

P08-01: PAEDIATRIC SECTION

# CEREBRAL PALSY











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# CEREBRAL PALSY (CP)






- a **BRAIN** disease with musculoskeletal pathology
- 2/1000 live births
- Heterogeneous disorder of movement and posture
- Characterized by changes in muscle tone, muscle weakness, involuntary movements, ataxia, or a combination
- **Three distinctive features common to all CP patients:**
  1. Some degree of motor impairment
  2. Insult to the developing brain
  3. A neurological deficit that is NONPROGRESSIVE

# THE "GMFCS" GROSS MOTOR FUNCTION CLASSIFICATION SYSTEM

| Level | Mobility                          | Equipment Needs  | Physical Ability*   |
|-------|-----------------------------------|--|---|
| I     | Walks without limitations         | <p><b>None</b></p> <p>Can walk, run, jump and move without limitations</p>   |       |
| II    | Walks with limitations            | <p><b>Minimal</b></p> <p>May require equipment when:</p> <ul style="list-style-type: none"> <li>• Learning to walk</li> <li>• Traveling long distances</li> </ul>      |     |
| III   | Walks with handheld equipment     | <p><b>Handheld</b></p> <ul style="list-style-type: none"> <li>• Canes, crutches and walkers</li> <li>• Wheeled devices for long distance</li> </ul>                    |   |
| IV    | Self-mobile with limitations      | <p><b>Total</b></p> <ul style="list-style-type: none"> <li>• Self mobility with power chairs</li> <li>• Assisted transportation</li> <li>• Sitting supports</li> </ul> |   |
| V     | Dependent on humans and equipment | <p><b>Extreme</b></p> <ul style="list-style-type: none"> <li>• Adaptive equipment</li> <li>• Assistive technology</li> <li>• Communication device</li> </ul>           |   |

\*The GMFCS does not take cognitive ability and IQ into consideration when determining ability. Cognitive function is a critical aspect of one's overall functional ability.

# GMFCS: CLINICAL IMPORTANCE

| Level |   | MEAN FEMORAL NECK ANTEVERSION (FNA) | MEAN FEMORAL NECK-SHAFT ANGLE (NSA) | RISK OF HIP DISLOCATION |
|-------|---|-------------------------------------|-------------------------------------|-------------------------|
| I     |    | 30                                  | 136                                 | SAME AS NORMAL          |
| II    |   | 36                                  | 141                                 | 15%                     |
| III   |  | 40                                  | 149                                 | 41%                     |
| IV    |  | 40                                  | 155                                 | 69%                     |
| V     |  | 40                                  | 163                                 | 90%                     |



# MOTOR DEVELOPMENT MILESTONE



1 month



2 months



3 months



4 months



5 months



6 months



7 months



8 months



9 months



10 months



11 months



12 months

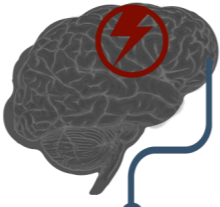
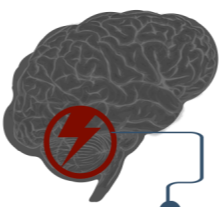
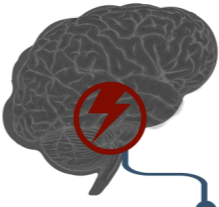
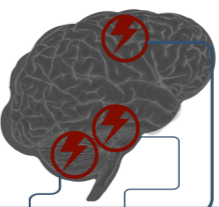
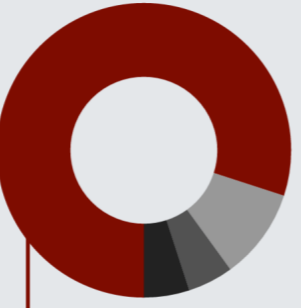


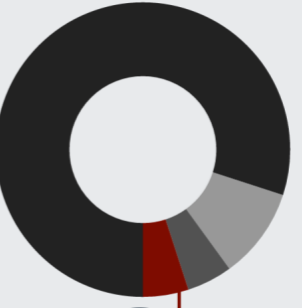
# GEOGRAPHIC CLASSIFICATION

## Limb Involvement Classification System Cerebral Palsy

| Type           | Monoplegia                                     | Hemiplegia   | Double Hemiplegia  | Diplegia  | Paraplegia                                      | Triplegia   | Quadriplegia   | Pentaplegia  |
|----------------|--|--|--|---|---|---|--|--|
| Affected Limbs | 1  | 2  | 4  | 4   | 2   | 3   | 4  | 5  |
| Description    | The one affected limb is most commonly the arm | The arm and leg of one side of the body are affected | Both arms and both legs are affected, although one side is more involved | Paralysis of corresponding parts on both sides of the body. The legs are typically impaired most. | The lower body is impaired, including both legs | Generally, the three affected limbs include both arms and one leg | Quadriplegia is most commonly associated with spastic CP | Both arms, both legs, the neck and head are affected |

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# MOTOR DISTURBANCE CLASSIFICATION

| Type                     | Spastic   | Ataxic  | Dyskinetic (Athetoid)   | Mixed   |
|--------------------------|---|---|---|---|
| Location of Brain Injury |  <p>Motor Cortex</p>  |  <p>Cerebellum</p>   |  <p>Basal Ganglia</p>                              |  <p>Mixed Regions</p>  |
| Prevalence               |  <p>80%</p>  |  <p>10%</p>   |  <p>5%</p>  |  <p>5%</p>  |
| Muscle Tone              | Hypertonia  | Hypotonia   | Mixed   | Mixed   |
| Associated Conditions    | <ul style="list-style-type: none"> <li>Involuntary movements</li> <li>Pain</li> <li>Spasms</li> <li>Hip Dislocation</li> <li>Contractures</li> <li>Joint Deformities</li> <li>Tightness</li> <li>Scoliosis</li> </ul> | <ul style="list-style-type: none"> <li>Poor Fine Motor Skills</li> <li>Postural Problems</li> <li>Tremors</li> <li>Hearing Impairment</li> <li>Visual Impairment</li> <li>Balance Problems</li> </ul> | <ul style="list-style-type: none"> <li>Difficulty Sitting</li> <li>Difficulty Walking</li> <li>Difficulty Grasping Objects</li> </ul> | <ul style="list-style-type: none"> <li>Different motor disturbances in different limbs</li> <li>Mixed muscle tone (hypertonia and hypotonia)</li> </ul> |

# RISK FACTORS

## PRENATAL

### MATERNAL

- SEIZURE DISORDER
- MENTAL RETARDATION
- PREVIOUS PREGNANT LOSS

### FETUS

- GENETIC DISORDER (MOST COMMON)

### PREGNANCY

- RH INCOMPATIBILITY
- POLYHYDRAMNIOS
- PLACENTAL RUPTURE
- DRUG OR ALCOHOL EXPOSURE

### EXTERNAL FACTORS

- TORCH SYNDROME

## PERINATAL (BIRTH-A FEW DAYS)

### DELIVERY

- BIRTH ASPHYXIA
- TRAUMA
- OXYTOCIN AUGEMENTATION
- ULBILICAL CORD PROLAPSE
- BREECH PRESENTATION
- LBW < 1500 G (INCIDENCE 60/1000)

FRAGILITY OF THE PERIVENTRICULAR VESSELS

## POSTNATAL

### HYPOXIC ISCHEMIC ENCEPHALOPATHY

- MECONIUM ASPIRATION
- PERSISTENT FETAL CIRCULATION

### INFECTION (GROUP B STREPTOCOCCUS & HERPES)

- ENCEPHALITIS
- MENINGITIS



SIGNIFICANT MOTOR DEVELOPMENT: AGE 2 YEARS

# PHYSICAL EXAMINATION



## OBSERVATION

- GAIT
- POSTURE
- SPINE DEFORMITY
- PELVIC OBLIQUITY
- TORSIONAL ABNORMALITIES

## SPECIAL TESTS

- TRENDELENBERGE
- SILVERSKIOD
- THOMAS
- STAHELI
- OBER
- DUNCAN-ELY

## ASSESSMENT

- SOFT TISSUE CONTRACTURE:  
ROM
  - HIP
  - KNEE
  - ANKLE
- TONE AND **REFLEX**
- SENSORY EVALUATION

# DIAGNOSIS

- History: prenatal, perinatal and post natal
- Developmental milestones
- Physical examination





## PROGNOSTIC FACTOR

# GOOD AND POOR PREDICTORS

### AMBULATION PREDICTION

- Independent ambulation: sitting independently by age 2 years
- unlikely Will ever walk without assistance: cannot sit independently by age 4 years
- Unlikely will ever walk at all: has not learned to walk by age 8 years

### BLECK'S POOR PROGNOSTIC SIGNS FOR WALKING

- An impossible asymmetrical tonic neck reflex
- Persistent Moro reflex
- Strong extensor thrust on vertical suspension
- Persistent neck-righting reflex
- Absence of normal parachute reaction after 11 month.

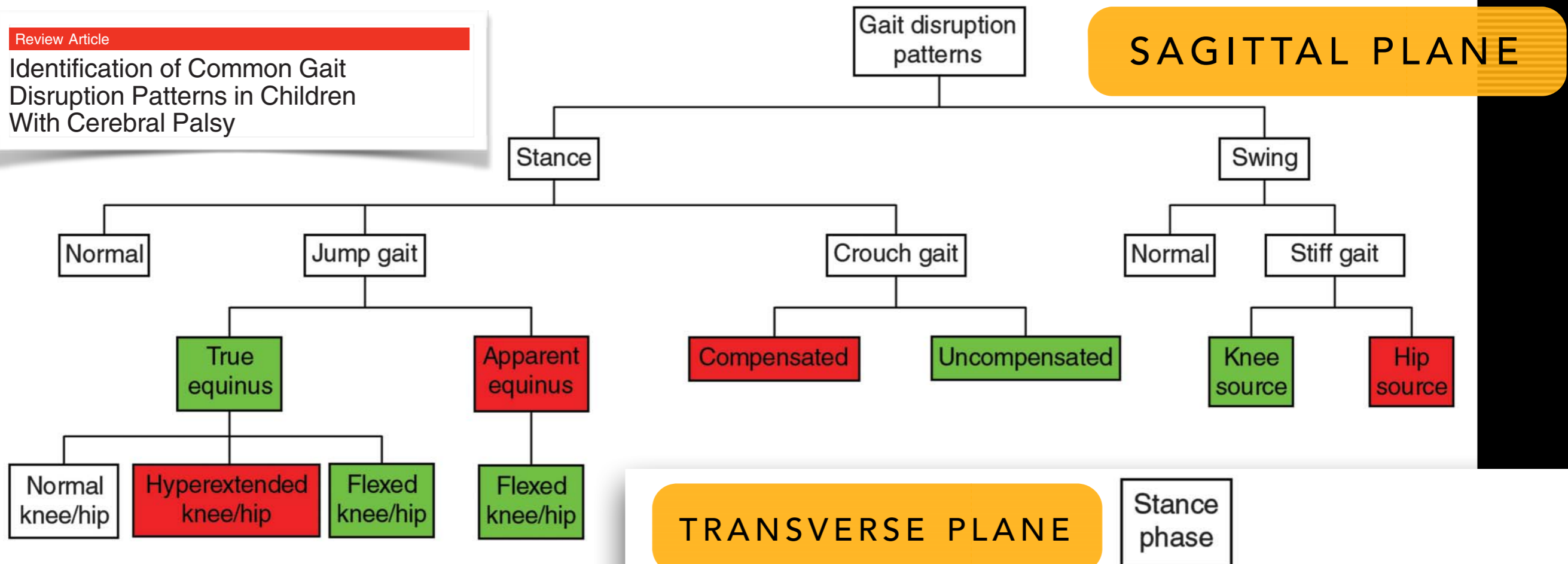
PERSISTENT OF PRIMITIVE RELEXES

## OBSERVATION I: GAIT

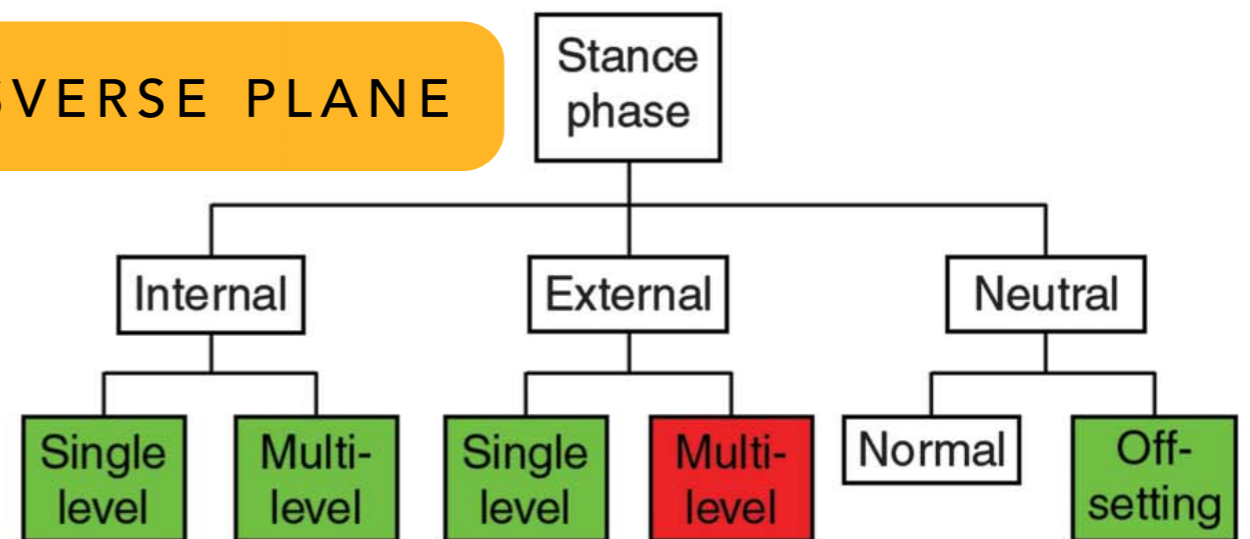
# GAIT PATTERN IN CP

Review Article

Identification of Common Gait Disruption Patterns in Children With Cerebral Palsy



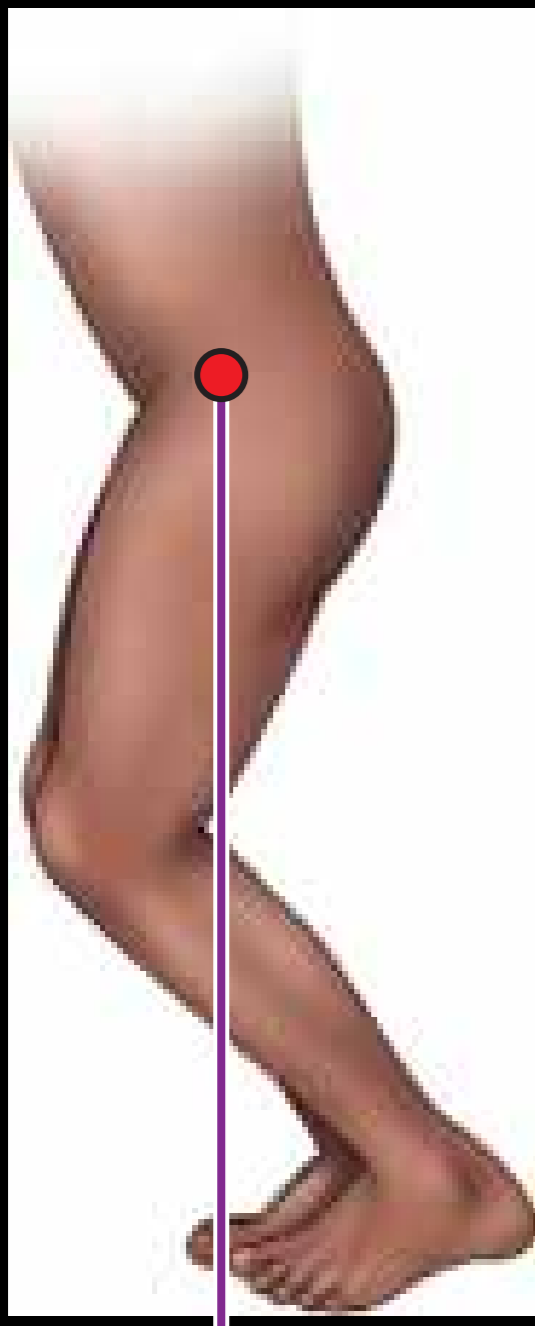
**TRANSVERSE PLANE**





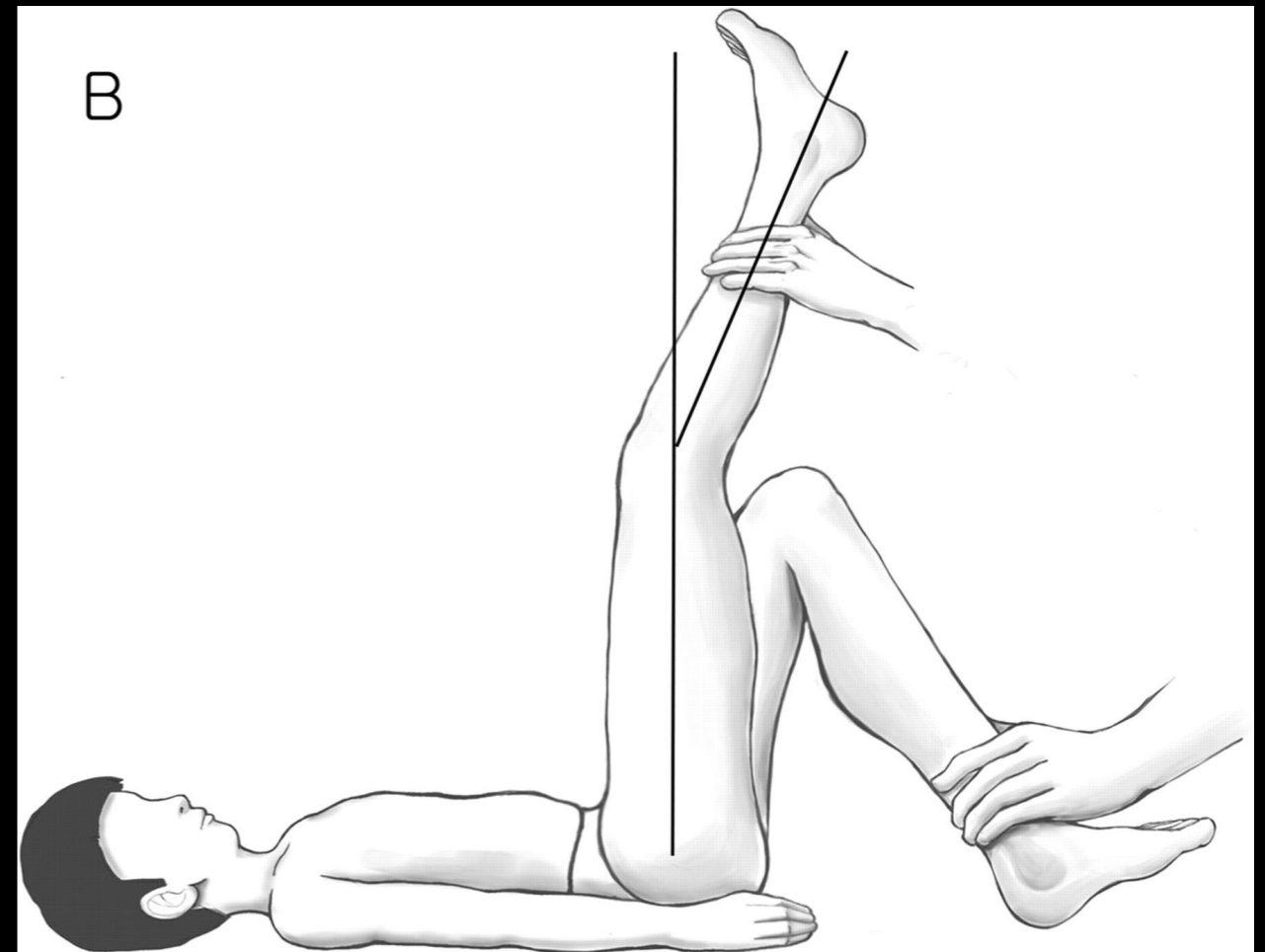
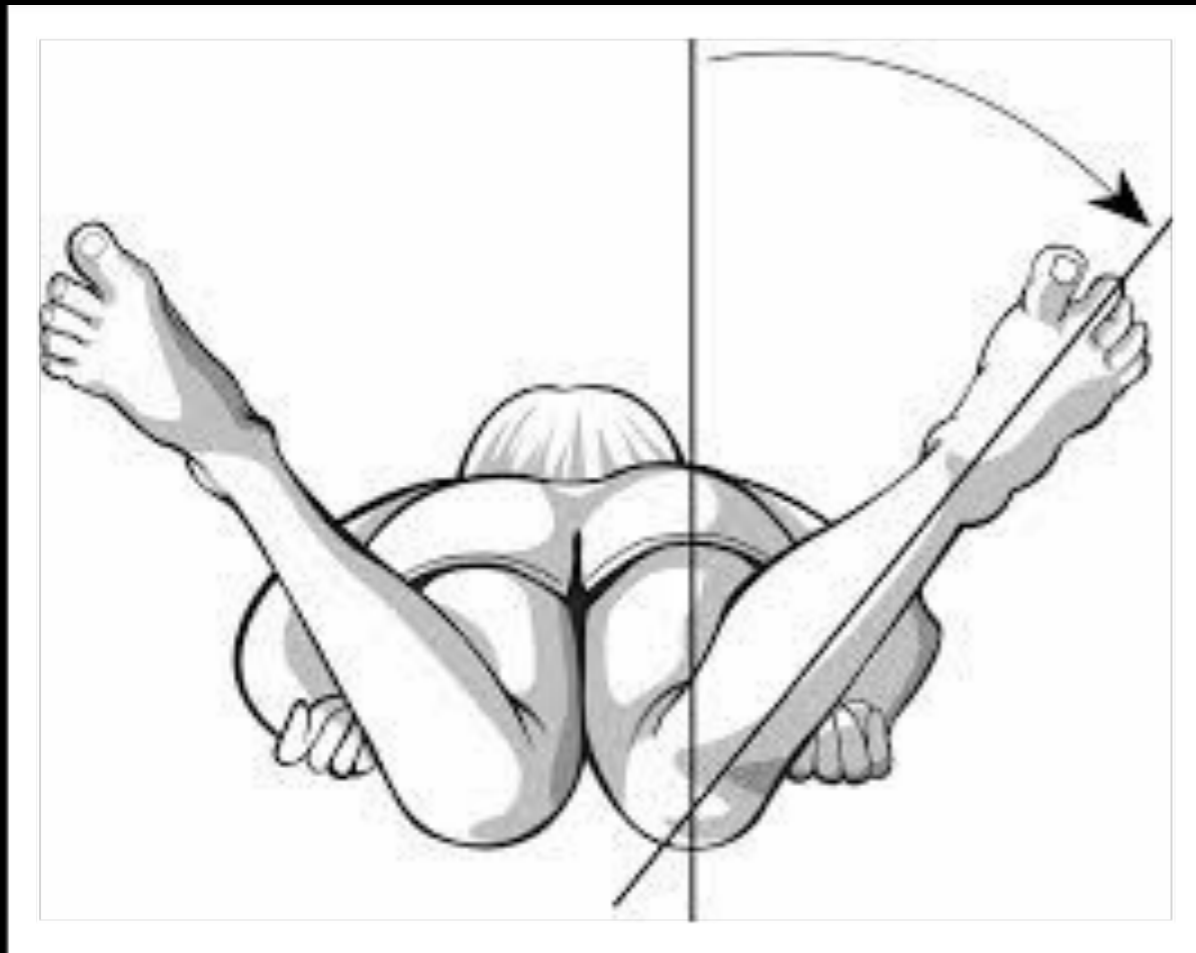
OBSERVATION

# POSTURE



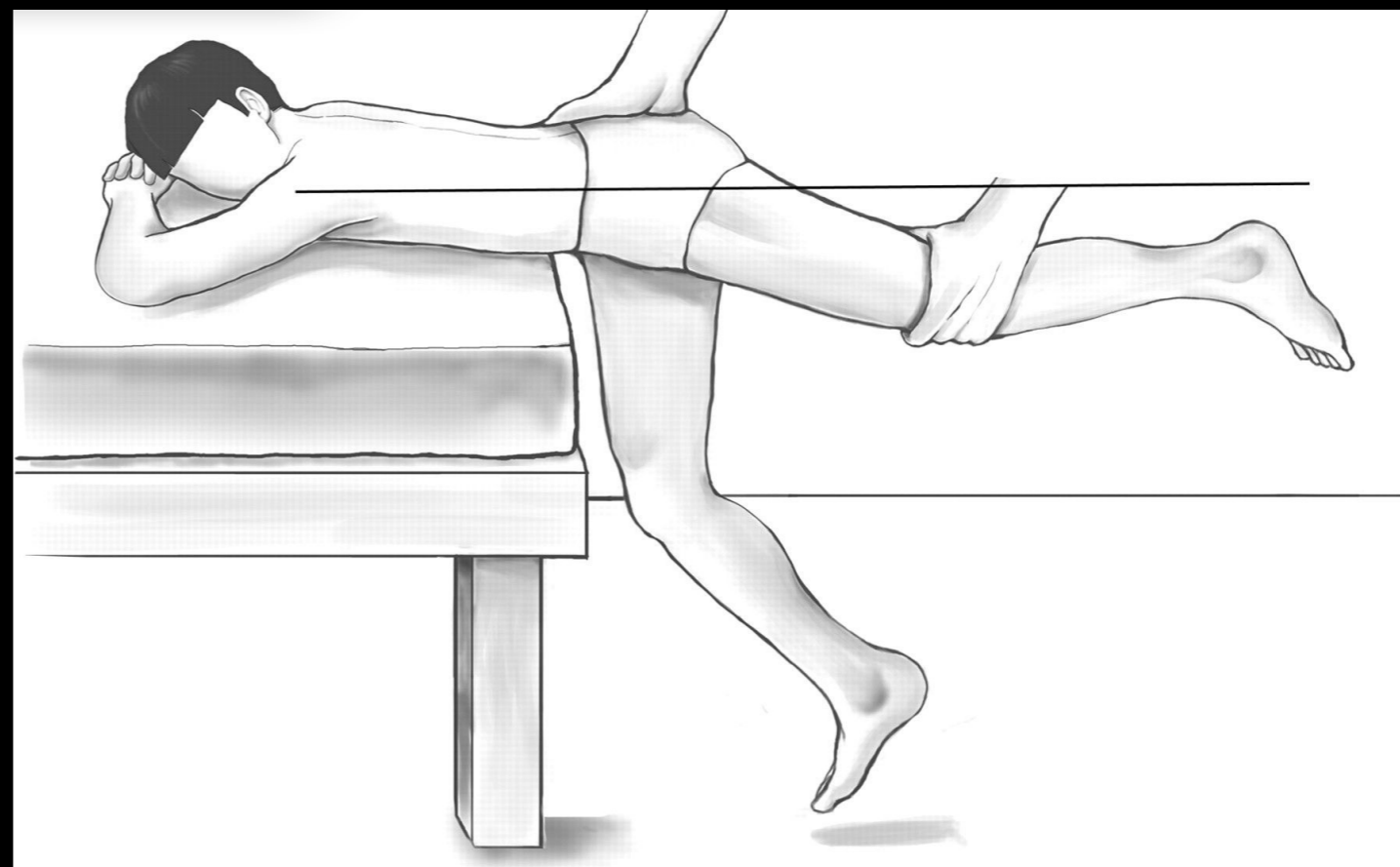
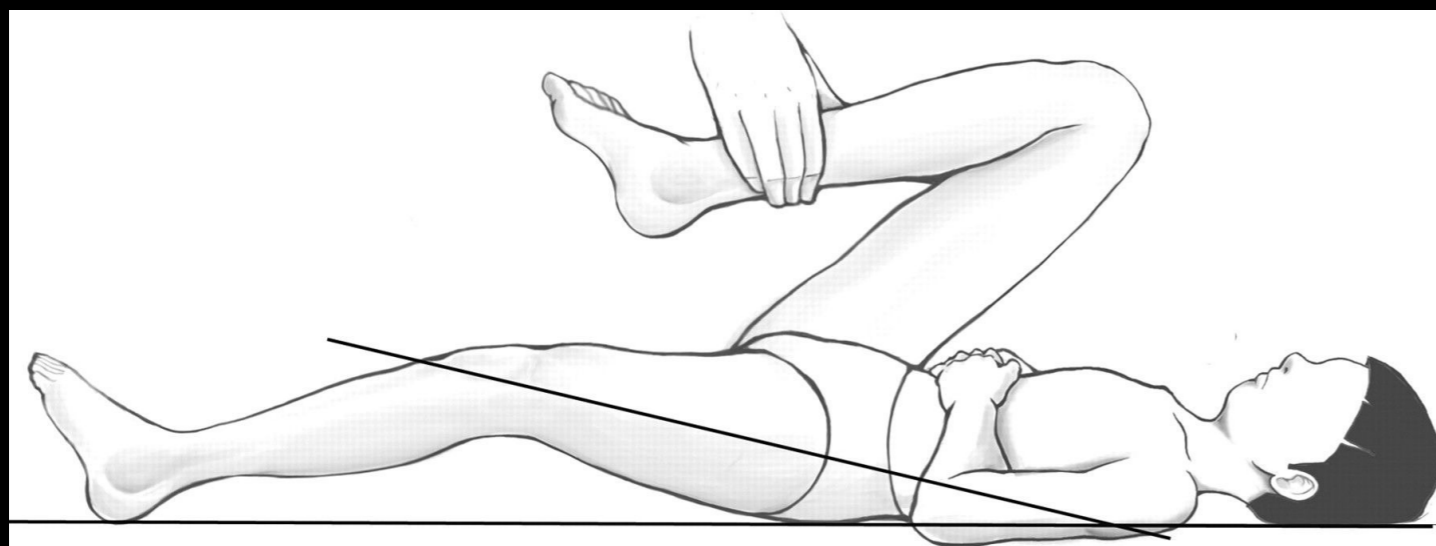
# RANGE OF MOTIONS

# FEMORAL ROTATION & POPLITEAL ANGLE



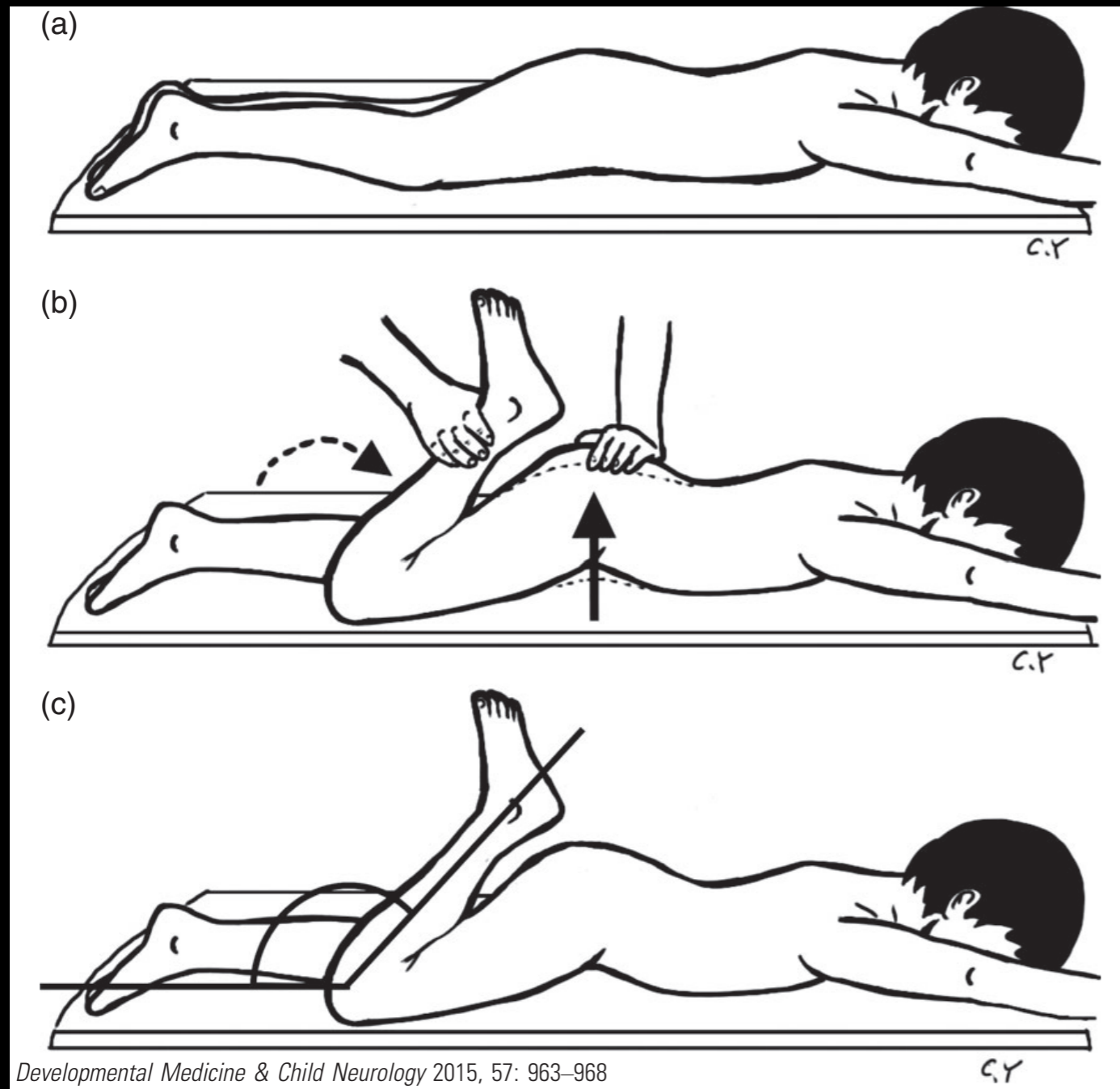
SPECIAL TESTS: FLEXION CONTRACTURE

# THOMAS AND STAHELII TESTS



## SPECIAL TEST: EXTENSION THIGHNESS

# DUNCAN-ELY TEST



### METHOD

A. PRONE POSITION

B. THE LOWER LEG IS BROUGHT INTO FLEXION

C. THE KNEE FLEXION ANGLE IS MEASURED

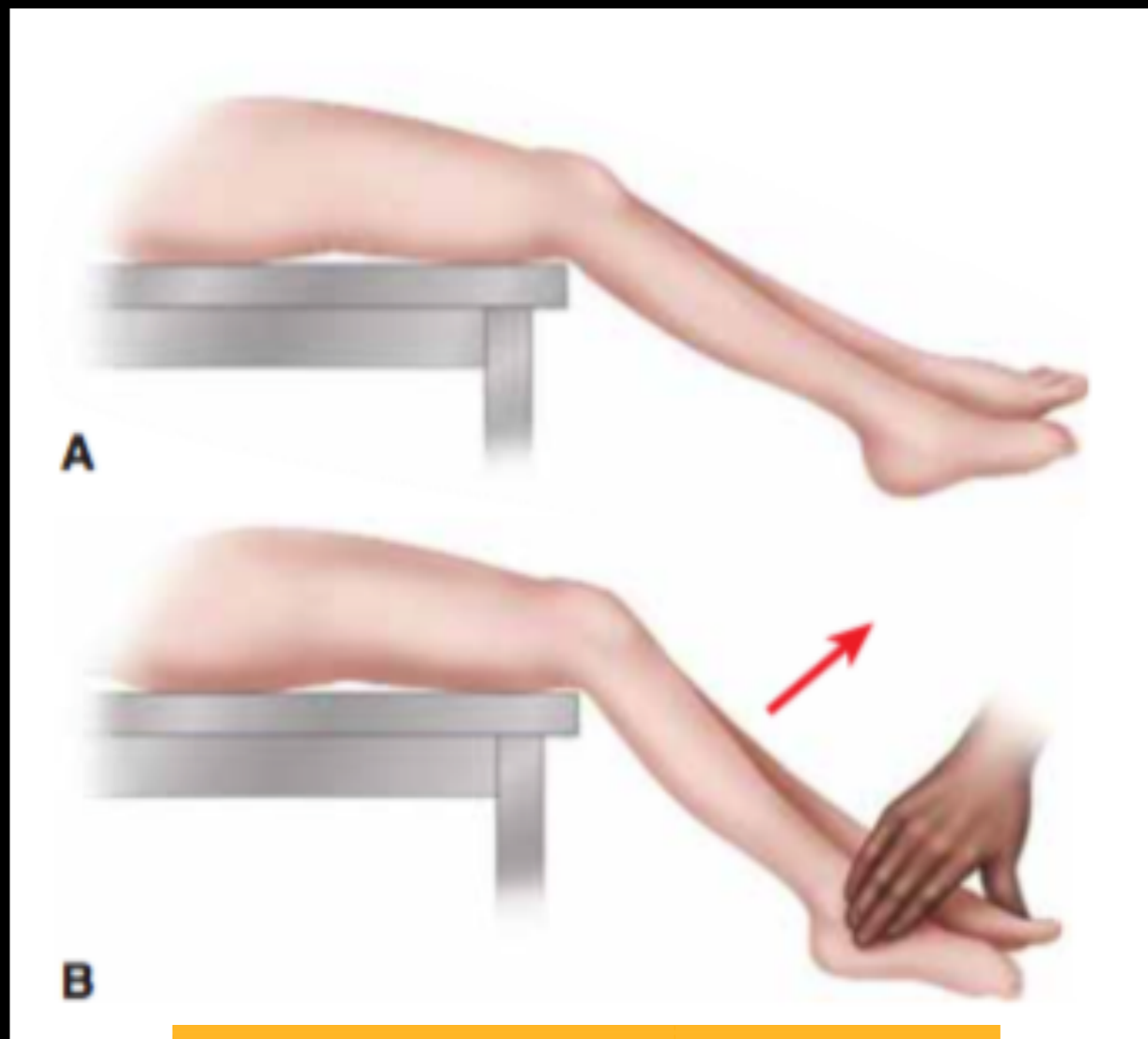
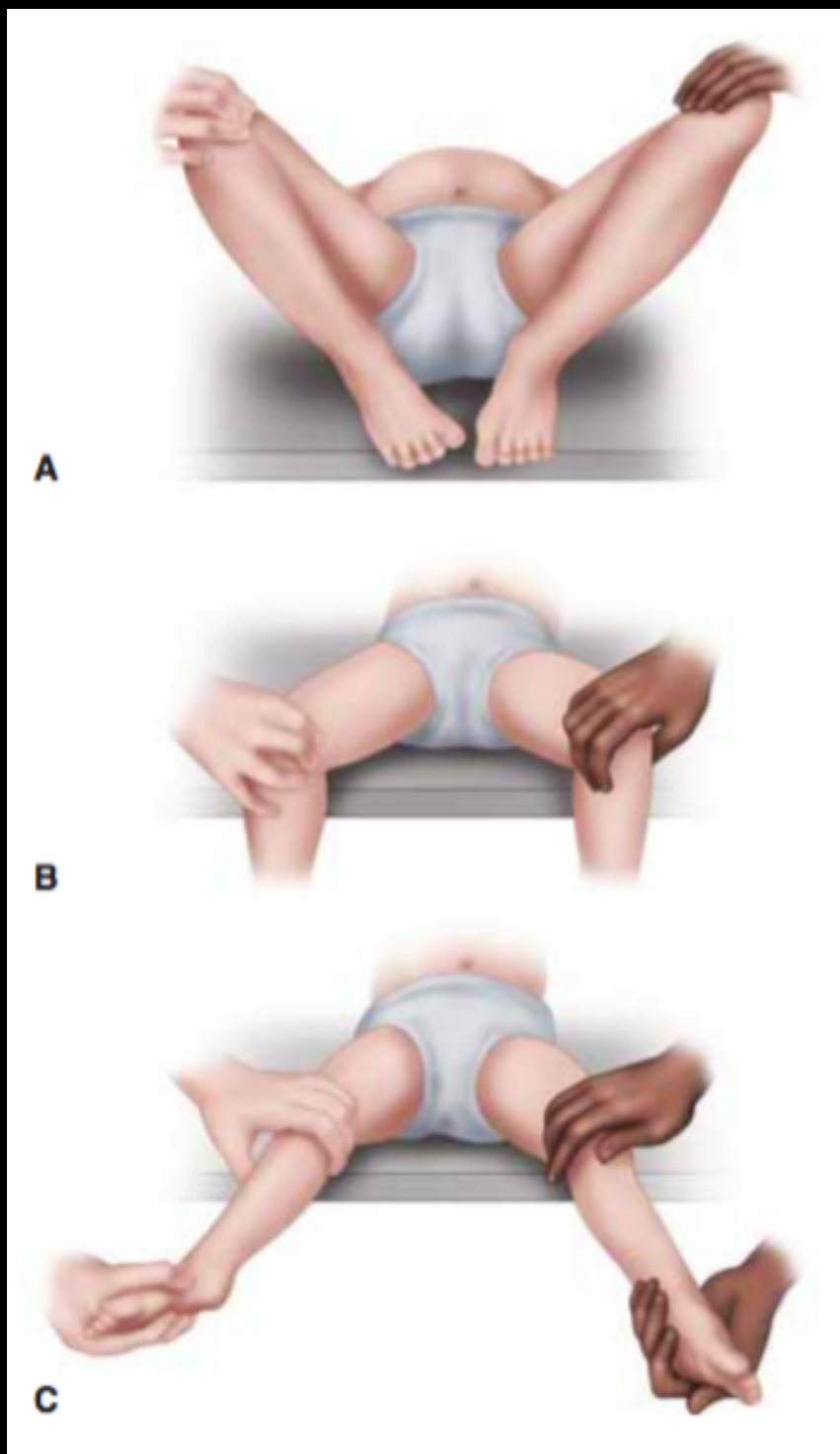
- The point at which the hip rises or resistance is felt by the examiner

### INTERPRETATION

- ASSESS RECTUS FEMORIS THIGHNESS

# SPECIAL TESTS

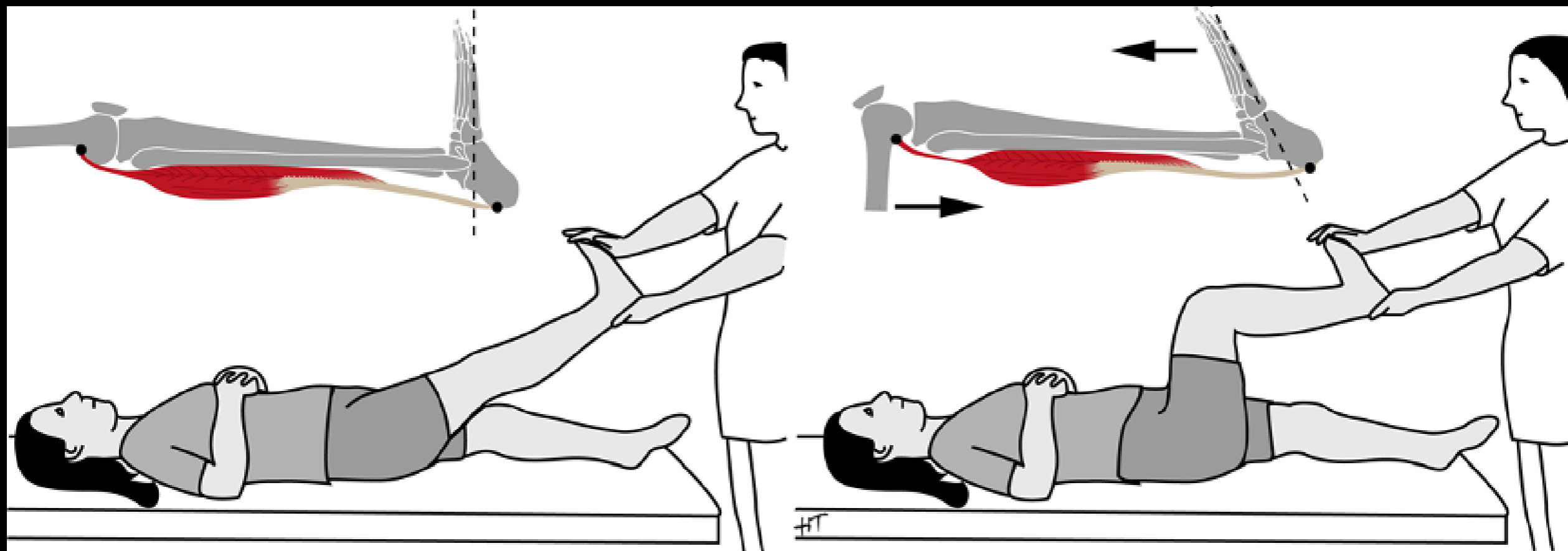
## ADDUCTOR AND MEDIAL HAMSTRINGS TIGHTNESS



**QUADRICEPS POWER**

SPECIAL TESTS

# SILFVERSKIOLD





# Normative reference values for lower limb joint range, bone torsion, and alignment in children aged 4–16 years

Table 4 Normative values for lower limb joint range of motion, bone torsion, and alignment in children aged 4–16 years

| Measures                      | Methods                              | Mean (SD) (deg.) | Range      | Correlated with age | Previously published norms |                               |
|-------------------------------|--------------------------------------|------------------|------------|---------------------|----------------------------|-------------------------------|
|                               |                                      |                  |            |                     | Age group (years)          | Passive ROM (deg.)            |
| Hip extension                 | Modified Thomas test<br>Staheli test | 12.5 (5.4)       | 4–24       | $r = -0.47^*$       | Not located                | Not located                   |
|                               |                                      |                  |            |                     | 6–17 [1]                   | 15 (6)                        |
|                               | Prone hip extension                  | 5–15 [16]        | 11.1 (3.7) |                     |                            |                               |
| Hip abduction                 | Hips and knees extended              | 37.7 (6.9)       | 24–58      | $r = -0.47^*$       | 6–10 [20]                  | Girls: 21 (5); boys: 19 (4)   |
|                               |                                      |                  |            |                     | 11–17 [20]                 | Girls: 22 (3); boys: 15 (5)   |
|                               |                                      |                  |            |                     | 8–16 [19]                  | Girls: 45–50 <sup>a</sup>     |
| Hip rotation                  | Hip extension, knee flexion          | 40.6 (6.0)       | 25–58      | $r = -0.40^*$       | 6–10 [20]                  | Girls: 51 (12); boys: 43 (12) |
|                               |                                      |                  |            |                     | 11–17 [20]                 | Girls: 44 (14); boys: 34 (10) |
|                               | Hips, knees flexed                   | 59.6 (9.0)       | 37–78      | $r = -0.66^*$       | Not located                | Not located                   |
|                               | Internal rotation                    | 57.6 (12.3)      | 24–87      | $r = -0.40^*$       | From 7 [8]                 | Girls: 40; boys: 50           |
|                               |                                      |                  |            |                     | 8–16 [19]                  | Girls: 50–60 <sup>a</sup>     |
| External rotation             | 48.1 (10.8)                          | 19–75            |            |                     | 6–10 [20]                  | Girls: 47 (11); boys: 42 (10) |
|                               |                                      |                  |            |                     | 11–17 [20]                 | Girls: 42 (9); boys: 36 (11)  |
|                               |                                      |                  |            |                     | From 7 [8]                 | 45 (25–65)                    |
|                               |                                      |                  |            |                     | 8–16 [19]                  | Girls: 50–57 <sup>a</sup>     |
|                               |                                      |                  |            |                     | 6–10 [20]                  | Girls: 45 (12); boys: 42 (12) |
| Femoral anteversion           | 26.9 (7.8)                           | 7–46             |            | $r = -0.60^*$       | 11–17 [20]                 | Girls: 44 (8); boys: 39 (11)  |
|                               |                                      |                  |            |                     | 8 [9,10,43]                | 20–25                         |
| Hamstring length              | Popliteal angle                      | 25.6 (10.5)      | 1–53       | $r = 0.29^{\#}$     | 14–16 [9,10]               | 16                            |
|                               |                                      |                  |            |                     | 6–16 [13]                  | 25                            |
|                               |                                      |                  |            |                     | 5–10 [14]                  | 26 (0–50)                     |
| Knee extension <sup>b</sup>   | True popliteal angle                 | 22.7 (10.3)      | 0–44       | $r = 0.29^{\#}$     | 5–15 [16]                  | 25.2 (9.9)                    |
|                               |                                      |                  |            |                     | 6–17 [1]                   | 30.7 (13.6)                   |
|                               |                                      |                  |            |                     | 5–15 [16]                  | 14.2 (7.6)                    |
| Knee valgus                   | Supine                               | 5 (3)            | 2–9        |                     | 2–8 [5]                    | Girls: 5.4; boys: 1.6         |
|                               |                                      |                  |            |                     | 9–19 [5]                   | Girls: 2.4; boys: 1.8         |
| Ankle dorsiflexion            | Knee flexed                          | 26.9 (6.6)       | 12–43      | $r = -0.38^*$       | 6–17 [1]                   | 3.6 (3.6)                     |
|                               |                                      |                  |            |                     | 4 [6]                      | 8                             |
|                               |                                      |                  |            |                     | 10–13 [6,7,11]             | 4–6                           |
|                               |                                      |                  |            |                     | 5–15 [16]                  | 23.8 (5.4)                    |
|                               |                                      |                  |            |                     | 7–14 [15]                  | 38–42 (21–61)                 |
| Knee extended                 | Knee extended                        | 21.3 (5.4)       | 9–42       | $r = -0.36^{\#}$    | 7–16 [1]                   | 21.5 (8.4)                    |
|                               |                                      |                  |            |                     | 2–8 [5]                    | 22–25                         |
|                               |                                      |                  |            |                     | 9–19 [5]                   | 16–23                         |
|                               |                                      |                  |            |                     | 7–14 [15]                  | 24–28 (5–50)                  |
|                               |                                      |                  |            |                     | 7–16 [1]                   | 8.6 (6.8)                     |
| Bimalleolar axis <sup>c</sup> | 16.0 (5.9)                           | 3–32             |            |                     | 5–15 [16]                  | 7.1 (4.4)                     |
|                               |                                      |                  |            |                     | From 7                     | 20 (0–45)                     |

All measures show means and SDs, with the exception of knee extension and knee valgus (median and interquartile range given).

ROM, range of motion.

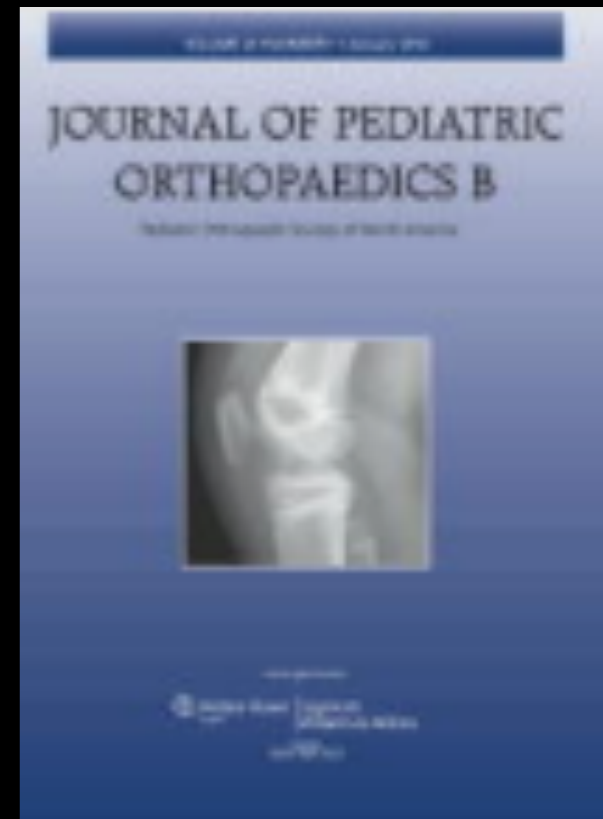
<sup>a</sup>Estimated from graph.

<sup>b</sup>Positive values = knee hyperextension; negative values = knee flexion.

<sup>c</sup>Positive values = external; negative values = internal.

\*Significant at  $P < 0.01$ .

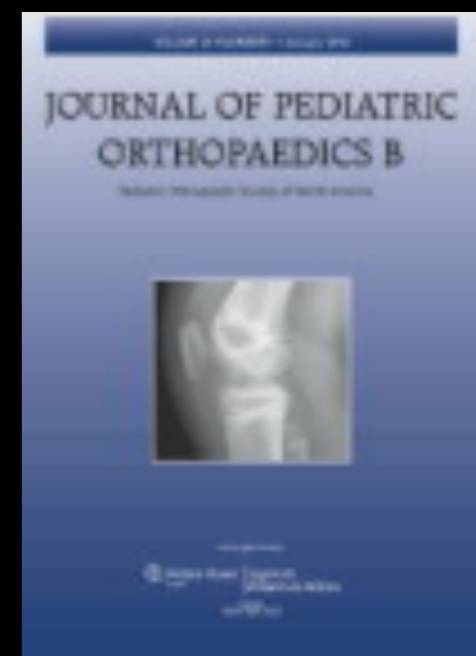
<sup>#</sup>Significant at  $P < 0.05$ .



# Normative reference values for lower limb joint range, bone torsion, and alignment in children aged 4–16 years

Anita J. Mudge<sup>a</sup>, Karen V. Bau<sup>a</sup>, Leanne N. Purcell<sup>a</sup>, Jenny C. Wu<sup>a</sup>, Matthias W. Axt<sup>a</sup>, Paulo Selber<sup>a,d</sup> and Joshua Burns<sup>a,b,c</sup>

Journal of Pediatric Orthopaedics B 2014, 23:15–25



**Table 5** Age group comparison values

| Measures                      | Methods                   | Mean (SD) (n=53) | 4–7 years (n=20) | 8–11 years (n=17) | 12–16 years (n=16) |
|-------------------------------|---------------------------|------------------|------------------|-------------------|--------------------|
| Hip extension                 | Modified Thomas test      | 12.5° (5.4)      | 15.0° (4.5)*     | 13.0° (6.4)       | 9.1° (3.4)         |
| Hip abduction                 | Hips and knees extended   | 37.7° (6.9)      | 42.1° (6.5)**    | 36.4° (4.8)       | 33.6° (6.4)        |
|                               | Hip extended, knee flexed | 40.6° (6.0)      | 43.6° (5.5)*     | 39.8° (5.4)       | 37.8° (5.8)        |
|                               | Hips and knees flexed     | 59.6° (9.0)      | 66.8° (7.1)**    | 57.2° (6.5)       | 53.1° (7.0)        |
| Hip rotation                  | Internal rotation         | 57.6° (12.3)     | 61.3° (12.4)*    | 61.2° (10.7)      | 49.0° (9.7)*       |
|                               | External rotation         | 48.1° (10.8)     | 49.5° (13.1)     | 44.1° (7.9)       | 50.5° (9.6)        |
| Femoral anteversion           |                           | 26.9° (7.8)      | 30.7° (5.9)*     | 29.1° (7.0)       | 19.7° (6.1)*       |
| Hamstring length              | Popliteal angle           | 25.6° (10.5)     | 21.7° (11.2)     | 27.8° (11.5)      | 28.1° (7.1)        |
|                               | True popliteal angle      | 22.7° (10.3)     | 18.8° (11.4)     | 24.8° (9.8)       | 25.0° (8.3)        |
| Knee extension <sup>a</sup>   |                           | 4° (5)           | 5° (4)*          | 4° (6)            | 1° (4)             |
| Knee valgus                   |                           | 5° (3)           | 5° (1)           | 5° (3)            | 6.5° (4)           |
| Ankle dorsiflexion            | Knee flexed               | 26.9° (6.6)      | 29.0° (6.0)*     | 27.4° (6.9)       | 23.7° (6.3)        |
|                               | Knee extended             | 21.3° (5.4)      | 22.9° (6.1)      | 21.9° (4.4)       | 18.8° (4.9)        |
| Bimalleolar axis <sup>b</sup> |                           | 16.0° (5.9)      | 15.8° (6.2)      | 14.3° (5.0)       | 17.9° (6.1)        |

All measures show means and SDs, with the exception of knee extension and knee valgus (median and interquartile range given).

<sup>a</sup>Positive values = knee hyperextension, negative values = knee flexion.

<sup>b</sup>Positive values = external, negative values = internal.

\*Significant difference at  $P < 0.01$  with the 12–16 years age group.

♦Significant difference at  $P < 0.05$  with the 12–16 years age group.

\*Significant difference at  $P < 0.01$  with the 8–11 years age group.



# ORTHOPAEDIC PROBLEMS

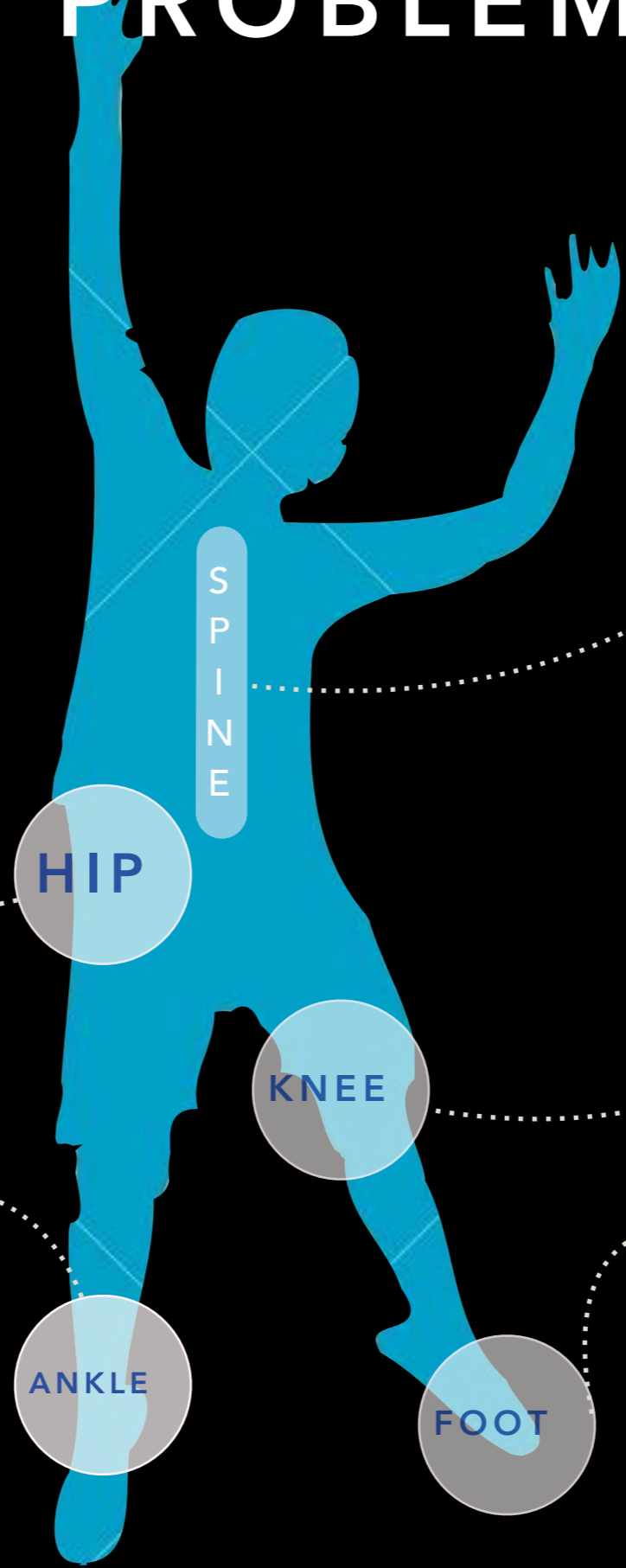
- FLEXION DEFORMITIES
- **ADDUCTION** DEFORMITIES
- **SUBLUXATION/DISLOCATION**

- **SCOLIOSIS**

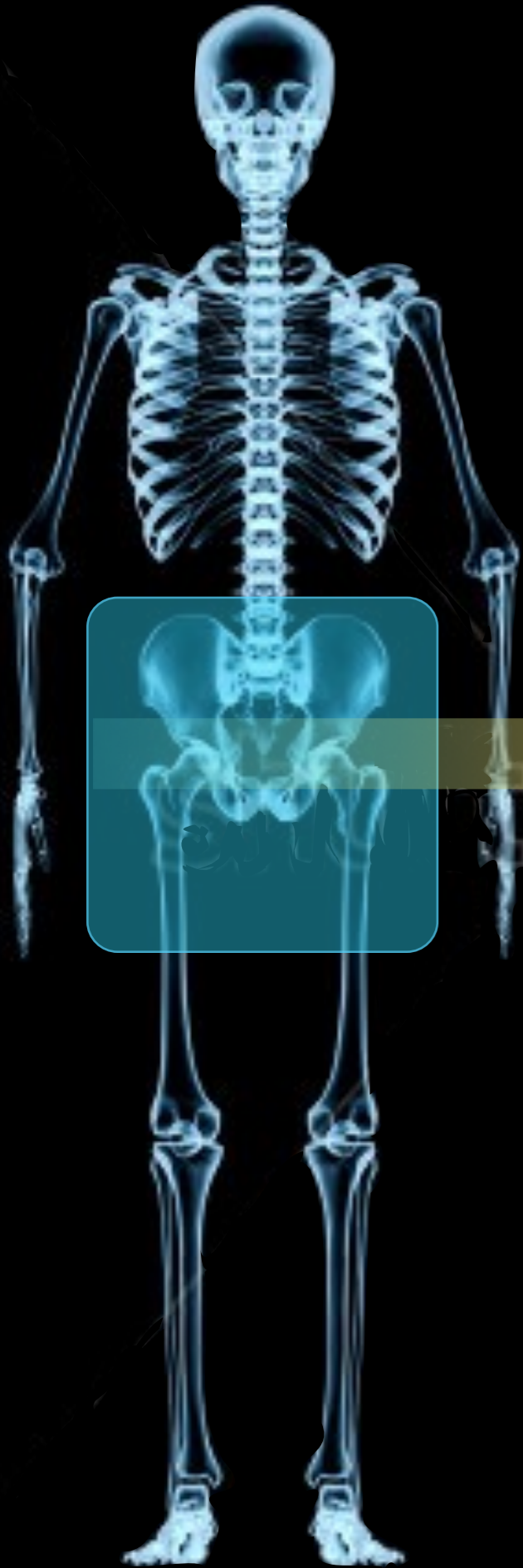
- **HAMSTRING** CONTRACTURE
- EXCESSIVE RECURVATUM

- **EQUINUS**: MOST COMMON DEFORMITY

- EQUINOPLANOVALGUS
- EQUINOVARUS
- CLAW TOES
- HALLUX VALGUS



# INVESTIGATION RADIOGRAPHIC STUDIES



PERKIN'S LINE

50

HILGENREINER LINE

A

B

**REIMER'S INDEX (MIGRATION  
PERCENTAGE, MP)**

- $(A/B) \times 100$
- NORMAL: <5%
- >33%: SUBLUXATION
- >100%: DISLOCATION

# INVESTIGATION RADIOGRAPHIC STUDIES

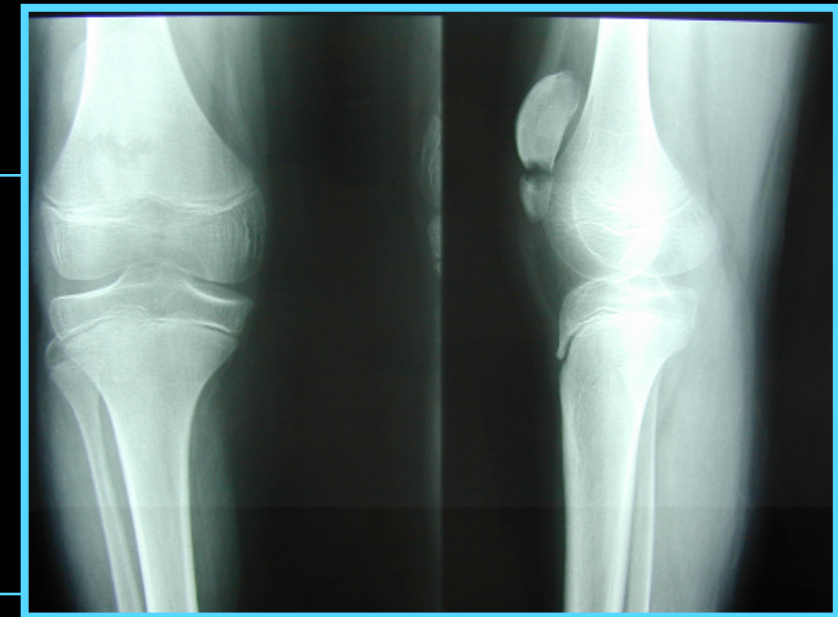


## SPINE

- WATCH FOR SCOLIOSIS IN GMFCS 4 AND 5

## KNEE

- PERSISTENT CROUCH AND RECTUS FEMORIS SPASTICITY
- FATIGUE FRACTURE OF THE PATELLA

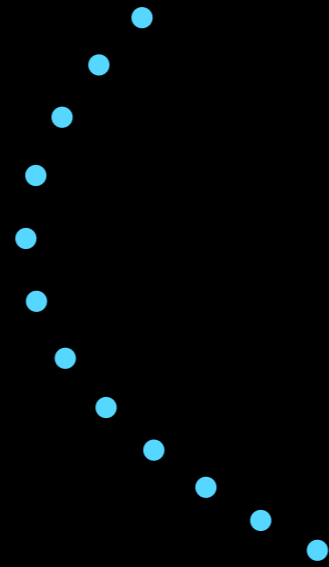


## FOOT-ANKLE

- EQUINOVALGUS
- VARUS



**T**TREATMENTS



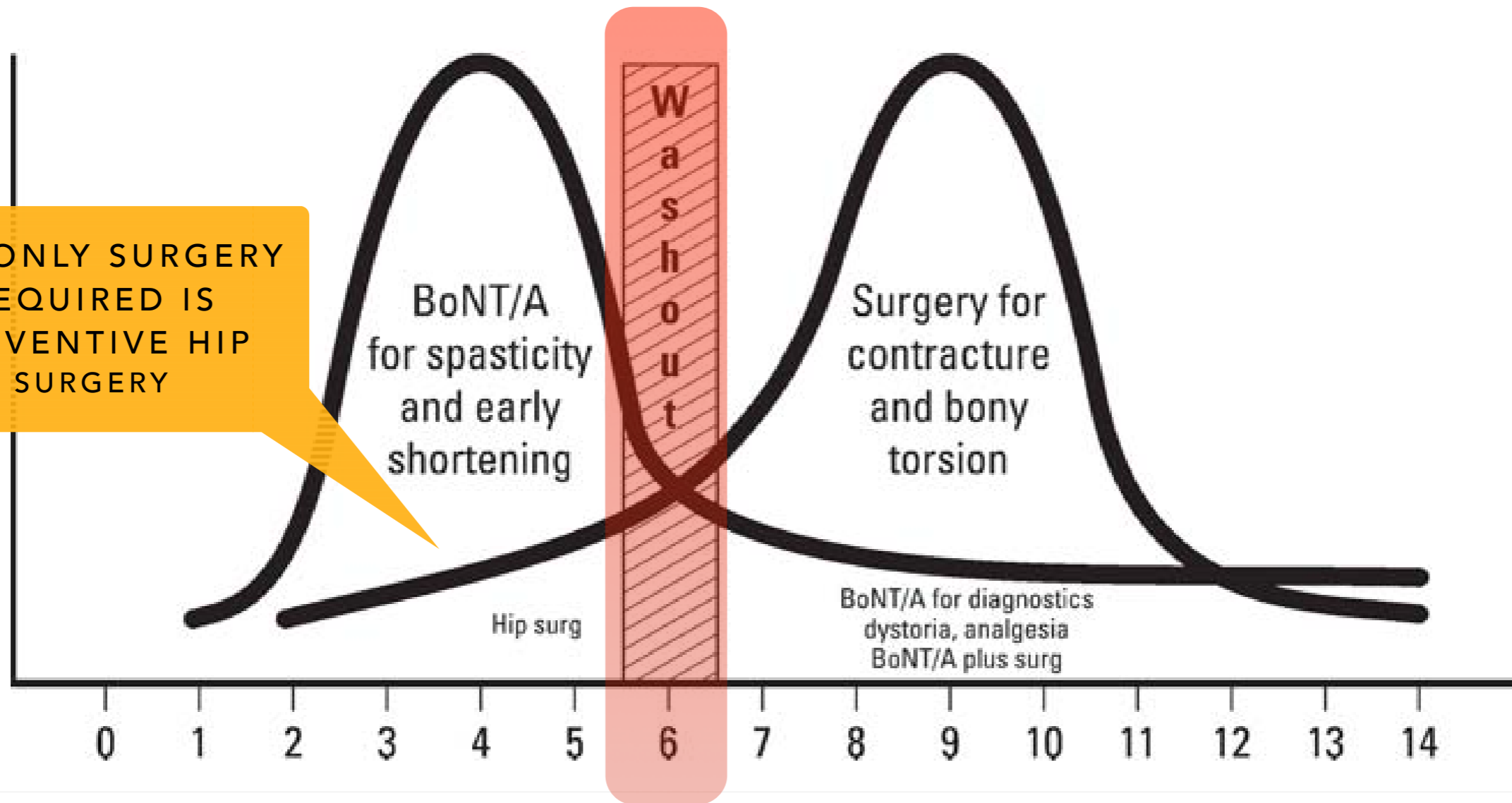
**MULTI**DISCIPLINARY APPROACH

# CP MUSCULOSKELETAL MANAGEMENT

## GENERAL ALGORITHM

### CP: Musculoskeletal Management Algorithm

THE ONLY SURGERY  
REQUIRED IS  
PREVENTIVE HIP  
SURGERY





# CONSERVATIVE TREATMENT

- Should be a primary or conjunctive with surgery

## MEDICATIONS

- BACLOFEN
  - SYSTEMIC
  - INTRATHECAL
- DIAZEPAM
- DANTROLENE
- BOTULINUM TOXIN

## REHABILITATION

- STRETCHING EXERCISE
- BRACING

## ROLE OF ORTHOPAEDIC SURGEON (LORI A.KAROL, 2015)

- **Early:** Diagnosis, information
- **Young children:** orthotics, walking aids, tone management
- **School age children:** possible tendon or bone surgery in ambulatory patients
- **Nonambulators:** hip surgery, scoliosis management

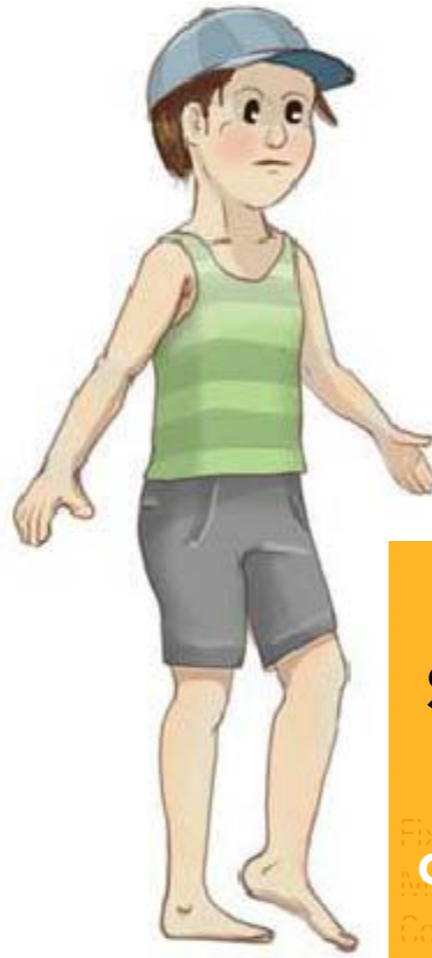
# "PROGRESSIVE" MUSCOLOSKELETAL PATHOLOGY

## STAGE OF PROGRESSION



**STAGE I**  
Spastic  
No fixed  
contracture

- Physical Therapy
- Orthotics
- Botulinum Neurotoxin A



**STAGE II**  
Fixed  
contracture

- Tendon Lengthening



**STAGE III**  
Fixed  
contracture  
Bony  
deformities

- Tendon Lengthening
- Rotational Osteotomies
- Arthrodeses

# PRINCIPLE OF SURGERY

## General reason for surgery

- **Contracture** resulting in decrease function, pain or interfere with daily living activities
- To improve gait in ambulatory school-age child
- GMFCS worsening in early adolescence

## OPERATIVE TREATMENT PROCEDURES

1. CORRECT STATIC OR DYNAMIC DEFORMITY
2. BALANCE MUSCLE POWER ACROSS A JOINT
3. REDUCE SPASTICITY (NEURECTOMY)
4. STABILIZE UNTROLLABLE JOINTS



AVOID "BIRTH DAY SURGERY"



# BIRTHDAY SYNDROME & SEMLS

## SINGLE EVENT MULTILEVEL SURGERY

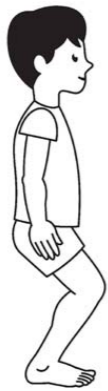
### Birthdays Syndrome: Mercer Rang

? TAL

? HS

? Psoas

? Rectus femoris



Equinus

Crouch

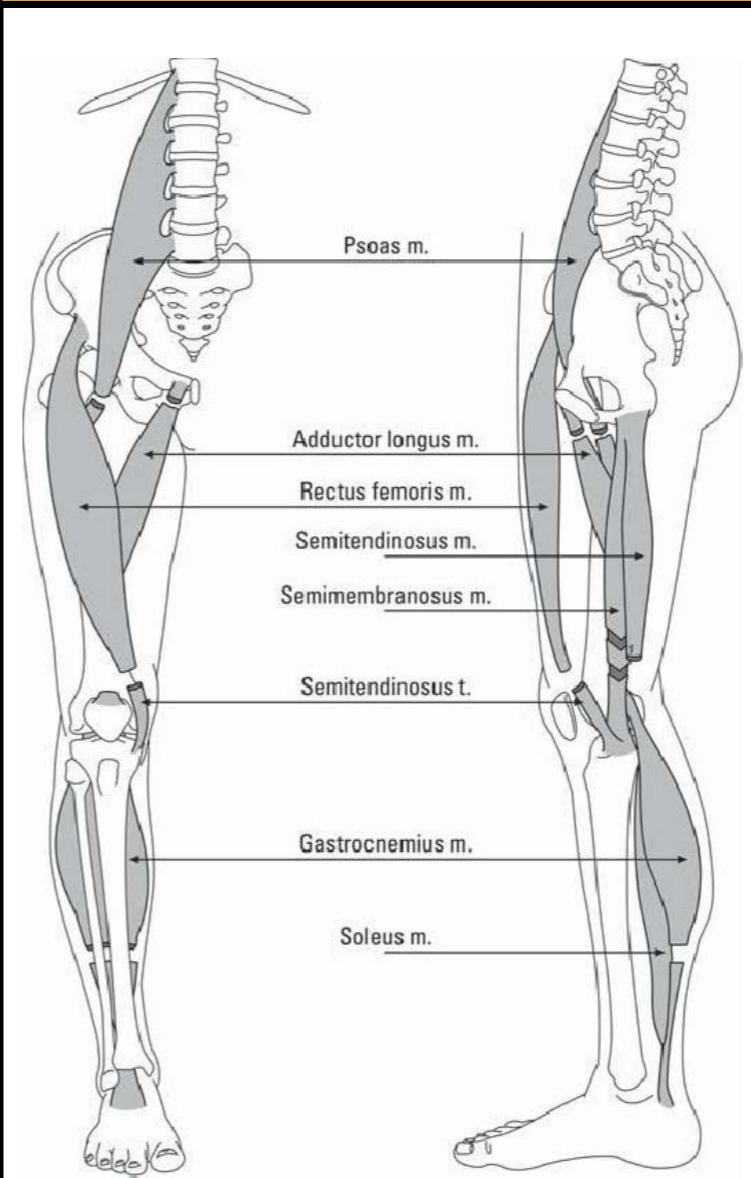
Flexion

Stiff knee

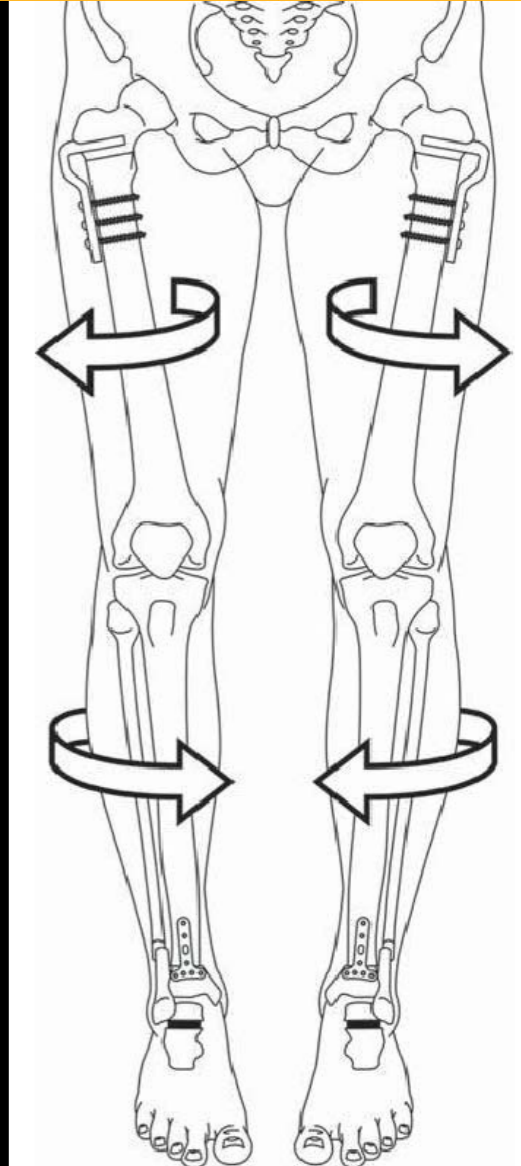
Okay

MULTIPLE PROCEDURES PERFORMED AT DIFFERENT TIMES

### MULTIPLE PROCEDURES PERFORMED AT ONE TIME



SOFT TISSUE



BONE

## SURGICAL MANAGEMENT

# HIP: ADDUCTION DEFORMITIES

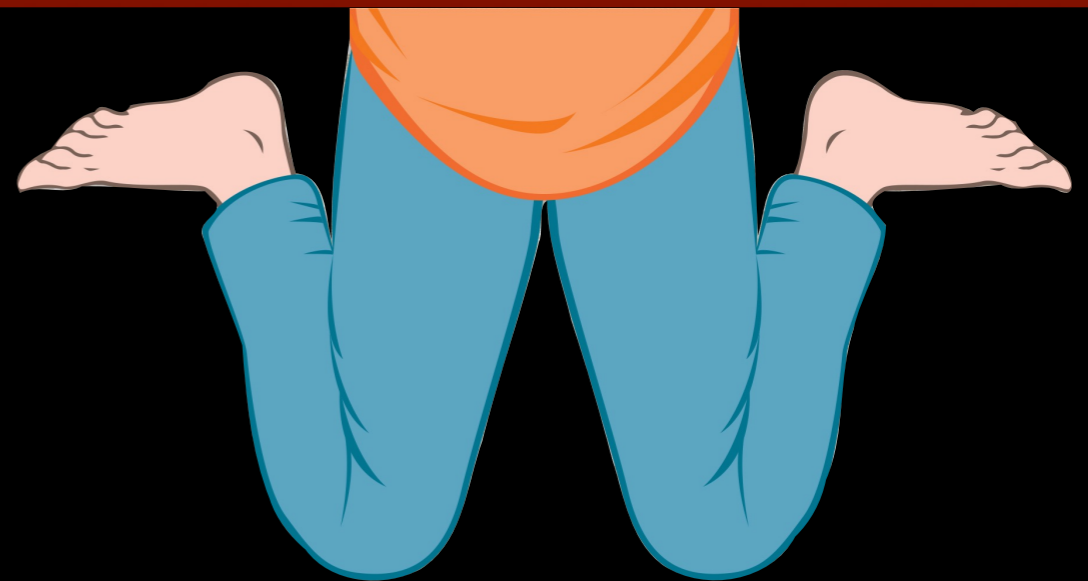
The most common deformity of the hip in children with CP causing;

- Scissoring gait
- Hip subluxation
- Difficulty with perineal hygiene

Procedures: adductor tenotomy and release

- Usually bilateral preventing "windswept" pelvis
- AVOIDS NEURECTOMY !!!
- Immediate PT program and abduction bracing after surgery

Don't be confused with  
**"PSEUDOADDUCTION"**  
(FLEXION-INTERNAL ROTATION DEFORMITY)



# ADDUCTOR TENOTOMY & RELEASE

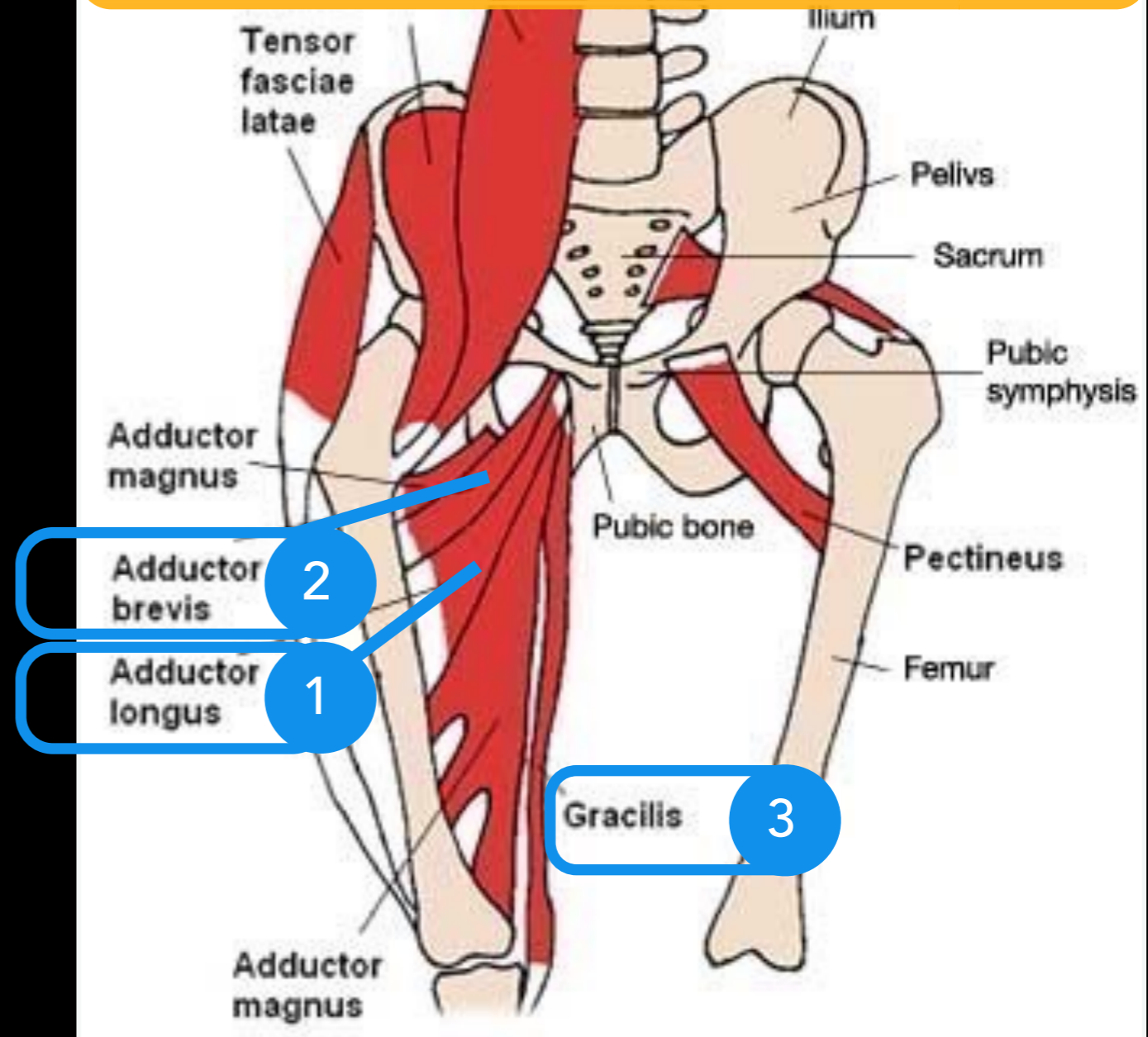
- **Indications**

1. Mild contracture (scissoring gait or early hip subluxation)
2. Younger than 8 yrs (preferably < 4 yrs)
3. Abduction < 30 degree
4. MP < 50%

- **Postoperative care**

- Abducted position for 1 month (LLC, brace)

**Goals:** restoration > 60 degrees with the hip flexed & 45 degrees with the hips extended



# HIP: FLEXION DEFORMITIES

## Crouched gait and posture

- Flexion of the hip with or without flexion contracture around the hip, knee, and ankle
- **Compensated by**
  - Lumbar lordosis
  - Knee flexion
  - Ankle DF

## Procedures:

1. Iliopsoas recession
2. Iliopsoas release

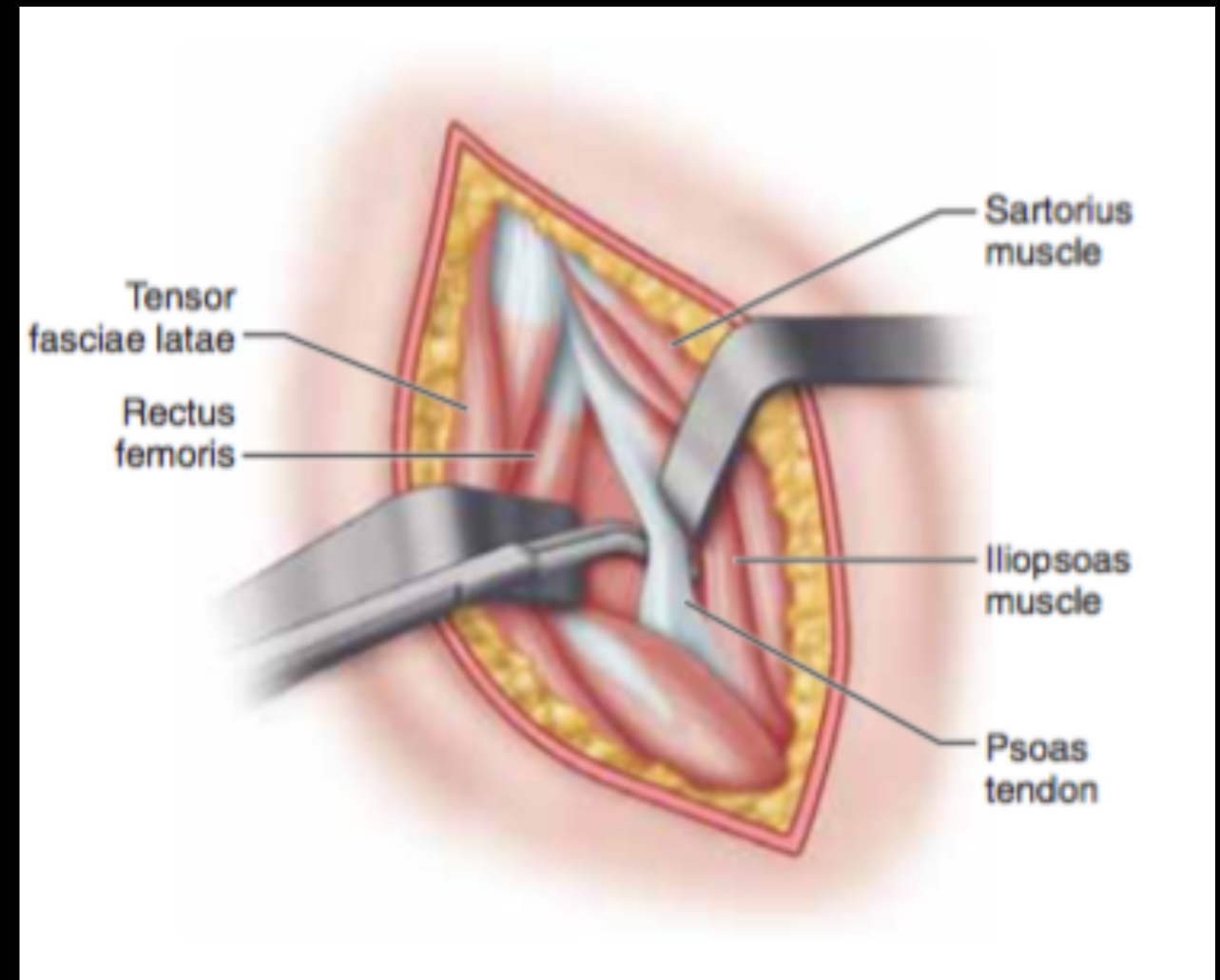
# ILIOPSOAS PROCEDURES

## 1. Iliopsoas recession

- Psoas lengthening procedure through an intramuscular recession over the pelvic brim
- **Indications:**
  - **Ambulatory** child
  - Hip IR during walking
  - Flexion contracture 15-30 degrees
  - More extensive release if > 30 degrees contracture

## 2. Iliopsoas release at the lesser trochanter

- Better for **nonambulatory** patients
- Risk of excessive hip flexion weakness





# HIP: SUBLUXATION

## Hip at risks

- Flexion contracture  $> 20$  degrees
- Abduction  $< 30$  degrees
- Increased neck-shaft angle
- Increased femoral anteversion
- Acetabular dysplasia
- **Abnormal migration index**
  - Hip subluxation when **MP**  $> 33\%$
  - Ineffective of nonoperative treatments

## Surgical Management

### 1. Soft tissue procedures

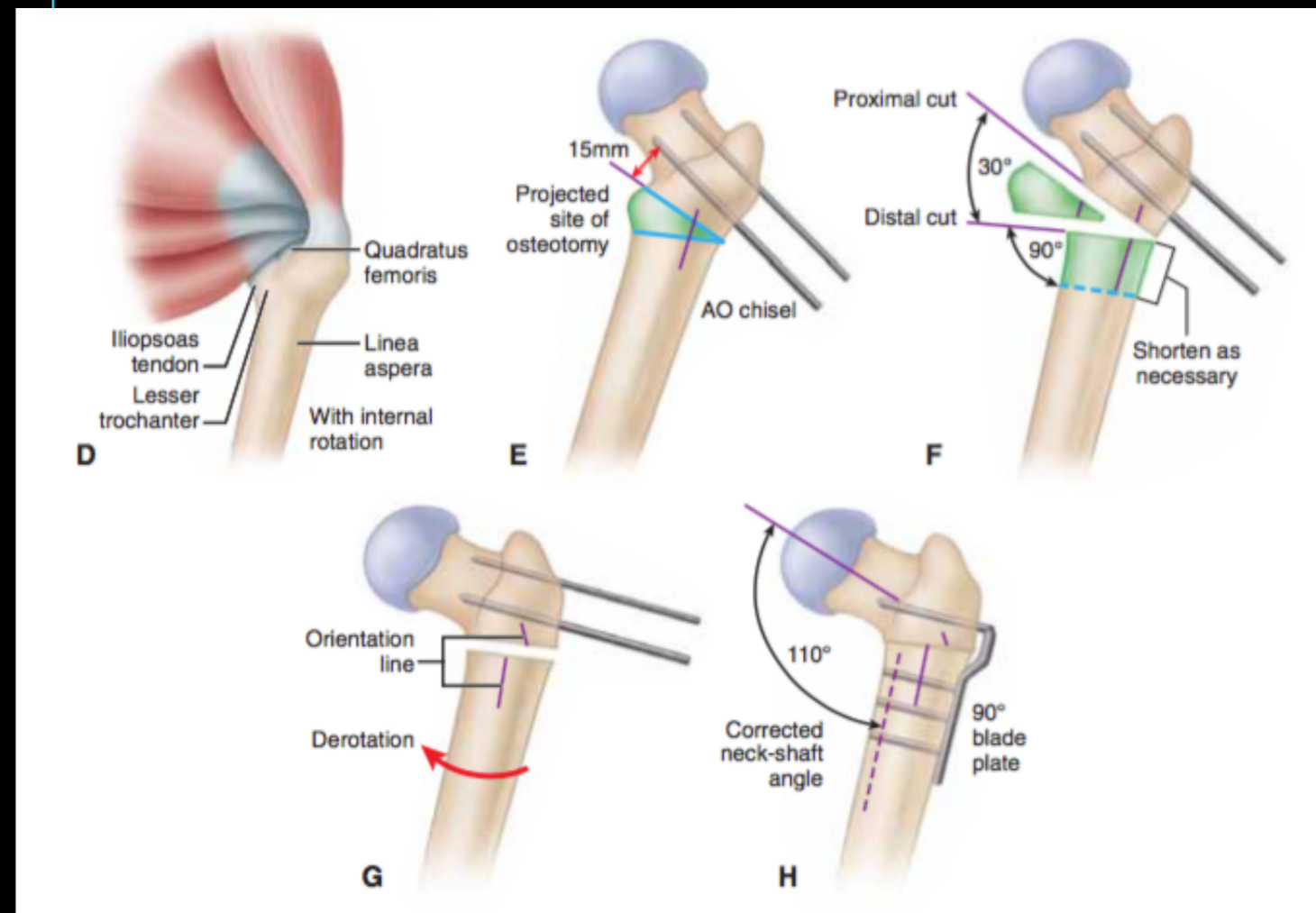
1. Adductor release
2. Adductor transfer

### 2. Bony procedures

- VDRO and shortening
- Acetabular osteotomies
  - Dega osteotomy
  - Shelf procedure

# SURGICAL MANAGEMENT FOR HIP SUBLUXATION: **VDRO** **V**ARUS **D**EROTATIONAL (ER) **O**STEOTOMY

- For excessive anteversion
- Often combined with soft tissue release and femoral shortening
- To reduce anteversion and the neck-shaft angle to 115 degrees in ambulators
- **Complications**
  - Recurrence
  - Risk of AVN related to age and MP
  - Decubitus ulcers and Fx in high GMFCS



# HIP: DISLOCATION

- Common in CP, especially in quadriplegics
- Related to high GMFCS level
- Typically, **superolateral dislocation**
- **Posterosuperior acetabular deficiency**
- Poor remodeling potential of the acetabulum

## **Drummond et al: 4 criterias for open reduction**

1. **Moderately mature intellectual**
2. **At least sitting potential**
3. **Minimal or corrected pelvic obliquity**
4. **Unilateral dislocation**

**Goals:** improvement in quality of life, pain relief and improved hip motion



# SURGICAL MANAGEMENT SPASTIC VS DEVELOPMENTAL DYSPLASIA OF THE HIP

**Table 1**  
**Comparison of Spastic Hip Dysplasia and Developmental Dysplasia of the Hip**

| Factor                          | Spastic Hip Dysplasia  | Developmental Dysplasia of the Hip  |
|---------------------------------|--|---|
| Findings at birth               | Hip usually normal   | Hip usually abnormal  |
| Age at risk                     | Usually normal in the first year of life; recognized after age 2 yr                        | Most often recognized in the first year of life                                 |
| Detection                       | Radiographs needed in most cases   | Physical examination in most cases  |
| Etiology                        | Spastic muscles drive femoral head out of an otherwise normal acetabulum, pelvic obliquity | Mechanical factors (eg, breech), ligamentous laxity, abnormal acetabular growth |
| Childhood progression           | Progressive subluxation common   | Progressive subluxation rare  |
| Natural history                 | Pain in many subluxated or dislocated hips by second or third decade                       | Pain in many subluxated hips by fourth or fifth decade                          |
| Acetabular deficiency           | Usually posterosuperior  | Usually anterior  |
| Early measures                  | Muscle lengthening   | Pavlik harness or closed reduction  |
| Missed or failed early measures | Hip osteotomies, often without open reduction  | Closed or open reduction, often without osteotomies (before age 18 mo)          |
| Salvage                         | Castle procedure osteotomy, interposition arthroplasty                                     | Usually total hip replacement   |

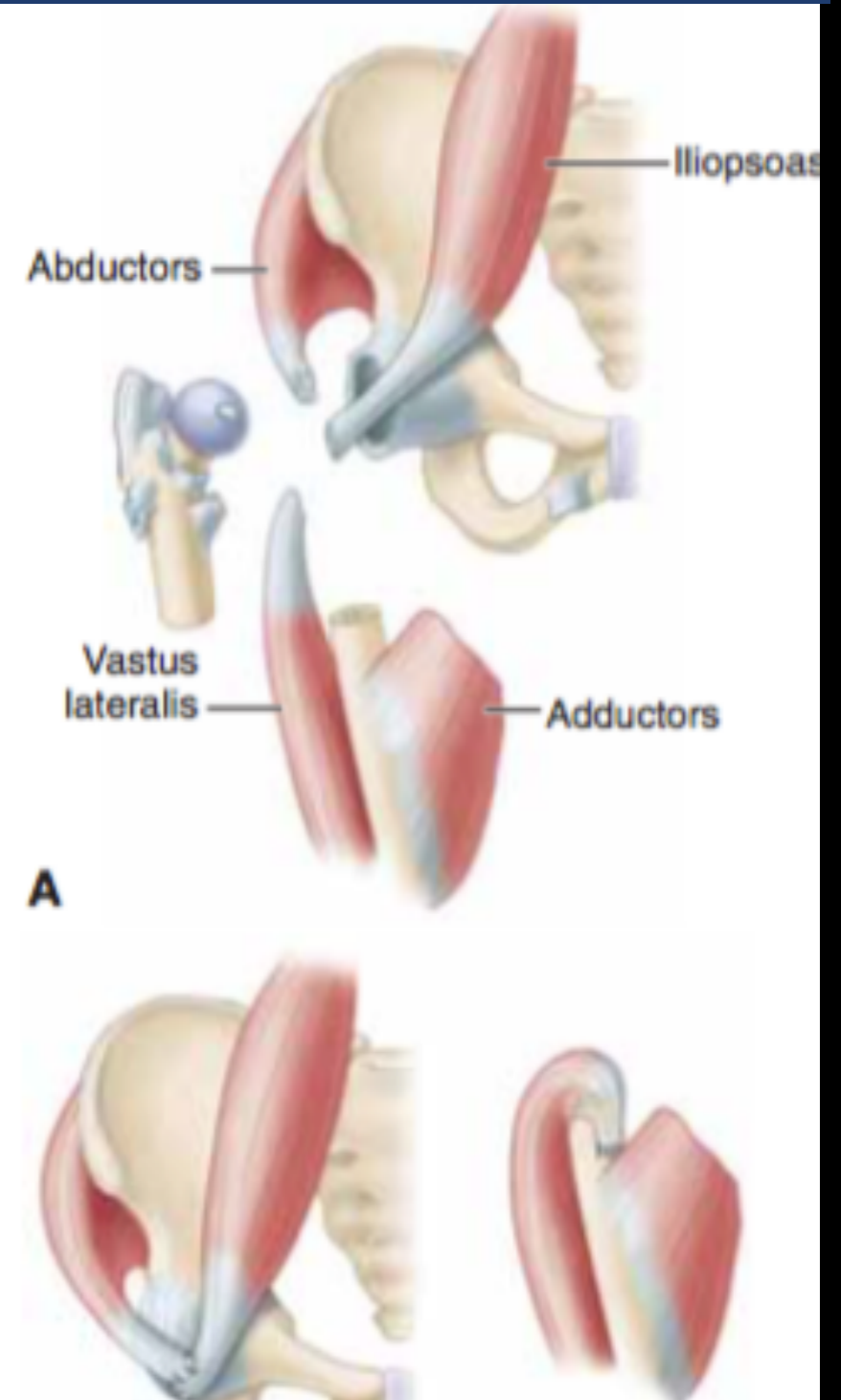
# SURGICAL MANAGEMENT: HIP DISLOCATION

## SALVAGE PROCEDURES

### Options:

1. Observation
2. Relocation procedures (femur, acetabulum, both)
3. Proximal femoral resection + soft tissue interposition arthroplasty
4. Hip arthrodesis
5. THR (selected cases)

### CASTLE (MODIFIED BY MCCARTHY) PROCEDURE

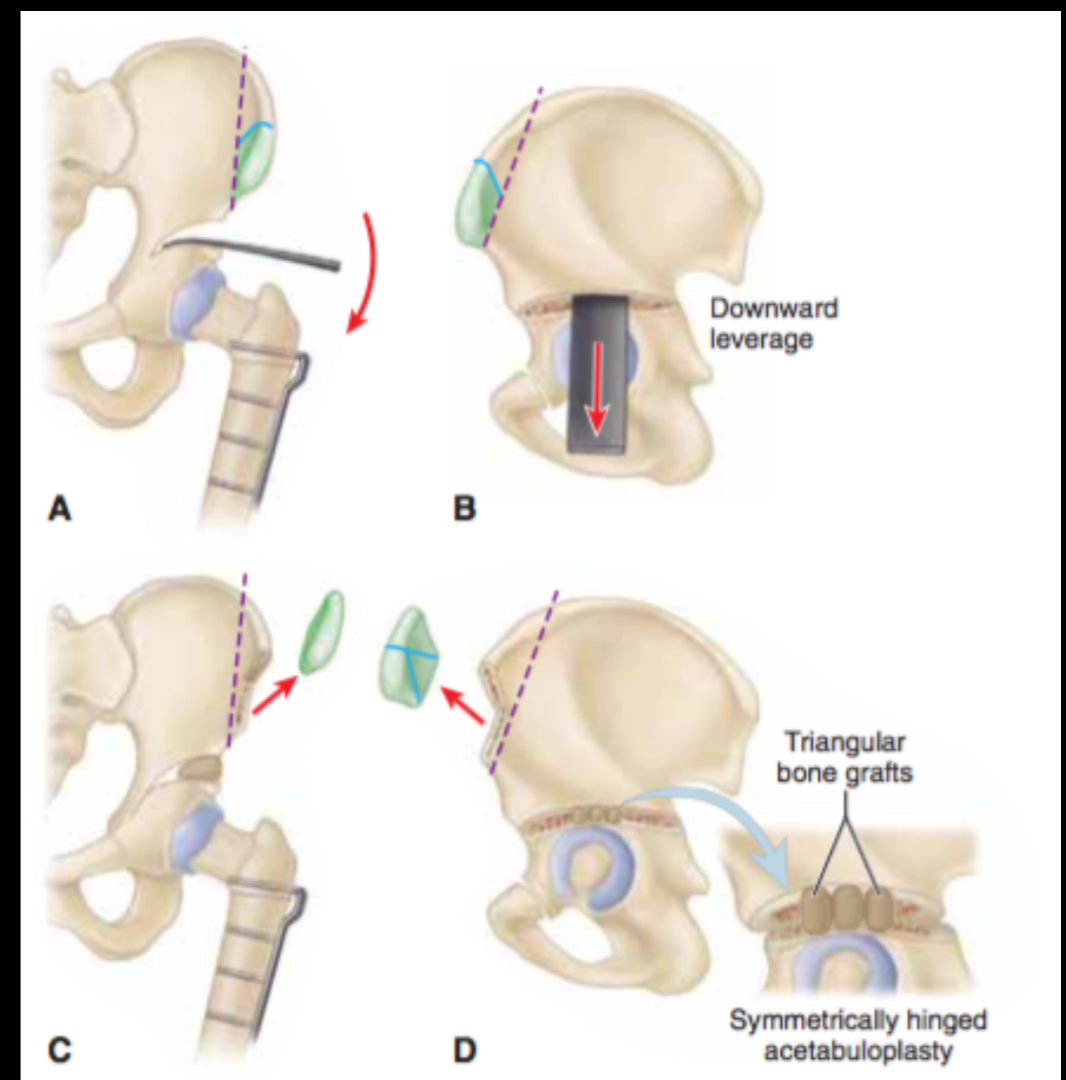
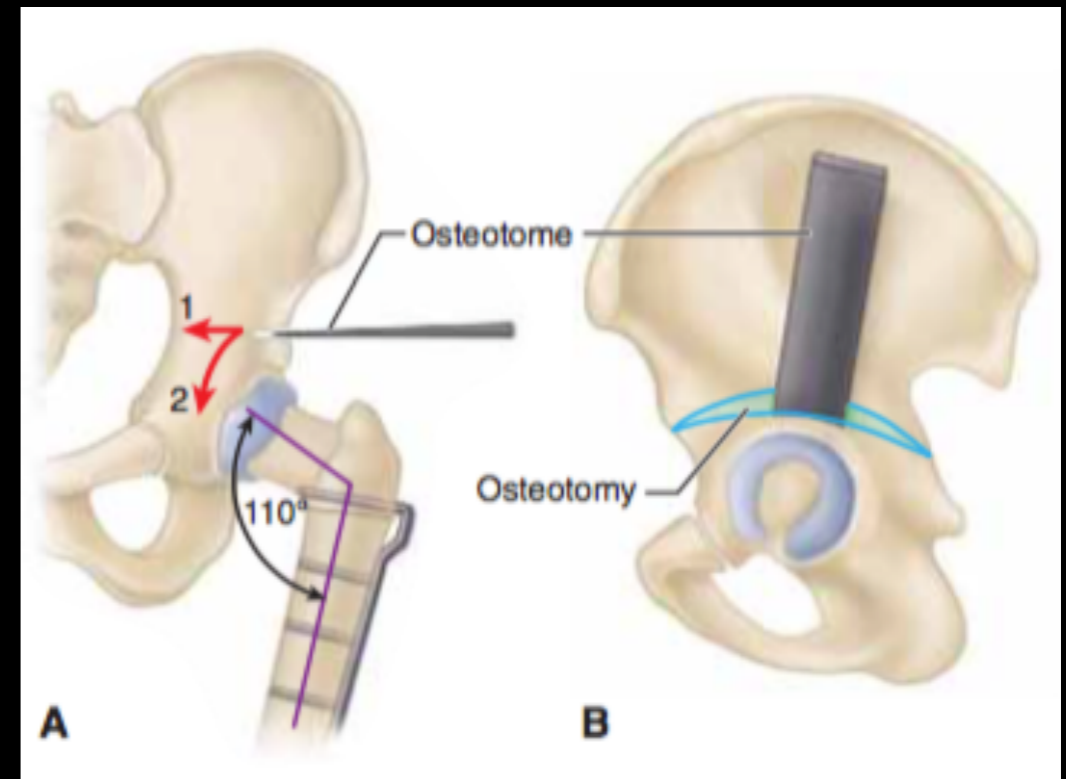


POST OP: SKELETAL TRACTION 6 WEEKS

# SURGICAL MANAGEMENT: HIP DISLOCATION

## SAN DIEGO PROCEDURE

- Combined one-stage correction of spastic diplegic hip
- **Includings:**
  - Soft tissue lengthening
  - Open reduction with capsulorrhaphy
  - VDRO
  - Periacetabular osteotomy
- Post operative hip spica cast for 6 weeks
- Vigorous PT until 10 weeks



## SURGICAL MANAGEMENT

# KNEE FLEXION DEFORMITIES

- **Most common knee deformity in CP**
- **Serial stretching and bracing in mild deformities**

### **Surgical options**

1. **Fractional lengthening of hamstrings tendons**
2. **Distal femoral extension osteotomy and patellar tendon advancement**
3. **Rectus femoris transfer**

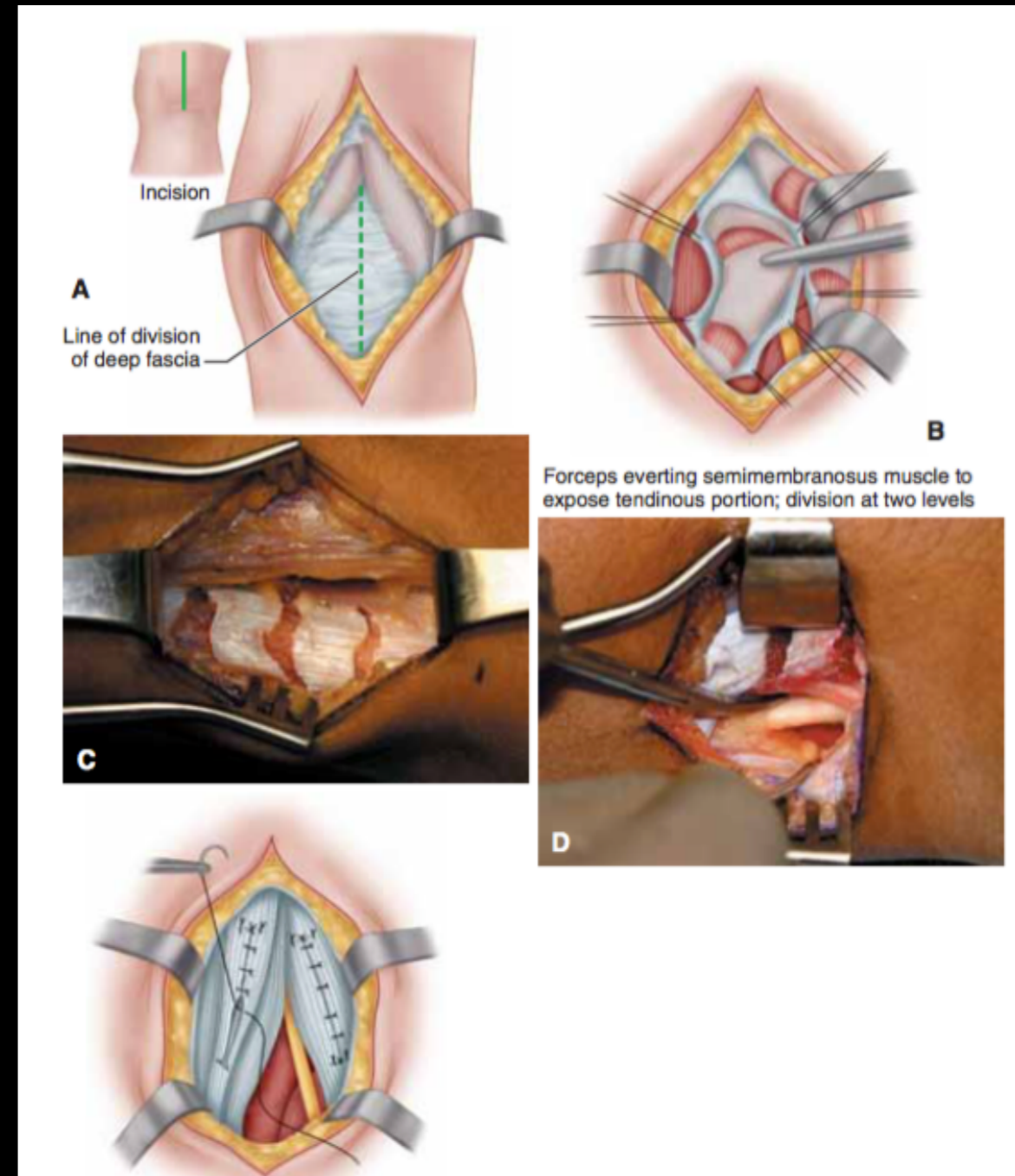
# SURGICAL MANAGEMENT: KNEE FLEXION DEFORMITIES HAMSTRING LENGTHENING

## Indication

- A straight-leg rise of  $< 70$  degrees or
- Popliteal angle of  $< 135$  degrees in the absence of significant bony deformity
- **NOT TO OVERLENGTHEN** >> excessive weakness and knee hyperextension gait

## Procedure: medial to lateral !!!

- Z-plasty of the gracilis and semitendinosus tendons
- Fractional lengthening of the semimembranosus
- Biceps femoris lengthening **if** further correction is needed



POST OPERATIVE: LLC FOR 3-4 WEEKS  
+IMMEDIATE STRAIGHT-LEG RAISES



# SURGICAL MANAGEMENT: KNEE FLEXION DEFORMITIES

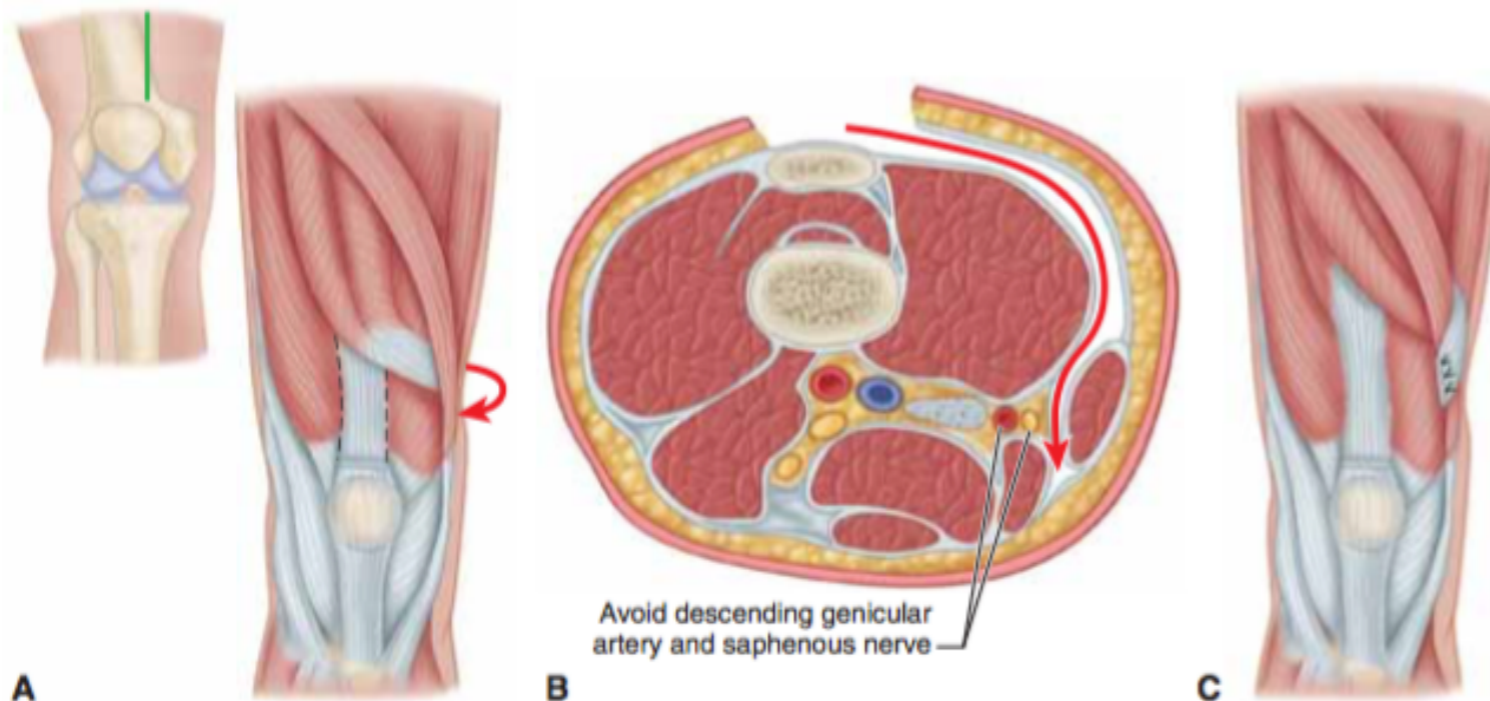
## DISTAL RECTUS FEMORIS TRANSFER

### Indication

- Stiff knee gait (co-contraction of quadriceps and hamstrings)
- To help achieve balanced knee function during swing phase

### Procedure:

- Rectus femoris is separated from vastus medialis, lateralis and intermedius
- Transferred through medial intermuscular septum to sartorius and sutured to it



POST OPERATIVE: KNEE  
IMMOBILIZER  
(LLC FOR 3-4 WEEKS IF HAMSTRING  
IS RELEASED ALSO)

# ANKLE AND FOOT

- 70%-90% of CP children affected
- **Deformities**
  - **Ankle equinus**: the most common deformity
  - Equinovarus, equinovalgus
- Small muscles spasticity >> hallux valgus, claw toes, and forefoot adduction

## Equinus treatment

1. **Conservative**: stretching, **bracing (\*\*\*)**, BTX-A and casting
2. **Surgery**
  - **No exact indication !!!**
  - Typically indicated when the ankle cannot be brought into neutral position

# SURGICAL MANAGEMENT: ANKLE EQUINUS

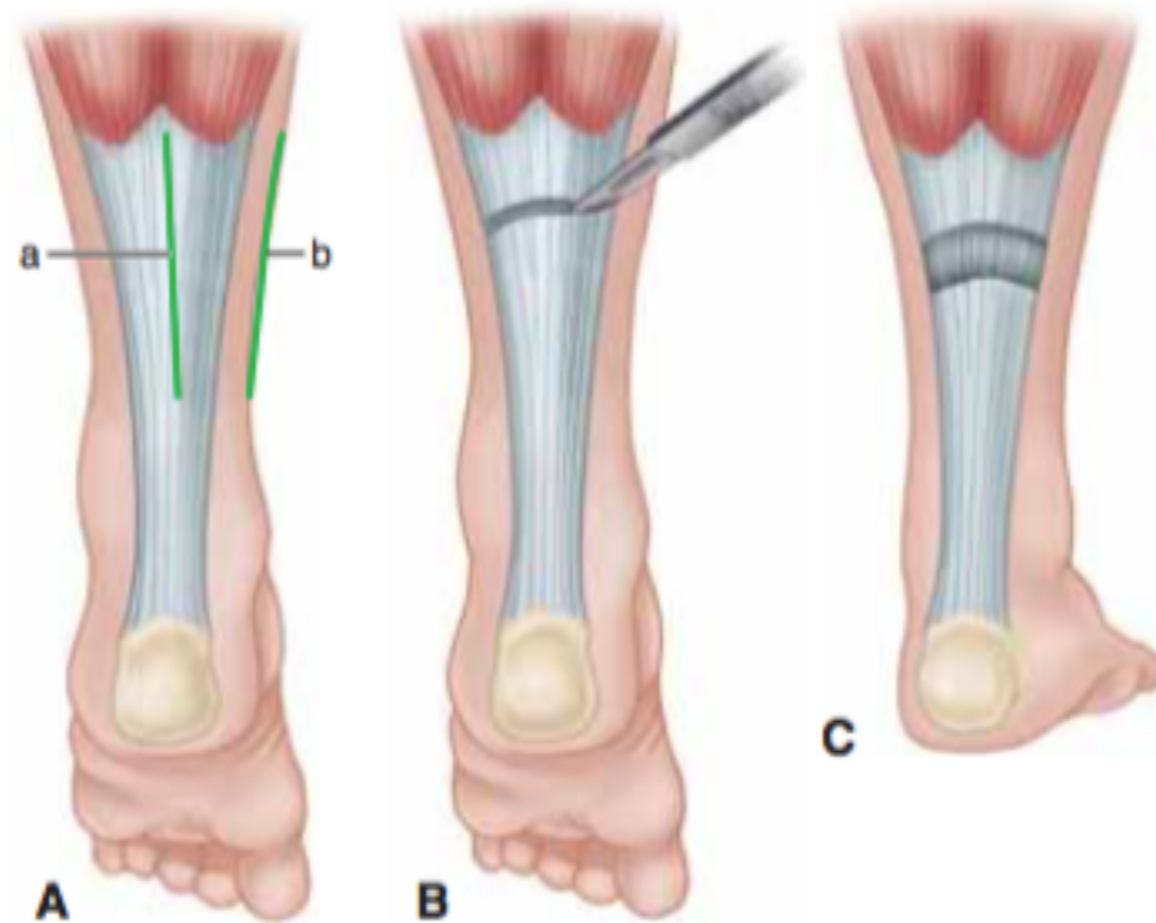
## GASTROCNEMIUS-SOLEUS LENGTHENING

### Technical point: level of correction

1. **Mild to moderate contractures:** musculotendinous junction
2. **More severe:** Achilles tendon level (open or percutaneous)

COMPLICATION: CROUCH GAIT

STRAYER, LATERAL TO MEDIAL

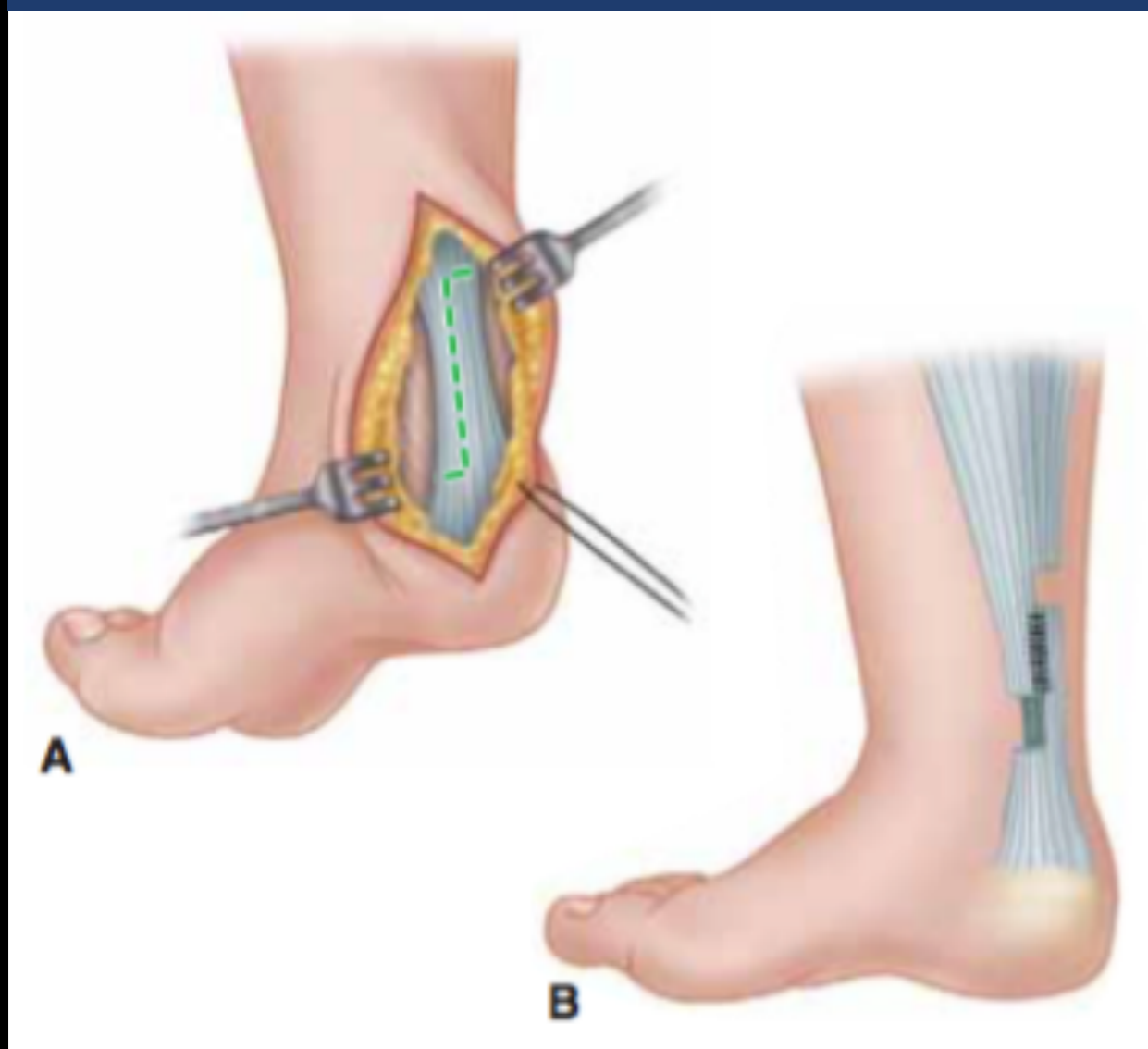


POST OPERATIVE SHORT LEG CAST FOR 4 WEEKS

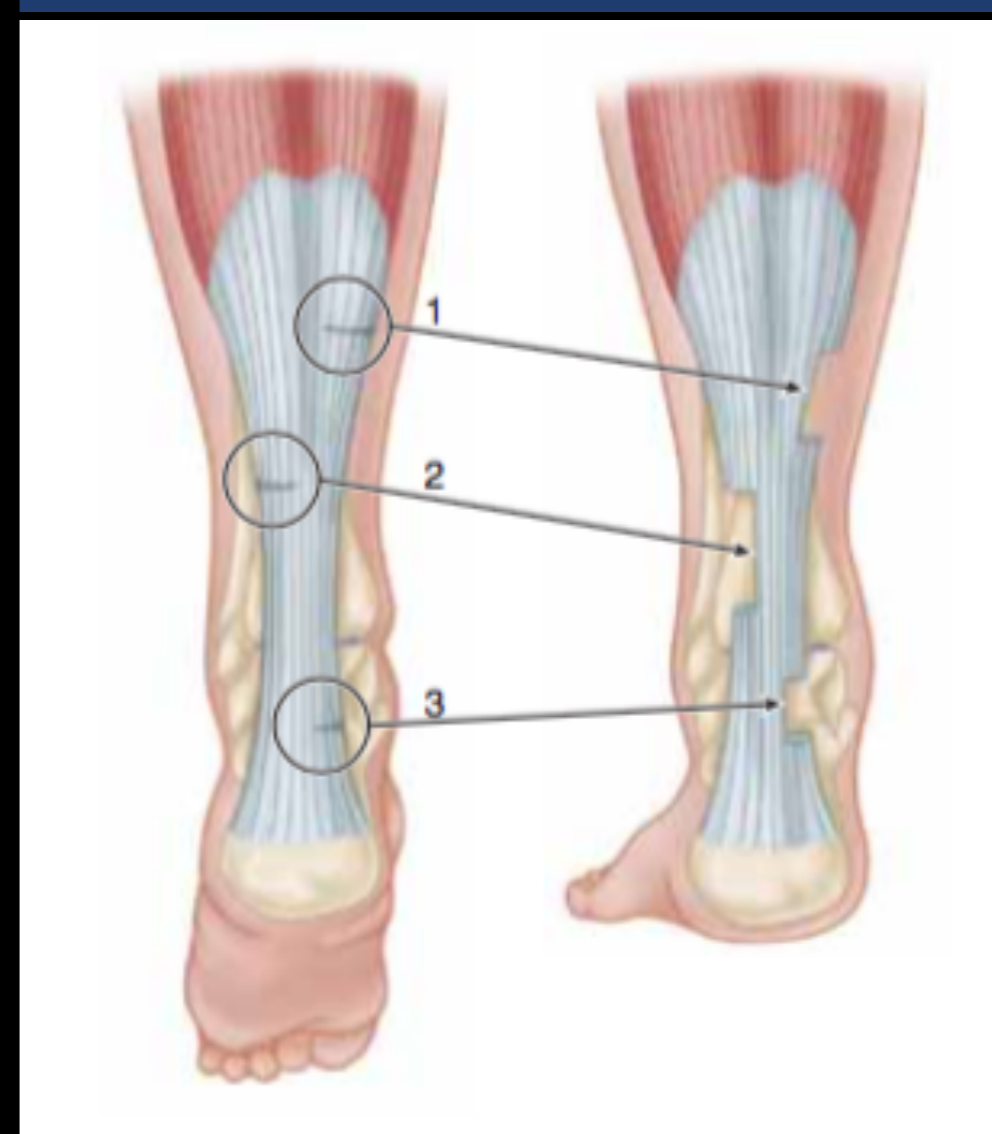
# SURGICAL MANAGEMENT: ANKLE EQUINUS

# ACHILLES TENDON LENGTHENING

## Z-PLASTY



## PERCUTANEOUS



POST OPERATIVE SHORT LEG CAST FOR 6 WEEKS

# THANK YOU

1. Early diagnosis and prompt treatment
2. Multidisciplinary team
3. Assessment of whole body
4. SEMLS rather than "Birthday Surgery"
5. Power of "Counseling"