POST POLIO RESIDUAL PARALYSIS (PPRP)

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INTRODUCTION

Infectious disease characterized by

Asymmetric flaccid motor paralysis

- **Clinical manifestations:**
  1. asymptomatic infection (90-95%)
  2. abortive poliomyelitis
  3. non paralytic polio myelitis
  4. paralytic polio myelitis (1%)

CLINICAL COURSE

- **Three stages:**
  - acute stage
  - convalescent stage
  - chronic stage

DISTRIBUTION

Lower limb	92 %
Trunk + LL	4 %
LL + UL	1.33 %
Bilateral UL	0.67 %
Trunk + UL + LL	2 %

RESIDUAL PHASE OF POLIOMYELITIS

INTRODUCTION

- As the convalescent phase of poliomyelitis ends residual phase starts
- Even with intensive exercise programs it may not be possible to restore the muscle power.
- Best can be achieved by elevation of grade of muscle power
- Therefore training individual for making good use of muscle at the sub fatigue level is of importance.

PROGRESSIVE DEFORMITIES IN RESIDUAL PHASE.

- Inaccessibility to medical care to majority of childrens have led to large number of people with moderate to severe deformalities.

CAUSES OF PROGRESSIVE DEFORMITY

- MUSCLE IMBALANCE –

Flaccid paralysis is the main cause of functional loss and muscle imbalance .when a muscle or a group of muscle is paralysed,the opponent strong muscle pull the joints to their side.

- ***UNRELIEVED MUSCLE SPASM***

  Contractures of the paralysed muscles have a tendency for deforming the joint in the direction of contracture. This can be prevented by passive stretching and splinting.

- ***GROWTH***

  Bony growth depends upon the stimulus by active healthy stretching around the growth plate , which is lacking in case of polio affected childrens causing limb length inequality , attenuation of blood vessels and reduced blood supply leading to reduced growth of the bone.

- ***GRAVITY AND POSTURE***

  - Gravity plays an important role in maintaining the posture and deformity.

  - Paralysed group of muscles are not in a position to maintain posture.

HOW TO RECOGNIZE PARALYSIS CAUSED BY POLIO

- Paralysis (muscle weakness):
  - usually begins when the child is small, often during an illness like a bad cold with fever and sometimes diarrhea
  - Paralysis may affect any muscles of the body, but is most common in the legs. Muscles most often affected are described in following slides.
  - Paralysis is of the 'floppy' type (not stiff). Some muscles may be only partly weakened, others limp or floppy

- In time the affected limb may not be able to straighten all the way, due to shortening, or ‘contractures’, of certain muscles.

- The muscles and bones of the affected limb become thinner than the other limb. The affected limb does not grow as fast, and so is shorter.

- Unaffected arms or legs often become extra strong to make up for parts that are weak.
- Knee jerks and other tendon reflexes in the affected limb are reduced or absent

Of children who become paralyzed by polio:

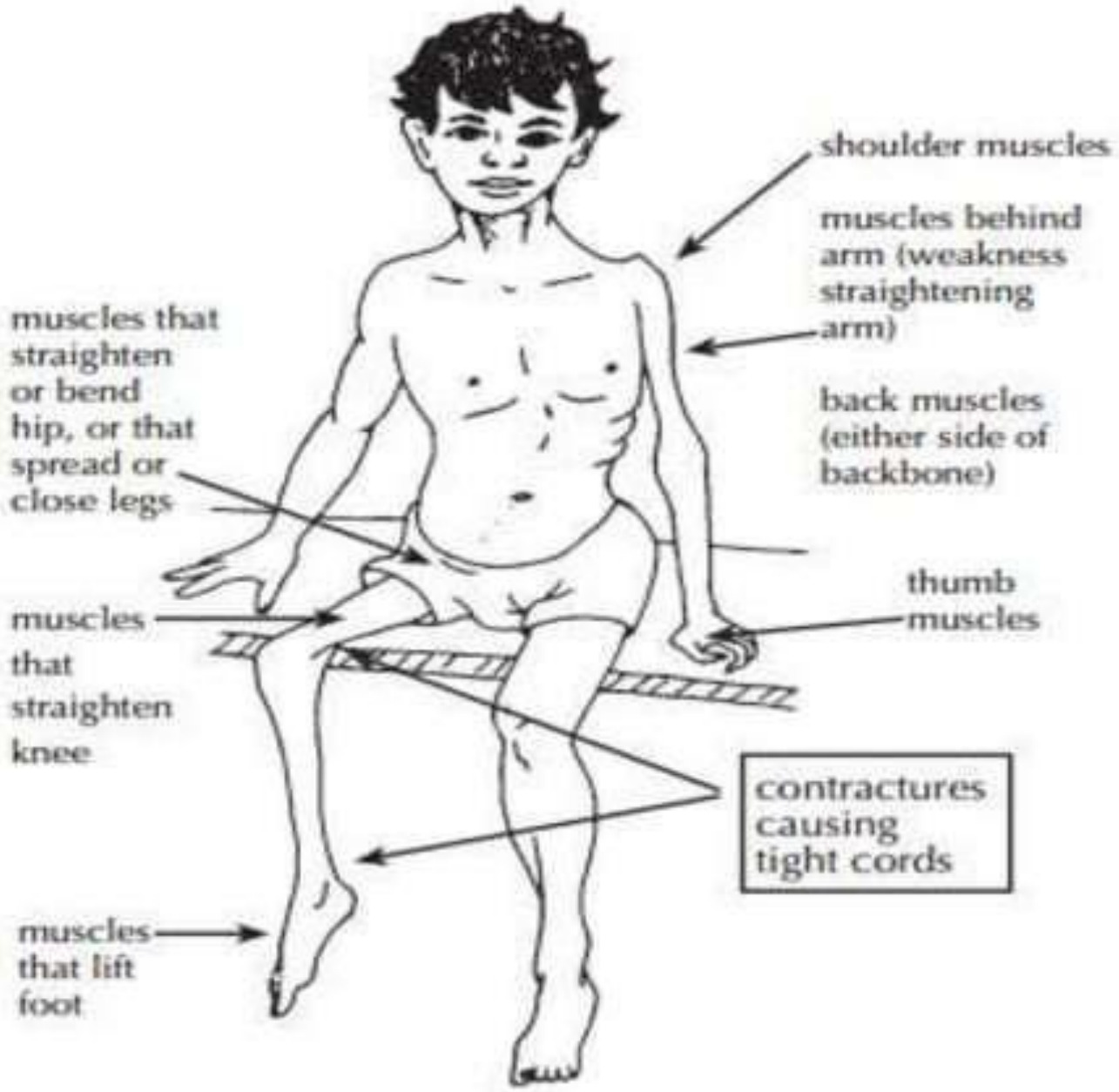
30% recover completely in the first weeks or months.

30% have mild paralysis.

30% have moderate or severe paralysis.

10% die (often because of difficulty breathing or swallowing).

MUSCLES COMMONLY WEAKENED BY POLIO



SECONDARY PROBLEMS TO LOOK FOR WITH POLIO

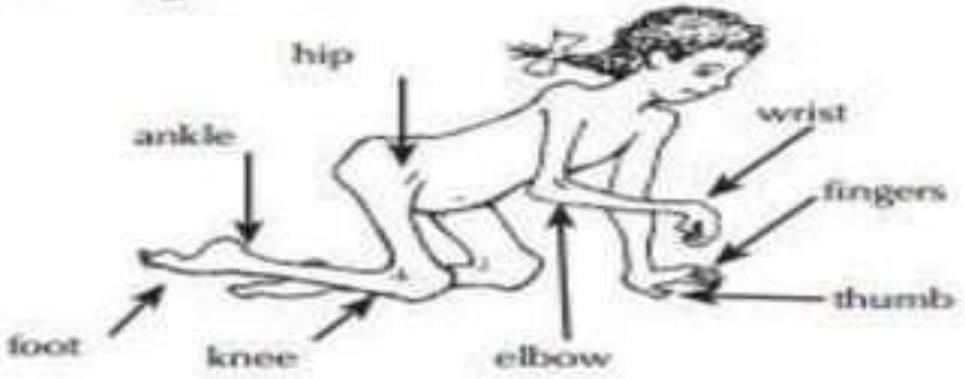
- By secondary problems, we mean further disabilities or complications that can appear after, and because of, the original disability.

- The paralysis does not get worse with time. However, secondary problems like contractures, curve of the backbone and dislocations may occur

CONTRACTURES OF JOINTS

TYPICAL CONTRACTURES IN POLIO

A child with paralysis who crawls around like this and never straightens her legs will gradually develop contractures so that her hips, knees, and ankles can no longer be straightened.



TYPICAL DEFORMITIES OF ANKLE AND FOOT

bending down at ankle (tiptoe contracture)

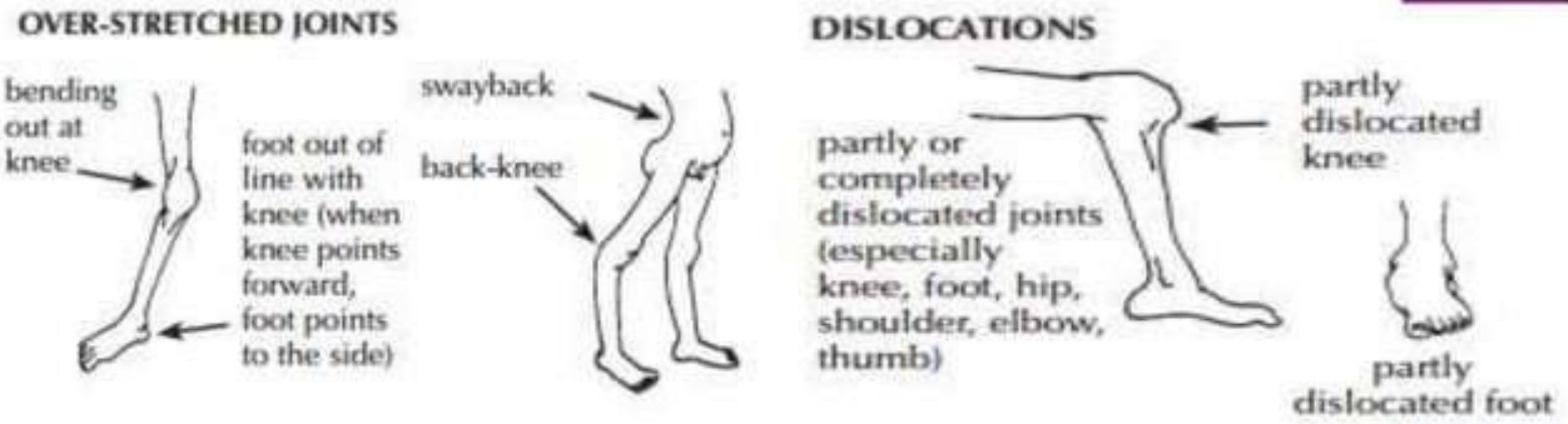
bending down at mid-foot

bending out at ankle

bending in at ankle

OTHER COMMON DEFORMITIES

- Weight bearing (supporting the body's weight) on weak joints can cause deformities.



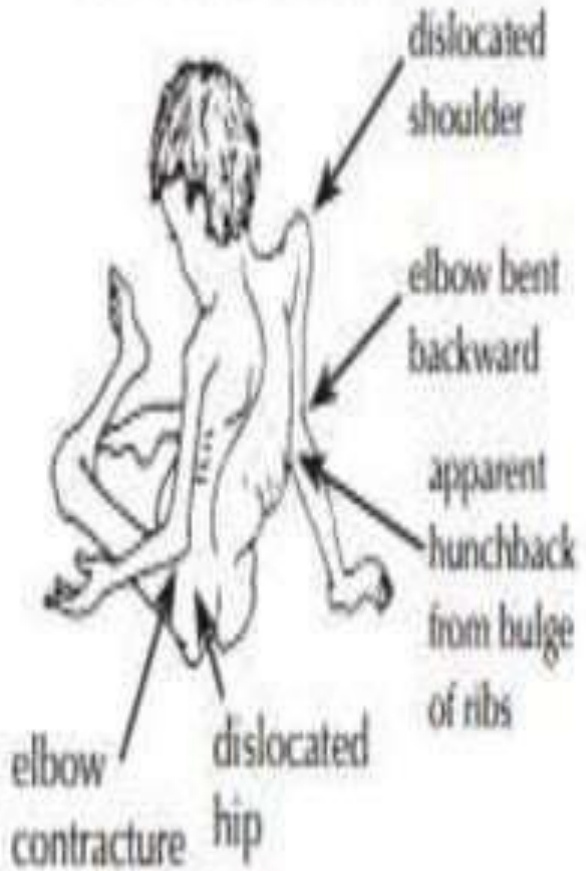
OTHER COMMON DEFORMITIES

SPINAL CURVE

Minor curve of spine can be caused by tilted hips, as a result of a short leg.

More serious curve of the spine is caused by muscle weakness of the back or body muscles. The curve can become so severe that it endangers life by leaving too little room for the lungs and heart.

a severely paralyzed child



At first, the spinal curve straightens when the child is positioned better. But in time the curve becomes more fixed (will not straighten any more). For information on spinal curves, see Chapter 20.

EVALUATION OF POLIO

- **Step 1:-**
  - child and family History
  - watch the child move about.
  - Observe carefully which parts of the body seem strong, and which seem weak.
  - Look for any differences between one side of the body and the other—such as differences in the length or thickness of the legs.
  - any obvious deformities, or joints that do not seem to straighten all the way

- If the child walks, what is unusual about the way child does it?
  - Does child dip forward or to one side
  - Does child help support one leg with hand
  - Is one hip lower than the other Or one shoulder
- Does child have a hump back, a sway back, or a sideways curve of the back.

- **Step 2:-**
- Range-of-motion testing
- Muscle testing
- Check for deformities:
  - Contractures,dislocations (hip, knee, foot, shoulder, elbow); difference in leg length; tilt of hips; and curve or abnormal shape of the back.

MUSCLE POWER GRADING

- Grade 0 total paralysis (no contraction palpated)
- Grade 1 evidence of slight contractility but no joint movement
- Grade 2 complete range of motion with gravity eliminated
- Grade 3 complete range of motion against gravity
- Grade 4 complete range of motion against some resistance
- Grade 5 complete range of motion against maximal resistance

MUSCLES	RIGHT ROM	M.P
ILIPSOAS (flexes and laterally rotates thigh)		
GLUTEUS MAXIMUS (extends, laterally rotates, abducts thigh)		
GIUTEUS MEDIUS (abducts thigh)		
GLUTEUS MINIMUS (abducts thigh and medially rotates femur)		
ADDUCTOR MAGNUS (adducts and extends thigh)		
ADDUCTOR LONGUS (adducts thigh)		
KNEE QUADRICEPS		
HAMSTRINGS		

and extends thigh)		
ADDUCTOR LONGUS (adducts thigh)		
KNEE QUADRICEPS		
HAMSTRINGS		
GASTROCNEMIUS (plantar flexes foot, flexes leg)		
SOLEUS (plantar flexes foot)		
TIBIALIS ANTERIOR (dorsi flexes foot)		
TIBIALIS POSTERIOR (plantar flexes and inverts foot)		
PIRIFORMIS (external rotator of hip)		

DEFORMITIES

- Vary according to degree of muscle imbalance, or if patient presented in early phase or late phase.
- Early stage
  - Child is febrile with rigidity of neck and tender muscles.
  - Asymmetric involvement

- **Most Severely Paralysed Muscle**

  - Tibialis Anterior

- **Most common muscle Paralysed -**

  - Quadriceps femoris

- **Most commonly involved muscles in Upper Limb**

  - Deltoid

- Late stage:
  - Paralysis may result into wasting weakness
  - The common deformity at hip is flexion-abduction-external rotation
  - The common deformity at knee is flexion,in severe cases tripledeformity comprising of flexion,posterior sublaxation and external rotation.
  - At foot equino varus is commonest others may be equino valgus calcaneo valgus and calcaneo varus

- The limbs may become short.
- With time deformities becomes permanent due to contracture of soft tissue
- Mal development of bones in deformed position

DIFFERENTIAL DIAGNOSIS OF POST POLIO PARALYSIS

• *Poliomyelitis*	- Asymmetrical - Lower motor neurone type - No sensory loss - Improves with time, or is static
• Myopathy	- Usually symmetrical, follows a pattern - Lower motor neurone type - No sensory loss - Deteriorates with time
• *Spina bifida and other spinal disorders*	- Usually symmetrical - Motor+sensory loss - Deteriorates with growth
• *Neuropathy*	- Usually bilateral, 'Glove and stocking' pattern - Motor+sensory loss - May improve with treatment

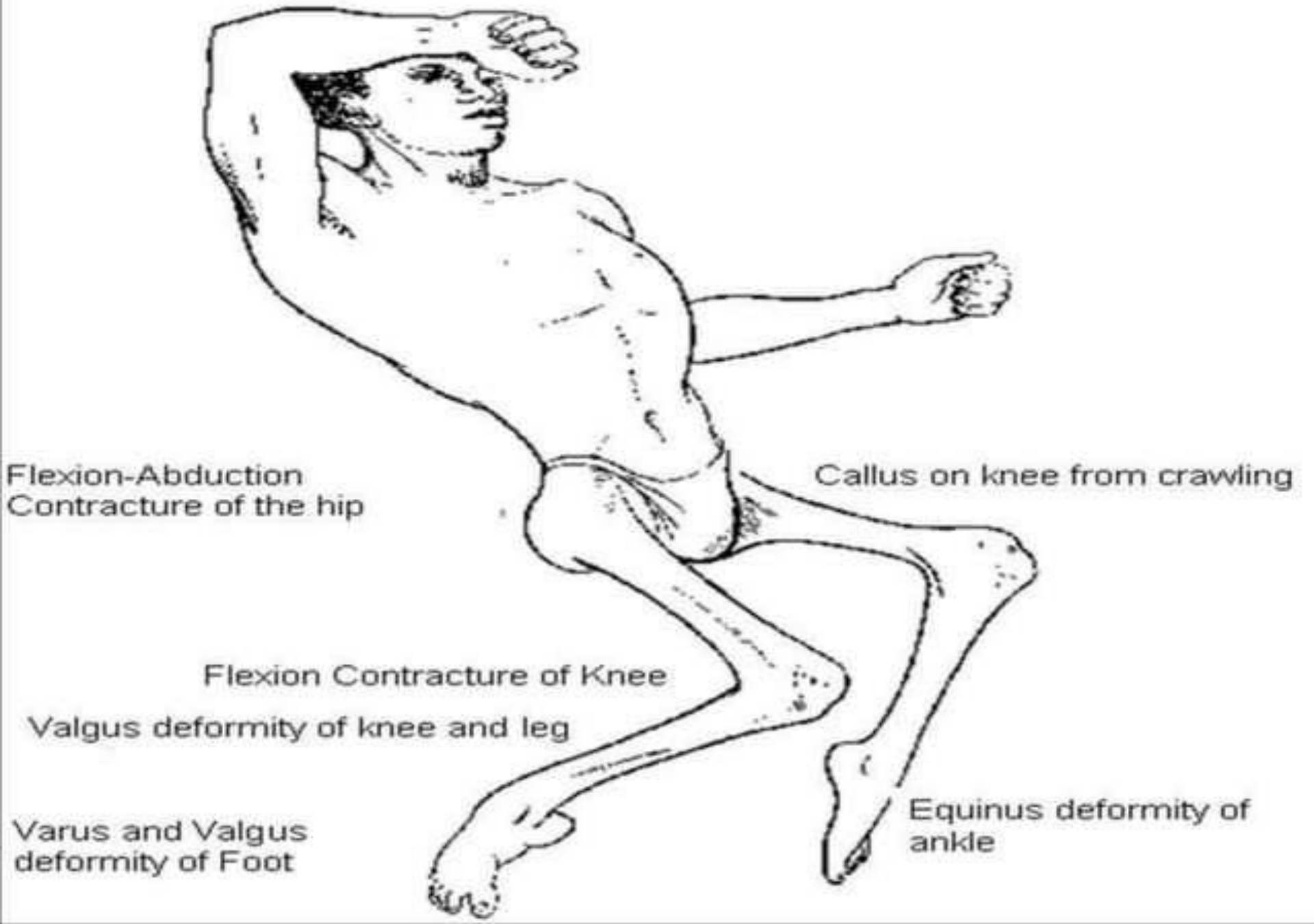
MANAGEMENT

- Management starts with diagnosis & accurate muscle charting (assessing power & deformities)
- Discussion of expectations
- Assessment resources
- Family support

DEFORMITY CORRECTION

- Mainly lower limb
- Aim for walking with or without orthosis by getting straight limb with plantigrade foot
- Methods
  - Reconstructive surgery
  - Physiotherapy
  - Orthosis

THE TYPICAL CONTRACTURES OF POLIO



RECONSTRUCTIVE SURGERY

- Correction of deformities
- Improving the function (transfer of a tendon or muscle, removal of deforming force)
- Stabilizing paralyzed joints (arthrodesis)

WHY SURGERIES ARE DONE IN POLIO?

- Balancing of power
- Stabilization of joints
- Correction of deformities
- Limb lengthening

TENDON TRANSFER

- Tendon transfers are indicated when dynamic muscle imbalance results in a deformity
- Surgery should be delayed until the maximal returns of the expected muscle strength has been achieved

- **Objectives of tendon transfer**
- To provide active motor power
- To eliminate the deforming effect of a muscle
- To improve stability by improving muscle balance

CRITERIA AND SELECTING THE TENDON FOR TRANSFER

- Muscle to be transferred must be strong enough
- Free end of transferred tendon should be attached as close as possible to the insertion of paralised tendon
- A transferred tendon should be retained in its own sheath or should be inserted in the sheath of another tendon or it should be passed through the subcutaneous fat

- Nerve supply and blood supply of transferred muscle must not be impaired
- Joint must be in satisfactory position
- Contracture must be released before tendon transfer
- Transferred tendon must be securely attached to bone under tension slightly greater than normal
- Agonists muscles are preferable to antagonists

ARTHRODESIS

- Most efficient method for permanent stabilization of a joint
- A relaxed or flail joint is stabilized by restricting its range of motion.
- Bony procedures can be delayed until skeletal growth is complete
- When the tendon transfer and arthrodesis is combined in the same operation the arthrodesis is performed first

WHEN TO OPERATE

- wait for atleast 1 1/2 years after paralytic attack
- Tendon transfers done in skeletally immature
- Extra articular arthrodesis 3-8 years
- Tendon transfer around ankle and foot after 10yr of age can be supplimented by arthrodesis to correct the deformity
- Triple arthrodesis >10-11 years
- Ankle arthrodesis >18 years

HIP DEFORMITIES

- Paralysis of the muscles around the hip can cause severe impairment
  - Flexion and abduction contractures of the hip.
  - Paralysis of the gluteus maximus and medius muscles.
  - Paralytic hip dislocation

ILIOTIBIAL BAND CONTRACTURE

- The iliotibial band contracture produces flexion deformities of the hip and knee on the same side.

- Spasm of the hamstrings, hip flexors, tensor fasciae latae,and hip abductors is common during the acute and convalescent stages of poliomyelitis.

ILIOTIBIAL BAND CONTRACTURE

- Straight-leg raising usually is limited.
- The patient assumes the frog position, with the knees and hips flexed and the extremities completely externally rotated. When this position is maintained for even a few weeks, secondary soft tissue contractures occur; a permanent deformity develops

ILIOTIBIAL BAND CONTRACTURE DEFORMITIES

- *Flexion, abduction, and external rotation contracture of the hip.*
  - The iliotibial band lies lateral and anterior to the hip joint, and its contracture can cause flexion and abduction deformity. The hip is externally rotated for comfort and, if not corrected, the external rotators of the hip contract and contribute to a fixed deformity

ILIOTIBIAL BAND CONTRACTURE DEFORMITIES

- ***Genu valgum and flexion contracture of the knee:***
  - With growth, the contracted iliotibial band acts as a taut bowstring across the knee joint and gradually abducts and flexes the tibia

ILIOTIBIAL BAND CONTRACTURE DEFORMITIES

- ***Limb-length discrepancy:***
  - Although the exact mechanism has not been clearly defined and may be related more to the loss of neurological and muscle function, a contracted iliotibial band on one side may be associated with considerable shortening of that extremity after years of growth.

ILIOTIBIAL BAND CONTRACTURE DEFORMITIES

- ***External tibial torsion, with or without knee joint subluxation:***

  - Because of its lateral attachment distally, the iliotibial band gradually rotates the tibia and fibula externally on the femur; this rotation may be increased if the short head of the biceps is strong. When the deformity becomes extreme, the lateral tibial condyle subluxates on the lateral femoral condyle and the head of the fibula lies in the popliteal space.

ILIOTIBIAL BAND CONTRACTURE DEFORMITIES

- ***Secondary ankle and foot deformities:***
  - With external torsion of the tibia, the axes of the ankle and knee joints are malaligned, causing structural changes that may require surgical correction.

ILIOTIBIAL BAND CONTRACTURE DEFORMITIES

- ***Pelvic obliquity:***
  - When the iliotibial band is contracted, and the patient is supine with the hip in abduction and flexion, the pelvis may remain at a right angle to the long axis of the spine
  - When the patient stands,the affected extremity is brought into the weight-bearing position (parallel to the vertical axis of the trunk), the pelvis assumes an oblique position The iliac crest is low on the contracted side and high on the opposite side.

- The trunk muscles on the affected side lengthen, and the muscles on the opposite side contract. An associated lumbar scoliosis can develop. If not corrected, the two contralateral contractures (the band on the affected side and the trunk muscles on the unaffected side) hold the pelvis in this oblique position until skeletal changes fix the deformity

ILIOTIBIAL BAND CONTRACTURE DEFORMITIES

- ***Increased lumbar lordosis:***
  - Bilateral flexion contractures of the hip pull the proximal part of the pelvis anteriorly; for the trunk to assume an upright position, a compensatory increase in lumbar lordosis must develop.

CONSERVATIVE TREATMENT

- It can be minimized or prevented in the early convalescent stage of poliomyelitis
- The patient should be placed in bed with the hips in neutral rotation,slight abduction,and no flexion
- All joints must be carried through a full range of passive motion several times daily.
- The hips must be stretched in extension, adduction, and internal rotation.
- knee roll is used to prevent a genu recurvatum deformity

SURGERY

- For abduction and external rotation contractures, a complete release of the hip muscles (Ober-Yount procedure) is indicated

OBER-YOUNT PROCEDURE

- Iliopsoas tendon, sartorius, rectus femorus, tensor fasciae latae, gluteus medius and minimus

FIGURE 34-16 Complete release of flexion-abduction-external rotation contracture of hip. **SEE TECHNIQUE 34-19.**

COMPLETE RELEASE OF MUSCLES FROM ILIAC WING AND TRANSFER OF CREST OF ILIUM

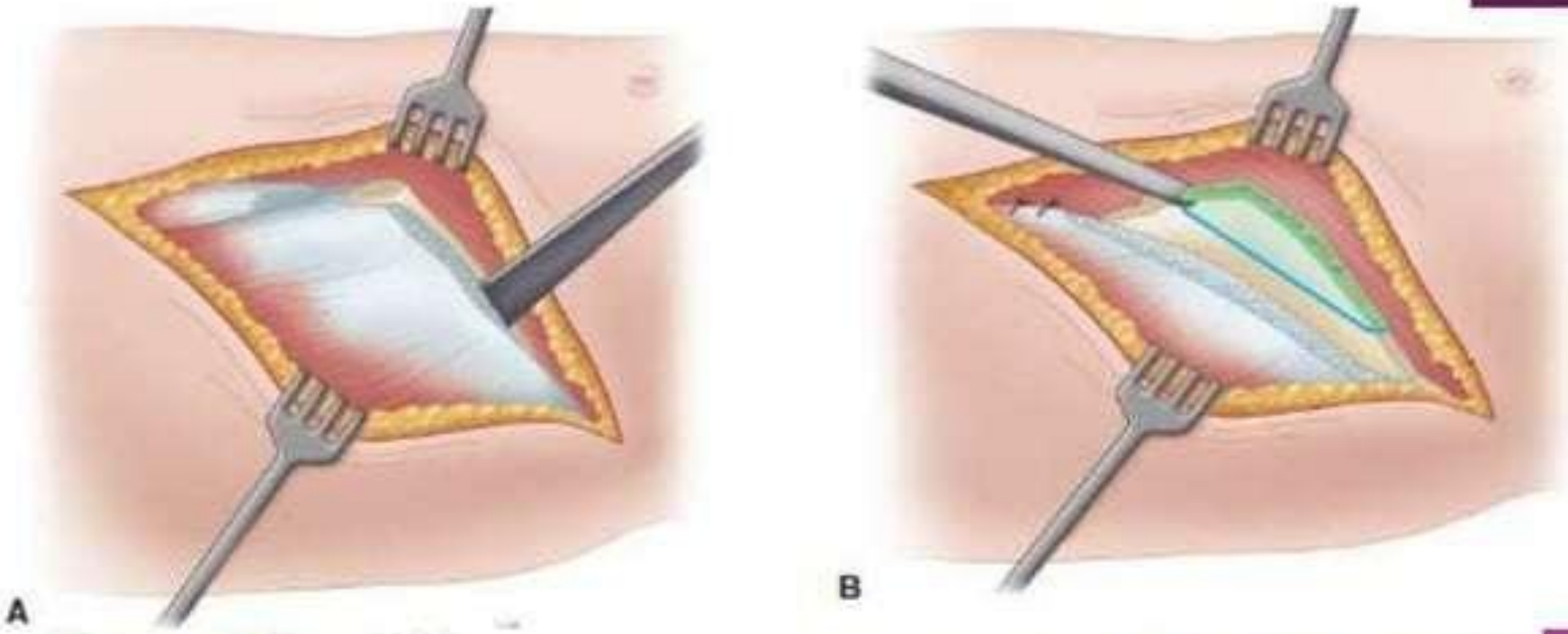


FIGURE 34-17 Campbell transfer of crest of ilium for flexion contracture of hip. **A,** Origins of sartorius, tensor fasciae latae, and gluteus medius muscles are detached from ilium. **B,** Redundant part of ilium is resected. **SEE TECHNIQUE 34-20.**

PARALYSIS OF THE GLUTEUS MAXIMUS AND MEDIUS

- Paralysis result in unstable hip and an unsightly and fatiguing limp.

- During weight bearing on the affected side when the gluteus medius alone is paralyzed, the trunk sways toward the affected side and the pelvis elevates on the opposite side (the "compensated" Trendelenburg gait).

- When the gluteus maximus alone is paralyzed, the body lurches backward

TRENDELENBURG TEST

- When a normal person bears weight on one extremity and flexes the other at the hip, the pelvis is held on a horizontal plane and the gluteal folds are on the same level
- when the gluteal muscles are impaired, and weight is borne on the affected side, the level of the pelvis on the normal side drops lower than that on the affected side.

- when the gluteal paralysis is severe, the test cannot be made because balance on the disabled extremity is impossible

TREATMENT

- POSTERIOR TRANSFER OF THE ILIOPSOAS FOR PARALYSIS OF THE GLUTEUS MEDIUS AND MAXIMUS MUSCLES

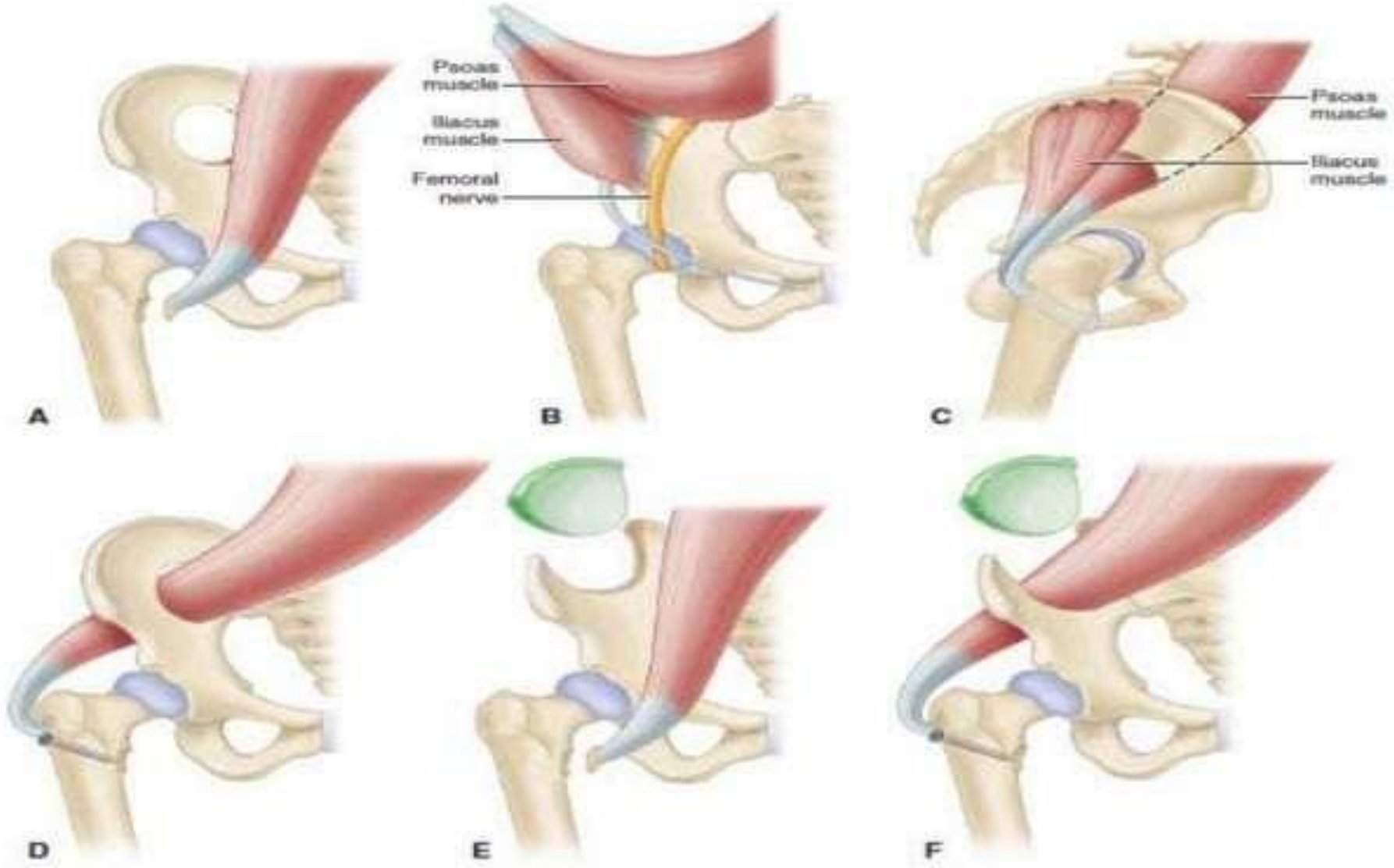


FIGURE 34-18 Sharrard transfer of iliopsoas muscle. **A,** Iliopsoas tendon is released from lesser trochanter. **B,** Tendon and lesser trochanter are detached, iliacus and psoas muscles are elevated, origin of iliacus is freed, and hole is made in ilium. **C,** Iliopsoas tendon is passed from posterior to anterior through hole in greater trochanter. **D,** Iliopsoas muscle and lesser trochanter are secured to greater trochanter with screw. **E** and **F,** Modification of technique in which muscle and tendon are redirected laterally through notch in ilium and inserted into greater trochanter, as described by Weisinger et al. **SEE TECHNIQUE 34-21.**

PARALYTIC DISLOCATION OF THE HIP

- If a child contracts limbs in poliomyelitis before age of 2 years, and the gluteal muscles become paralyzed but the flexors and adductors of the hip do not, the child may develop a paralytic dislocation of hip

- Dislocation also can develop because of fixed pelvic obliquity,in which the contralateral hip is held in marked abduction,usually by a tight iliotibial band or a structural scoliosis

TREATMENT

- Reduction of the hip in young children often can be achieved by simple abduction, sometimes aided by open adductor tenotomy and traction
- If the hip cannot be reduced by traction, open reduction and adductor tenotomy may be required,
- In combination with primary femoral shortening, varus derotation osteotomy of the femur, and appropriate acetabular reconstructions

KNEE DEFORMITIES

- The disabilities caused by paralysis of the muscles acting across the knee joint

  - Flexion contracture of the knee
  - Quadriceps paralysis.
  - Genu recurvatum
  - Flail knee

Flexion contracture of the knee

- Flexion contracture of the knee can be caused by a contracture of the iliotibial band.
- Iliotibial band also causes genu valgum and an external rotation deformity of the tibia on the femur.
- Flexion contracture also can be caused by paralysis of the quadriceps muscle when the hamstrings are normal or only partially paralyzed.

TREATMENT

- **<15 - 20* contracture:**
  - Posterior hamstring lengthening and capsulotomy.
- **20-70* contracture:**
  - suprac
    femur

FIGURE 34-12 Supracondylar extension osteotomy of femur for fixed knee flexion deformity in older child.

- **>70* knee flexion contracture:**
  - Division of the iliotibial band and hamstring tendons,combined with posterior capsulotomy.
  - Skeletal traction after surgery is maintained through a pin in the distal tibia; a second pin in the proximal tibia pulls anteriorly to avoid posterior subluxation of the tibia.
  - Long-term use of a long-leg brace may be required to allow the joint to remodel.

PARALYSIS OF THE QUADRICEPS MUSCLE

- Set of four muscles rectus femorus along with 3 vastus muscles.
- Quadriceps act as the great extensor muscle of the knee.
- Paralysis of the quadriceps muscle causes severe disability of knee.
- The knee may be extremely unstable especially if there is even a mild fixed flexion contracture.

TREATMENT

- **TRANSFER OF BICEPS FEMORIS AND SEMITENDINOSUS TENDONS**

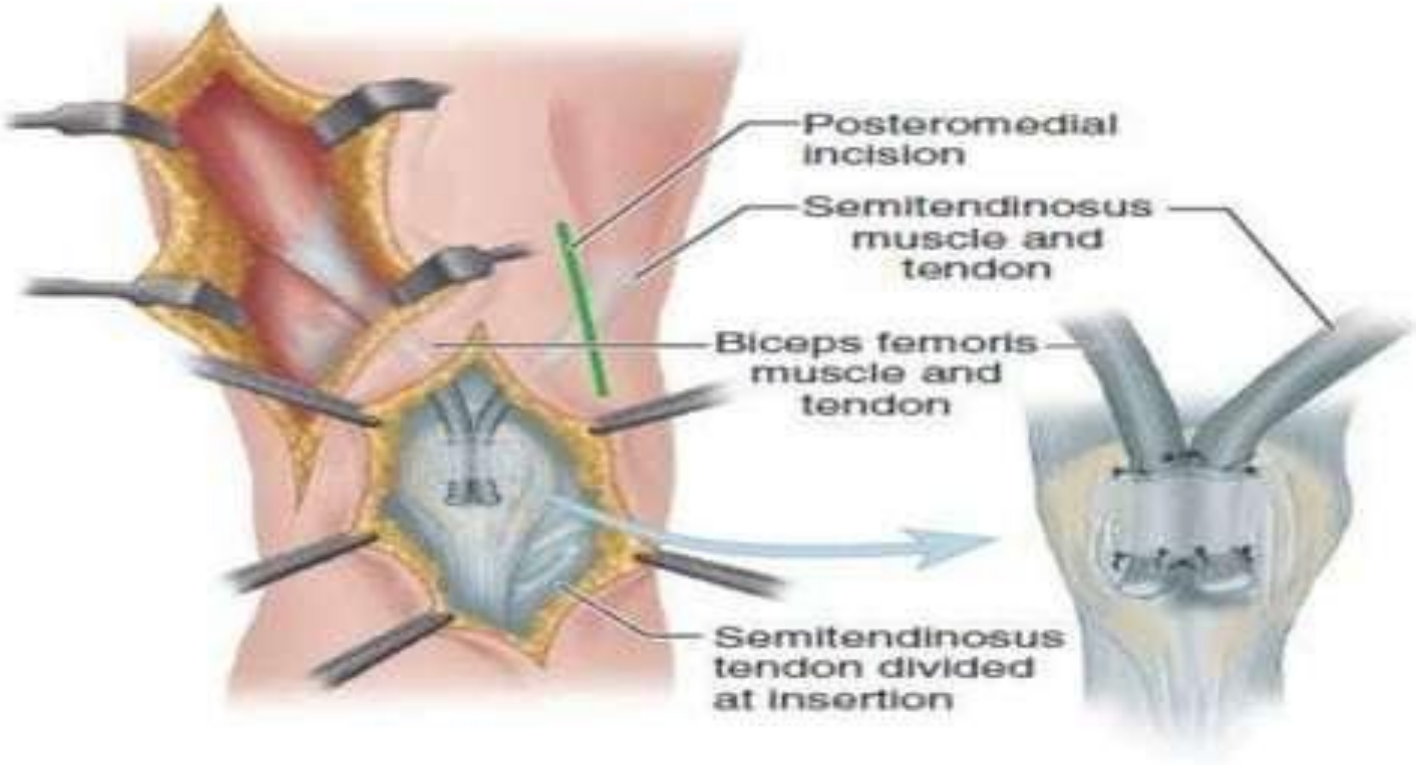


FIGURE 34-13 Transfer of semitendinosus and biceps femoris tendons to patella for quadriceps paralysis. **SEE TECHNIQUE 34-16.**

GENU RECURVATUM

- In genu recurvatum the knee is hyperextended
- Genu recurvatum from poliomyelitis is of two types
  - Lack of power in the quadriceps
  - The hamstrings and the gastrocnemius-soleus muscles weakness.

GENU RECURVATUM

- **Lack of power in the quadriceps:**
  - The quadriceps lacks the power to lock the knee in extension; the hamstrings and gastrocnemiussoleus usually are normal

- **The hamstrings and the gastrocnemius-soleus muscles weakness:**
  - These muscle weakness causes hyperextension of the knee often followed by stretching of the posterior capsular ligament.

GENU RECURVATUM

- The pressures of weight bearing and gravity cause changes in the tibial condyles and in the proximal third of the tibial shaft.
- The condyles become elongated posteriorly
- Their anterior margins are depressed compared with their posterior margins
- The angle of their articular surfaces to the long axis of the tibia which is normally 90 degrees becomes more acute.

GENU RECURVATUM

- The angle of their articular surfaces to the long axis of the tibia which is normally 90 degrees becomes more acute.
- The proximal third of the tibial shaft bows posteriorly
- Partial subluxation of the tibia may gradually occur.

TREATMENT

- Closing wedge osteotomy for genu recurvatum.

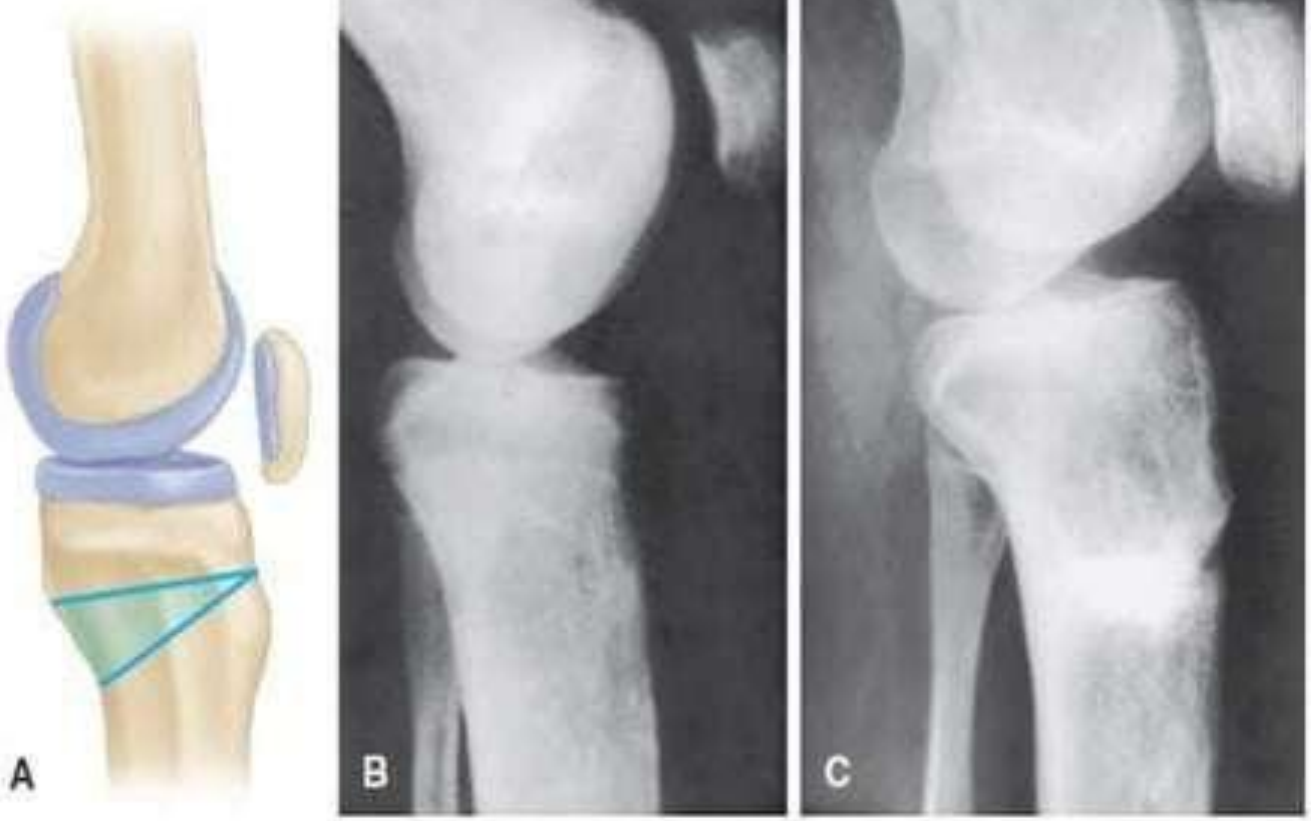


FIGURE 34-14 Closing wedge osteotomy for genu recurvatum. A, Wedge of bone removed from tibia. B, Recurvatum secondary to anterior tilt of tibial plateau. C, Five months after operation. **SEE TECHNIQUE 34-17.**

TRIPLE TENODESIS FOR GENU RECURVATUM

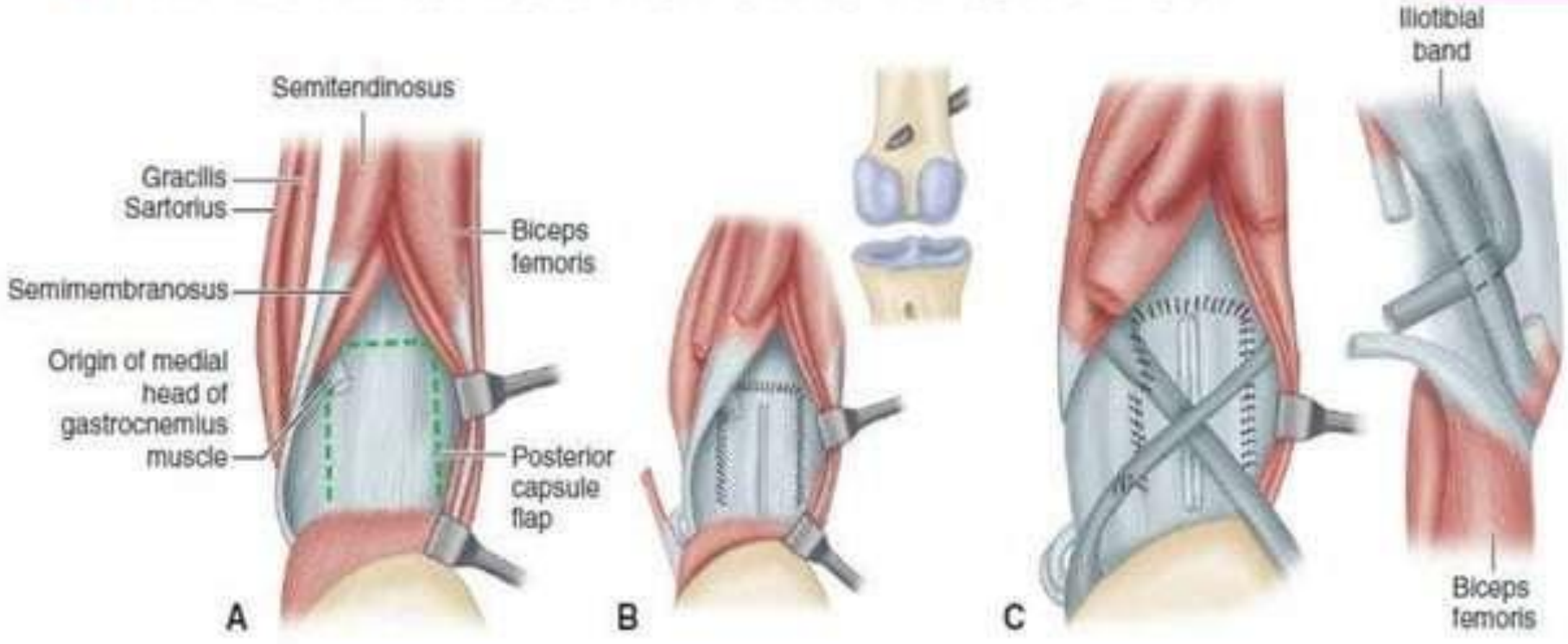


FIGURE 34-15 Perry, O'Brien, and Hodgson operation for genu recurvatum. **A**, Origin of medial head of gastrocnemius has been released, leaving proximal strap. Broad flap of posterior capsule is released for future advancement. **B**, Semitendinosus and gracilis tendons are divided at musculotendinous junctions. Each is passed through tunnel in tibia, then across exterior of joint, and then through tunnel in femur. Flap of posterior capsule is advanced and sutured snugly with knee flexed 20 degrees. **C**, Cross straps are made with biceps femoris and iliotibial band. **SEE TECHNIQUE 34-18.**

FLAIL KNEE

- The knee is unstable in all directions.
- Muscle power sufficient to overcome this instability is unavailable for tendon transfer.
- **Treatment :**
- Locking knee long leg knee brace.
- Knee arthrodesis

FOOT AND ANKLE

- Most dependent parts of the body subjected to significant amount of deforming forces.
- **Deformities includes:-**

  - equinus
  - equino varus
  - equino valgus
  - calcaneous
  - cavovarus
  - claw toes
  - dorsal bunion

EQUINUS FOOT

- Anterior tibial muscle
- Peroneal and long toe extensor muscles

- **Treatment:**
- Serial stretching and cast
- Achilles tendon lengthening
- Posterior capsule release

- Posterior bone block of cambell
- Lambrinudi operation
- Pantalar arthrodesis

EQUINOVARUS DEFORMITY

- Tibialis anterior muscle
- Long toe extensors and peroneal muscle

- **Treatment:**
- **Young children4-8 yrs:**
- Stretching of plantar fascia and posterior ankle structure with wedging casting
- TA lengthening
- Posterior capsulotomy
- Anterior transfer of tibialis posterior or
- Split transfer of tibialis anterior to insertion of p.brevis (if tibialis posterior is weak)

- **Children >8yrs:**
- Triple arthrodesis
- Anterior transfer of tibialis posterior
- Modified jones procedure

EQUINO VALGUS DEFORMITY

- Anterior and posterior muscle weakness with strong peroneals and gastroconemius-soleus muscle

- **Treatment:**
- Skeletally immature:
  - Repeated stretching and wedging cast
  - TA lengthening
  - Anterior transfer of peroneals
  - Subtalar arthrodesis and anterior transfer of peroneals

    (Grice and green arthrodesis)

- Skeletally mature :
  - TA lengthening
  - Triple arthrodesis followed by anterior transfer of peroneals

CAVOVARUS DEFORMITY

- Seen due to imbalance of extrinsic muscles or by unopposed short toe flexors and other intrinsic muscle

Treatment:

- Plantar fasciotomy , Release of intrinsic muscles and resecting motor branch of medial and lateral plantar nerves before tendon surgery
- Peroneus longus is transferred to the base of the second MT
- Extensor hallucis longus is transferred to the neck ofneck of 1st MT

CLAW TOE

- Hyperextension of MTP and flexion of IP
- Seen when long toe extensors are used to substitute dorsiflexion of ankle

Treatment:

For lateral toes:

→division of extensor tendon by z-plasty incision,dorsal capsulotomy of MTP

For great toe:

→FHL transferred to prox.phalanx,IP joint arthrodesis

(or)

→division of EHL ,proximal slip attached to neck of 1st MT,distal slip to soft tissues+ IP arthrodesis

FLAIL FOOT

- All muscles paralised distal to the knee
- Equinus deformity results because passive plantar flexion and cavoequinus deformity because – intrinsic muscle may retain some function

- **Treatment:**
- Radical plantar release
- Tenodesis
- In older pt mid foot wedge resection may be required
- ANKLE ARTHRODESIS

THANK U