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Directorate General of Khoula Hospital

Department of Orthopedic

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Approval Process

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Contents Table:

Acronyms:

DDH	Developmental dysplasia of the hip
OPD	Outpatient Department
AHCP	Allied HealthCare Provider

Management of Developmental Dysplasia of The Hip Under 6 Months Age Guidelines

1. Introduction

Developmental dysplasia of the hip (DDH) is a spectrum of pediatric hip disorders that ranges from acetabular dysplasia to complete hip dislocation. The incidence varies from a population to another. The management of this disorders is, by and large, depends on the age of the child at diagnosis. Children less than 6 months of age can benefit from dynamic hip bracing like Pavlik harness. The success rate of such intervention can reach up to 79% especially with early application, proper application and compliance of the guardians. Early detection of this disorder in children is another challenge. Various screening methods have been proposed but can be divided into clinical or radiological, universal or selective. At present. Most of the health institutes, including Khoula hospital, follow the universal clinical screening program. Every child born at Khoula hospital undergoes examination by a pediatrician. This method, although is less costly, carries high false negative rate. Moreover, the child may have merely acetabular dysplasia which if not detected earlier can eventually lead to hip dislocation at later age. Hip click is a very common in newborn as the incidence of hip subluxation is 1/200 newborns more than 90% of these instabilities resolve by 2 weeks of age.

2. Scope

These guideline apply to all pediatricians, radiologists and orthopedic surgeons dealing with children less than 6 months of age with developmental of dysplasia of the hip.

Excluding children who have teratologic hip abnormalities or hip abnormalities associated with neuromuscular, genetic, or acquired complex musculoskeletal or developmental abnormalities.

3. Purpose

The purposes of these guidelines are:

3.1. To standardize the management of children less than 6 months of age with DDH.

3.2. To provide clear guidance of initial assessment and screening of DDH.

4. Definitions

4.1. Developmental Dysplasia of the Hip (DDH): a condition that affects the neonatal and infant hip joint. DDH is a term used to describe a spectrum of abnormalities affecting the relationship of the femoral head to the acetabulum. These may include an immature hip, a hip with mild acetabular dysplasia, a hip that is dislocatable, a hip that is subluxated, or a hip that is frankly dislocated.

4.2. Ortolani and Barlow tests: are test used to clinically detect unstable hips. The description of which will follow in these guideline.

4.3. Pavlik Harness: is a dynamic splint used to maintain hip reduction and stimulate acetabular remodeling.

4.4. Proximal Perichondrium is a composite of echoes comprised of the rectus femoris tendon (reflex head), the fat deposit of the joint capsule and the perichondrium of the cartilage roof.

4.5. The turning Point / Bony rim: the bony rim is the turning point from concavity to convexity.

5. Guidelines

For the ease of use by different stakeholders, the Guidelines are divided into three parts. The **first** part is about pediatrician assessment and clinical screening of the newly born child. The **second** part is about radiological screening of the hip whereas the **third** part describes the orthopedic clinical pathway and application of Pavlik harness of the DDH.

5.1. Pediatrician assessment and clinical screening

5.1.1 Pediatrician should be the first line to detect babies at risk of DDH

5.1.2 All newborns with the following risk factors should be referred to pediatric orthopedic clinic at age of 4 to 6 weeks with a booked appointment of hip ultrasound at the same day of OPD appointment:

A. Breech presentation at 32 weeks of gestation or later
B. Family history or sibling history of DDH
C. Oligohydramnios
D. Abnormal clinical examination of the hips:

i. Evidence of hip instability : the proper Barlow and Ortolani tests see **appendix 1**
ii. Limited hip abduction
iii. Limb length discrepancy

5.1.3. Pediatrician should arrange the appointment for both ultrasound and pediatric orthopedic (4 to 6 weeks of age) in the same day.

5.1.4. The parents should be stressed on avoidance of improper swaddling.

5.1.5. Hip clicks are common in this age group, literature showed week link between hip click and DDH. However, if hip is stable but the click is felt by two examiner then the child should follow the pathway of this guideline.

5.1.6. Asymmetry of gluteal fold is common in all ages. However, the child still can be referred for hip screening.

5.1.7. Double diaper has shown no value in treating hip instability.

5.1.8. Infant age should be based on corrected gestational age.

5.2. Radiological Screening

5.2.1. The hip ultrasound should be done by a trained radiologist before the ossification of femoral epiphysis, ideally at 4-6 weeks.

5.2.2. For the sake of improved communication, the Graf ultrasound technique has been adopted. The essentials of this technique see **Appendix 3** and **Appendix 4** contains both the extended and short forms of Graf classification.

5.2.3 Sonogram format

a) Name of patient.
b) Date of birth.
c) Side specified.
d) Two standard plane sonograms of each side.
e) One (1) sonogram per side with measurement lines.
f) Scale of magnification 1.7:1.
g) Bony coverage (d: D ratio) is the ratio of acetabular depth to diameter of femoral head.

5.2.4 Standard report:

The report should contain:

A. The description with preliminary type.
B. Angle measurement, Alpha/Beta.
C. Type of DDH

5.3. Clinical orthopedic pathway and Treatment

5.3.1. The treating doctor should ensure the ultrasound is already done along with the first assessment by the pediatrician.

5.3.2. The treating doctor should take a detailed history of the child. Identify and document the risk factors.

5.3.3. In clinical examination it is recommended to do the following tests respectively:

A. hip instability see **appendix 1** first and then
B. asymmetry see **appendix 2**,
C. followed by the general inspection.

5.3.4. It is important not to test for hip adductor tightness before testing hip stability, as the maneuver of stretching out of the flexed hips may cause discomfort. This will reduce the likelihood of the infant becoming unsettled, either from exposure or handling.

5.3.5. In general inspection, the following should be looked for

A. Dysmorphic features
B. Torticollis
C. Spine examination looking for signs of dysraphism
D. Metatarsus adductus

5.3.6. The treating doctor should check the sonograms himself to ensure that usability criteria are met and measure the angles.

5.3.7. The essentials of hip sonogram is shown in **Appendix 3**.

5.3.8. Based on the clinical examination and sonogram, the child follows either of the pathways see **appendix 5**.

5.3.9. If the baby is eligible for Pavlik Harness the following steps should be followed:

A. If the Pavlik harness is applied by allied health care person, the doctor has to double check harness fitting and final position see **appendix 6**.

B. Instruction paper should be given to the family on how to take care of the child in the Pavlik harness.

C. The follow up visit of patient in Pavlik harness should be every 3 weeks with ultrasound hips on arrival with the Pavlik harness worn by the baby.

D. If the ultrasound showed no improvement after 3 weeks of proper use then the harness should be discontinued.

E. In every visit with Pavlik harness, the child should be assessed for fitting and position in the Pavlik harness.

F. If femoral nerve palsy is detected then the harness has to be discontinued.

G. Contraindications of the use of Pavlik harness:

i. Clavicle: clinical healing should be checked before application
ii. Brachial plexus injury
iii. Teratologic hip dislocation
iv. Thoracic or high lumbar level myelomeningocele
v. Ortolani negative DDH
vi. Femoral nerve palsy
vii. Allergy to the synthetic material

5 Responsibilities

6.1. HoD of Neonatal Intensive Care Unit shall:

6.1.1. Ensure all pediatricians are aware and adhere to these guidelines.

6.1.2. Ensure provision of training for clinical screening of the neonates and identification of high risk neonates for hip dysplasia to the department pediatricians.

6.1.3. Emphasize all pediatricians to book hip ultrasound appointment at same date of pediatric orthopedic OPD.

6.2. Director of Radiology shall:

6.2.1. Ensure all radiologists are aware about these guidelines

6.2.2. Ensure all radiologists are following the essentials of Graf technique.

6.2.3. Standard images meeting the usability criteria are uploaded

6.3. HoD of Orthopedic Department shall:

6.3.1. Ensure all surgeons attending the care of the target patients are aware and adhere to these guidelines.

6.4. HoD Pediatric Orthopedic Unit shall:

6.4.1. Ensure all unit members are aware of the guideline

6.4.2. Provision of training for the unit members on performance of proper clinical examination.

6.4.3. Provision of adequate training to the unit members and OPD staff on Pavlik harness application and care.

6 Document History and Version Control

Document History and Version Control			
Version	**Description of Amendment**	**Author**	**Review Date**
01	Initial Release	Dr Masoud Al Abdali	
02			
03			
04			
05			

Written by	**Reviewed by**	**Approved by**

7 Attachments:

Appendix one: examination of hip instability

Appendix two: examination of hip asymmetry

Appendix three: hip ultrasound

Appendix four: Graf classification

Appendix five: Flowchart of management of based on hip sonogram

Appendix six: Pavlik harness application

8 References:

Title of book/ journal/ articles/ Website	Author	Year of publication
Lovell and Winter's Pediatric Orthopedics, Seventh edition	S.L Weinsten, J.M Flynn	2014
DETECTION AND NONOPERATIVE MANAGEMENT OF PEDIATRIC DEVELOPMENTAL DYSPLASIA OF THE HIP IN INFANTS UP TO SIX MONTHS OF AGE	AAOS	2014
Appropriate Use Criteria for the Management of Developmental Dysplasia of the Hip in Infants up to Six Months of Age (Intended for Use by General Pediatricians and Referring Physicians)	AAOS	2018
Screening, assessment and management of DEVELOPMENTAL DYSPLASIA OF THE HIP	The National Cooperative of Health Networks Association	2011
Appropriate Use Criteria for the Management of Developmental Dysplasia of the Hip in Infants up to Six Months of Age (Intended for Use by Orthopedic Specialists)	AAOS	2018
Hip sonography, diagnosis and management of infant hip dysplasia (second edition)	R.Graf	2017
A Reliable and Valid Objective Structured Assessment of Technical Skill for the Application of a Pavlik Harness Based on International Expert Consensus.	Bradely CS et al.	2015
International Hip Dysplasia Institute (IHDI)	Th medical advisory board	

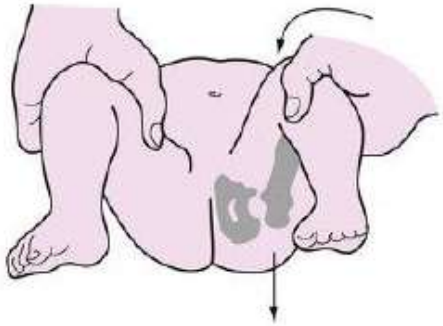
APPENDIX 1

Examination of instability

These tests carry 100% of specificity and only 60% of sensitivity. In other words, negative tests do not rule out DDH. Each hip should be examined separately while stabilizing the other one. The examination should be carried out on a firm table, or couch. The test is performed by standing at the end of the examination couch facing the baby.

Ortolani test:

- The Ortolani test is used to reduce a dislocated hip.
- Both hips are flexed to 90 °, with the knee grasped and thigh held between the thumb and index fingers. (Each hip should be examined separately.
- The second and third fingers lie over the greater trochanter and as the hip is gently abducted, these digits attempt to lift the dislocated femoral head into the acetabulum reduces.
- The relocation of the dislocated hip will produce a low pitch "clunk" sound



Barlow's maneuver: "Clunk" of exit as the femur is dislocated from the acetabulum

Barlow test:

- The Barlow test is a provocative manoeuvre used to uncover hip instability.
- One hand stabilises the pelvis whilst the other grasps the knee and flexes the hip to 90 °.
- The examiner's fingers should lie over the greater trochanter with the thumb resting on the inner side of the thigh.
- The hip being examined is then adducted by 10-20 °. Gentle, but firm, backward pressure is then applied.

Ortolani's maneuver: "Clunk" of entry as the dislocated femur reenters the acetabulum

- A small amount of movement is usually detectable in the neonatal hip, which disappears after a few weeks.
- If instability is present, a gliding sensation will be felt, due to the femoral head riding up onto the edge of the acetabulum. This indicates that the hip is subluxating.
- If the hip is dislocating, the gliding sensation is present but is followed by a distinct loss of resistance as the femoral head escapes the socket.

APPENDIX 2

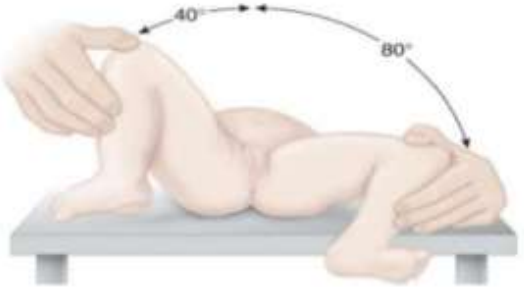
Examination of asymmetry

P.S: these tests are helpful in case of unilateral DDH

Limitation of abduction:

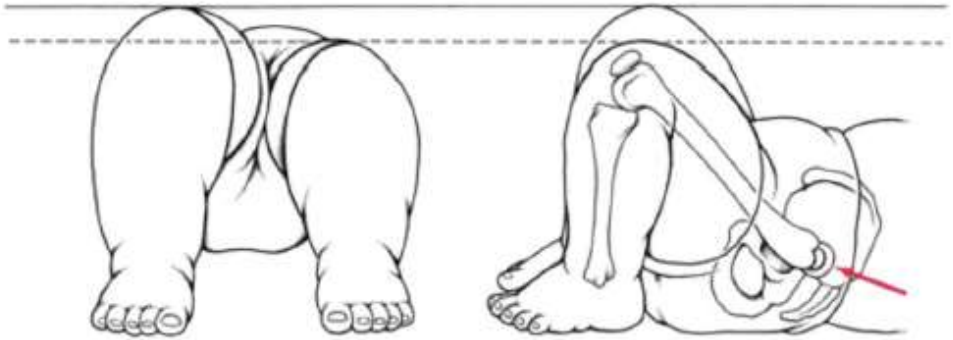
The most sensitive sign of hip dysplasia in over 3 months old children

- With the examiner standing at the end of the examination couch, both hips are flexed to 90 °. The hips are then abducted slowly, allowing the hips to gently stretch out.
- Asymmetry is detected by comparing the range of hip motion and assessing the degree of resistance between the two sides.
- This maneuver must be performed gradually as many infants will find it uncomfortable, particularly if hip dysplasia is present.



Galeazzi test

- The pelvis has to be leveled
- The examination should be on a firm table or couch



Other tests: these are least sensitive:

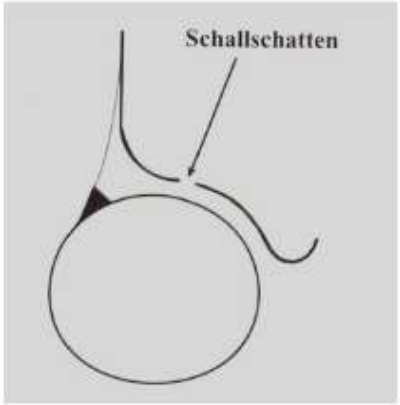
Klisic test, Asymmetrical gluteal fold, asymmetrical femoral artery pulsation and asymmetrical hamstrings stretch test.

APPENDIX 3

Infant hip ultrasound

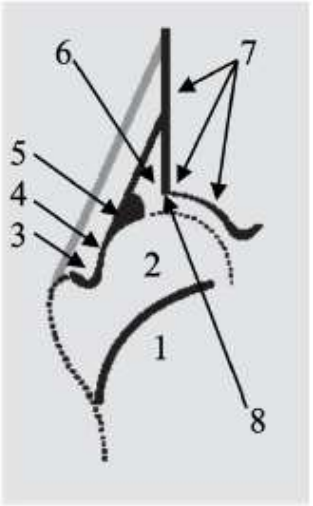
Proximal Perichondrium is a composite of echoes comprised of the rectus femoris tendon (reflex head), the fat deposit of the joint capsule and the perichondrium of the cartilage roof.

The turning Point / Bony rim: the bony rim is the turning point from **concavity to convexity.**



Anatomical Identification

1. ChB
2. Femoral Head
3. Synovial fold
4. Joint Capsule
5. Labrum
6. Cartilage
7. Bony roof
8. Bony rim (turning point)



Usability check list

These landmark must be present in order to measure the angles, absent of one of this makes image un acceptable

1. Lower end of labrum (exception is decentered hip)
2. Middle cross section : straight echo of the ilium
3. Acetabular labrum

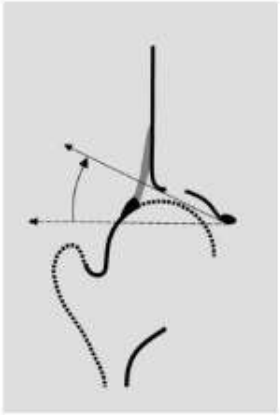
When these three landmarks are present on the sonogram, then this is the Standard Plane. Only Sonograms that are in the Standard Plane can be measured.

APPENDIX 3

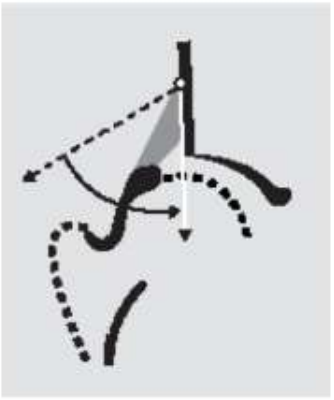
Infant hip ultrasound

Measurement Technique
Measurements must only be carried out in the Standard Plane.

2. Bony roof line: The lower limb of the Ilium is the pivot point. A tangent is placed laterally from the pivot point just touching the bony roof. (Not the bony rim)

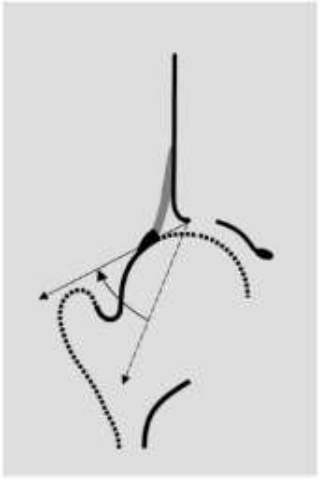


1. Base line:
   a. First the uppermost of cartilaginous point must be sought
   b. Sonographically it is the point where the echo of the proximal perichondrium meets the echo of the ilium.
   c. Anatomically it is the point where the head of rectus femoris originate from the ilium.
   d. From this point a tangent is placed along the echo of the ilium



The angle between the Base line and Bony roof line is the ALPHA angle

3. Cartilage roof line
   It is drawn from the turning point/bony rim (concavity/convexity) through the middle of the labrum> the middle of the labrum means its strongest echo.



APPENDIX 3

Infant hip ultrasound

The Cartilaginous roof line and base line form the BETA angle.

bony roof good

bony roof deficient

bony roof poor

BONY RIM SHARP

BONY RIM BLUNT

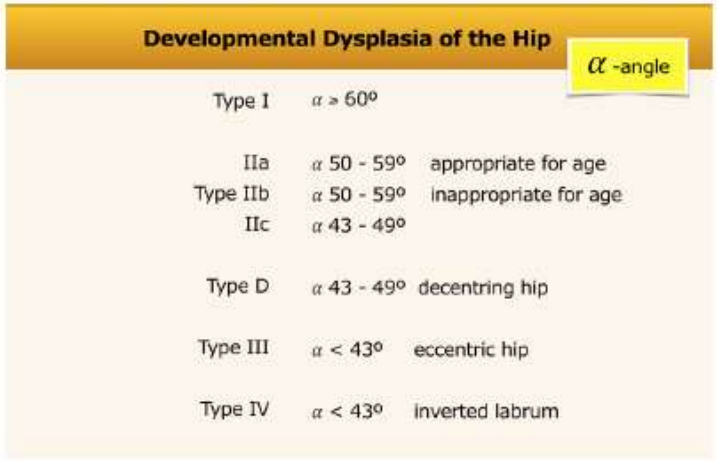
BONY RIM ROUNDED

BONY RIM FLAT

APPENDIX 4

Graf classification

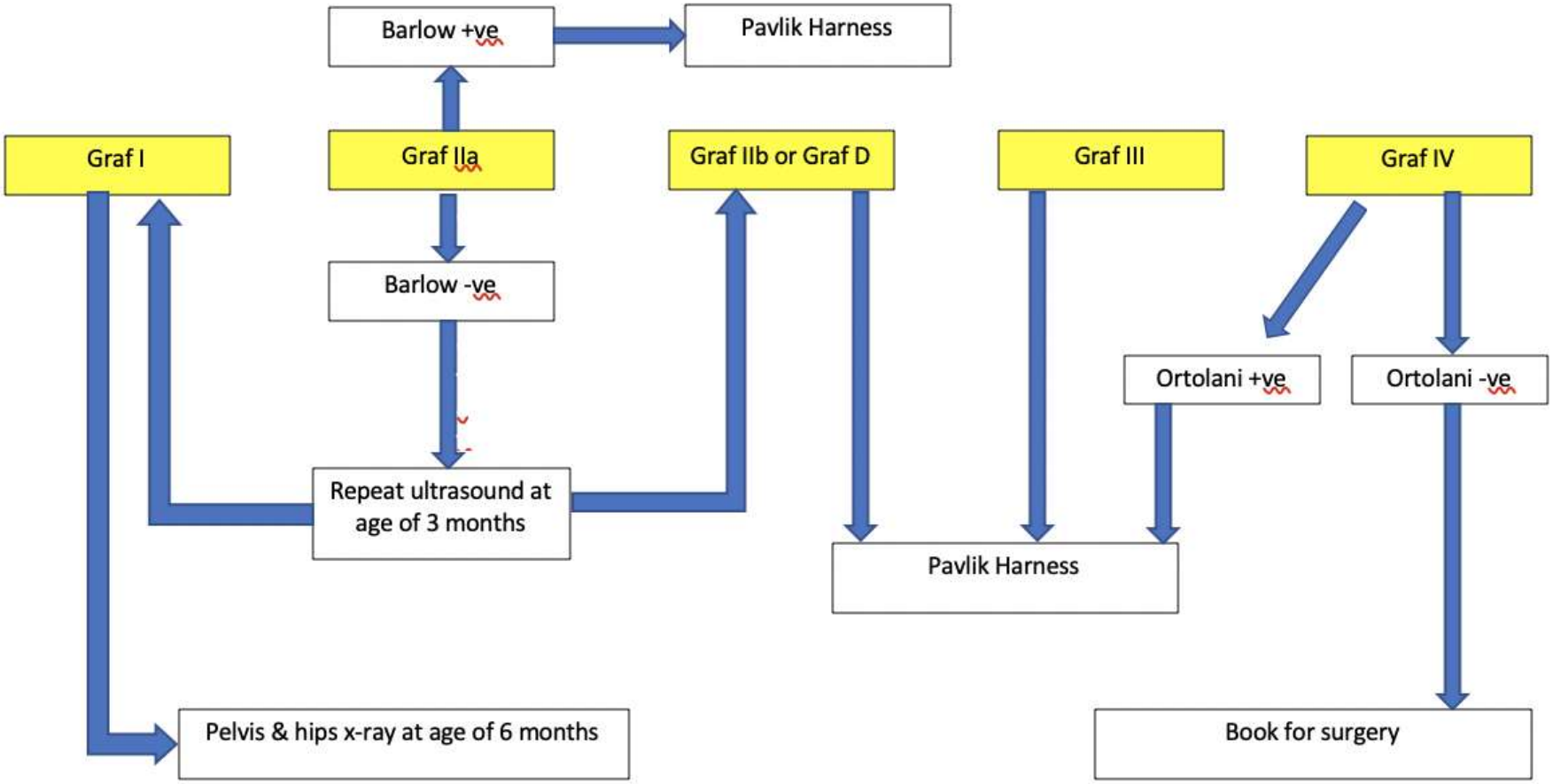
Type	Maturity	Bony roof	Bony angle	Bony rim	Cartilage roof	β-angle	Age
Type I	mature	good	α ≥ 60°	sharp	good coverage femoral head	Ia = β < 55° Ib = β > 55°	All
Type II a+	immature but appropriate for age	adequate	50-59°	blunt	coverage femoral head		< 3 mo
Type II a-	immature and inappropriate for age	deficient	50-59°	rounded	coverage femoral head		< 3 mo
Type II b	delay in development	deficient	50-59°	rounded	coverage femoral head		> 3 mo
Type II c	stable or unstable	severely deficient	43-49°	rounded / flat	still coverage femoral head	β < 77°	All
Type D	decentring hip	severely deficient	43-49°	rounded / flat	displaced	β > 77°	All
Type III	eccentric hip	poor	< 43°	flat	labrum pressed upwards		All
Type IV	eccentric hip	poor	< 43°	flat	labrum pressed downwards		All



APPENDIX 5

1

Flowchart of management based on hip sonogram



APPELDIX 6

Application of Pavlik Harness

Application set-up

The baby should be undressed.
A diaper/nappy and a single thin layer body garment can remain.

The correct size harness should be chosen. While not essential, the baby's chest circumference can be measured at the nipple line using a tape measure as a guide.

Size Chart

Size	Month	Chest Circumference
Premie	*	< 14"
Small	0 - 3	14" - 16"
Medium	3 - 6	16" - 18"
Large	6 - 9	18" - 21"
X-Large	*	> 21"

APPELDIX 6

Application of Pavlik Harness

If the baby is on the border of 2 sizes of harnesses, the larger size should be chosen.

Halter, Chest and Shoulder Straps

The straps on the harness halter should be opened.

The baby should be placed supine on top of the halter.

APPELDIX 6

Application of Pavlik Harness

The chest strap should be brought around the chest and secured at the nipple line.

The shoulder straps should be checked to cross posteriorly, then brought over the shoulders and threaded through the buckles on the chest strap.

APPELDIX 6

Application of Pavlik Harness

The shoulder straps should be secured to keep the chest strap at the level of the nipple line around the entire chest wall.

Stirrups, Anterior and Posterior Straps

The foot stirrup straps should be opened.

The foot stirrups should be applied to the correct foot *(red = right)*

APPELDIX 6

Application of Pavlik Harness

The foot stirrup straps should be secured around the lower leg.

Each foot needs to be held in the foot piece/arch support using the provided sock or a soft shoe.

The anterior (hip flexion) straps should be pulled through the correct buckle on each side.

APPELDIX 6

Application of Pavlik Harness

The line of pull of the anterior straps should follow the anterior axillary line on each side.

The right and left anterior straps should be adjusted and secured with the hips in 90˚ to 110˚ of flexion.

The posterior (adduction limiting) straps should be pulled through the correct buckle on each side.

APPELDIX 6

Application of Pavlik Harness

The posterior straps should be adjusted and secured to allow for abduction by gravity (not forced abduction).

The posterior straps should be adjusted to restrict hip adduction beyond neutral.

The final position of each hip is re-checked once all straps are secured.

APPELDIX 6

Application of Pavlik Harness

Future Reapplication

The anterior (hip flexion) straps are marked or taped where they have been secured for reapplication.

The shoulder straps are marked where they have been secured for reapplication.

The chest strap is marked where it has been secured for reapplication.

The posterior straps are marked or taped where they have been secured for reapplication.