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Paediatric Orthopedics : When does Physiology become Pathology?

A/Prof Arjandas Mahadev
Head and Senior Consultant
Department of Orthopaedic Surgery
KK Women's and Children's Hospital
SINGAPORE



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SCOPE

When to Worry?

FLATFEET

LOWER LIMB MALALIGNMENT

INTOEING

ACHES AND PAINS

ABNORMAL GAIT/LIMPING CHILD

FLATFEET

FLATFEET

Two diagnostic groups

- **Dynamic**
 - Due to generalised ligamentous laxity
 - Due to tight TA
- **Fixed Flatfeet**
 - Neuromuscular e.g. CP
 - Idiopathic
 - Tarsal coalition with/without peroneal spasm

Physiological



Pathological

FLATFEET

Dynamic



FLATFEET

Management

Dynamic with no tight TA

- Watch and Masterly Inactivity

Dynamic with tight TA

- Stretching and Medial Arch Support

Fixed

- Treat underlying problem - usually needs surgery.

Good Shoeing

- Heel in line with back of leg
 - Firm heel counter
- Arch lifted off and not bearing weight
 - Built in soft arch supports
- No pressure on weight bearing area
 - Good padding of the sole with good flexibility

Arch Supports

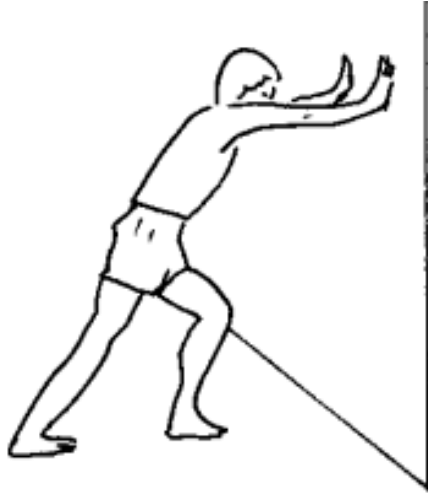
- Most effectively used when the heel is aligned in a good pair of shoes
- DOES NOT create an arch- only supports it and arch will collapse again once removed
- No need for custom made ones as child is still growing.

Arch Supports



Conventional orthotics do not support the arch, but use a wedge shape under the heel to affect foot position. Note how heel soft tissue deforms on contact. How can this control the whole foot if it can't move the heel??

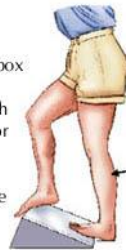
Heel Cord Stretching



A. Sit with your legs straight in front of you. Wrap a towel around the ball of your foot and hold the loose ends in each hand. Pull the ends of the towel toward you until you feel a gentle stretch in the back of your calf.



B. Stand on an incline box with the higher edge toward the wall. With your heel on the floor and knee straight, lean toward the wall until you feel a gentle stretch in your calf.

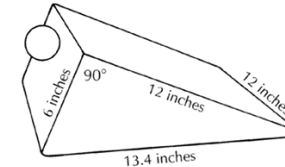


Achilles tendon stretch



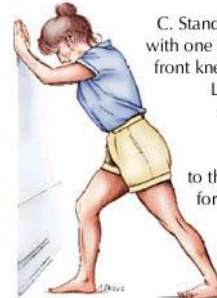
Hamstring stretch

Achilles tendinitis and tight hamstrings seem to go hand in hand. In addition to stretching your heel cords, be sure to stretch the back thigh muscles (hamstrings) as well. While sitting, with your knee slightly bent, place one leg out in front of you. Lean toward your toes until you feel a stretch in the back of your thigh. Hold for 30 seconds and then lean back to release the stretch.



Incline box (or heel cord box)

C. Stand about an arm's length from a wall with one foot in front of the other. Bend the front knee and put your hands on the wall. Lean forward until you feel a gentle stretch in the calf of your back leg.



Next, bring your back leg closer to the wall and bend both knees. Lean forward until you feel a gentle stretch in the heel cord of your back leg.

FLATFEET

When to Worry ?





FLATFEET

- **Dynamic**
 - Due to generalised ligamentous laxity
 - Due to tight TA
- **Fixed Flatfeet**
 - Due to pathological ligament laxity.
 - Due to pathological tight muscles /contracture
 - Talar anatomy
 - oblique talus
 - Vertical talus
 - Tarsal coalition with/without peroneal spasm

TARSAL COALITION

Calcaneo Navicular

9 to 12 years

oblique xray



Talo - calcaneum

12 to 15 years

CT

50% bilateral

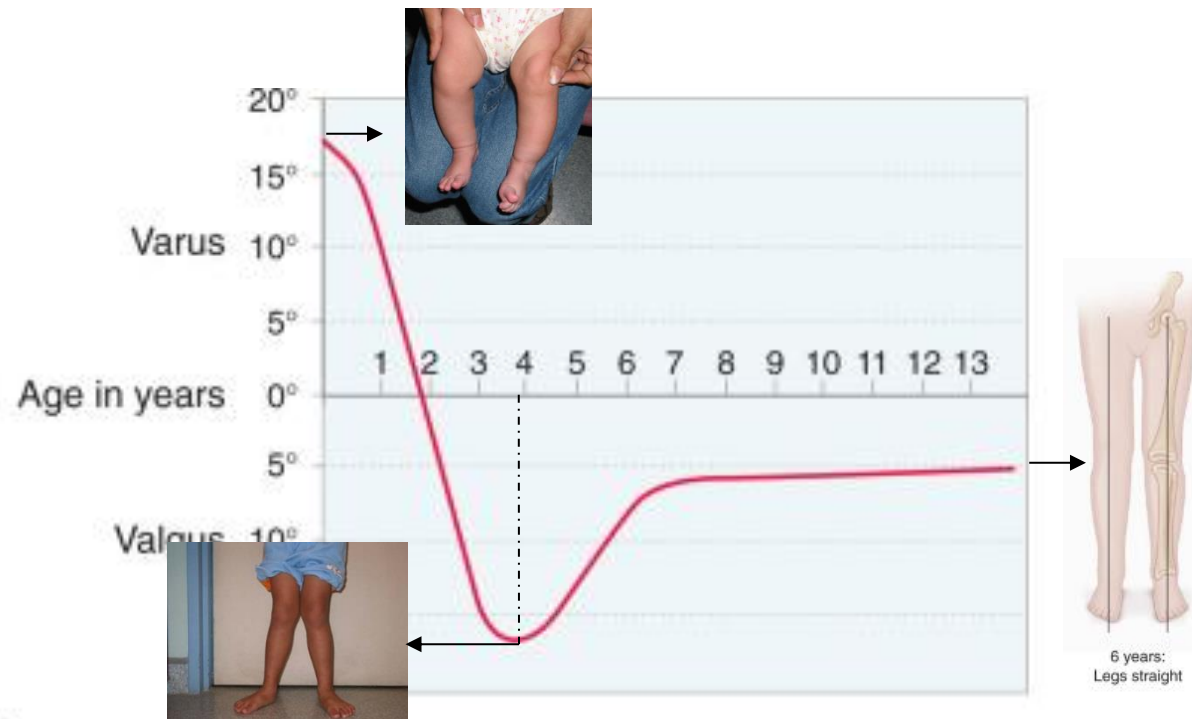


Treat if < 30% involved- treat with soft tissue interposition

- fat
- ext digitorum brevis

Spasmodic peroneal flatfoot.

LOWER LIMB MALALIGNMENT



A

Normal alignment by age

BOWLEGGEDNESS

Tibial Intorsion and Tibia Vara



Tibial Intorsion

→
Corrects by age 3



When to worry?

5 YEAR OLD GIRL



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KNOCK KNEES

Genu Valgum

- Most commonly physiological
- Corrects to adult alignment by school going age
- Monitored with intermalleolar distance



When to worry ?



INTOEING



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INTOEING

Physiological

Birth to walking

Metatarsus Adductus

Toddler to 3 yrs

Tibial Intorsion

School going to 10 yrs

Femoral Anteversion

INTOEING

Metatarsus Adductus

Management

- Serial casting if diagnosed early
- Reverse Last shoes in older children
- Stretching will suffice if mild

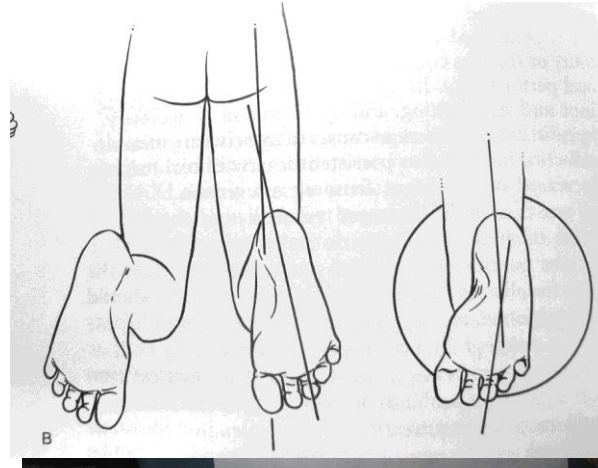


INTOEING

Tibial Intorsion

Measured as

- Thigh foot Angle
- Trans Malleolar Axis



INTOEING

Tibial Intorsion

Management

- Watch if not associated any other deformity
- Physiological and self limiting.

INTOEING

Femoral Anteversion

- History of W-sitting



INTOEING

Femoral Anteversion

- History of W-sitting
- Increased Internal Rotation



INTOEING

Femoral Anteversion

- History of W-sitting
- Increased Internal Rotation
- Reduced External Rotation



INTOEING

Femoral Anteversion

Management

- Cross legged sitting
- Reassurance will out turn by 10 yrs of age
- Consider behavior modification



When to worry ?

ACHES AND PAINS

ACHES AND PAINS

Growing Pains

- Cause unknown
- From age 3 or so.
- Pain mainly at night. Episodes for years.
- Clinic examination is normal.
- Massage and tender loving care usually will suffice.
- Self limiting – gets better after school going

ACHES AND PAINS

Growing Pains

When to worry ?

- Pain with limping
- Pain extends into the day and affect play.
- Beyond school going
- Does not get better with simple remedies

ABNORMAL GAIT/LIMPING

ABNORMAL GAIT/LIMPING

- Gait is a function of brain development
- Brain development is mostly done when child achieve ability to converse in full sentences – around 3.
- Until then gait is still not stable or “adult pattern”

LIMPING CHILD

When to worry?

LIMPING CHILD

When to worry ?

Before age of 3

- Biggest concern is an undiagnosed dislocated hip (DDH)
 - Significant limb length discrepancy
 - Asymmetrical thigh crease
 - Hip clicks
 - The hip “does not feel” the same on both sides



Limping
2½ yr old boy

LIMPING CHILD

When to worry ?

- 3 to school going
- School going through adolescents
- Adolescents

To exclude
Trauma,
Infection and
Tumour
for All groups

LIMPING CHILD

When to worry ?

- 3 to school going
- School going through adolescents
- Adolescents
- Transient synovitis
 - Inability to bear weight
 - Associated with excessive running too much
 - May be related to upper respiratory infection
 - Gets better with rest

LIMPING CHILD

When to worry ?

- 3 to school going
- School going through adolescents
- Adolescents
- Perthes
 - Loss of blood supply to the hip
 - Unknown cause
 - Can cause early degenerative disease



12 year old limping boy



13 year old
Limping with
Left knee pain



13 year old limping adolescent





LIMPING CHILD

When to worry ?

- 3 to school going
- School going through adolescents
- Adolescents
- Slipped Upper Femoral Epiphysis
 - Thought to be due to excessive weight on a “weak” hip
 - Diagnosis delayed because they can present with knee pain
 - Always need surgery to stop progression

CONCLUSION

Most common conditions are thankfully physiological in nature.

It is however important to recognise a condition that is beyond physiological as most time than not early treatment will resolve the condition.



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Arjandas.Mahadev@singhealth.com.sg



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A Primary Physicians' guide to Common Congenital and Developmental Conditions in Paediatrics Orthopaedics

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SCOPE

DDH

CLUBFEET

TORTICOLLIS

SCOLIOSIS

Developmental Dysplasia of Hips

- Incidence 1:1000 live births
- Risk factors
 - 1st female child
 - Family history
 - Breech
 - Condition predisposing to crowding of uterus
 - Multiple pregnancies
 - Primiparity
 - Fibroids or other uterine growths
 - Low AFI
 - Big baby eg in GDM

DDH

Management

Diagnosis

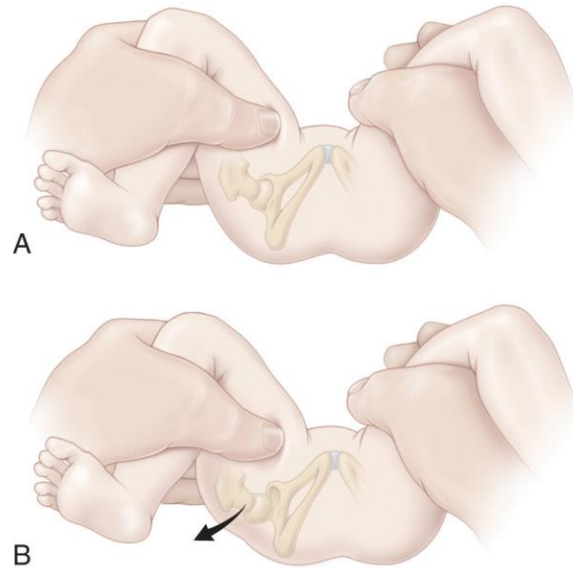
- Clinical
- Ultrasound
- Xrays

DDH

Management

Diagnosis

- Clinical
- Ultrasound
- Xrays



Barlow maneuver

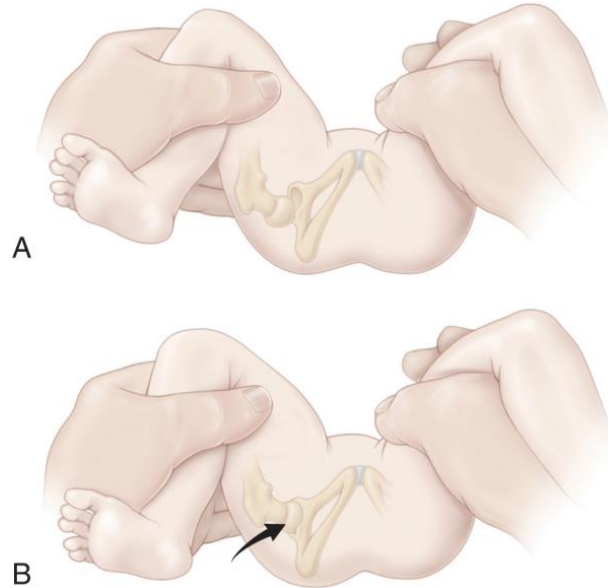
–Test of “dislocatability”

DDH

Management

Diagnosis

- Clinical
- Ultrasound
- Xrays



Ortolani maneuver

– Test of “reducibility”

DDH

Management

Diagnosis

- Clinical
- Ultrasound
- Xrays

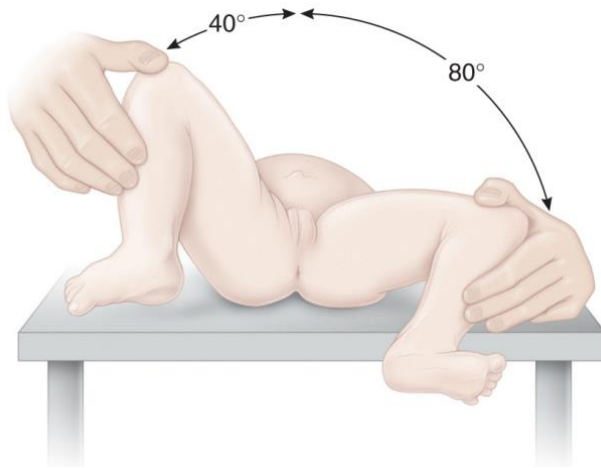
Beyond 3 months

- Reduced Abduction
- Asymmetrical crease
- LLD (Galeazzi positive)
- Treledenburg Gait

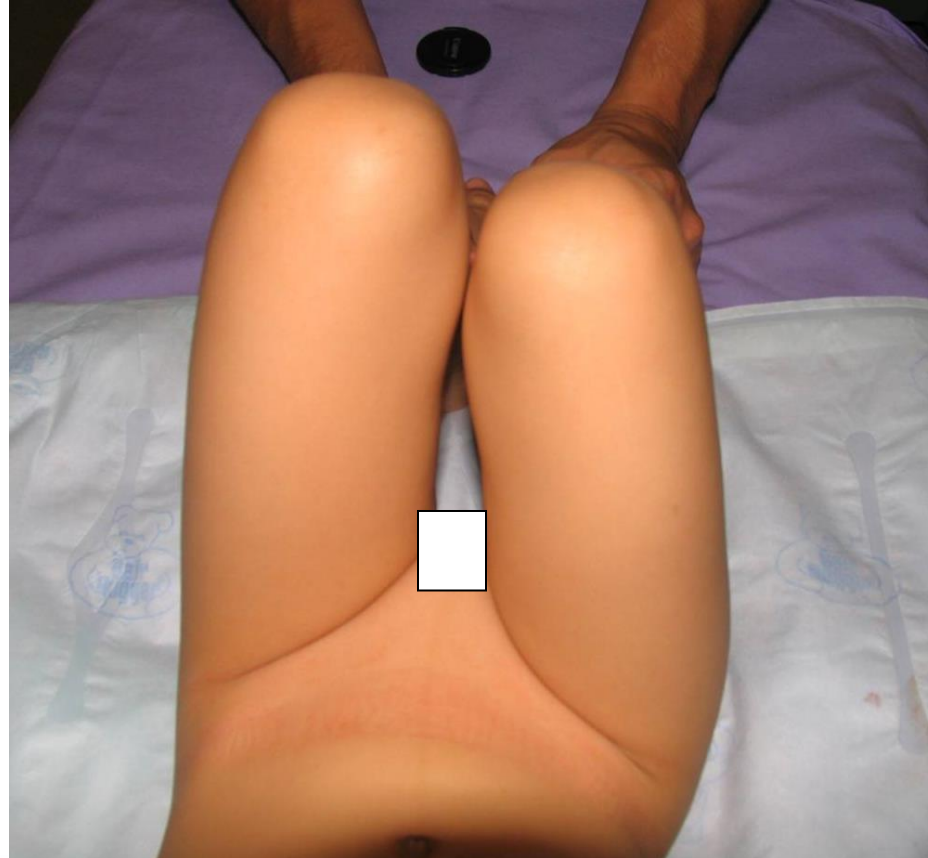
Reduced Abduction

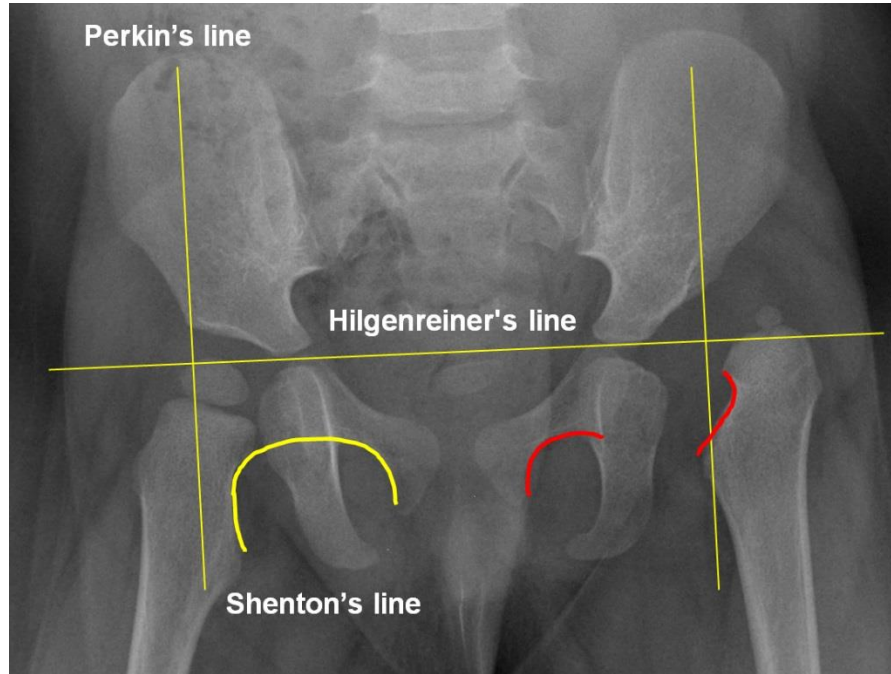


Reduced hip abduction



LLD (Galeazzi positive)





DDH

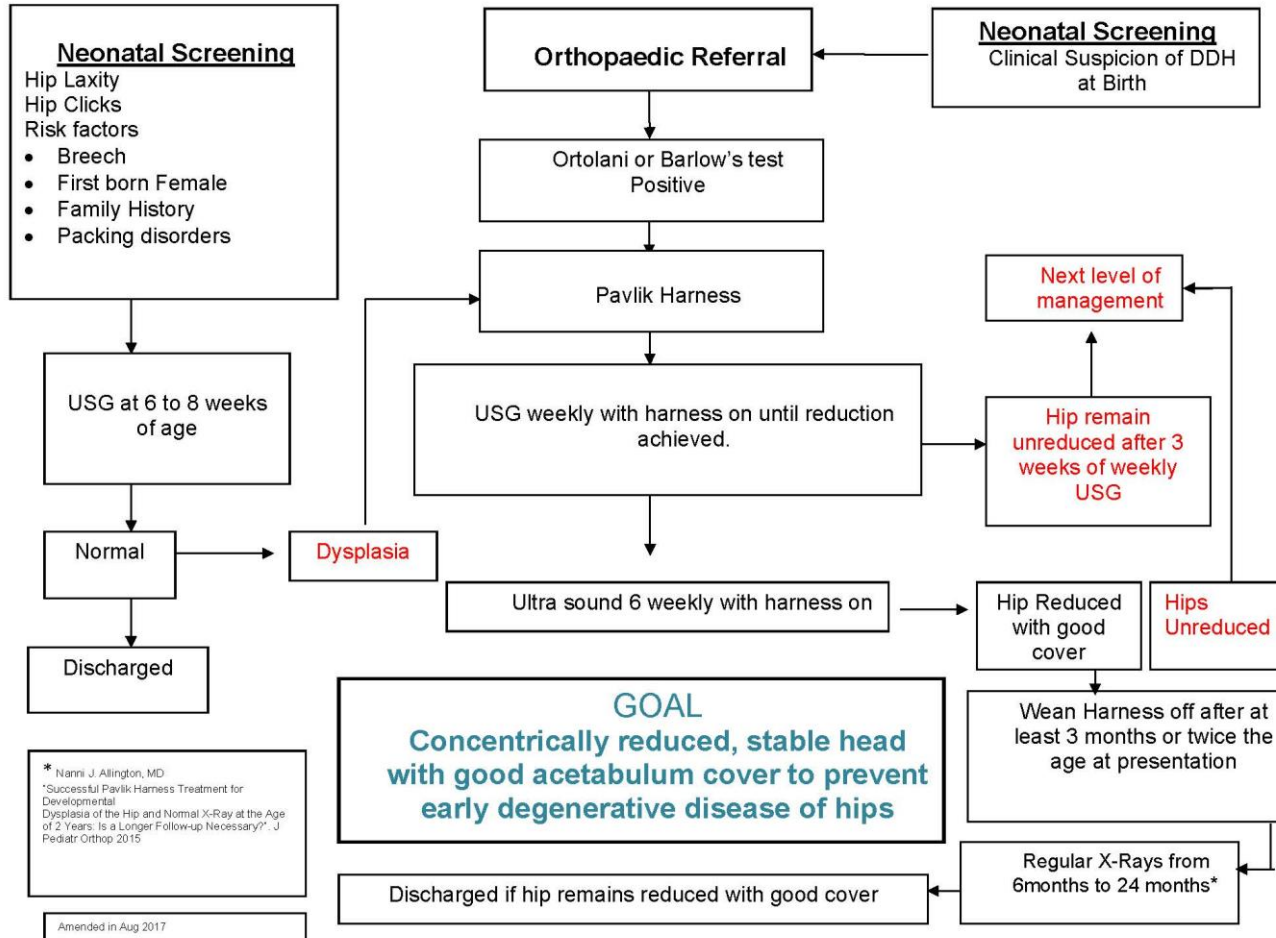
Management

GOAL:

**CONCENTRICALLY REDUCED AND STABLE
HIPS WITH GOOD ACETABULAR COVER**

**To Avoid Early Degenerative Disease of the
Hips**

SCREENING PROTOCOL FOR DDH KKH



DDH

Up to 6 Months

Clinically reducible hips

- Pavlik Harness
- Check U/S weekly until hip reduced
- Then 6 weekly
- Xrays at 6, and 18 months
- Discharged with
 - Spherical
 - Centrally reduced
 - Well covered hips



Pavlik Harness

Anterior straps – to keep hips flexed at 100°

Posterior straps – to limit adduction of the hips
(4 finger breadths)



Pavlik harness worn full time for 3 months then wean

DDH

Birth to 6 Months

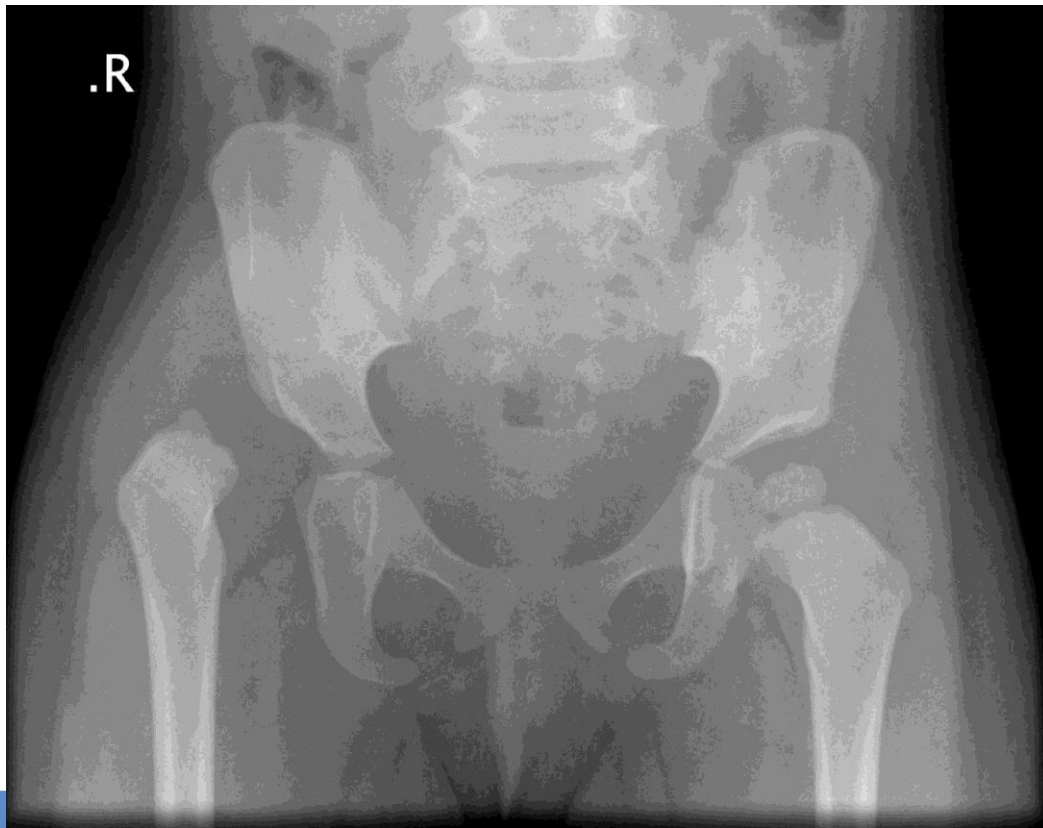


1st Xray at 4 months



Follow up at 8 months

2 year old girl Neglected DDH



DDH

Beyond 18 months

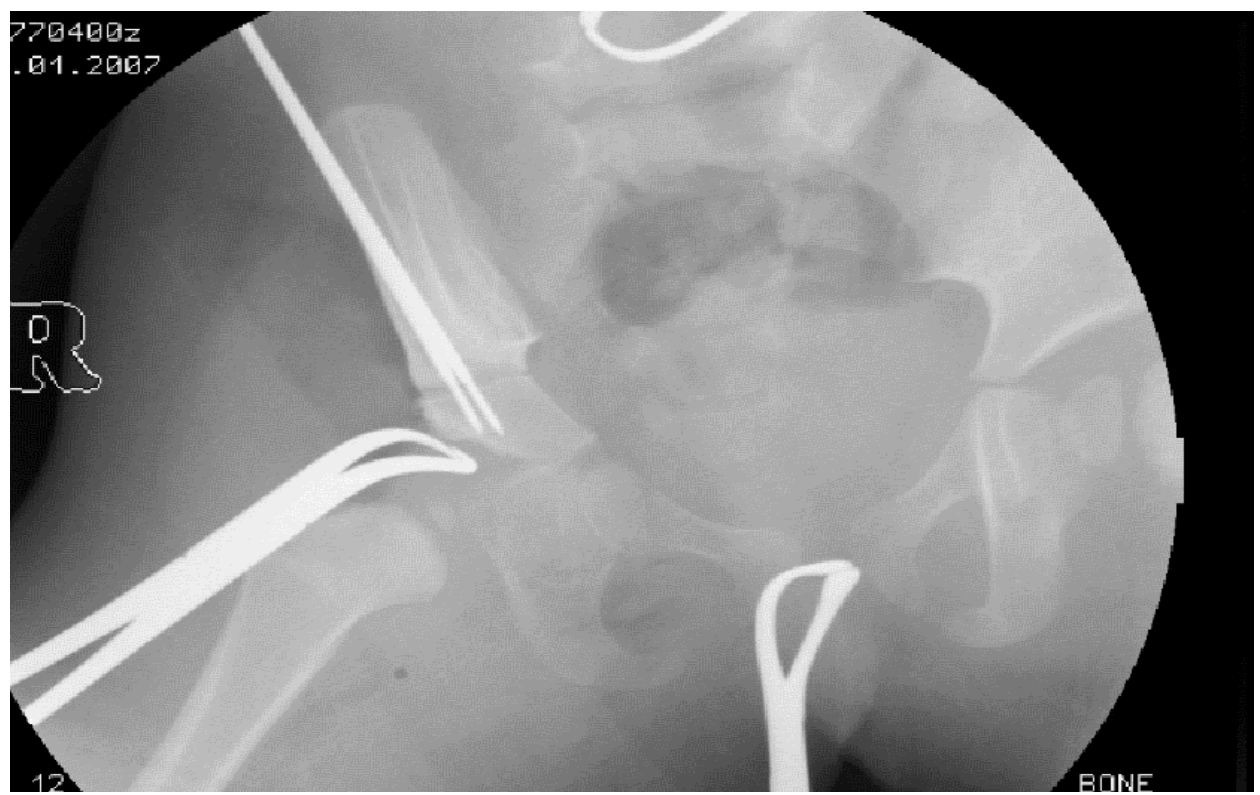
- Remodelling potential of acetabulum thought to decrease after this age.
- Not enough to just reduce the hip
- Need to also provide acetabular cover

DDH

Salter Osteotomy



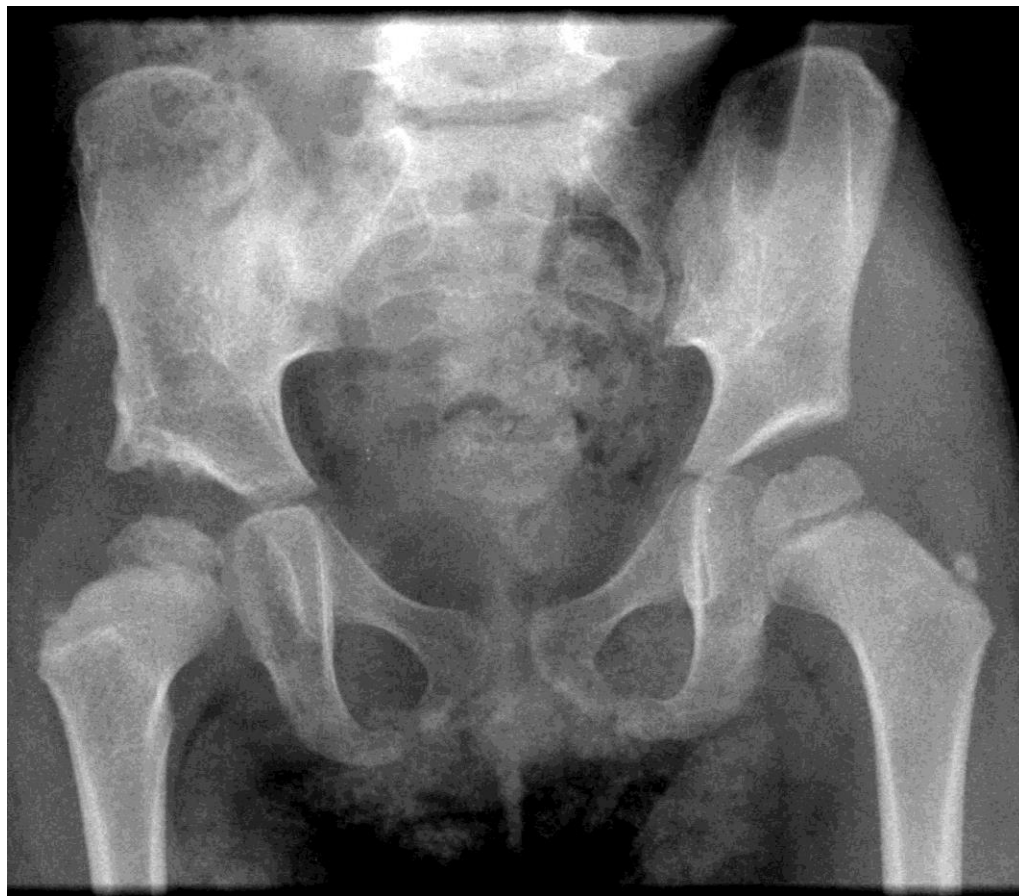
Intra operative



4 month post op



3 years old (1 year post op)



4 years old (2 years post surgery)



Age		Treatment
Newborn to 6 months	Reducible hips Ultra sound diagnosed	Pavlik harness
	Irreducible hips Teratologic hips	Adductor release and Closed Reduction Adductor AND Iliospoas release by Medial Approach
6 months to 18 months		Adductor and Iliospoas release. Open reduction. Capsuloraphy.
> 18 months		Add Salter Possibly Femoral shortening after 2 years



CLUBFOOT

Introduction

Incidence 1:1000

Subgroups

- Flexible or positional
 - If able to Dorsiflex foot then Positional
- Structural
 - Idiopathic
 - Neuromuscular / Paralytic (L4)
 - Syndromic

CLUBFOOT

Introduction

Clinical features

- Hindfoot **E**quino**V**arus
- Forefoot **S**upination
- Metatarsus **A**dductus
- **C**avus

C A V E



CLUBFOOT

Management

Goal of Treatment

- Painless foot
- Plantigrade foot
- Functional foot

Principles of Treatment

- Correct Early
- Correct fully
- Maintain correction

PONSETI CASTING

- A particular way of serial casting and manipulation
- A particular sequence of correction
- Percutaneous Tenotomy part of serial casting and manipulation
- A particular way of maintaining the correction

PONSETI CASTING

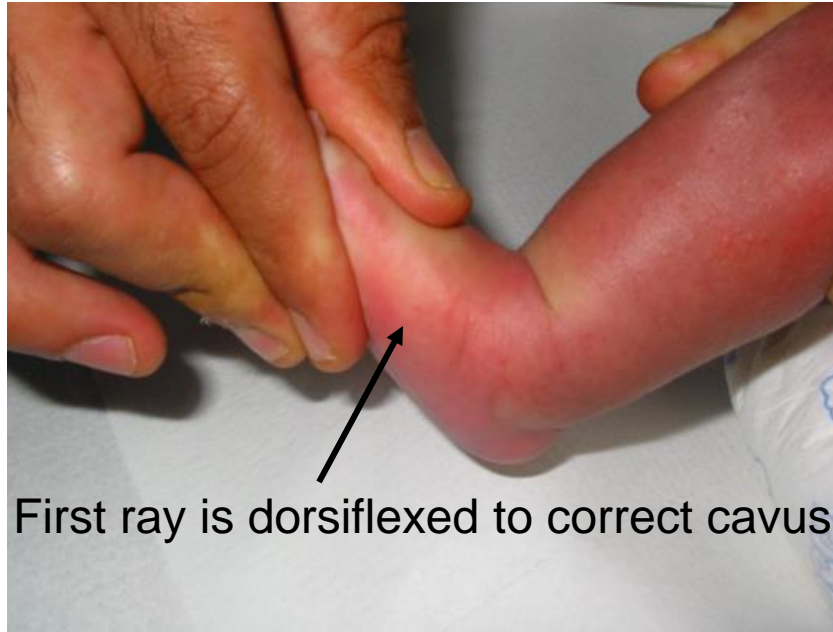
Cavus

Metatarsus Adductus

Hindfoot varus

Hindfoot equinus

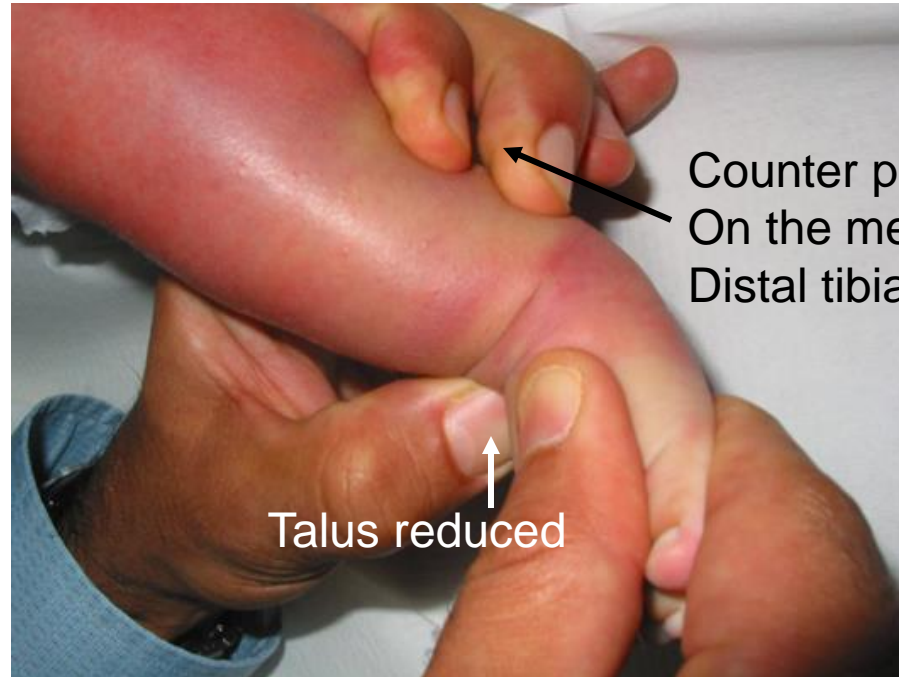
PONSETI CASTING



First ray is dorsiflexed to correct cavus

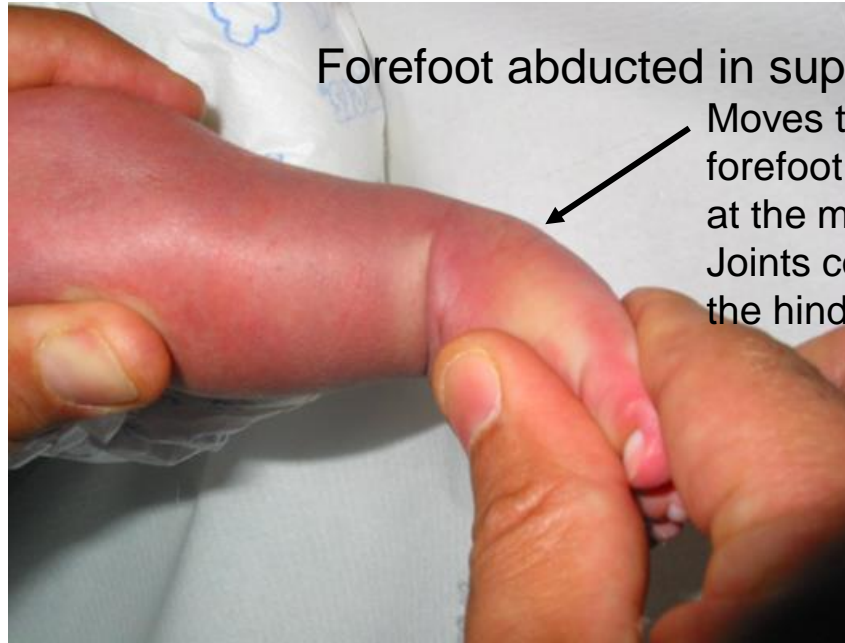
PONSETI CASTING

To correct
MTA



No attempt at manipulating hindfoot to avoid rocker bottom foot

PONSETI CASTING



Forefoot abducted in supination

Moves the
forefoot and navicular
at the midtarsal and subtalar
Joints correcting
the hindfoot varus

No attempt at manipulating hindfoot to avoid rocker bottom foot

PONSETI CASTING

Serial Casting and Manipulation



Toe to Groin casting with
Plaster of Paris

Hindfoot not forced into dorsiflexion

Forefoot in supination
and abduction.

PONSETI CASTING

Percutaneous tenotomy
after forefoot correction



CLUBFOOT

Foot Abduction Orthosis

- 23hrs/ day for 3 months
- Then wean till child being to cruise
- Then night and nap till 4 years old.



TORTICOLLIS

Introduction

Clinical description, sometimes called **wry neck**

Classification

- Muscular/idiopathic - tight sternocleidomastoid (SCM)
- Secondary
 - Squint
 - Hearing problems
 - Flat head (plagiocephaly)
 - Bony fusion of cervical spine (Klippel Feil)
 - Tumours and infections in the neck
 - Trauma

1 month old boy

Pseudotumour of L SCM



TORTICOLLIS

Clinical features

Childs tilts or looks to the
sides opposite to the tight
SCM

Facial asymmetry on the side
of the torticollis



TORTICOLLIS

Clinical features

- Limited lateral rotation on the same side of torticollis
- Limited lateral flexion on the opp side of torticollis



TORTICOLLIS

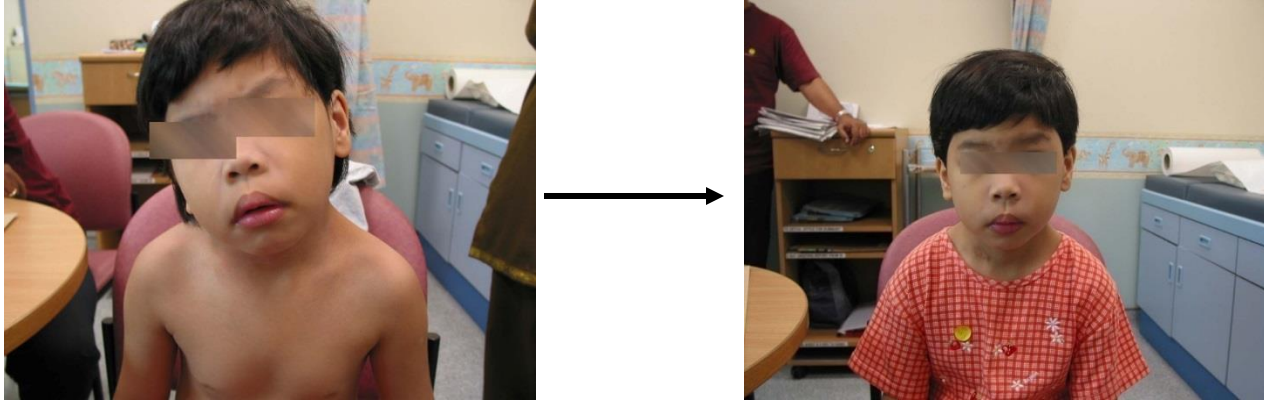
Management

- Exclude secondary causes
- If under 1 year can be treated effectively with stretching



TORTICOLLIS

Surgery



- Surgery usually needed for those above 1 year old.
- Release of the SCM is done with or without a reconstruction of the sternal head

SCOLIOSIS

CLASSIFICATION

- Idiopathic
- Congenital
- Neuromuscular
- Syndromic e.g Marfan's syndrome

CLASSIFICATION

- Idiopathic
- Adolescent
 - after 11 years of age to the end of skeletal growth
- Juvenile
 - at age 5 to 6 years
- Infantile
 - in the first year of life

CLASSIFICATION

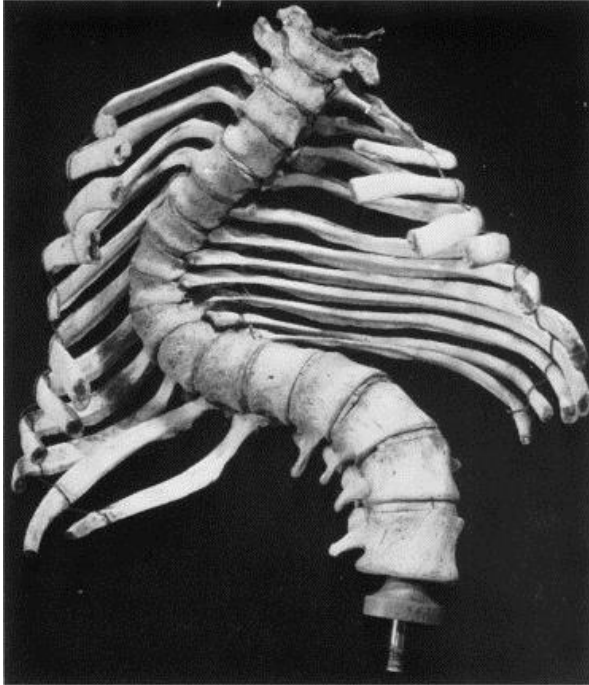
- Idiopathic
- Adolescent
 - after 11 years of age to the end of skeletal growth
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- Infantile
 - in the first year of life

ETIOLOGY

- Neurologic Dysfunction
- Connective Tissue Abnormalities
- Genetic Factors

The exact cause of idiopathic scoliosis remains unknown, despite considerable investigation

PATHOPHYSIOLOGY



- Trapezoidal vertebrae
- Rotation of spine producing the hump
- Reduced lung capacity
- Neurologic deficits are rare

Epidemiology

- Prevalence
 - 6-7 years: 0.05% (girls), 0.02% (boys)
 - **11-12 years: 1.37% (girls), 0.21% (boys)**
 - **13-14 years: 2.22% (girls), 0.66% (boys)**
- Recommends
 - **screening of girls between 11-14 years**

Idiopathic Scoliosis in Singapore Schoolchildren

A Prevalence Study 15 Years Into the Screening Program

Hee-Kit Wong, FRCS, James H. P. Hui, FRCS, Uma Rajan, FA, MS, and
Hwee-Pin Chia, MMed

Spinal screening

- The Forward Bending Test is the method used to screen for abnormal spinal curve.

An angle of 6° and greater requires an Xray and review by spine specialist.



A



B



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PRESENTING COMPLAINT

- Cosmesis
- Backpain
- Respiratory symptoms
- Neurologic deficits

PRESENTING COMPLAINT

- Cosmesis
- Backpain – **uncommon**
 - to investigate further if present
- Respiratory symptoms – **uncommon**
 - Occurs when curve magnitude reaches 100°
- Neurologic deficits – **rare**
 - More common in left sided curves e.g. syrinx

Physical examination

General inspection

- Syndromic features
- cafe au lait spots
- subcutaneous nodules
- axillary freckles, which are seen in neurofibromatosis
- hairy patches
- skin dimples: an underlying sign of spinal dysraphism
- Feet (Cavovarus)

Back examination

- Posture from front, side and back
 - Sagittal profile-kyphosis (AIS usually hypokyphosis)
- Shoulder and pelvis level
- Spinal balance – C7 plumbline, listing
- Adam Forward Bending Test
 - Scoliometer
 - Hump, rib asymmetry
- LLD, block test

Neurological examination

- LL (motor, sensory and reflexes)
- Abdominal reflexes- asymmetrical (syringomyelia/ACM)
- Back sensation --> suspended sensory loss
- Hamstrings (popliteofemoral angle)
- Gait: short leg gait from LLD

C7 plumbline

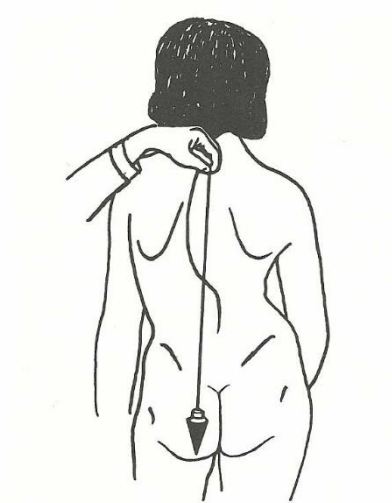
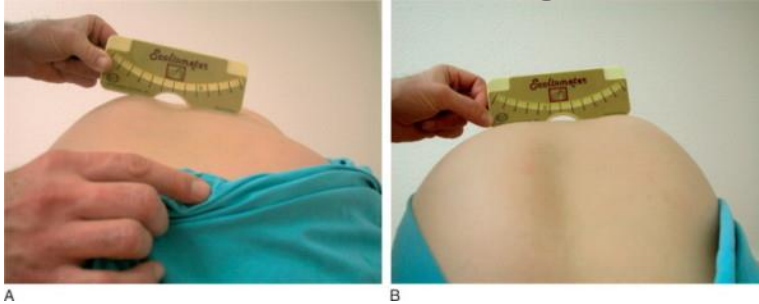


Figure 13.7. Diagram of a left thoracic scoliosis with a plumb dropped from the C7 spinous process. Weight shift can be noted by the plumb line striking the left buttock.

PHYSICAL EXAMINATION

Adams forward bending Test



Angle of trunk rotation
(ATR) $> 6^\circ$

Signs of underlying disorders



Café au lait spots



Sacral dimple



Axillary freckling



Hairy patch



Pes cavus

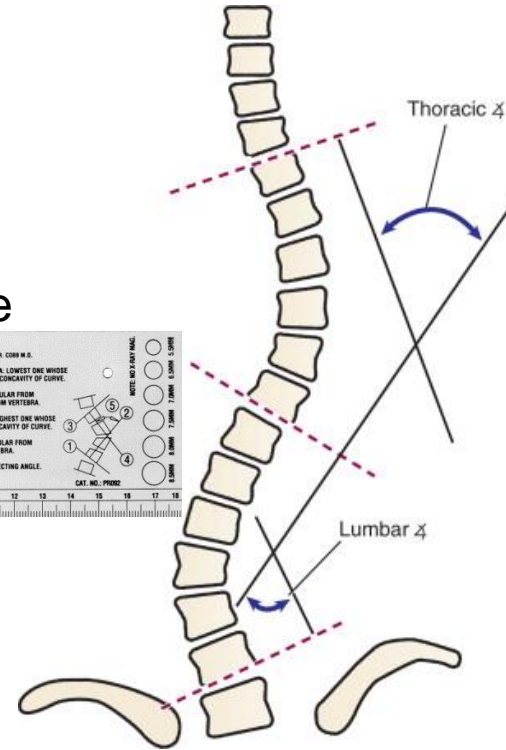
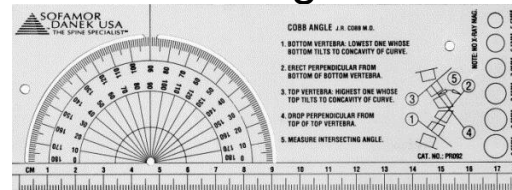


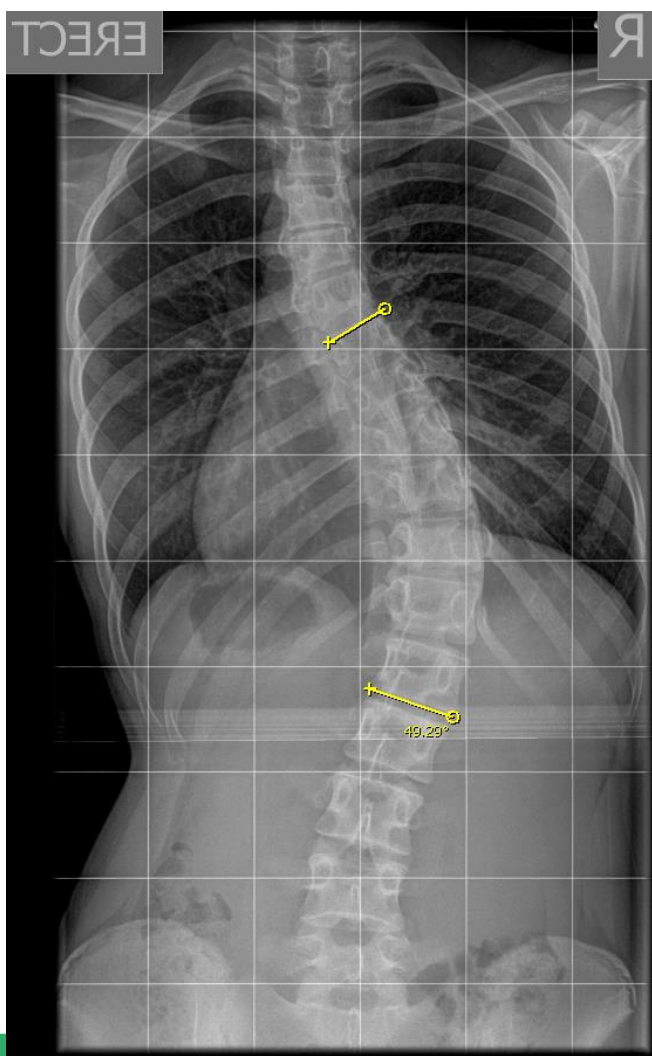
Marfan

Plair



Cobb angle





Digital measurement using PACS

TREATMENT GOAL

Stop Progression of Curve
to prevent effects of natural history

TREATMENT

Observation
Brace
Surgery

Treatment Guide

	Risser's Sign		
Curve Magnitude	Grade 0 /Premenarchal	Grade 1 or 2	Grade 3, 4, or 5
< 25°	Observation	Observation	Observation
30°-40°	Brace therapy - begin when curve is >25°	Brace therapy	Observation
>45°	Surgery	Surgery	Surgery - when curve is >50°

Observation

No treatment is needed for curves $< 25^\circ$, regardless of the patient's maturity.

Brace

Indication

- immature children(Risser grade 0, 1, or 2)
- curves in the range of 30° to 45° or who have documented progression exceeding 5°
- Risser grade 0 when their curves reach 25°

Contraindication

- large curves ($>45^{\circ}$) in a growing adolescent
- patients who find wearing an orthosis to be emotionally intolerable

Brace Types

Milwaukee Brace

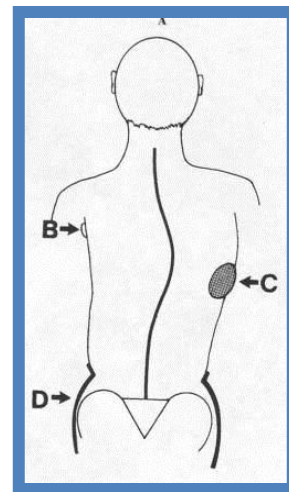
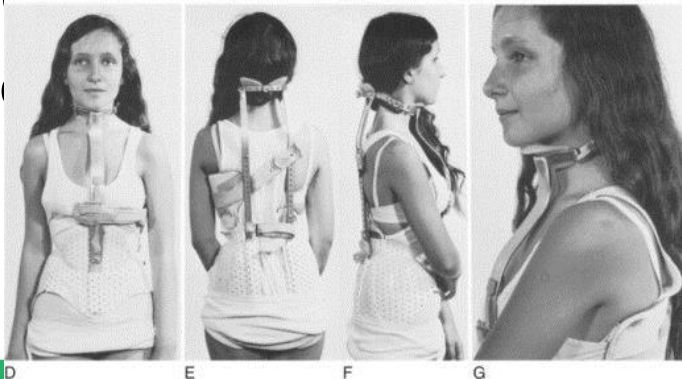
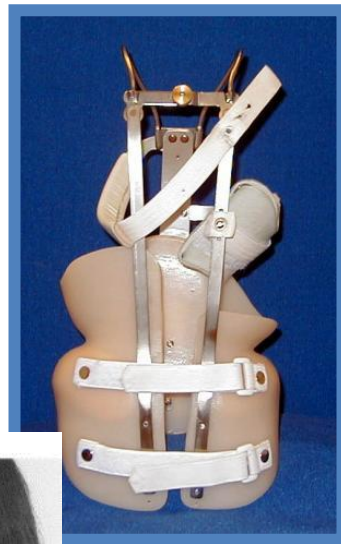
Boston Brace

Brace Types

Milwaukee Brace

Boston Brace

- a pelvic girdle, a suprastructure, and lateral supports
- applied



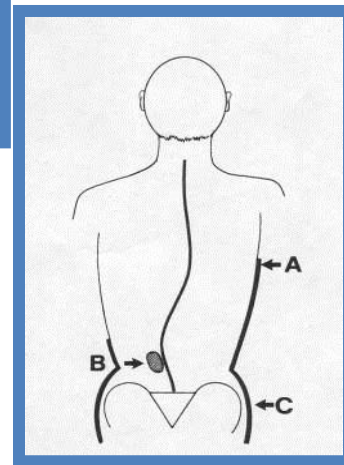
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Brace Types

Milwaukee Brace

Boston Brace

- individually constructed by an orthotist
- Most commonly used TLSO today
- apex at T7 or below



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Surgery

Goals

- reduce the magnitude of the deformity
- to obtain fusion to prevent future curve progression
- to do so safely

Should result in a well-balanced spine in which the patient's head, shoulders, and trunk are centred over the pelvis

Surgery

Indications

- $> 50^\circ$ at skeletal maturity
- Thoracolumbar and lumbar curves $>40^\circ$ to 45°
- Smaller curve with poor cosmesis

Treatment Guide

	Risser's Sign		
Curve Magnitude	Grade 0 /Premenarchal	Grade 1 or 2	Grade 3, 4, or 5
< 25°	Observation	Observation	Observation
30°-40°	Brace therapy - begin when curve is >25°	Brace therapy	Observation
>45°	Surgery	Surgery	Surgery - when curve is >50°

Conclusion

Main focus for the primary physician in the management of Common Congenital and Developmental Conditions in Paediatrics Orthopaedics are:

- Accurate diagnosis
- To determine or even assist in screening to change natural history for the better.



KK Women's and
Children's Hospital
SingHealth

Arjandas.Mahadev@singhealth.com.sg



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