeks after birth, the acetabular cartilage developed more rapidly than the femoral head, resulting in progressive increased coverage. At birth, the femoral head and the acetabulum had a primarily cartilaginous rim (the labrum) that surrounded the bony acetabulum and caused the socket to deepen.

Development of the femoral head and acetabulum were intimately related, and normal adult hip joints depended on further growth of these structures. Hip dysplasia may occur in utero, perinatally, during infancy or childhood (Homer *et al.*, 2000).

There were four periods the hip was most at risk of dislocation:

1. The 12th gestational week
2. The 18th gestational week
3. The final 4 weeks of gestation, and
4. The postnatal period.

During the 12th gestational week, the hip is at risk as the fetal lower limb rotates medially. All elements of the hip joint will develop abnormally. The hip muscles development begins around the 18th gestational week. Neuromuscular problems at this time, such as myelodysplasia and arthrogryposis, will lead to teratologic dislocations. During the final 4 weeks of pregnancy, mechanical forces have a role. Conditions such as oligohydramnios or breech position predispose to DDH (Hinderaker *et al.*, 1994). Postnatally, infant positioning such as swaddling, combined with laxity of the ligament, also has a role (Homer *et al.*, 2000). Ligament laxity was related to hormonal as well as genetic factors. It caused abnormal motion between the femoral head and the acetabulum, causing deterioration of both the cartilaginous and osseous structures. The abnormal motion prevented normal ossification of the acetabulum and contributed to dysplasia (Donaldson *et al.*, 1997). DDH was more likely to occur in infants who have a sibling or parent with DDH (van Holsbeeck *et al.*, 2001).

Causative factors behind DDH have been disputed in the past. The pathophysiology remained very debatable and several concepts were propounded. For a better pathophysiologic understanding, Gomes *et al.* (1998) had carried out a study of the morphology and development of 22 prenatal and neonatal hips. At first, the acetabulum was cartilaginous and distorted by the moving femoral head; this acetabulum was histologically affected by the femoral pressure. The pathologic hip was characterized by defective posterior bony coverage of the femoral head by the acetabulum. The acetabulum was ossified during the 3 months following birth, forming a cup-like cavity under the pressure of the femoral head (Gomes *et al.,* 1998). It remains unclear whether the pathogenesis was primarily caused by dysplasia or whether dysplasia was secondary to abnormal joint laxity (Reikeras *et al.,* 2002).

2.3 The etiology of DDH

The etiology of DDH was complex and multifactorial, with factors affecting both acetabular morphology and hip stability. If a shallow cartilaginous acetabulum provided poor structural support to the femoral head, the head was allowed to move, and stretching of the ligamentous support was lax, excess motion will cause deterioration of the acetabulum and progress to dysplasia. These two mechanisms were closely related (Donaldson *et al.*, 1997). The factors involved in the etiology of DDH included the small intrauterine space of the primipara, breech presentation, oligohydramnios, congenital dislocation of the knee, congenital muscular torticollis, and metatarsus adductus (Henrikus *et al.*, 1999). Breech position occurred in about 3% of births, and DDH occurred more frequently in breech presentations, reported as many as 23%. The frank breech position of hip flexion and knee extension placed a newborn or infant at the highest risk.

Postnatally, infant positioning such as swaddling, combined with ligamentus laxity also has a role (Donaldson *et al.*, 1997 and Homer *et. al.*, 2000). In addition, in Native Americans, the postnatal practice of strapping a child's hip in extension contributed to DDH. Physiologic factors included ligament laxity in female infants. This laxity stemmed from the influence of the maternal hormones estrogen and relaxin and explained why DDH was six times commonner in females. A genetic influence on DDH was supported by studies of family history, siblings, and twins (Hennrikus *et al.*, 1999).

2.4 Natural History in Untreated Patients of DDH

The natural history of DDH in the newborn is quite variable. Neonates with acetabular dysplasia without instability may go on to have normal hips without treatment, but those with instability or frank dislocation often demonstrate progressive radiographic changes and loss of motion, followed by pain. In contrast, spontaneous resolution of dysplasia without intervention is unlikely in children over age 6 months. For a number of reasons, these children almost always require more aggressive treatment than younger children. This is related to the more extensive pathophysiologic changes in older children, as well as the decreased potential for acetabular remodeling with increasing age.

The natural history of untreated complete dislocations depends on two factors: bilaterality and the development or lack of development of a false acetabulum (Weinstein SL,1987). Patients with bilateral untreated high dislocation without a false acetabulum have a good range of motion and no pain. However, hyperlordosis and low-back pain develop over time. If the completely dislocated femoral head articulates with the ilium and the patient has a false acetabulum, secondary degenerative arthritis will develop in the false acetabulum. Whether a patient with an untreated unilateral complete dislocation has pain depends on the development or lack of development of a false acetabulum. Other associated problems include limb-length inequality, which can be major (up to 10 cm); ipsilateral valgus knee deformity with attenuation of the medial collateral ligament; degenerative changes in the lateral knee compartment; gait disturbance; and secondary scoliosis.

The natural history of hip subluxation is clear; degenerative joint disease will develop in all patients, usually in the third or fourth decade of life. The natural history of untreated dysplasia in adults is more difficult to predict because physical signs are usually absent and patients only present with dysplasia as an incidental finding on radiographs or if they have symptoms. There is, however, good evidence to support the fact that dysplasia, particularly in females, leads to degenerative joint disease in adults. (Cooperman DR, 1983)

The information that has been gleaned regarding the natural history of untreated dysplasia and subluxation in adults can be extrapolated to residuals of dysplasia and subluxation after treatment. In a thirty-one-year follow-up study of 152 hips treated with closed reduction, it was evident that the number of subluxations increased over time, as dysplastic hips went on to subluxation and degenerative joint disease developed.

The reason for degenerative changes in dysplastic hips is probably mechanical and is probably related to increased contact stress with time. There is a clear association between excessive contact stress and late degenerative joint diseases in other mechanical disorders (genu varum and genu valgum). In a recently published study, this same association between dysplastic hips and the development of degenerative joint disease was found at the time of long-term follow-up (Hadley NA,1990).

Persistence of hip dysplasia into adolescence and adulthood may result in abnormal gait, decreased abduction, decreased strength, and an increased rate of degenerative joint disease. Wedge and Wasylenko reported that the presence of an

abnormal acetabulum was associated with adverse clinical outcomes. Stulberg and Harris demonstrated that 50% of patients with idiopathic osteoarthritis had associated primary acetabular dysplasia, implicating dysplasia as a risk factor for the onset of osteoarthritis. In general, the natural history of adults with unilateral dislocations that have persisted since childhood is less favorable than that for those with bilateral dislocations; the former have the additional problems of limb-length inequality, asymmetrical motion and strength, gait disturbance, and knee disorders. Patients with chronic subluxation may experience symptoms earlier than those with true dislocation. Cooperman et al showed that degenerative joint disease developed early in subluxated hips but later in life in dysplastic hips without overt subluxation. Most authors agree that subluxation will lead to early degenerative disease, but that persistent isolated acetabular dysplasia has a less profound, yet equally predictable, effect on the development of symptoms.

2.5 Incidence and prevalence of DDH

A prospective screening by Ortholani and Barlow maneuvers over a period of two years showed that the prevalaence of DDH in Malaysia was 0.7 per 1000 birth (Boon NY,1989). It was low compare to 4.7 per 1000 birth in Singapore (Ang KC, 1997) ,5.6 per 1000 in Australia (Bower C,1987) and 3.5 per 1000 in Saudi Arabia (Mirdad .T, 2002).

The incidence of hip dislocation in unscreened populations is estimated to be one to two cases per 1,000 children of European origin (Asher MA, 1986). The abnormality is rare in black Africans (Aronsson DD, 1994).

It is more common in population that practice swaddling or use infant cradle boards(Kutlu A, 1992). The clinical tests (Ortolani and Barlow) are 100% specific, but have a sensitivity of only 60% at best (Jones D, 1998). Sensitivity further decreases if the primary screening personnel are inexperienced (Eastwood DM, 2003). Clinical screening programmes have been shown to decrease slightly the incidence of surgery for late DDH (Boeree NR, 1994 and Sochart DH, Paton RW, 1996). Wynne-Davies reported an increased risk with positive family history that was 6% for healthy parents and an affected child, 12% with affected parents, and 36% with an affected parent and one affected child. Apart from that, children with neonatal hip instability and a family history of DDH seemed to represent a subgroup with an increased failure risk of primary treatment and might need prolonged abduction treatment (Hansson *et al.,* 1983).

South Australian studies have previously confirmed breech presentation and female sex to be risk factors for DDH (Chan A, et al, 1997).

The true incidence of DDH can only be presumed. There is no `gold standard` for diagnosis during the newborn period. Physical examination, plain radiography, and ultrasounography all are fraught with false-positive and false-negative results. Arthrography and magnetic resonance imaging, although accurate for determining the precise hip anatomy, are inappropriate methods for screening the newborn and infant (Homer *et al.,* 2000).

The reported incidence of DDH ranges considerably (Reikeras *et al.,* 2002) and is very much influenced by genetic and racial factors, diagnostic criteria, the experience and training of the examiner, and the age of the child at the time of examination (Homer *et al.,* 2000).

Palmen in 1961 reported that 20 in 1000 newborns had unstable hips when stressed (Donaldson *et al.,* 1997). Barlow in 1962, found that 58% of neonatal instability spontaneously resolved by 7 days and 80% by 2 months (Donaldson *et al.,* 1997). Although the numbers vary, the prevalence of dislocation is approximately 1.3 in 1000, and that of dislocatable hips requiring treatment is about 1.2 in 1000 newborns in North America and Western Europe. Barlow and Dunn reported about 2% of newborns are found to have some degree of hip instability, but only 0.2% will probably progress to

dislocation if left untreated. Majority of these were detectable by the Ortolani and Barlow clinical examinations (Donaldson *et al.,* 1997).

Some newborn screening surveys suggested an incidence as high as 1 in 100 newborns with evidence of instability (Homer *et al.,* 2000). Bialik (1999) reported sonographic DDH incidence of 55.1 per 1000. However, follow-up of those cases had given the true incidence of 5 per 1000 hips. It was suggested their approach for better founded the definition of DDH and for an appropriate determination of its incidence.

The incidence was higher in girls. The left hip was involved 3 times as commonly as the right hip, perhaps related to the left occiput anterior positioning of most non-breech newborns. In this position, the left hip resided posteriorly against the mother`s spine, potentially limiting abduction (Homer *et al.,* 2000).

By carefully reviewing the literature on DDH (or CDH) and its incidence, we can discern three main phases

1. a period (approximately from the 1920s to the 1950s) when the incidence was arbitrarily estimated as 0% to 40% by various authors (0% for blacks; 0.06%–40% for whites);
2. a period (approximately from the 1950s to the 1980s) of clinical neonatal screening based mainly on the detection of unstable hips (0.041%–16.8%), while adding to the neonatal incidence the late-diagnosed DDH patients (an exercise that becomes even more complicated by the addition

of the incidence of hips with coxarthrosis arising from initially undiagnosed DDH).

3. a period (from the 1980s onward of screening of neonatal hips by using recently introduced sonographic(techniques, which resulted in an overall incidence of 4.4% to 51.8% (4.4% for blacks and 7.15% as the lowest incidence for whites).

Thus, clinical and sonographic neonatal screening, whether separately or in combination, seems to have introduced more confusion by eventually disclosing wide discrepancies between the clinical and sonographic findings (Viktor Bialik 2007).

2.6 Diagnosis

2.6.1 Clinical screening – Ortolani and Barlow test.

2.6.2 Ultrasound

2.6.3 Radiograph

2.6.4 Computed Tomography Scan

2.6.5 Magnetic Resonance Imaging

2.6.1 Clinical screening – Ortolani and Barlow

DDH is an evolving process, and its physical findings on clinical examination change (De Pellegrin *et al.,* 1991 Arronson *et al.,* 1994, and Stoffelen *et al.,* 1995). The newborn must be relaxed, warm, and comfortable, with diaper removed and preferably examined on a firm surfaced. A crying child will contract hip and leg muscles, which may disguise hip instability (Hennrikus *et al.,* 1999).

The Barlow test has been associated with a high negative predictive value (0.99) but a low positive predictive value (0.22).(Burger BJ:1990). When the Ortolani and Barlow tests are combined, they show high specificity (0.98–0.99) in the diagnosis of hip dislocation or subluxation. Sensitivity varies by the skill of the examiner and by the number of examinations performed. With experienced examiners, sensitivity is between 0.87 and 0.99 (Burger BJ, 1990). The Ortolani and Barlow tests become less sensitive

in older infants, in part because of the larger size and muscle bulk and the development of hip contractures. (Weinstein, 1987)

Patience and skills are required. There were no pathognomonic signs for a dislocated hip. The examiner must look for asymmetry. Indeed, bilateral dislocations are more difficult to diagnose than unilateral dislocation as symmetry is retained. Asymmetry of thigh or gluteal folds is better observed when the child is prone. Apparent limb length discrepancy, restricted motion especially abduction are significant, but not pathognomonic signs. With the infant supine and the pelvis stabilized, abduction to 75 degrees and adduction to 30 degrees should occur readily under normal circumstances (Homer *et al.,* 2000). Other features that will arouse suspicion include asymmetry of the thigh folds, a positive Allis or Galeazzi sign (relative shortness of the femur with the hips and knees flexed), and leg length discrepancy.

From birth to approximately 2 months of age, the Barlow test and Ortolani sign (Hennrikus, 1999) are helpful in diagnosing hip instability. These tests were first described by Le Damany in 1908 (Clegg *et al.,* 1999). Both tests are no longer positive by 8 to 12 weeks of life due to decreased capsule laxity and increase muscles tightness.

The Ortolani (relocation) maneuver attempts to relocate a dislocated hip that rests posterior to the acetabulum. Again, one hip is held at 90 degree of flexion and in abduction to stabilize the pelvis. The hip to be examined is flexed to 90 degree and the examiner`s long finger is placed posteriorly on the greater trochanter while moving the

hip into abduction. If a palpable `clunk` (not `click`) is felt, the result of the Ortolani manoeuvre is positive and the dislocated hip has been returned to the acetabulum (Hennrikus, 1999).

The Barlow (dislocation) test is provocative, and attempts to dislocate unstable hip. Both of the patient's hips are flexed to 90 degree and abducted. While one hip is kept in the abducted position to stabilize the pelvis, the other hip is gently adducted and pushed posteriorly. The unstable hip will be felt to dislocated or `clunk` (not `click`) as the hip moves out of the acetabulum. A positive result on the Barlow test identifies a dislocated hip (Hennrikus, 1999). These manoeuvres are performed one hip at a time (figure 2.1).

The goal is not to prove that the hip can be dislocated. Forceful and repeated examinations can break the seal between the labrum and the femoral head. These strongly positive signs of Ortolani and Barlow are distinguished from a large array of soft or equivocal physical findings present during the newborn period. High-pitched clicks are commonly elicited with flexion and extension . A dislocatable hip has a rather distinctive clunk, whereas a subluxable hip is characterized by a feeling of looseness, a sliding movement, but without the true Ortolani and Barlow clunks. Separating true dislocations (clunks) from a feeling of instability and from benign adventitial sounds (clicks) takes practice and expertise.

In Clinical Practice Guidelines by American Academy of Pediatrics, the decision that positive examination for Barlow and Ortolani will produce `clunk` sound of dislocation or reduction (Homer *et al.,* 2000). `Click` findings are related to soft tissue clicking from the ligamentum teres, iliopsoas tendon, labrum, or tensor fascia (Hennrikus, 1999). Both Ortolani and Barlow tests are legal requirement in every UK newborn baby (Eastwood, 2003). The specificity is high, essentially 100%, but the sensitivity is low with false-positive results leading to over-treatment and false negative results associated with a high late presentation rate. Sensitivity is improved significantly with the use of experience examiners (paediatricians, orthopaedic surgeons or physiotherapists) but it is not a legal requirement that the tests are performed by such people; nor in these days of clinical governance is necessary that the examiner has been trained to do them (Eastwood, 2003).

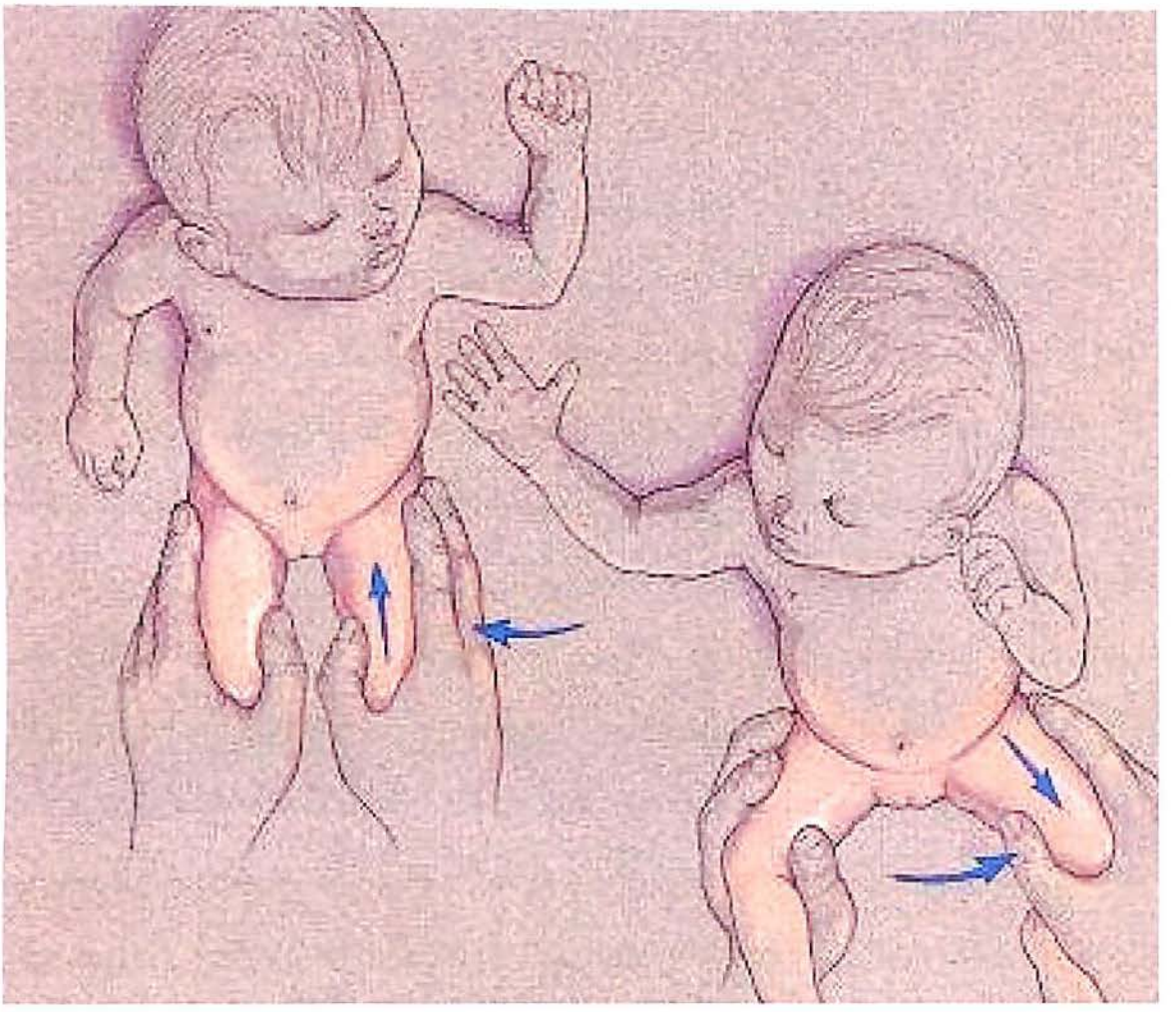

Figure 2.1: Maneuvers used during the physical examination assess the hips for dysplasia. (Right) Ortolani maneuver. (Left)Barlow maneuver. Adopted from American Family Physican, 1999.