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METHODICAL INSTRUCTION OF PRACTICAL EMPLOYMENT ON A THEME: DEVELOPMENTAL DYSPLASIA OF THE HIP (DDH). CONGENITAL DISLOCATION OF THE HIP (CDH).

Actually of theme: The term congenital dislocation of the hip dates back to the time of Hippocrates. This condition has been diagnosed and treated for several hundred years. 1 in 100 newborn infants have clinically unstable hips (subluxatable – the ball of the hip is able to be moved around loosely in the hip joint joint – or dislocatable – the ball of the hip is able to be actually slid in and out of joint with a "clunk" that can be felt), whereas only 1 in 800 to 1,000 of newborn infants eventually experience a true dislocation whereby the ball of the hip lies outside the socket. The etiology is not clear, but hip dysplasia does appear to be related to a number of different factors. Multifactorial inheritance means that many factors are involved in causing a birth defect. Certain geographic, ethnic, and cultural factors have been associated with increased rates of DDH. Among Native Americans and Laplanders, the prevalence of hip dysplasia is much higher (nearly 25-50 cases per 1000 persons), and the prevalence is very low among southern Chinese and African American populations. Congenital hip dislocation is more frequently encountered in Caucasians than in Negroes. CHD is very common in Mediterranean and Scandinavian countries but is almost unknown in China, possibly due to the Chinese custom of carrying the infant on the mother's back with the child's hips flexed and abducted. If DDH is diagnosed early, simple and effective noninvasive treatment options usually result in excellent long-term anatomic and functional outcomes.

A patient with residual dysplasia who is older than 1 years should be treated with operatively procedure. Less invasive surgical techniques (eg, endoscopic techniques, image-guided surgery) are currently being developed in an effort to decrease the morbidity of surgery and to ease recovery. Pelvic and hip osteotomy may be needed for residual hip dysplasia. Children with hip dysplasia who are diagnosed in adolescence and undergo surgical treatment fare somewhat better but often require secondary procedures as adults for painful arthritis (to lead to early osteoarthrosis).

General purpose: to be able to work independently clinically and roentgenologically to expose developmental dysplasia of hip joint and congenital dislocation of the hip in new-born (to 6 months), in toddler 6-12 months, children, older than 1 year and juvenile and young adults to appoint medical treatment depending on age and degree of non development of hip joint.

The educational purposes

A=1 (The first level of mastering)

To familiarize with a clinical and radiological features developmental dysplasia of the hip, congenital dislocation of the hip. To know about principles of modern diagnostics, treatment and preventive abnormal development of the hip joints.

A=2 (The second level of mastering)

To know clinical and radiological features developmental dysplasia of the hip, congenital dislocation of the hip. Know the normal growth of the hip, theories of etiology of congenital disease, Pathophysiology, complication of abnormal development of the hip joint. To master methods of conservative treatment in new-born (to 6 months), in toddler 6-12 months, children, older than 1 year, know and be able to use Pavlik harness (dynamic flexion abduction orthoses), to define indications and ways of surgical treatment of these diseases.

A=3 (The third level of mastering)

To be able to carry out the differential diagnosis developmental dysplasia of the hip, congenital dislocation of the hip and abnormal hip (disease) can also occur with other conditions. To know clinical differential signs. To be able to interprete roentgenograms in various age groups in DDH, the measurement used to evaluate the relationship of the femoral head and acetabulum include Hilgenreiner, Perkin circuit. Capable of ultrasound evaluation abnormal development of the hip joints in new-born. To choose tactics treatment which depending on age and degree of non development of hip joint.

To be able to make to reduce the dislocation of the femoral head by means of a flexion/abduction maneuver and used Pavlik harness for fixation.

To define indications to used others abduction bracing (devices) after four-month-old child and principle of overhead traction and surgical treatment of disease in various age groups.

A=4 (The fourth level of mastering)

On the basis of a clinical material and use of sources of the basic and additional literature to know pathological change are observed in DDH, CDH and the severity varies according to the stages of the disease. To know substantiation of clinical signs of DDH and CDH in infants, childhood and adolescents, the radiographic or ultrasonographic features abnormal growth of the hip. To know treatment regimen, performing monitoring treatment in various age groups in DDH. Causes of early and long-term complications of disease. To know complications of wrong diagnostics and treatment. To know the method of their prophylaxis and medical treatment.

Interdisciplinary integration:

Subject (discipline)	To know	To be able
Preliminary (normal anatomy, operative anatomy, topographical anatomy, histology, clinical biochemistry, patophysiology radiology, neurology).	1) Anatomical constitution of the hip regions in infants, childhood and adolescents, the secondary centre of ossification around the pelvis and proximal femur. 2) Periods of normal development of the hip. What causes developmental dysplasia of the hip (DDH)?. Position of the baby in the uterus, breech presentations. Embryologic, natal, and postnatal factors. 3) Structures of the hip joints, a place an attachment ligaments, their role in stabilization of a joint. 4) Muscles, their function and a role in dislocation of the hip. Muscle forces acting across the shaft of femur. 5) Anatomy-topographical features of region around the hip joints. A substantiation rational operative procedures (access). 6) Features of blood, nerves supply. (Vascular anatomy of femoral head) 7) Reparative regeneration of bony soft tissues around the hip joints. 8) Skin folds in the thighs	To defined radiographic or features abnormal growth of the hip and dislocation of the hip on the basis of radiological data. Roentgenologic anatomy of bones pelvis and proximal femur. Sonogram of normal hip at three. Pathophysiology abnormal growth of the hip. Diagnostic imaging technique of ultrasound. Access to vessels and nerves of proximal femur. Results of laboratory investigations
The following (which provided)	1) Terms immobilization in various age groups so that the hip can develop normally. 2) Preventive of possible complications of closed reductions and immobilization in the hip spica cast and ways of their prevention	To defined symptoms dysplasia and dislocation of the hip. To know rules of application of POP casts
Intrasubject integration (themes of the given discipline with which it is integrated).	1) Indication and methods of conservative medical treatment, immobilization. 2) Indication and choice of methods surgical treatment	1) To measure of active and passive motions in the hip joints. 2) To measure of the lengths of lower limbs, cause of changes. 3) To carry out medical immobilization hip spica cast. 4) To know rules of application of Pavlik harness, Gnevkovsky abduction bracing (device).

The plan and organizational structure of employment.

Basic stages of employment and their functions	Educational purposes in levels of mastering (memorizing)	Quality monitoring and training	Materials of methodical support (maintenance)	Hour, minute
1. Preparatory stage				
1. Organization of employment 2. Definition of the educational purposes and motivation 3. The control of an initial level of knowledge, skills	The teaching and educational purposes of employment before group of students are established	Opening speech of the teacher The written control, express-questioning.	Methodical instruction Test tasks	2-3 3-5 10
2. Basic stage				
4. Forming of professional abilities and skills. To seize knowledge of diagnostic algorithm of DDH in various age groups. To receive skill of conducting of orthopaedic inspection of infants, childhood and adolescents with DDH and CDH. Clinical: symptoms dysplasia and dislocation of the hip. To know indications and ways of conservative and operative treatment of these diseases, complication: a) To pay attention to the theories of etiology of congenital diseases. Pathophysiology of abnormal development of the hip joint. To define change of tissues of hip, legs at survey and palpation. b) To be able to measure relative and anatomic length of a segment c) To be able to interpret roentgenograms of the hip joint in infants, childhood and adolescents. The relation between the three bony points of pelvis. Neck-shaft of femur angle. d) Formations of the diagnosis. e) Treatment: substantiation of methods of treatment, the indication and ways of surgical treatment, principles of rehabilitation.		Inspection of patients (infants, childhood and adolescents), theoretical interviews. Studying of roentgenograms in an educational room. Discussion	Thematical patients, reference cards. Roentgenograms, tables, pictures, structural-logical charts, video materials. Educational rooms, structural departments, clinics.	30 20 30
3. Final stage				
5. For examination on an investigated theme it is recommended to solve situational tasks		Thematic situational tasks, independent work, discussion.	Educational room	20
6. Summarizing (theoretical, practical, organizational estimation)		Individual analysis of control practical skills.	Educational room Results of inspection reports, protocols, reference card for independent work with literature	10
7. Task home work		Concluding remarks of the teacher	Recommended literature	

1) Materials of the control over maintenance of a preparatory stage of employment

Questions, task, tests etc.

A=1

1. The hip region.
2. Structure of the hip joint.
3. Muscles around hip joint: function.

A=2

1. Place an attachment ligaments, muscles their anatomic and functional role._Muscle forces acting on the proximal femur.
2. Normal development of the hip. Vascular anatomy of femoral head .
3. Structures of the hip joint.

A=3

1. The hip in various age groups. Normal development of the hip in various natally periods. Muscles around of the hip joint, which depending on character of dislocation of the hip
2. Functional features structures around femoral head and their role in maintenance of function of the joints.
3. Structure. Anatomy-topographical features proximal femur. Neck – shaft of femur angle, projects to the coronal plane their value in maintenance of function of a tendons.

A=4

1. Normal development of the hip in various natally periods.
2. To measure of active and passive motions in the hip joint, of the lengths of lower limbs
3. Materials of maintenance of self-preparation of students.
4. Control questions. The written control (levels of mastering of a material).

A=1

Specific terms are used to better describe the conditions.
Etiology
Clinical inspection
Principle of treatment

A=2

Theories of etiology, pathophysiology.
Clinical features of DDH and CDH.
Radiographic features of congenital diseases.
Medical treatment of patients in various age groups. (conservative and operatively).

A=3

To carry out differential diagnostics DDH and CDH. To proved tactics of treatment patients in various age groups.
To carry out differential diagnostics DDH with other conditions, such as septic arthritis, traumatic hemarthrosis, and congenital coxa vara, Perthes disease, cerebral palsy, slipped capital epiphysis, disorders such as Ehlers-Danlos syndrome.
To proved tactics of conservative treatment DDH and CDH in depending on degree of non development of hip joint. Indications to overhead traction and operative treatment, their principles. Terms and principle of overhead traction, position and then immobilization extremity.

A=4

Techniques and methods of to reduce the dislocation of the femoral head by means of a flexion/abduction maneuver and used fixation and preventive of possible complications.
Anatomical predisposition aseptic necrosis of the femoral head, redislocation after closed reduction when the child is older than 8 months. Preventive of possible complications and ways of their prevention. Radiology and ultrasonographic monitoring treatment, CT scan.

2) Materials of the control over maintenance basic stage of employment.

Roentgenograms
Thematical patients
Measuring tape
Skin marking pencil
Goniometer

3) Materials of the control over maintenance final stage of employment.

Situational tests and tasks, roentgenograms.

Task 1.

1. To define the signs of dysplasia of hip joint at new-born.
2. To define clinically congenital dislocation of hip in new-born.
3. To appoint complex valuable medical treatment to the sick child with dysplasia and hip dislocation upto three years of age.
4. To interpret the roentgenograms of hip joints of children of three years old and at children older than 1 year.
5. To appoint orthopaedic medical treatment to the patient with hip dislocation from 1 month to 6 months, from 6 to 12 months.

6. To diagnose clinically hip dislocation in children older than 1 year.
7. What age children (roentgenogram) diagnostics is conducted in (sketch a chart Hilgenreynera from a textbook)?
8. In what age in norm the ossification of femoral head appears on roentgenogram?
9. What roentgenologic triad of HDH?
10. What size corner inclination roof (acetabular index (α)) of acetabulum in norm?
11. What id the size of neck-shaft angle of the femur in norm?
12. What medical treatment should conduct to the child with dysplasia of hip joints at diagnostics in a 3-4 month of age?
13. What orthopaedic medical treatment is appointed to the children with hip dislocation of children from 6 months, how to control efficiency of medical treatment?
14. What signs of congenital dislocation of hip at the children of 3-8 yrs age.
    a) from anamnesis
    b) character of step or claudication in unilateral or bilateral dislocation of hip
    c) at inspection from front, from sides, behind
    d) at palpation of hip joints and surrounding tissues appearances
    e) at measuring of length of lower extremity
    f) at measuring of volume of movement in joints.
15. To appoint orthopaedic medical treatment to the patient with hip dislocation in 1 to 2-3 years.
16. To appoint testimonies and principles of surgical medical treatment of hip dislocation.
17. To conduct differential diagnosis with similar diseases.
18. What types of shortening of low extremity arise up at congenital dislocation of hip and as to define them?
19. Why in congenital dislocation of hip the volume of rotatory movement in a hip joint is multiplied?
20. What causes the symptom Trendelenbourga?
21. What modern method of medical treatment can be applied at late (in 8 months -3 years) diagnostics of congenital dislocation of hip and his advantage on comparison with a method Lorentsa?
22. What testimonies to surgical medical treatment of congenital dislocation of hip:
    a) age
    b) noneffectiveness of conservative medical treatment
    c) late diagnostics
    d) anatomic features.
23. What principles of surgical, medical treatment of hip dislocation:
    a) reconstruction of acetabulum
    b) reconstructions of proximal department of femoral.
24. What complications are observed during conservative and surgical (except for septic) medical treatment of hip dislocation in childrens?
25. What the difference of traumatic dislocation of hip from congenital?
26. What the difference of paralytic dislocation of hip from congenital?
27. Why during varus deformation of neck of femur (coax vara) top of large tubercle is higher from the line Rozer-Nelatona?
29. How clinically and rentgenologically distinguish the patologic dislocation hip (septic arthritis) from congenital dislocation of hip?

Task 2.

Investigation.

1. To capture the clinical and roentgenological facilities of inspection of children with dysplasia and congenital dislocation of hip (general clinical and orthopaedic).
2. To conduct differential diagnostics with similar diseases of locomotor apparatus.
3. Taking into account age, roentgenologic and ultrasonographic pictures, to draw up a plan of medical treatment of disease.

Execution sequence:

1. During collection of anamnesis to pay attention to heredity, beginning of walking of child, feature of step, posture, subsequent diagnostic and medical measures.
2. Review the position on bed, step. Character of hip gait disordes, claudication, distortion of pelvis (pelvic tilt), visible shortening and positions of foot, level of patella, atrophy of soft tissue, appearance of large tubercle of femur. Examination in standing position: from one side: exposure of lumbar lordosis. Behind: atrophy of gluteal musculature, skin fold test of thigh. Thigh-to know the girth of the limb.
3. Palpation: The level of anterior superior iliac spine locate the projection of apex of large tubercle to linea Rozera-Nelatona, determination of symptom Galeazzi or Allen's sing. the state of soft tissues (color, gypotrophy, trophic violations)
4. Measuring of relative length of lower extremity and its shortening, anatomic length and shortening and functional shortening (Block test). Thigh and leg length. Trendelenburg test
5. It is measured to the volume of motions in a hip joint joint (flexion and extension, adduction and abduction, internal and external rotation) and correlation of them with normal parameters.
6. Interpretation of roengenograms, MRI , sonograms.

7. Differential diagnostics and guess (tentative), provisional, final diagnosis.
8. Planning of medical treatment.

Show the clinical and rentgenological data, diagnosis, method of medical treatment to the teacher and participation in the discussion of theme of practical work in a group.

Task 3.

For verification of capturing you material from a theme decide such situation tasks:

The contents of employment.

Developmental dysplasia of the hip – abnormal development of the hip joint.

Developmental dysplasia of the hip (DDH) is an abnormal relationship between the femoral head and acetabulum, but the two are in contact.

DEFINITION Developmental dysplasia of hip is defined as partial displacement of the femoral head from the acetabular cavity since birth.

Frequency: 1 case per 100 individuals.

Congenital dislocation of the hip, on the other hand, is associated with a complete loss of contact of the femoral head with the acetabular cartilage.

Frequency: 1 – 1,5 case per 1000 individuals

There is no contact between the articular surface of the femoral head and the acetabulum. Abnormal anatomic relationship between the femoral head and the acetabulum results in the absence of stimulus for normal development of these structures.

Risk factors: (4 F's)

- **F**emales
- **F**irst borns
- **F**amilial
- **F**aulty intrauterine position (e.g. breech)

Theories of Aetiology

1. Genetic theory. Dysplastic trait is found in families.
2. Hormonal theory. Hormone induced joint laxity.
3. Mechanical theory. Faulty intrauterine positions particularly in the first born. Primary acetabular dysplasia.

Hormonal theory – as the child's response to the maternal hormones (children have ligamentous laxity – looseness of the fibrous bands connecting bones together in joints). Maternal hormones associated with pelvic relaxation around the time of birth also aggravate the instability of the newborn hip joint by allowing softening and stretching of the baby's hip ligaments (the effects of additional estrogen produced).

Mechanical theory Infants in the frank breech position, characterized by prominent adduction of the hips and hyperextension of the knees, are at the highest risk. The breech position has been associated with a constellation of minor abnormalities (eg, frontal bossing, a prominent occiput, upwardly slanting low-set ears) known as the breech deformation complex.

Genetic theory appears to exist in that a 8-10-fold increase in the frequency of hip dysplasia occurs in children whose parents had DDH compared with those whose parents did not. The specific chance for it to happen in a second baby who is male is less than if the second baby is female.).

Remember

The incidences in DDH

- **1 per 1000 live birth.**
- **Left hip affected in 67% of cases.**
- **Family history present in 20%.**
- **Incidence of breech 30 to 50%.**
- **1:3 cases are bilateral.**
- **Female preponderance.**

Pathology

The following pathological change* are observed in DDH (fig.) and the severity varies according to the stages of the disease.

The normal growth of the acetabulum depends on normal epiphyseal growth of the triradiate cartilage and on the 3 ossification centers located within the acetabular portion of the pubis (os acetabulum), ilium (acetabular epiphysis), and ischium. Additionally, normal growth of the acetabulum depends on normal interstitial appositional growth within the acetabulum. The presence of the spherical femoral head within the acetabulum is critical for stimulating normal development of the acetabulum.

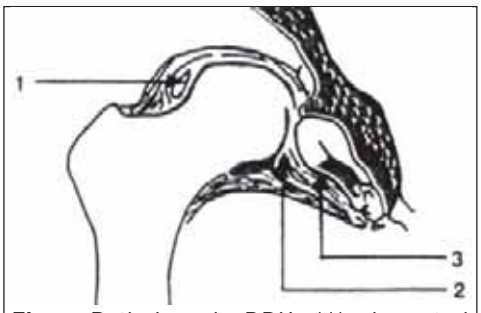


Fig. : Pathology in DDH: (1) elongated capsule, (2) stretched ligamentum teres (3) fibrofatty tissue within the acetabulum

Bone

Acetabulum There could be a primary acetabular dysplasia and the acetabulum is shallow. There could be a gap or groove at posterosuperior aspect. The triangular outer surface of ilium and acetabulum are

in the same line. Above the acetabulum there is a depression containing the head of the femur.

Head of femur The dislocated head of femur at first appears normal, ossification is delayed, later head is flat on its posterior and medial aspect. Femoral head when present in the ilium is buffer or conical shaped.

Neck of femur There could be shortening and anteversion.

Pelvis The pelvis is usually tilted forwards, it is small and atrophied. There is lordosis and it may be more vertical than normal.

Capsule The capsule could show hourglass constriction, one containing head and the other containing the acetabulum. Constriction is produced by iliopsoas and the ligamentum teres passes through this constriction and it is hypertrophied.

Muscles

Pelvifemoral group Adductors, sartorius, gracilis, rectus femoris, hamstrings, tensor fascia lata muscles. These muscles are shortened and they prevent reduction of the head.

Pertrochanteric group (obtumtors, quadratus femoris, Iliopsoas) These are elongated and the psoas forms an obstacle to reduction.

Gluteal muscles show little organic change but power is diminished.

Remember

Conditions due to packaging problems (i.e decreased intrauterine space)

DDH
Torticollis
Metatarsus adductus
Increased type III collagen

Stages of DDH (3 D's)

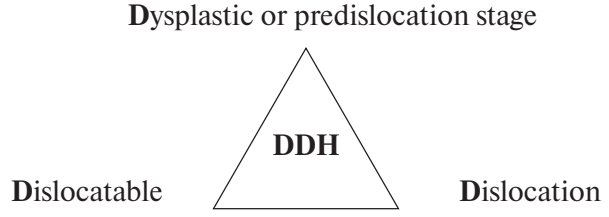


Fig. : Stages of developmental dysplasia of hip: (1) dysplastic stage, (2) dislocatable or subluxation stage, and (3) dislocation stage.

Dysplasia has two common usages in this disorder. In young infants, it is used both to signify an unstable hip and to refer to the radiographic or ultrasonographic features of poor acetabular development. A broader definition is simply abnormal growth of the hip.

Malformation of the hip socket, twisting of the thigh bone (femoral anteversion), and hip muscle shortening (contractures) will develop. Socket is too shallow, more like a saucer than the deep cup that it should be. Head does not sit securely into the acetabulum, to either partly slip out of the socket.

In older children and adults, the term is used only to describe radiographic abnormalities of the femoral head or the acetabulum. Dysplasia is defined as abnormal growth or development of the hip.

Clinical signs developmental dysplasia of the hip:

1) asymmetry of the gluteal thigh or labral skin folds
2) decreased abduction on the affected side
3) hypotrophy affected gluteal side

Clinical features congenital dislocation of the hip

Table

Clinical features of CDH in various age groups at glance

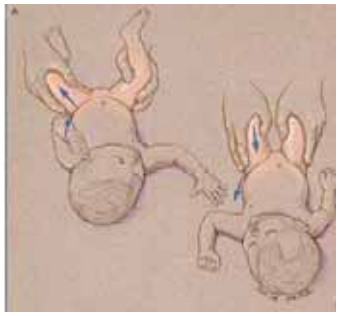
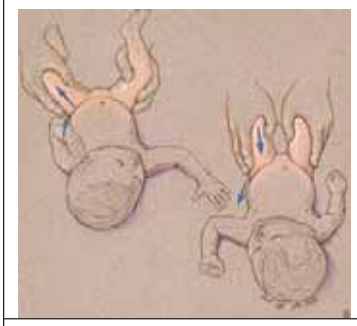
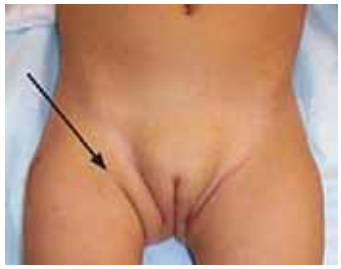
Infants	Childhood and adolescents	Adults
▪ Look for other anomalies. ▪ If hip is dislocated all signs of dislocations present ▪ Thigh and gluteal folds was asymmetric. ▪ Perineum widened. ▪ Abduction decreased by 50%. ▪ internal rotation increased. **Tests** 1. Galeazzi is sign positive. 2. Ortoteni's sign of entry is positive 3. Bartow's provocative test is positive (2,3 indicate reducible dislocation) 4. Delayed walking	1. Gait Waddling/ sailors 2. Lordosis 3. Deformity **Unilateral** shortening of leg **Bilateral** leg shortening with perineum wide, buttocks broad and flat 4. Palpation vascular sign of Narath is positive 5. Movements Abduction and lateral rotation are decreased 6. Telescopy is positive 7. Measurements Supratrochanteric shortening is present	▪ All the signs seen in adolescents ▪ Pain in the hip ▪ AH the features of osteoarthritis hip

Figure. A three-year-old with a left hip dislocation. Note the limited abduction.

The clinical features vary in infants, children and adults.

In infants First a thorough clinical examination is carried out to detect the presence of any other congenital anomalies. If the hip is dislocated, all features of dislocation are present. The gluteal and thigh folds are not symmetrical. The perineum is widened and abduction of the hip is decreased by 50% while the internal rotation movement is increased. Radiographic examination in infants is of little value, but Von Rosen's line (see Fig.) is helpful in making an early radiological diagnosis in this age group.

Table 20.4: Clinical tests in CDH

'Clinical	How to perform?	Inference
Bartow's test[1] 	This test is done within 2 to 3 days of birth. The Infant is supine with the knees fully flexed and the hip at 90° of flexion. The hip is slowly abducted to 45° and the head is slowly pushed towards the acetabulum by the fingers.	This test is positive when the joint is dislocated and the femoral head returns to the acetabulum with a click or jerk. Reliable and useful upto 6 months after which the greater trochanter cannot be held with tip of the middle finger.
Ortolanis test[2] 	This test is done between 3 to 9 months the infant is supine, with the hip and knee flexed. The hip is slowly adducted and abducted to detect any reduction of the femoral head into the acetabulum.	This test indicates the reduction of the dislocated hip. These two tests are generally reliable and should be performed as a screening tests in all cases of suspected CDH. They are misleading if abduction is restricted due to adduction contractures.
Galeazzi or Allen's sing 	The child is in supine position with both the hip and the knee in flexion. The level of both the knee joints are noted with reference to a horizontal line.	Normally both the knee should be at the same level. In OOH the affected knee is seen beneath the horizontal line indicating femoral shortening. The shortening is in the supratrochanteric region and can be assessed by the Bryant's triangle.
Skin fold test of thigh 	The child is completely stripped and in the vertical position the levels of the thigh folds studied.	Normally, the thigh folds are symmetrical in nature. In DDH they are no longer symmetrical due to the shortening of the affected limb.
Skin fold test of gluteal region 	The procedure is similar to the one performed above, but here the levels of the gluteal folds are noted.	Normally, the thigh folds are symmetrical in nature. In CDH they are no longer symmetrical due to the shortening of the affected limb.

[1] Thomas Geoffrey Barlow (1915-1975), Orthopaedic Surgeon.
[2] Ortolani Man us (1937), Orthopaedic Surgeon, Italy, England.

Children and adolescents
Here the patient shows a waddling or sailor's gait. There is an increased lumbar lordosis. The deformity frequently encountered in unilateral cases is shortening. In bilateral cases both the lower limbs are short, perineum is wide, buttocks are broad and flat. Femoral artery is prominently felt. Abduction and lateral rotation movements of the hip are decreased. Telescopy and Trendelenburg tests are positive. Clinical tests of importance in infants are not of relevance in this age group.

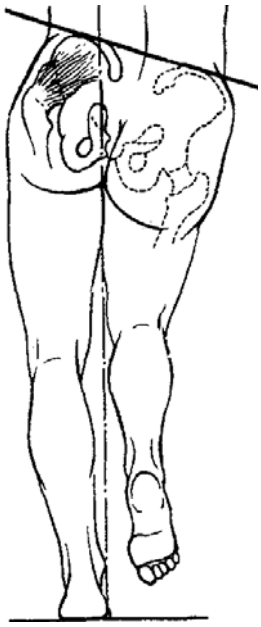


Fig. : **Trendelenburg test** (Trcndelengburg Frederick (Berlin). Professor of Surgery of Rostook, Bonn, Liepzig. He first described CDH in 1895)

When standing on the normal limb, the opposite hip is in a higher position, but when the patient or the child stands on the affected limb, the opposite pelvis drops indicating impairment of abductor mechanism due to OOH. This test cannot be performed in infants.

Trendelenburg's test – drop of normal hip when child, standing on both feet, elevates unaffected limb and bears weight on affected side, due to weakness of hip abductors.

In children with established dislocations, the action of the gluteus medius in pulling the pelvis downwards in the stance phase is ineffective or weak because of a lack of a stable fulcrum.

For a child with a left hip dislocation, the pelvis drops on the opposite side (i.e., right), causing instability.

To restore the stability and prevent falls to the left, the body lurches to the right side and shifts the center of gravity over the stance side (i.e., right hip). The top of the greater trochanter telescopes upward and mechanically hitches on the ilium to stabilize the joint.

This movement at every stance phase is called the Trendelenburg gait.

An abnormal hip examination can also occur with *other conditions,* such as septic arthritis, traumatic hemarthrosis, and congenital coxa vara. Infants with cerebral palsy may have a smaller but normally shaped acetabulum, with an imbalance between extensors and flexors. Abnormal joint laxity can also be seen in connective tissue disorders such as Ehlers-Danlos syndrome.

Remember

- **Ortolani's test (is a test of entry) relocates a dislocated hip.**
- **Barlow's test (test of exit) dislocates a dislocatable hip.**
- **Both these tests lose their significance after infancy.**

Ultrasound (sonography) is an excellent tool is the best under four months. Capable of visualizing the cartilaginous anatomy of the femoral head and acetabulum.

Performing a dynamic evaluation, monitoring treatment (Graf, 1980).

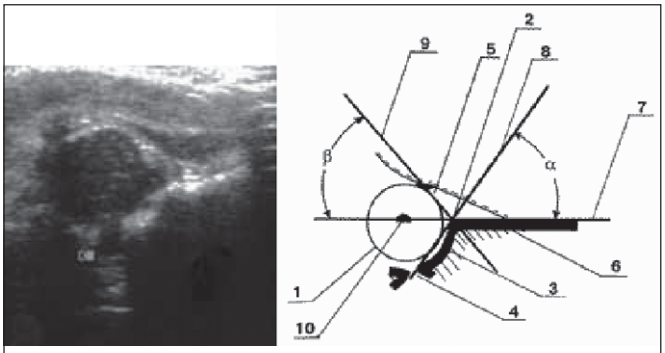


Fig. Sonogram of normal hip at three months.
1 - femoral head
2 - Bone ledge
3 - Bone part of the acetabulum
4 - Y- triradiate cartilage
5 - cartilaginous part of the acetabulum (limbus)
8 - line bone acetabular roof
9 - line cartilaginous acetabular roof
10 - the ossification center for the femoral head

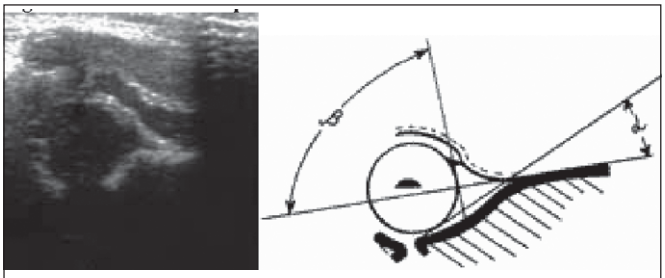
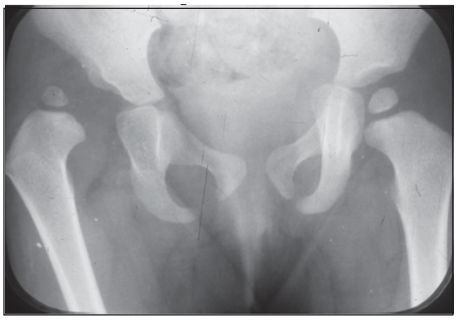


Fig. Subluxation of the hip

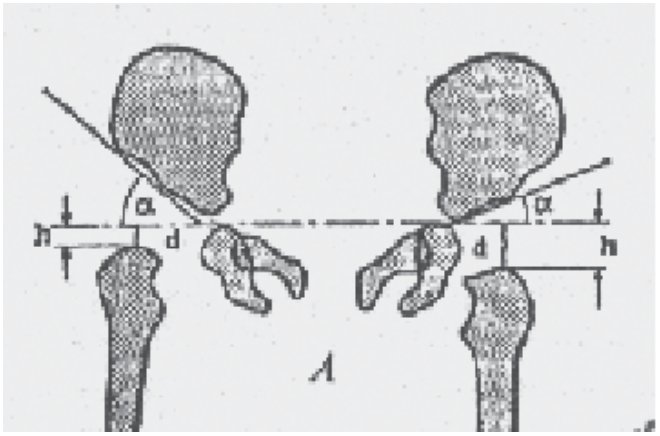
Unlike in infants radiographs of pelvis show important features in this age group (Fig.).

Radiographic evidence of hip dislocation does not become reliable until the femoral nucleus of ossification develops at three to five months of age.



The following radiological parameters should be noted.

Hilgenreiner's circuit



Hilgenreiner's line. This is a horizontal line drawn at the level of triradiate cartilage.

Acetabular index (**α**) Normal value is less than or equal to 30°. CE angle of Wiberg The normal value is 15-30°. Distance d в N = 10-12mm. Distance h в N=10 mm;

Perkin circuit

Perkin's line This is a vertical line drawn at the outer border of the acetabulum.

Lines perpendicular to the Hilgenreiner line through the superolateral edge of the acetabulum (Perkin lines) are drawn next, dividing the hip into 4 quadrants

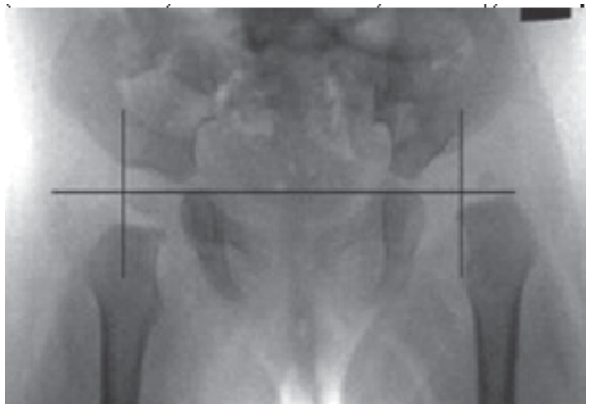


Fig. The left hip is dislocated; its femoral head lies in the superolateral quadrant. Femoral head on the right (normal) lies in the inferomedial quadrant formed by these lines

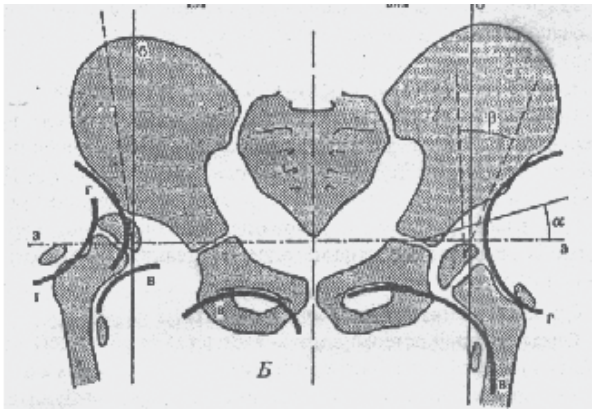


Fig. Broken Shenton's and Calve line

Shenton's line This is a smooth curve formed by the inferior border of the neck of the femur with the superior margin of the obturator foramen. This line is broken in DDH (Fig.).

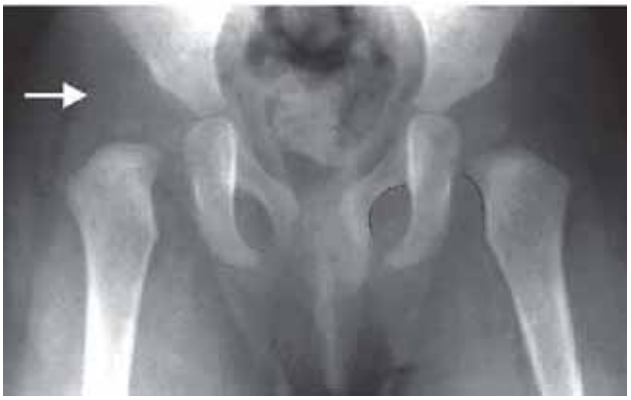


Fig. Right developmental dysplasia of the hip. Normal still makes femoral head contact with of the acetabulum Neck-shaft angle of the femur '!'ǂ greater than 130 degrees acetabular index angle 6 (55 degree).

The Hilgenreiner's line and the Perkin's line helps to assess the position of the femoral head. Normally the head lies in the lower and inner quadrant formed by these two lines. In DDH the head lies in the upper and outer quadrant, the continuity of Shenton's line is broken in DDH (Fig.). The acetabular index and the CE angle of Wiberg help to assess the acetabulum.

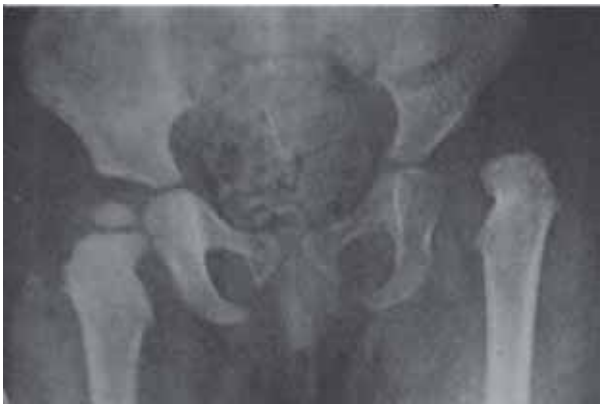


Fig. Unilateral hip dislocation

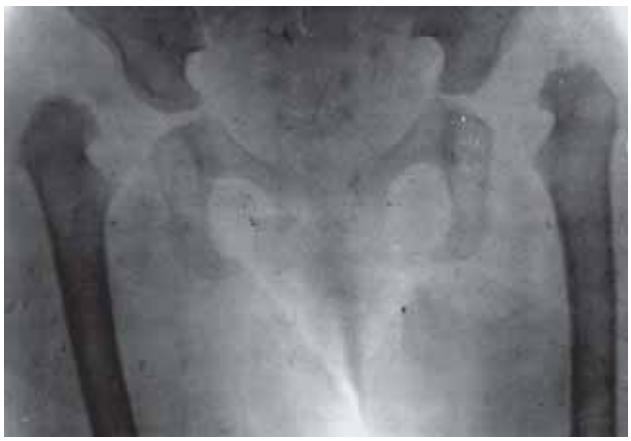


Fig. Bilateral dislocation of the hip

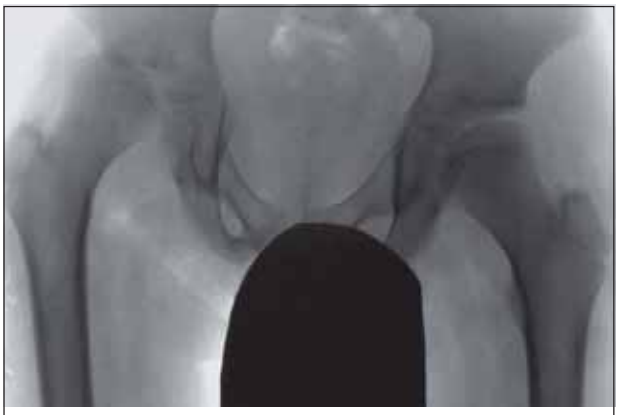


Fig. Dysplasia of the left hip in adolescent.

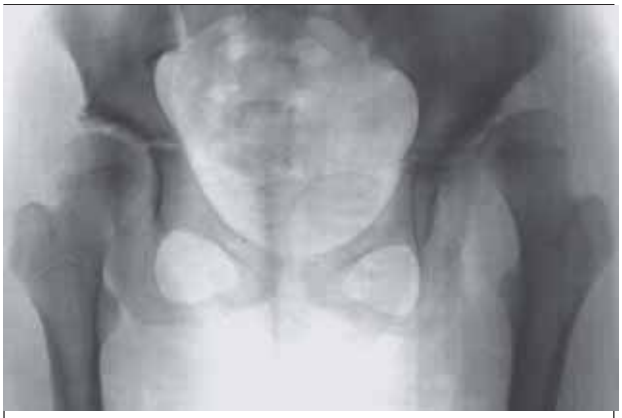


Fig. Dislocation of the left hip in adolescent.

In adults DDH in adults shows all the features seen in adolescents. In addition patient will have features of secondary osteoarthritis of the hip namely pain, stiffness, limp, crepitus, restricted movements, et.

Treatment

The earlier treatment is initiated, the greater the success and the lower the incidence of residual dysplasia and long-term complications.

The goal of treatment is to put the femoral head back into the socket of the hip so that the hip can develop normally.

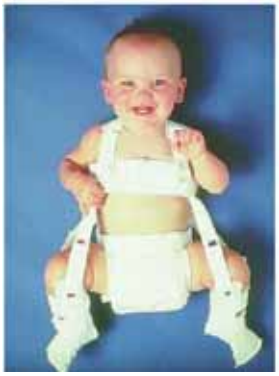
See the Table for the comparative study of the treatment regimen in various age groups in DDH.

In infants Reduction can be obtained and maintained by Pavlik harness which was first described by Arnold Pavlik in Czechoslovakia in the year 1958, von Rosen splints and other splints. Pavlik harness is the most important appliance useful in this age group. This is the only harness that promotes spontaneous reduction of a dislocated hip and maintains the reduction, whereas other appliances only maintain the reduction. Hence Pavlik harness is called as dynamic flexion abduction orthoses". This is useful in children less than 6 months of age. Apart from the reduction and the immobilisation, it allows

Table : Treatment divided into 5 age groups

Newborn (6months)	Hold if need pull •**Pavlik harness** and von Rosen splint is applied for 2 months. Later wean, by removing it 2 hours/day doubled every 2-4 weeks until device is worn in the night only Night bracing is continued till X-rays are normal. **X-rays are taken at:** 1 month, 6 month, 1year intervals **Gnevkovsky abduction bracing (device) after:** 1) failure of the Pavlik harness, 2) after four-month-old child If dislocation persists for 6 to 8 weeks abandon this programme and institute •**Traction** •**Closed reduction** •**Casting**
6 –18 months	Pull and hold In this age group harness is not successful. The recommended regime as follows: • Preoperative traction • Closed reduction and arthrogram. • Hip spica after confirmation of stable reduction. Desired position of the hip joint is human position (i.e. 95° flexion and 40° abduction at the hip). • Open reduction in child less than 18 months is done when closed reduction fails by using the Bikini skin incision.
Toddler (18-36 months)	Break and hold Here open reduction is combined with femoral or pelvic osteotomy or both and is the treatment of choice. **Femoral osteotomy** is tried first for untreated COH and is useful in less than 8 yrs of age **Pelvic osteotomy** The following varieties are • **Salter's** uses Symphysis pubis as the hinge. Useful between 18 months to 6 years • **Pemberton** Uses triradiate cartilage as the hinge. Useful between 1-10 years of age. • **Steel** (Triple innominate osteotomy) Useful in older children when symphysis pubis and triradiate cartilages are fused. • **Shelf operations** Here acetabulum is extended anteriorly, laterally and posteriorly. Useful in COH which have recurred after reduction. • **Chieri's osteotomy** Here medial displacement of the distal fragment is done usually as a last resort Useful in children over 4 years of age.
Child (3-8 yrs)	Open and break Here open reduction is the treatment of choice and is usually followed with femoral shortening (Klisic and Jankovic) and if necessary pelvis osteotomy.
Juvenile and young adults (8-18 years)	Open and replace Depending on the situation the following procedures are chosen • Femoral shortening with pelvic osteotomy. THR when osteoarthritis develops.

active movements in all directions except extension and adduction. Nappies can be changed easily. The success rate of this harness is 85 to 95%. However as the age advances, soft tissue contractures develop along with secondary changes in the acetabulum, which bring down the success rate of Pavlik harness. Complications include osteonecrosis and failure of reduction.



Between 6 and 18 months As mentioned earlier Pavlik harness has no role in the treatment of DDH in this age group. Here the treatment of choice is gentle closed reduction and hip spica application. But risk ↑↑ development of avascular necrosis of the head. Open reduction is done if this method proves unsuccessful.

Figure : A four-month-old child in a hip spica cast following bilateral closed reductions. DDH treated with plaster cast in frog leg position

Between 18 and 36 months Gradually traction (overhead traction) to the closed reduction (3-week period), then hip spica casting for at least 12 weeks

Fig. Overhead traction

In this age group open reduction is the treatment of choice as closed reduction is often not successful.

Open reduction involves lengthening tendons about the hip, removing obstacles to reduction, and tightening the hip capsule (Complications: head osteonecrosis and redislocation) Open reduction is to be followed with either pelvic or femoral osteotomy to provide concentric reduction of the femoral head within the acetabulum.

Role of osteotomies

Osteotomies are done for instability, failure of acetabular development or progressive head subluxation after reduction. They are done only if congruent reduction is possible, if there is satisfactory range of movements and if the femoral head has a reasonable sphericity.

The osteotomies could be femoral or pelvic and the choice is usually left to the surgeons, but there are some guiding principles.

Pelvic osteotomies are chosen if there is severe dysplasia and radiographic changes on the acetabular side.

Femoral osteotomies This is the procedure of choice if there are changes in the femoral head and if there is increase in anteversion of the neck.

3-8 years Here open reduction is followed either by femoral shortening or pelvic osteotomies.

8-18 years In this age group open reduction is followed by femoral shortening or pelvic osteotomies. If osteoarthritis of the hip develops, total hip replacement is the surgery of choice.

Innominate osteotomy in DDH

Salter's osteotomy This is indicated in patients with instability after reduction or in persistent DDH between 18 months to 6 years. The procedure consists of using the symphysis pubis as a hinge, osteotomising the acetabulum to cover the head (Fig.).

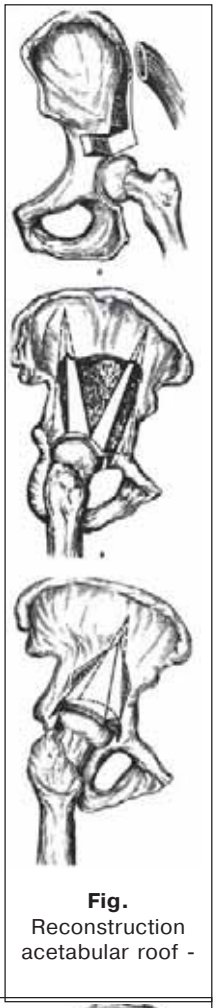


Fig. Reconstruction acetabular roof -

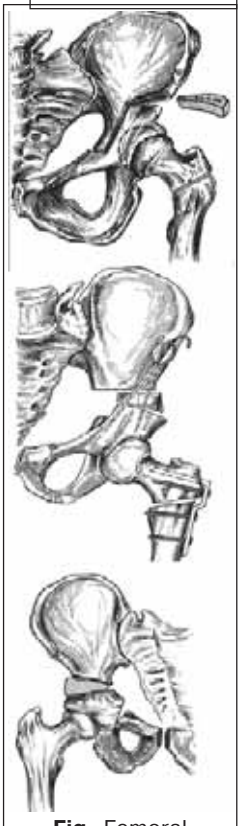


Fig. Femoral osteotomies (shortening) and reconstruction acetabular roof

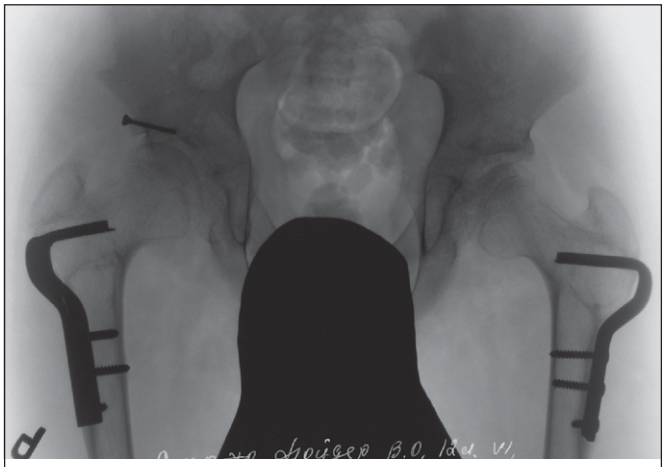


Fig. Correcting femoral osteotomies (derotation varus osteotomy - normal neck- shaft angle of the femur 130 degrees, antetorsion, anteversion) and to reconstruct right acetabular roof

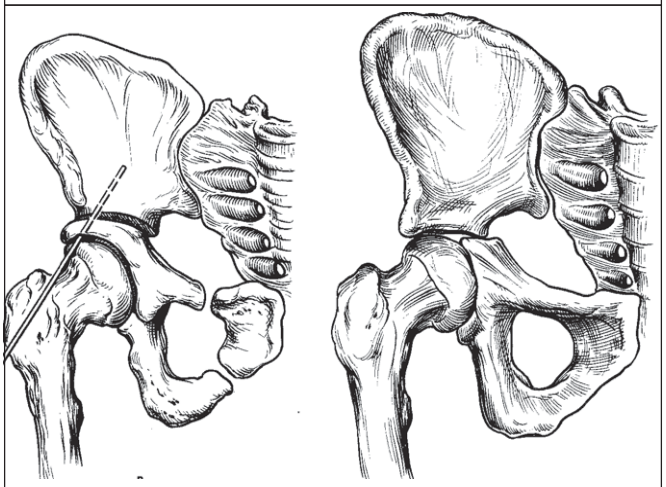


Fig. Salter's osteotomy

Pemberton's osteotomy It is indicated in paralytic dislocation and in postacetabular deficiency between 1 and 10 years. Here the osteotomy is done through the acetabular roof using triradiate cartilage as the hinge.

Steel's osteotomy This is useful in older children when symphysis pubis and the triradiate cartilage are fused. This is a triple innominate osteotomy.

Shelf operation It is indicated in CDH with recurrence. Here the acetabulum is extended laterally and anteriorly by bone graft (Fig.).

Chiari's osteotomy This is a salvage procedure and is indicated in children older than 4 years. Here the osteotomy is done through the ilium above the acetabulum and the distal fragment is pushed medially (Fig.).

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