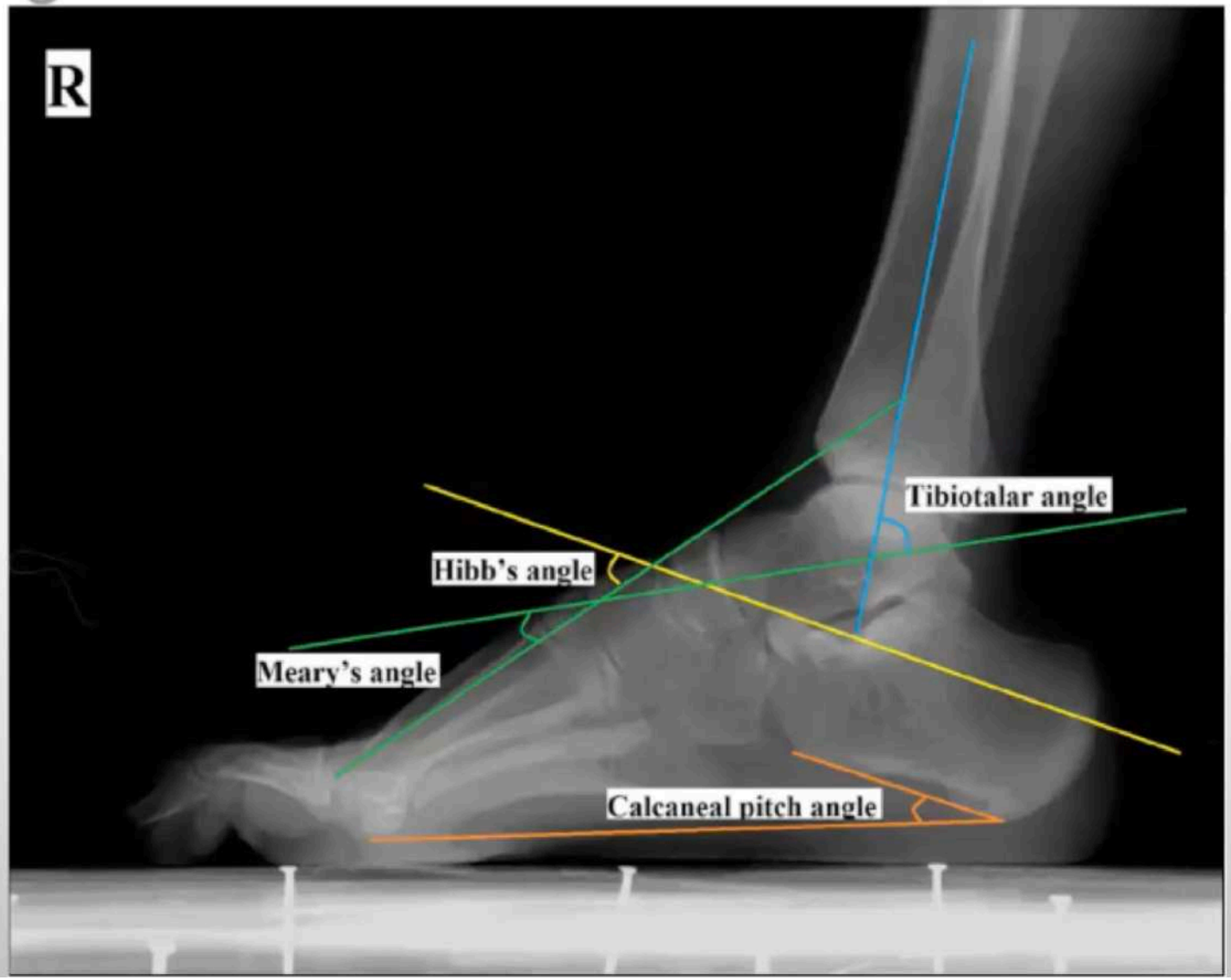
PES PLANUS AND PES CAVUS

DR RAHUL UPADHYAY

FOOT & ANKLE SURGEON

JAIPUR, INDIA



TYPES

- CONGENITAL FLAT FOOT- INHERITED, CVT, HYPERLAXITY, PHYSIOLOGICAL
- ADOLESCENT FLAT FOOT- INHERITED, TARSAL COALITION
- ADULT ACQUIRED FLAT FOOT- PTTD

CONGENITAL FLAT FOOT

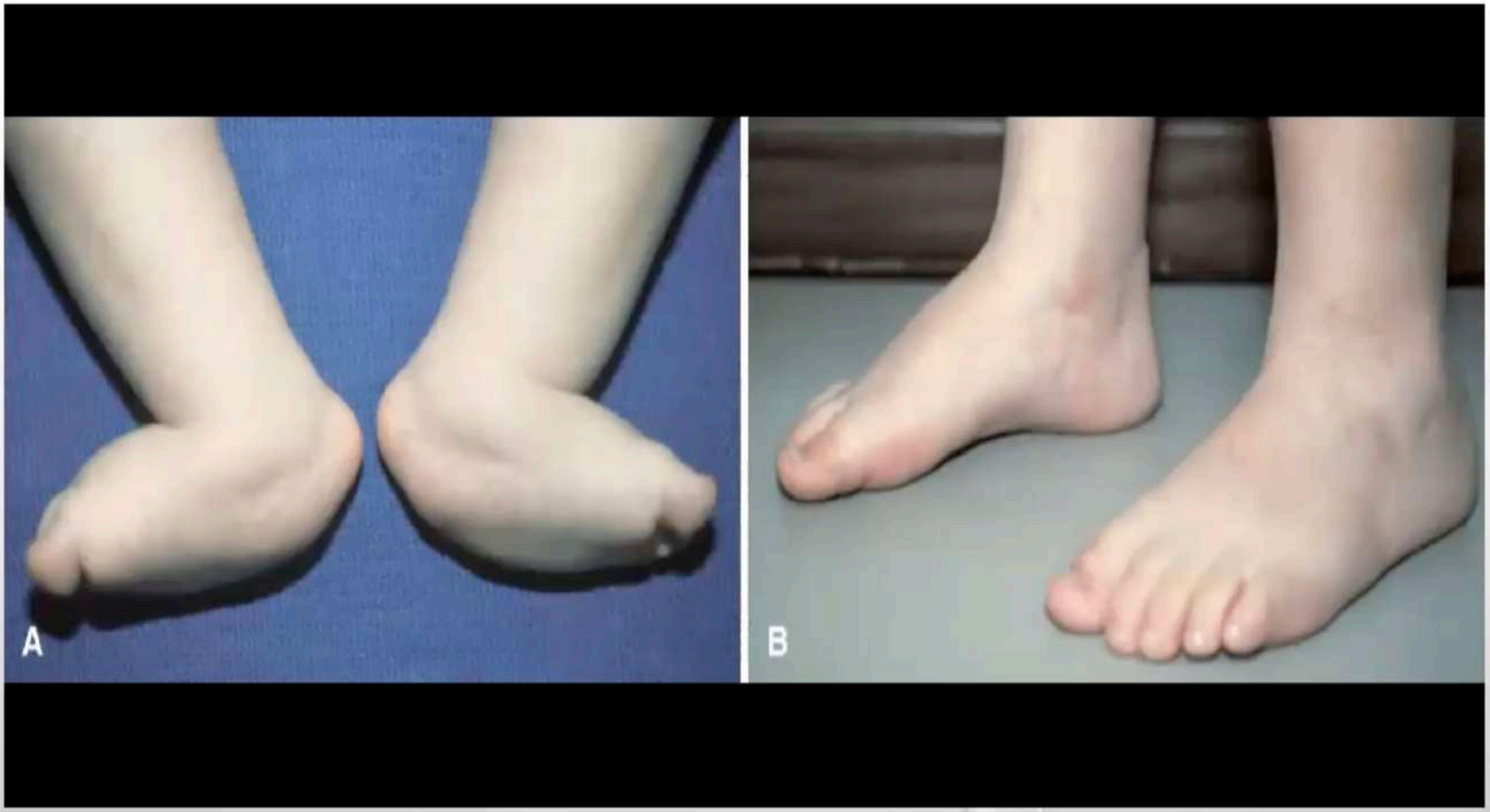
- INHERITED
- GENERALIZED HYPERLAXITY
- CONGENITAL VERTICAL TALUS
- PHYSIOLOGICAL

CONGENITAL RIGID FLAT FOOT

- CONGENITAL VERTICAL TALUS
- ROCKER BOTTOM FLATFOOT
- MAY BE ASSOCIATED WITH NEUROMUSCULAR DISORDERS
- ARTHROGRYPHOSIS
- MENINGOMYELOCELE

CLINICAL FINDINGS

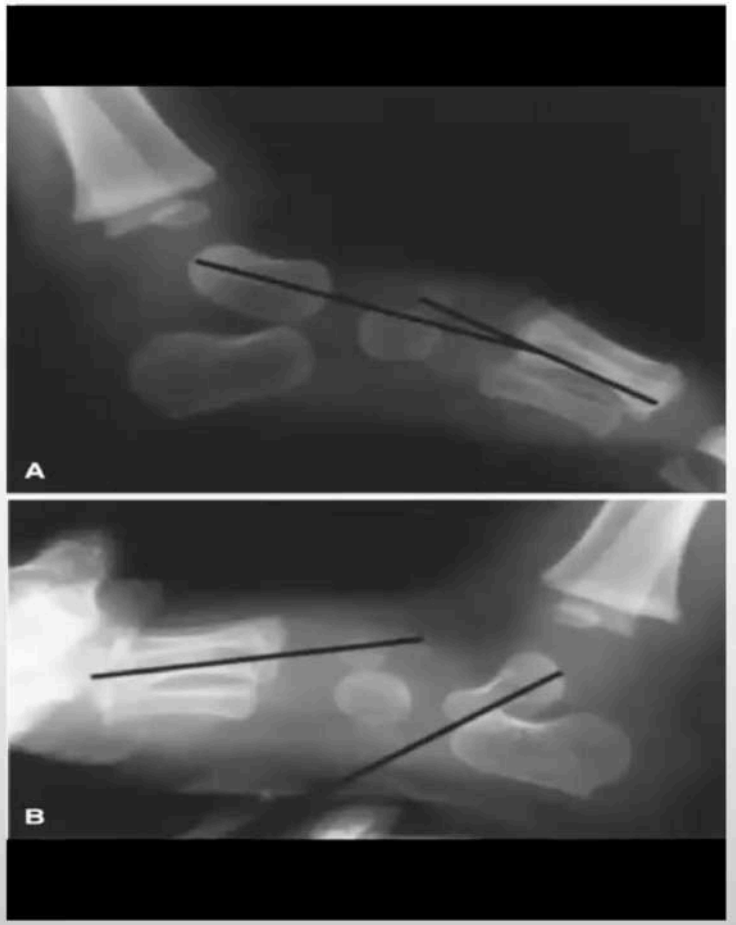
- CAN BE DETECTED AT BIRTH
- ROUNDED PROMINENCE OF MEDIAL AND PLANTAR SURFACE OF THE FOOT
- ABNORMAL POSITION OF TALUS HEAD.
- FOREFOOT IS DORSIFLEXED AT MIDTARSAL JOINT
- SOLE IS CONVEX
- DEEP CREASES ON DORSOLATERAL ASPECT OF FOOT

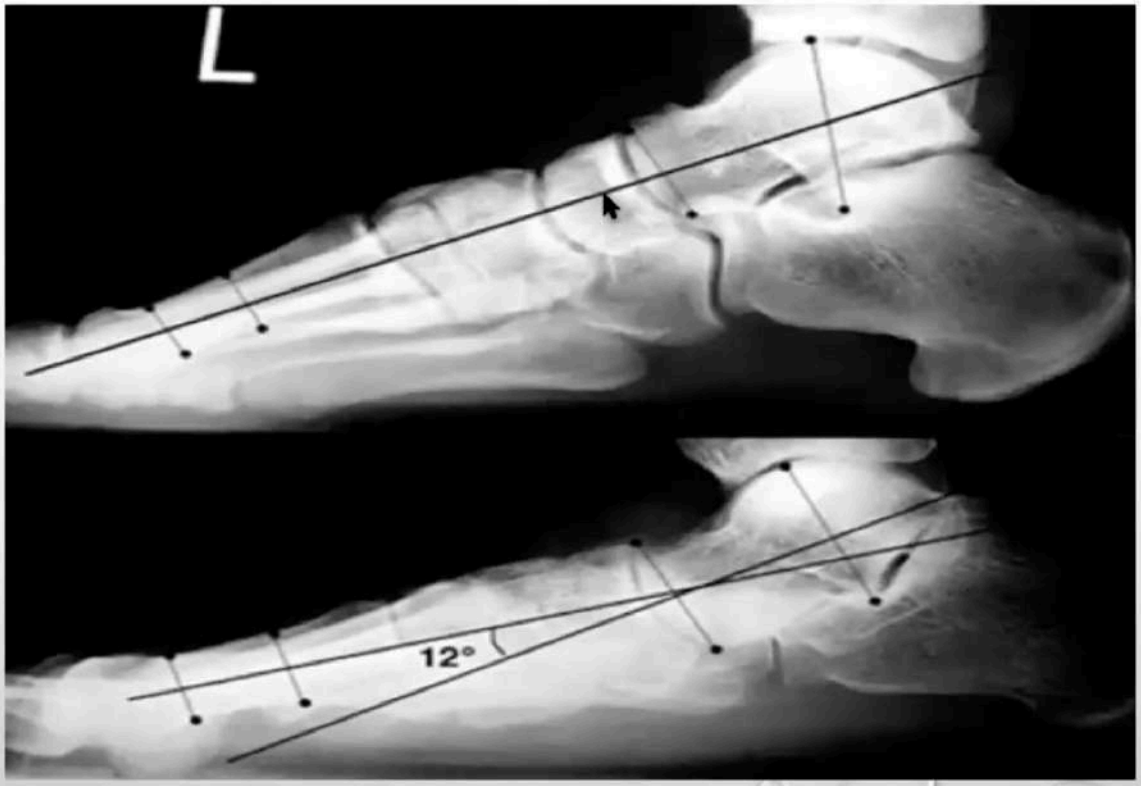


WITH GROWTH

- ADAPTIVE CHANGES OVER TALUS , BECOMES HOURGLASS
- CALLOSITIES BENEATH ANTERIOR END OF CALCANEUS
- CALLOSITIES OVER MEDIAL BORDER OF FOOT AND ABOVE TALUS
- ON WEIGHT BEARING, SEVERLY ABDUCTED FOREFOOT
- HEEL DOES NOT TOUCH THE GROUND.

RADIOLOGY





FLEXIBLE PES PLANUS

- PHYSIOLOGICAL
- GENERALIZED HYPERLAXITY
- MILD TO NO DEFORMITY ON REST
- ON WEIGHT BEARING- HEEL VALGUS, FOREFOOT ABDUCTION
- DEFORMITY IS CORRECTED PASSIVELY
- LATE ONSET PAIN AND SYMPTOMS

PHYSICAL EXAMINATION- MY APPROACH

- STANDING POSITION:
  - BAREFOOT STANDING
  - EXPOSE BOTH LOWER EXTREMITIES PROXIMAL TO KNEE JOINT
  - BOTH KNEES FACING FORWARD
  - LOOK FOR ANY OBVIOUS DEFORMITY, CHANGE IN ALIGNMENT
  - SWELLING OR FULLNESS OVER MEDIAL ANKLE
  - SKIN CHANGES LATERALLY OVER SUBFIBULAR REGION
  - ROTATE THE EXTREMITY BY 90 DEGREES, LOOK FOR FLATTENING OF ARCH DUE TO TN COLLAPSE, ALSO COMPARE WITH OPPOSITE SIDE.

- SEATING POSITION:
  - DIRECT TENDERNESS OVER MEDIAL MALLEOLUS, COURSE OF TIB POST TENDON
  - TENDERNESS OVER SUBFIBULAR REGION
  - CALLOSITY OF TALAR HEAD
  - PASSIVE CORRECTION OF DEFORMITY
  - ANKLE ROM- AVOID COMPENSATION FROM MIDFOOT JOINTS
  - SUBTALAR JOINT MOVEMENT

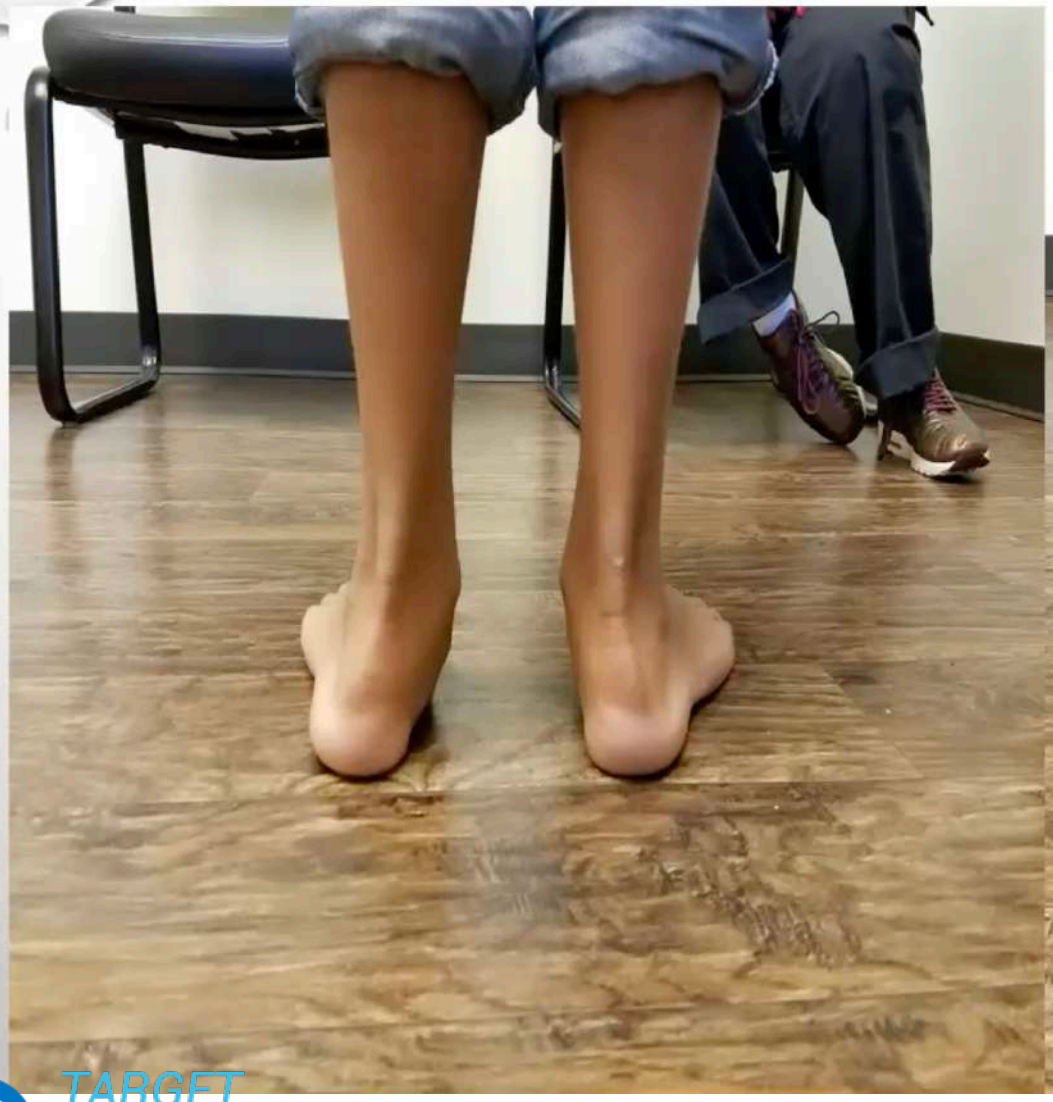
- SUPINE POSITION:
  - SILVERSKIOLDT TEST – TO ASCERTAIN ISOLATED GASTROCNEMIUS TIGHTNESS
  - ALWAYS HOLD SUBTALAR JOINT IN NEUTRAL POSITION WHILE DOING THE TEST
  - ASSESSMENT OF FIXED FOREFOOT VARUS-USUALLY COMPENSATORY TO HINDFOOT VALGUS IN LONG STANDING CASES
- PRONE POSITION:
  - SUBTALAR JOINT ASSESSMENT FOR MOVEMENT AND DEFORMITY
  -

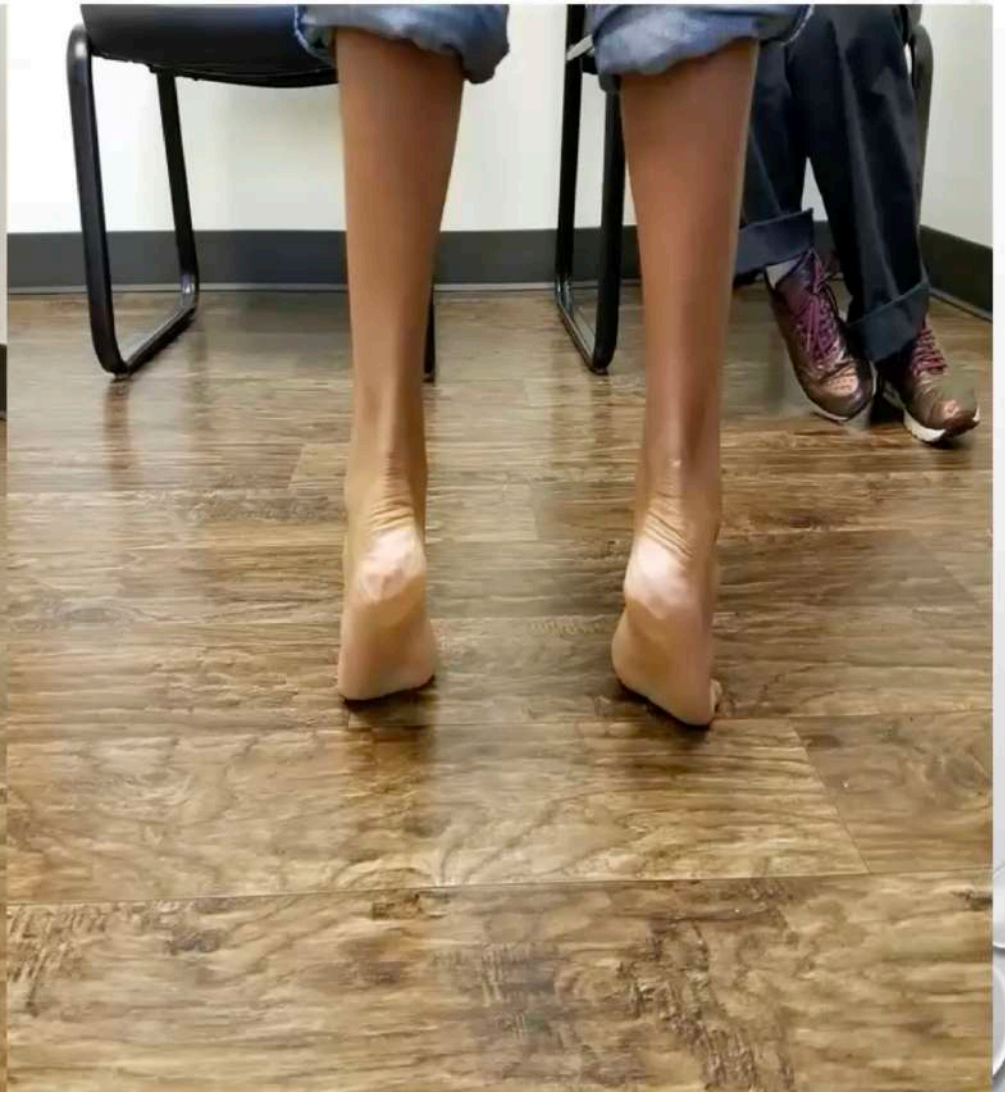
ASSESSMENT OF TIBIALIS POSTERIOR TENDON

- TEST MUSCLE STRENGTH AND INTEGRITY
- DOUBLE AND SINGLE LEG HEEL RAISE.
- DOUBLE LEG TIP TOEING HELPS IN SYMMETRICAL ASSESSMENT OF HINDFOOT INVERSION
- LOOK FOR ABILITY TO INITIATE AND MAINTAIN TIP TOEING.
- RESISTANCE ASSESSMENT OF TIBIALIS POSTERIOR FUNCTIONS

JHONSON AND STORM CLASSIFICATION

- STAGE 1: MILD PAIN, MOSTLY ASYMPTOMATIC
- STAGE 2: PAIN WITH TIB POST INVOLVEMENT
    - 2A: SINGLE LEG HEEL RAISE PRESENT
    - 2B: SINGLE LEG HEEL RAISE ABSENT
- STAGE 3: RIGID DEFORMITY
- STAGE 4: (MYERSON) : ANKLE INVOLVEMENT





- GAIT ANALYSIS

  - RELATIVELY PROLONGED STANCE PHASE

  - DECREASED CADENCE AND WALKING SPEED.

- SHOE INSPECTION:

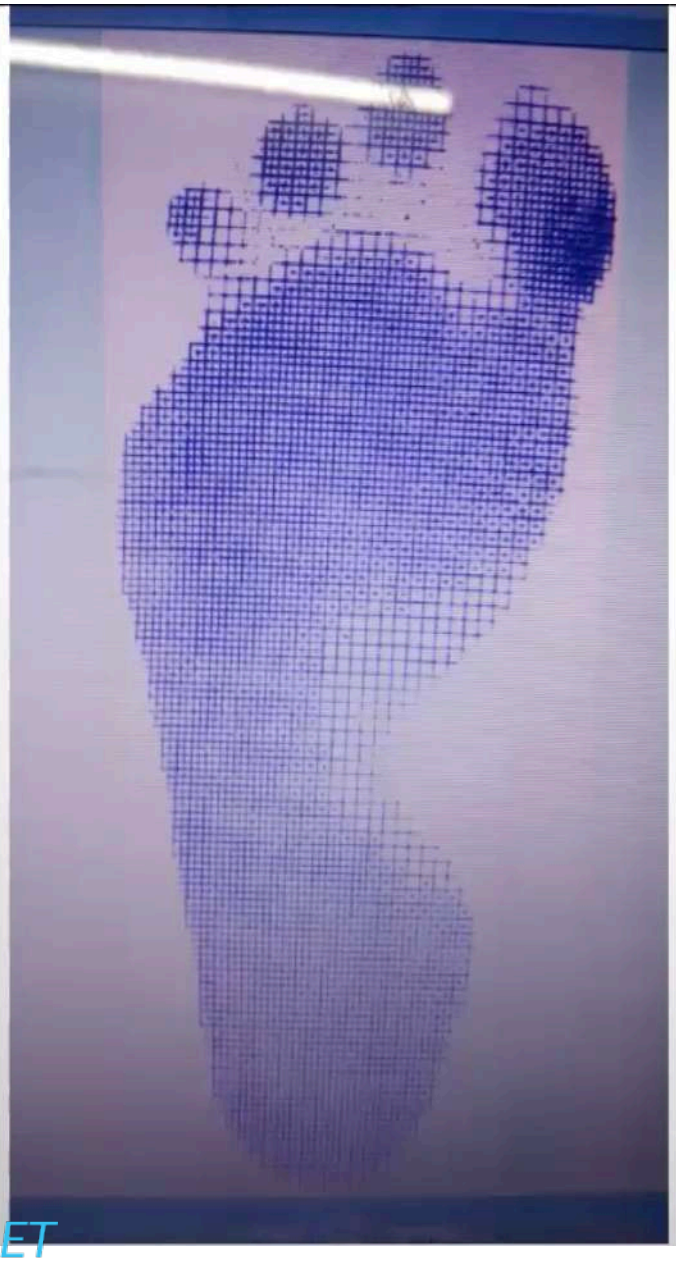
  - ABERRANT WEAR PATTERNS

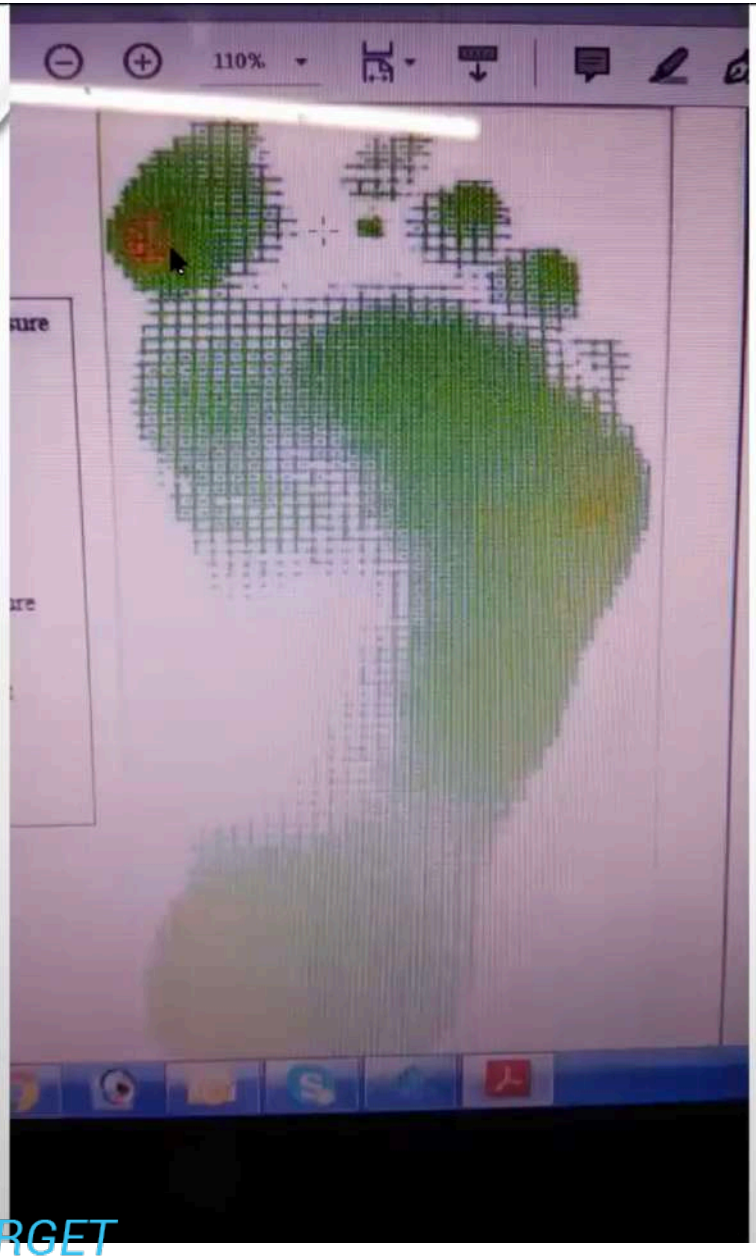
FRONT

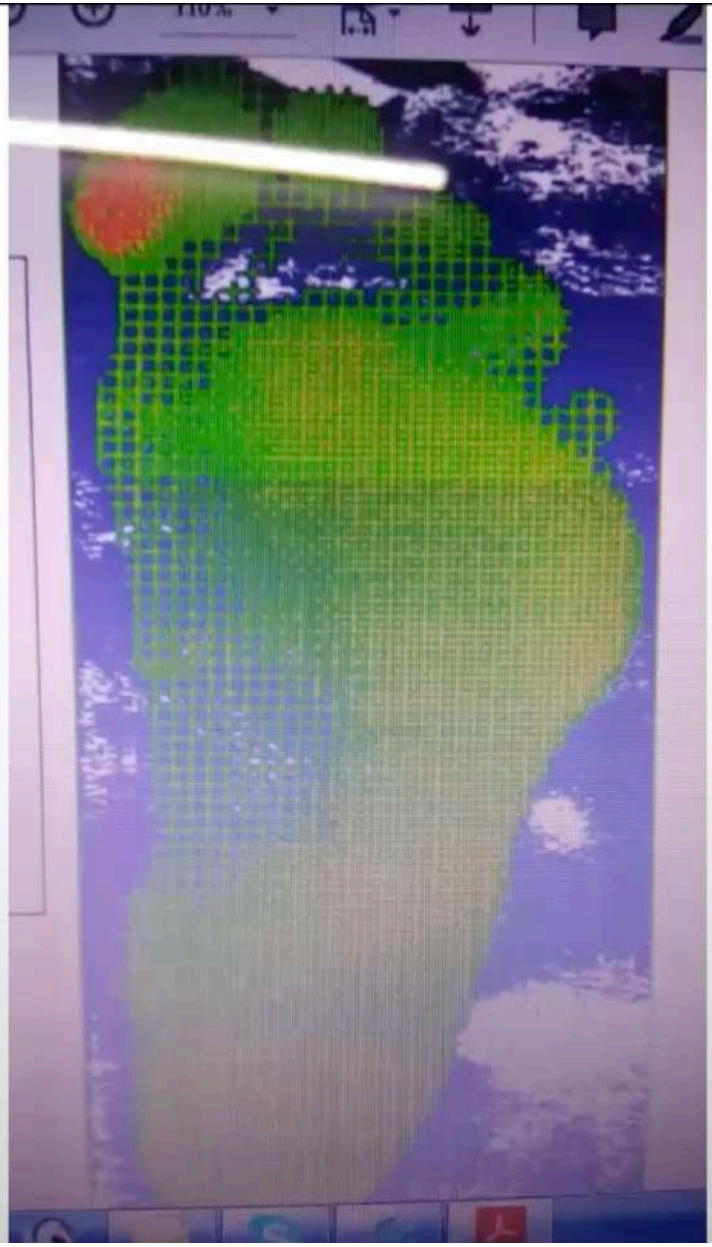
SIDE

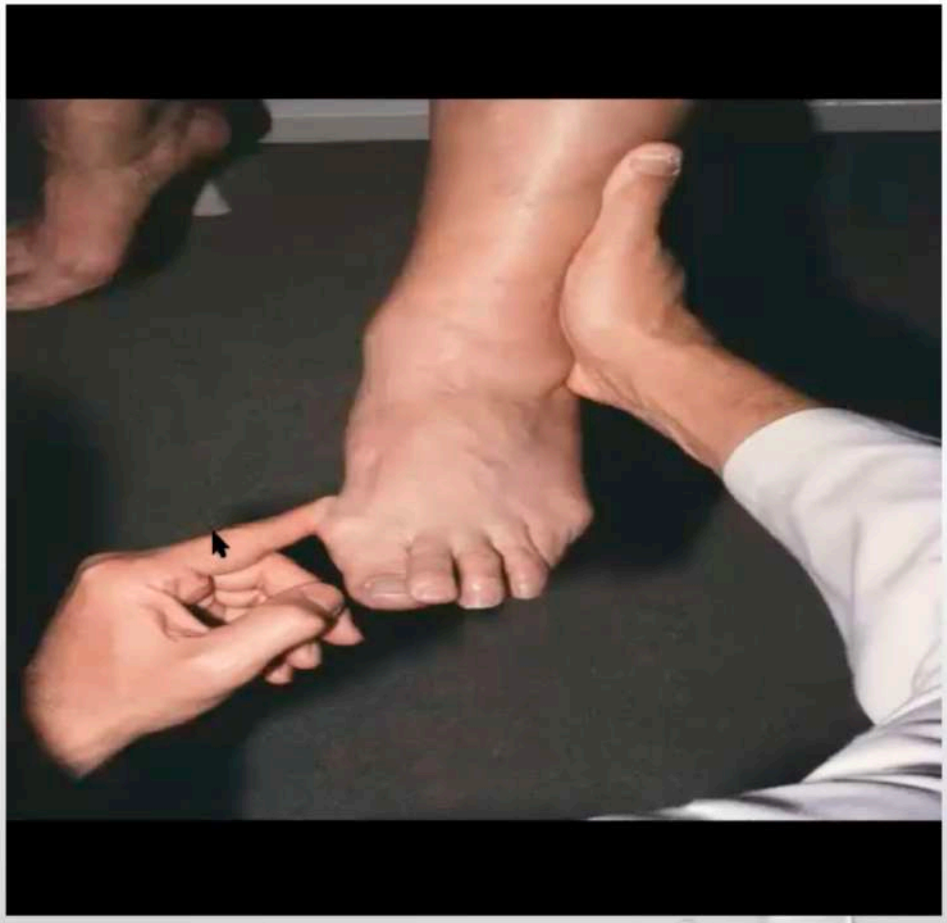
BEHIND

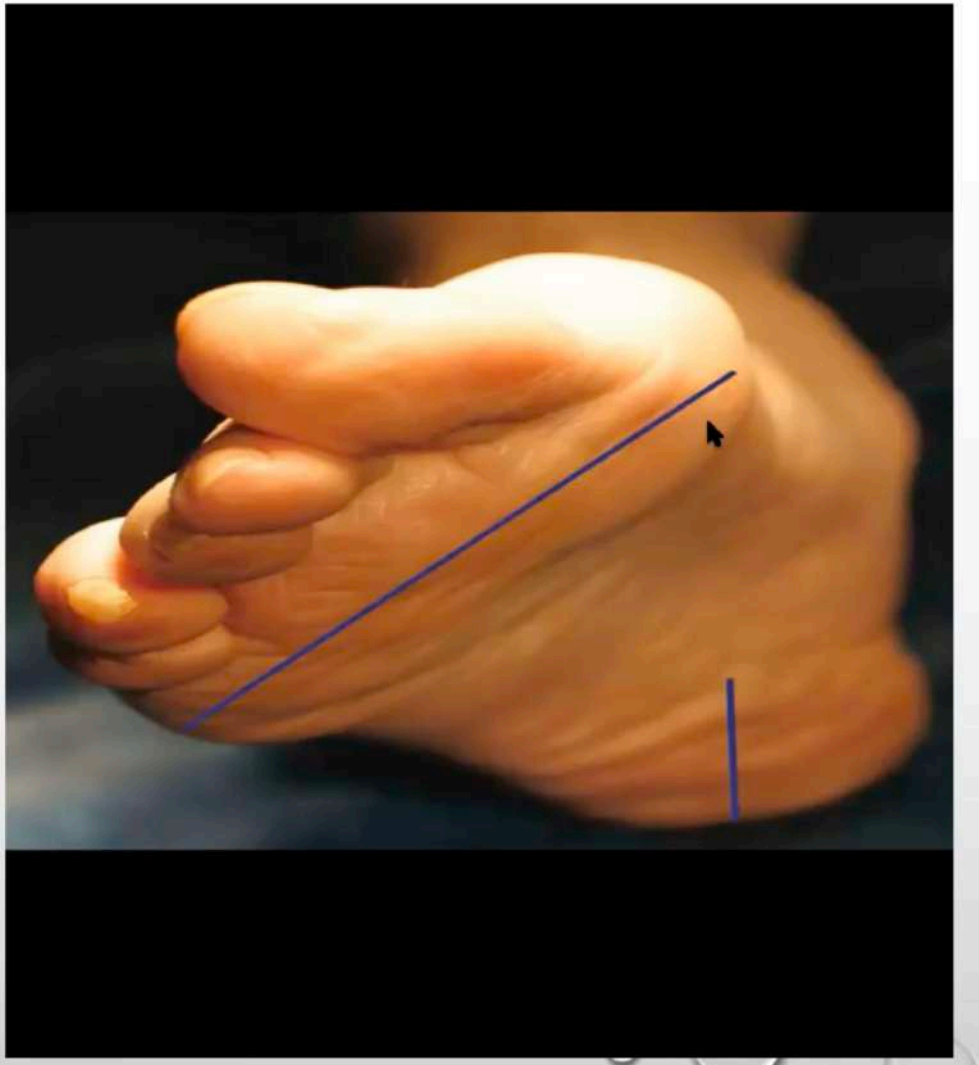
FOOT PRINT ASSESSMENT











IMAGING

- RADIOGRAPHY:

  - WEIGHT BEARING AP AND LATERAL RADIOGRAPHS OF FOOT AND ANKLE

  - HINDFOOT ALIGNMENT RADIOGRAPH- ASSESSMENT OF VALGUS DEFORMITY

OTHER VIEWS DO NOT ADD MUCH TO DIAGNOSIS OR TREATMENT OPTIONS.

- MRI :

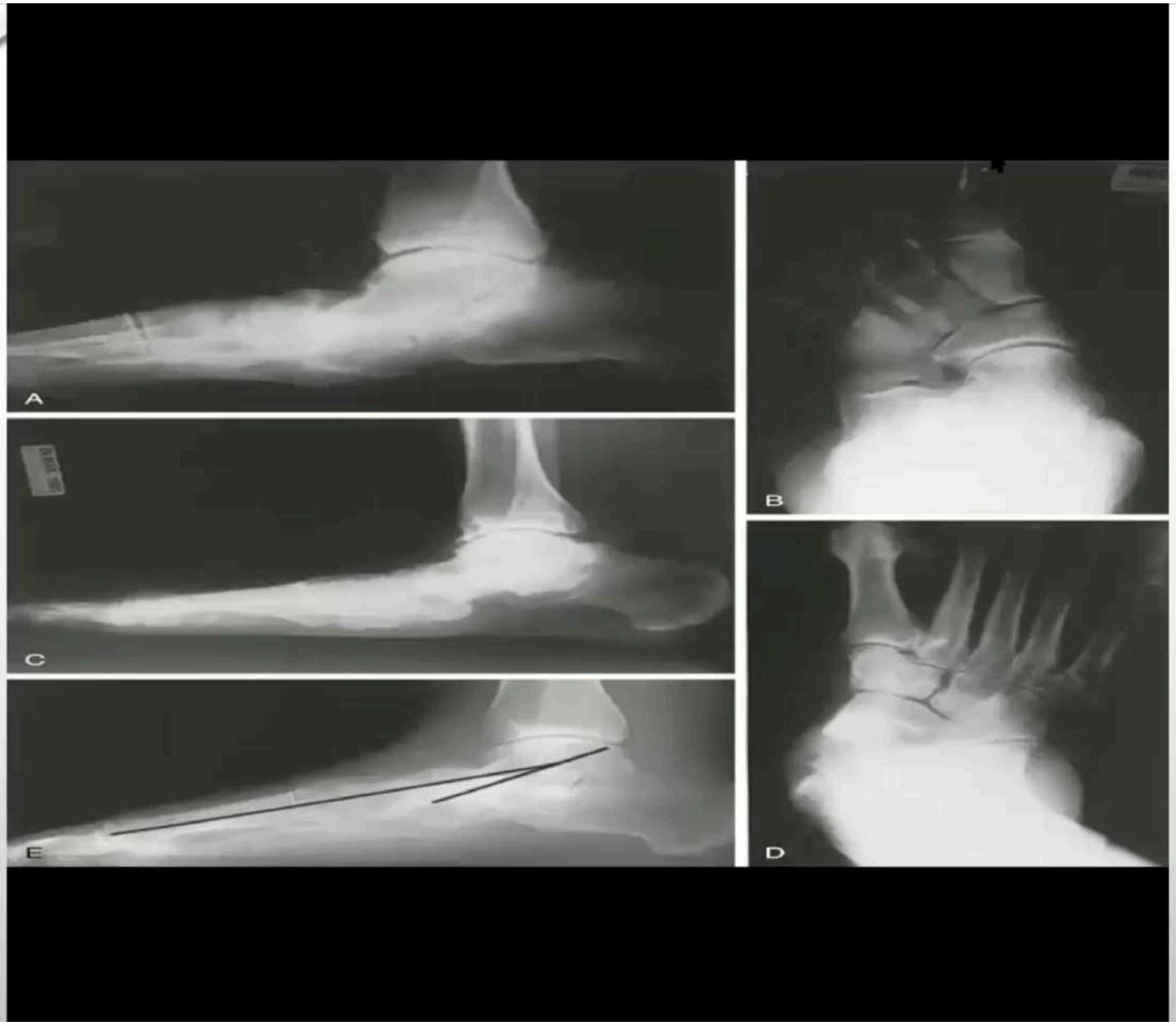
  -DETECTS SHEATH INFLAMMATION, SOFT TISSUE STATUS, ANATOMIC DETAIL OF PTT.

- CT : MAY HAVE ROLE IN RIGID FOOT , NOT MUCH IN FLEXIBLE STAGE 2.

TALONAVICULAR SAG

NAVICULO-CUNEIFORM SAG

VALGUS DISPLACEMENT OF TALUS



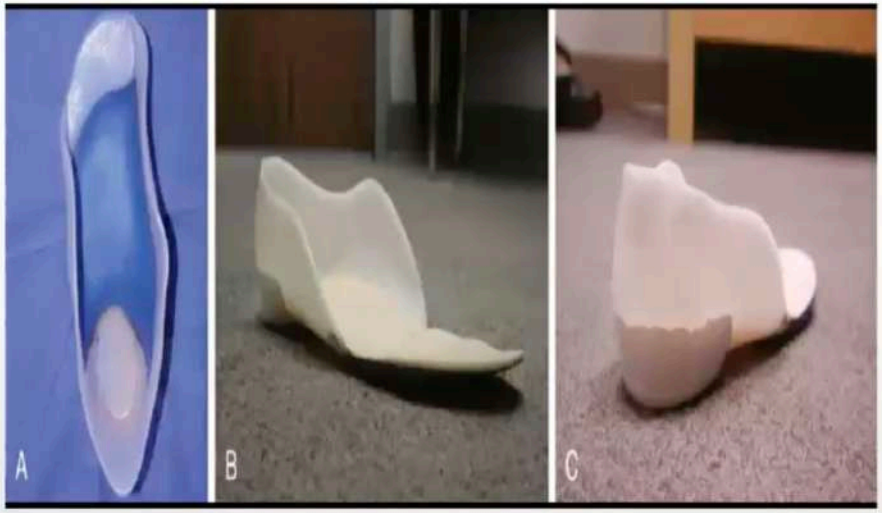
HOW DO I DECIDE MANAGEMENT ?

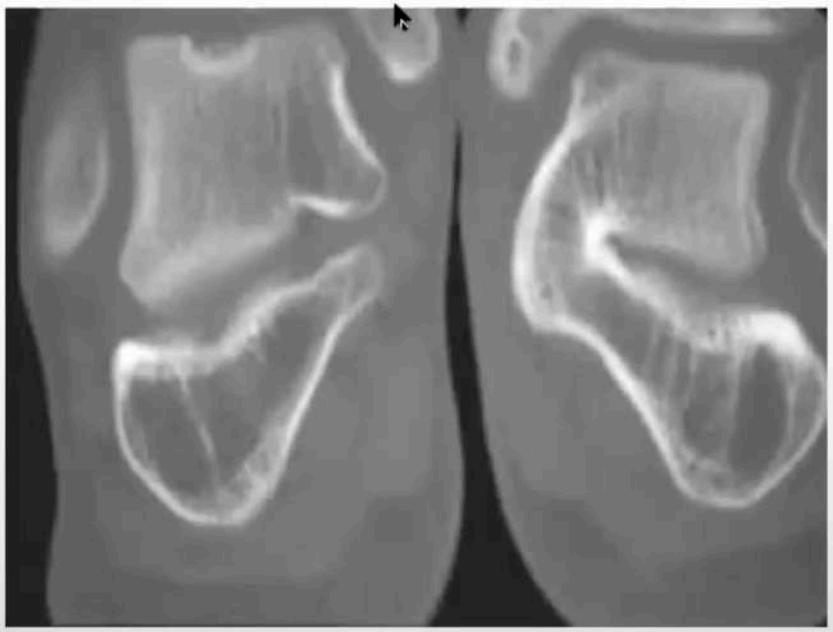
- ALL THE BEFORE MENTIONED FACTORS PLAY A VERY IMPORTANT ROLE IN DECISION MAKING.
- ONLY SYMPTOMATIC PATIENTS ARE TO BE SURGICALLY MANAGED, AVOID COSMETIC DEMANDS ALONE.
- OUTCOME ASSESSMENT AND DISCUSSION WITH PATIENTS.
- CLINICAL, RADIOLOGICAL ANALYSIS.

- CHILDREN UPTO 0-3 YEARS- SUPERVISED NEGLECT
- CHILDREN 3 – 12 YEARS- ORTHOTICS AND PHYSIO
- ADOLESCENTS AND ADULTS- CLINICAL DECISION

CONSERVATIVE

- TIB POST STRENGTHENING EXERCISES
- FOOT INTRINSIC MUSCLE STRENGTHENING
- GASTROCNEMIUS STRETCHING
- MEDIAL ARCH SUPPORT
- ORTHOTIC BRACES

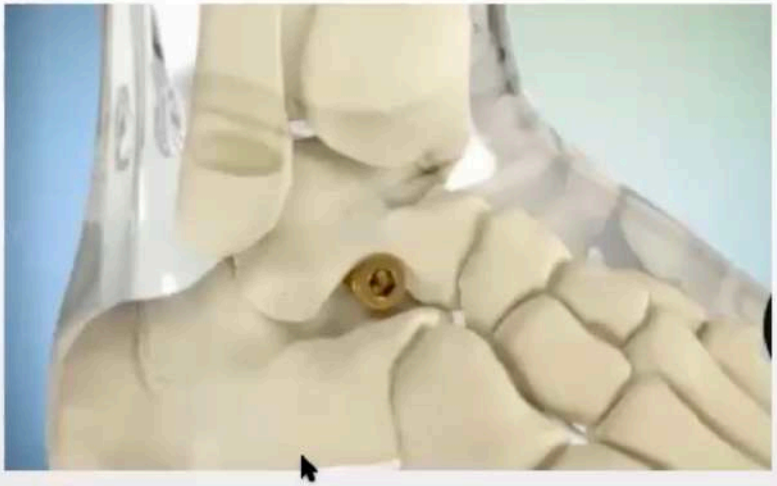


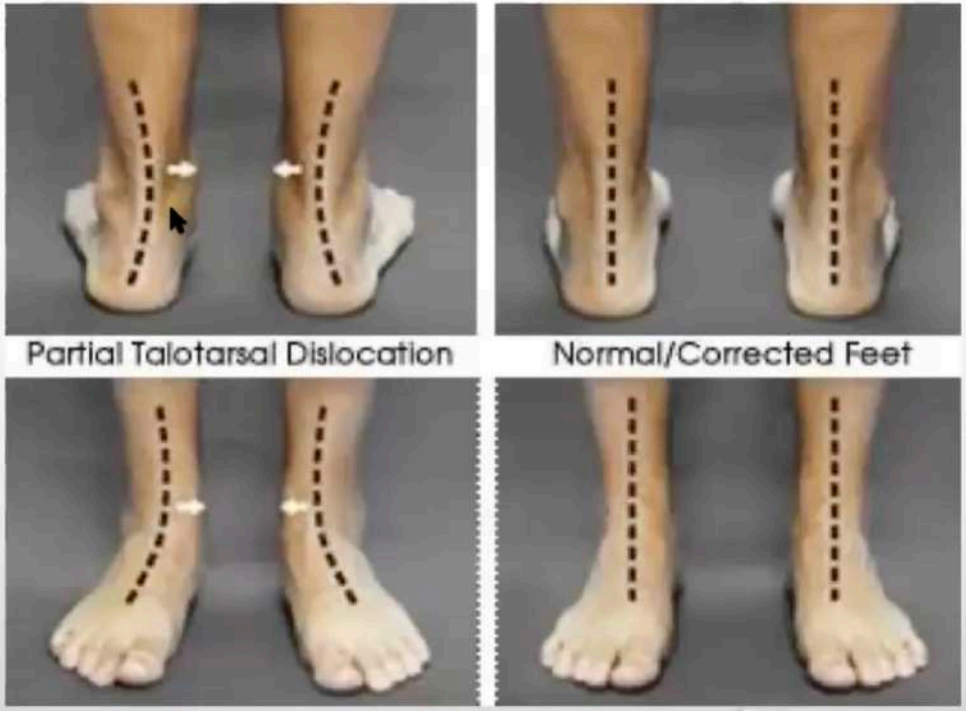


EXTRA OSSEOUS TALOTARSAL STABILIZATION (EOTTS)

- SMALL STENT
- SINUS TARSI POSITIONING
- PREVENTS PLANTAR FLEXION AND INVERSION OF TALUS
- HELPS IN REMODELING
- STRICT PATIENT PROFILE

Non-Weightbearing Findings	Static Weightbearing Findings	Dynamic Weightbearing Gait Analysis	Radiographic Findings
• >6° of talotarsal joint pronation	• Medial deviation of the talus (looks like two inner ankle bones) • Forefoot valgus • Deviation from the lower leg to foot • Calcaneal valgus (not always present) • Too many toes sign • Lower than normal medial arch (not always present)	• Prolonged period of TTJ pronation • Too many toes sign • Calcaneal valgus (not always present) • Arch collapse (may be present, but not necessary)	***DP View*** • Talar 2nd metatarsal angle >16° • Anteriorly deviated cyma (may be present) • Increased talocalcaneal angle • Decreased talonavicular coverage (may be present) ***Lateral View*** • Obliterated sinus tarsi • Talar declination >21° (may be present) • Anteriorly deviated cyma (may be present) • Increased talar 1st metatarsal angle (may be present)





STEPS IN STAGE 2

- GASTROCNEMIUS RECESSION (COMPLETE)
- MEDIAL DISPLACEMENT CALCANEAN OSTEOTOMY
- LATERAL COLUMN LENGTHENING (ONLY IN HIGH DEMAND PATIENT)
- FDL TRANSFER TO NAVICULAR
- PLANTAR FLEXION OSTEOTOMY OF CUNEIFORM- RARELY NEEDED.
- FDL TO FHL TENODESIS POST TRANSFER.
- TIB POST TO NEW FHL TENODESIS

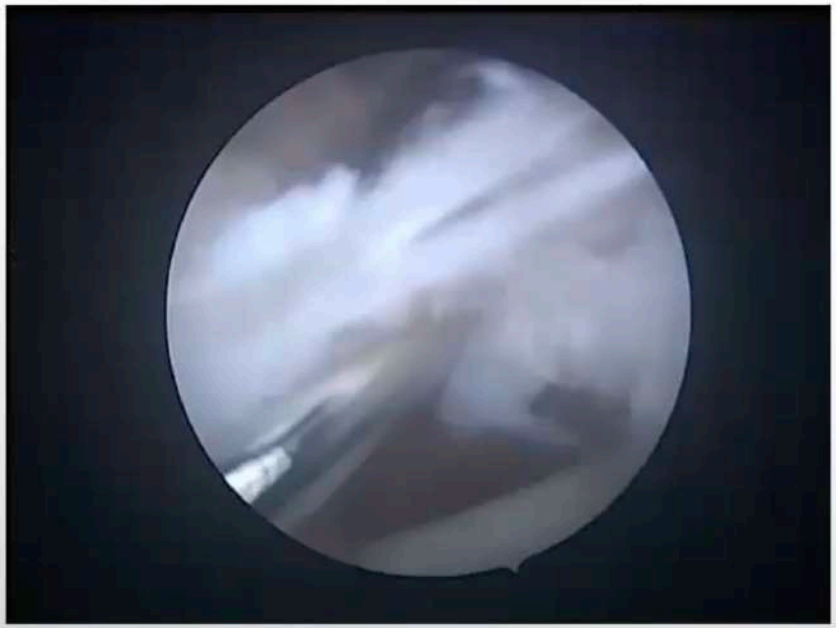
TRIVIA 1

- YOUNG FEMALE
- STAGE 2A
- COMPLAINS OF PAIN

a. Tib post debridement
b. Orthotic support
c. Local steroid injection
d. Reconstruction surgery

TIBIALIS POSTERIOR TENDOSCOPY, DEBRIDEMENT

- ARTHROSCOPIC TIB POST DEBRIDEMENT WAS DONE
- ORTHOTIC SUPPORT POST SURGERY WITH HEEL VALGUS BLOCK AND MEDIAL ARCH.
- PHYSIOTHERAPY, UNDER SUPERVISION FOR TIB POST STRENGTHENING.



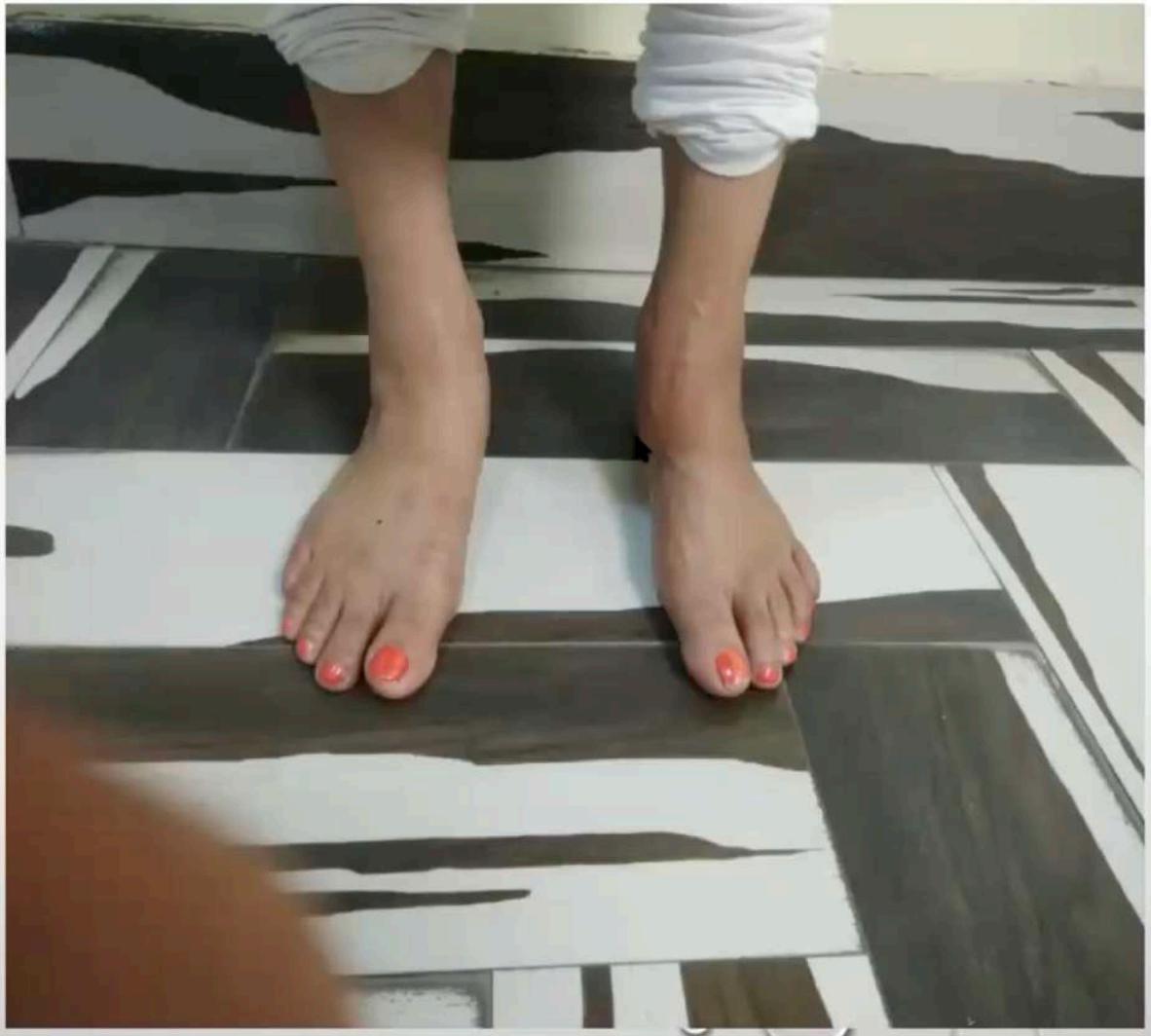
TRIVIA 2

- 30 YEAR OLD FEMALE
- SEVERE PAIN WITH DIFFICULTY IN WALKING ON LEFT SIDE. FLEXIBLE DEFORMITY
- SINGLE LEG HEEL RAISE ABSENT
- SILVERSKIOLDS TEST +

a. Conservative
b. Tib post debridement
c. Gastrocnemius recession, Fdl transfer, calcaneum osteotomy.
d. Triple arthrodesis

CALCANEAUM OSTEOTOMY

AP VIEW — OPERATED VS NON OPERATED



TRIVIA 3

- 40 YEARS FEMALE
- PAINFUL TN JOINT
- DEFORMITY FLEXIBLE BUT EARLY TN JOINT ARTHROSIS
- WANTS ONLY 1 SURGERY

a. Triple arthrodesis
b. Joint sparring osteotomies
c. Tendon transfers
d. conservative

TRIVIA

- ADOLESCENT MALE
- PAINFUL STAGE 2 PTTD
- PAIN WHILE PLAYING IN SCHOOL
- ASPIRING SOCCER PLAYER
- MEDIAL DISPLACEMENT CALCANEUM OSTEOTOMY , EXCISION OF COALITION, WITH TENOSYNOVECTOMY AND DEBRIDEMENT OF TIB POST WAS DONE.

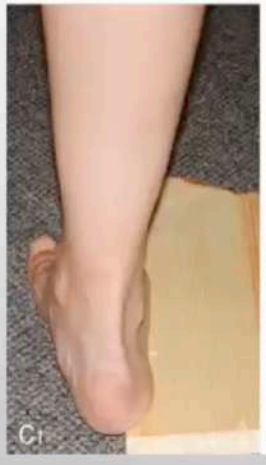
- FOOT WITH A HIGH ARCH THAT MAINTAINS ITS SHAPE AND FAILS TO FLATTEN OUT WITH WEIGHT BEARING
- INCREASED CALCANEAL PITCH
- PLANTAR FLEXION OF MEDIAL FOREFOOT
- ADDUCTION OF ENTIRE FOREFOOT
- PREDOMINANT DEFORMITY- HINDFOOT/ MIDFOOT OR BOTH

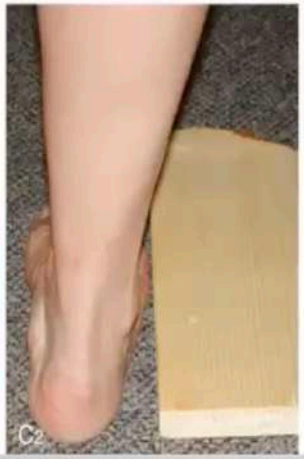
ETIOLOGY

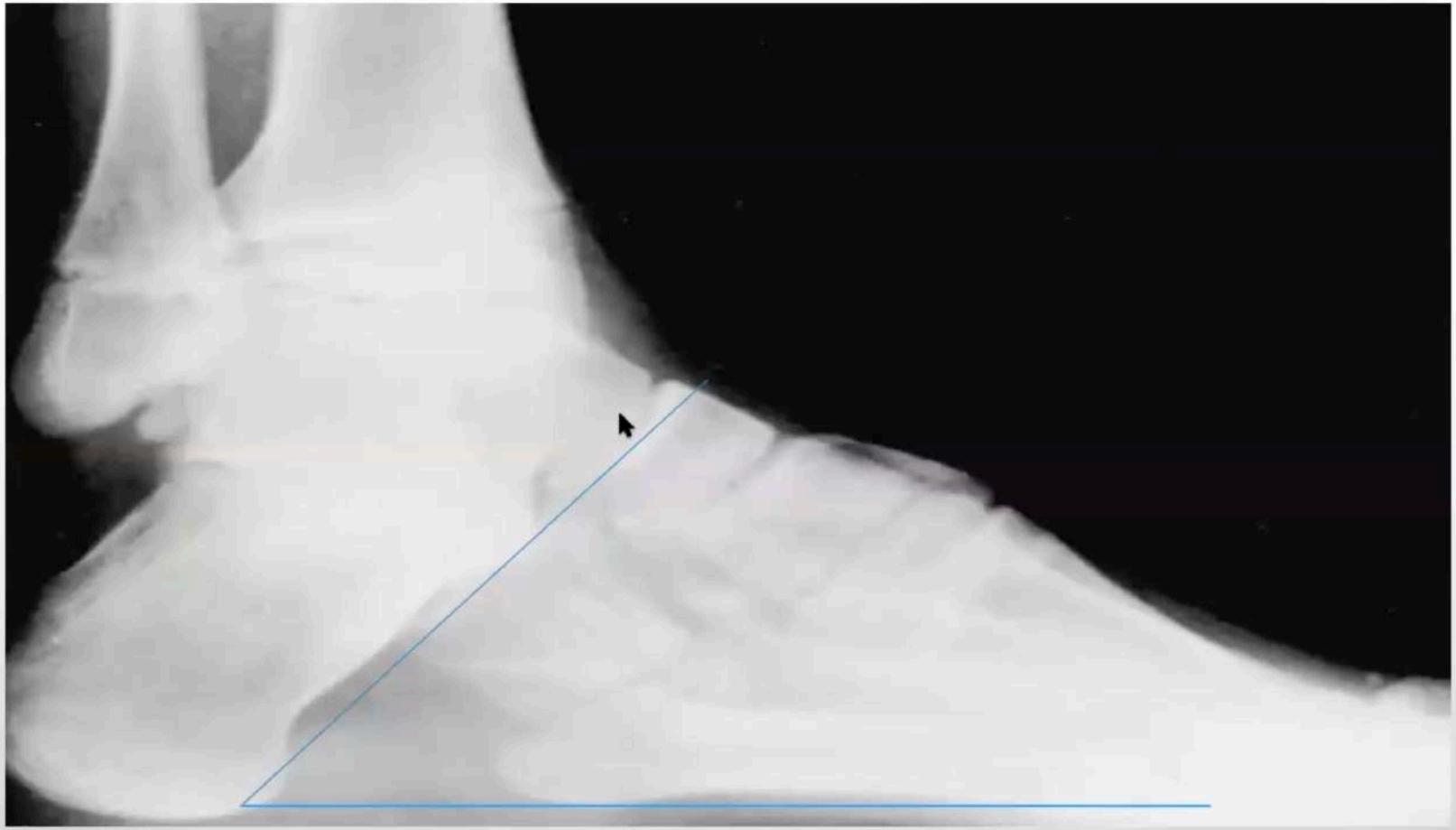
- MUSCLE IMBALANCE IS THE BASIS.
- EXTRINSIC/INTRINSIC (DUCHENNE 1959)
- PROXIMAL/DISTAL
- SUBTLE NEUROLOGIC LESION- BELOW CLINICAL DETECTION
- CMT DISEASE- NEARLY HALF OF THE CASES

I. Neuromuscular	
A. Muscle disease	Muscular dystrophy
B. Afflictions of peripheral nerves and lumbosacral spinal nerve roots	Charcot-Marie-Tooth disease
	Spinal dysraphism
	Polyneuritis
	Intraspinal tumor
C. Anterior horn cell disease of spinal cord	Poliomyelitis
	Spinal dysraphism
	Diastematomyelia
	Syringomyelia
	Spinal cord tumors
	Spinal musculature atrophy

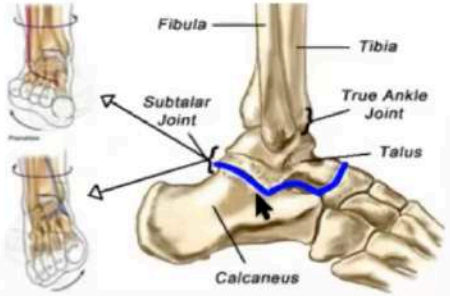
D. Long-tract and central disease	Friedreich ataxia
	Roussy–Lévy syndrome
	Primary cerebellar disease
	Cerebral palsy
II. Congenital	Idiopathic cavus foot
	Residual of clubfoot
	Arthrogryposis
III. Traumatic	Residuals of compartment syndrome
	Crush injury to lower extremity
	Severe burn
	Malunion of fractured foot







BIOMECHANICS



Collinear axis of talus and calcaneus → Talar head over calcaneus → Navicular moves superior → Vertical subtalar joint → Impaired midfoot function

↓

Hindfoot locked in inversion ← Restricted subtalar motion ← Gait abnormality ← Overloaded forefoot and lateral border of foot

Deformity	Weak Agonist Muscle(s)	Intact Antagonist Muscle(s)	Action
Equinus	Tibialis anterior	Gastrocnemius–soleus complex (triceps-surae)	Plantar flexion
Adduction and hindfoot varus	Peroneus brevis	Tibialis posterior	Adducts the foot, inverts the subtalar joint
Plantar flexion of the first ray	Tibialis anterior	Peroneus longus	Plantar flexes the first ray, creates a secondary forefoot cavus
Plantar flexion of the first ray	Tibialis anterior	Peroneus longus	Plantar flexes the first ray, creates a secondary forefoot cavus
Toe deformities	Foot intrinsics	Long toe flexors	Clawing occurs as the extrinsic forces are unmodified by the intrinsics; also depresses the metatarsal heads and accentuates cavus
Hallux claw toe	Foot intrinsics	EHL and FHL	Severe hallucal clawing occurs when a spared EHL is used to assist a weak tibialis anterior dorsiflex the foot

PHYSICAL EXAMINATION

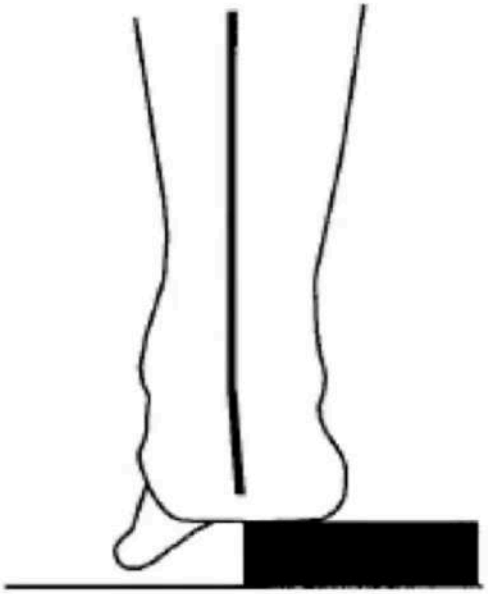
- HISTORY (PATIENT & FAMILY)
- LATERAL COLUMN PAIN – MC SYMPTOM
- LATERAL HINDFOOT INSTABILITY
- GAIT- GROUND CONTACT, HEEL POSITION, TOE POSITION DURING **STANCE**
- **SWING-** FOOT DROP, EHL AS DORSIFLEXOR, COCK UP DEFORMITY 1ST MTPJ
- PEEK A BOO- HEEL PAD SEEN FROM FRONT
- ACTIVE & PASSIVE ROM AT ANKLE, SUBTALAR, TRANSVERSE TARSAL AND MTPJ
- ASSESS MUSCLE FUNCTION

- **SILFVERSKIOLD TEST**-CHECK DORSIFLEXION WITH BOTH KNEE FLEXION AND KNEE EXTENSION
  - IF TIGHT ONLY WITH KNEE EXTENSION, THEN GASTROCNEMIUS IS TIGHT
  - IF TIGHT ALSO WITH KNEE FLEXION, THEN SOLEUS IS ALSO TIGHT

- GASTRONEMIUS TIGHTNESS OFTEN PRESENT WITH CAVOVARUS FOOT

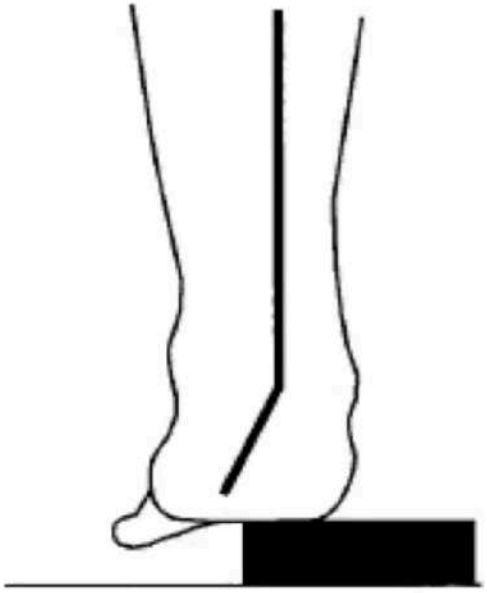
COLEMAN BLOCK TEST – FOR HINDFOOT VARUS AND FLEXIBILITY

Right hindfoot varus



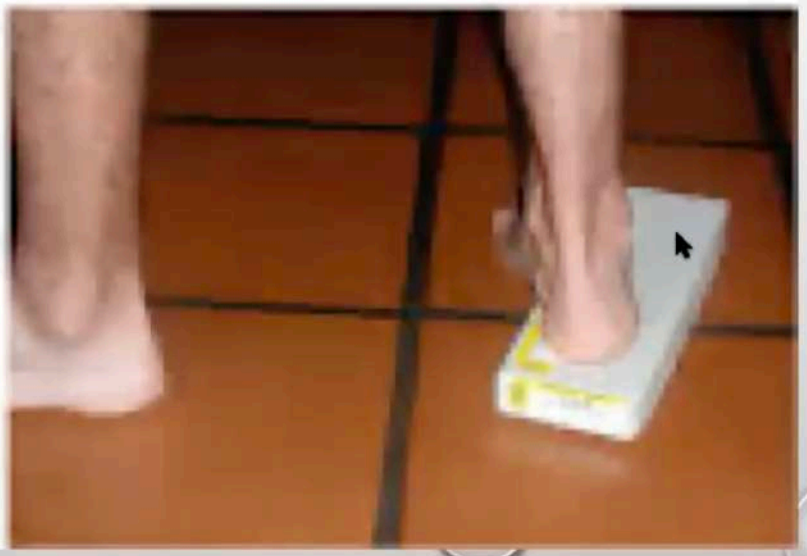
Forefoot-driven varus

- Forefoot rigid hindfoot mobile
- Hindfoot varus moves to valgus

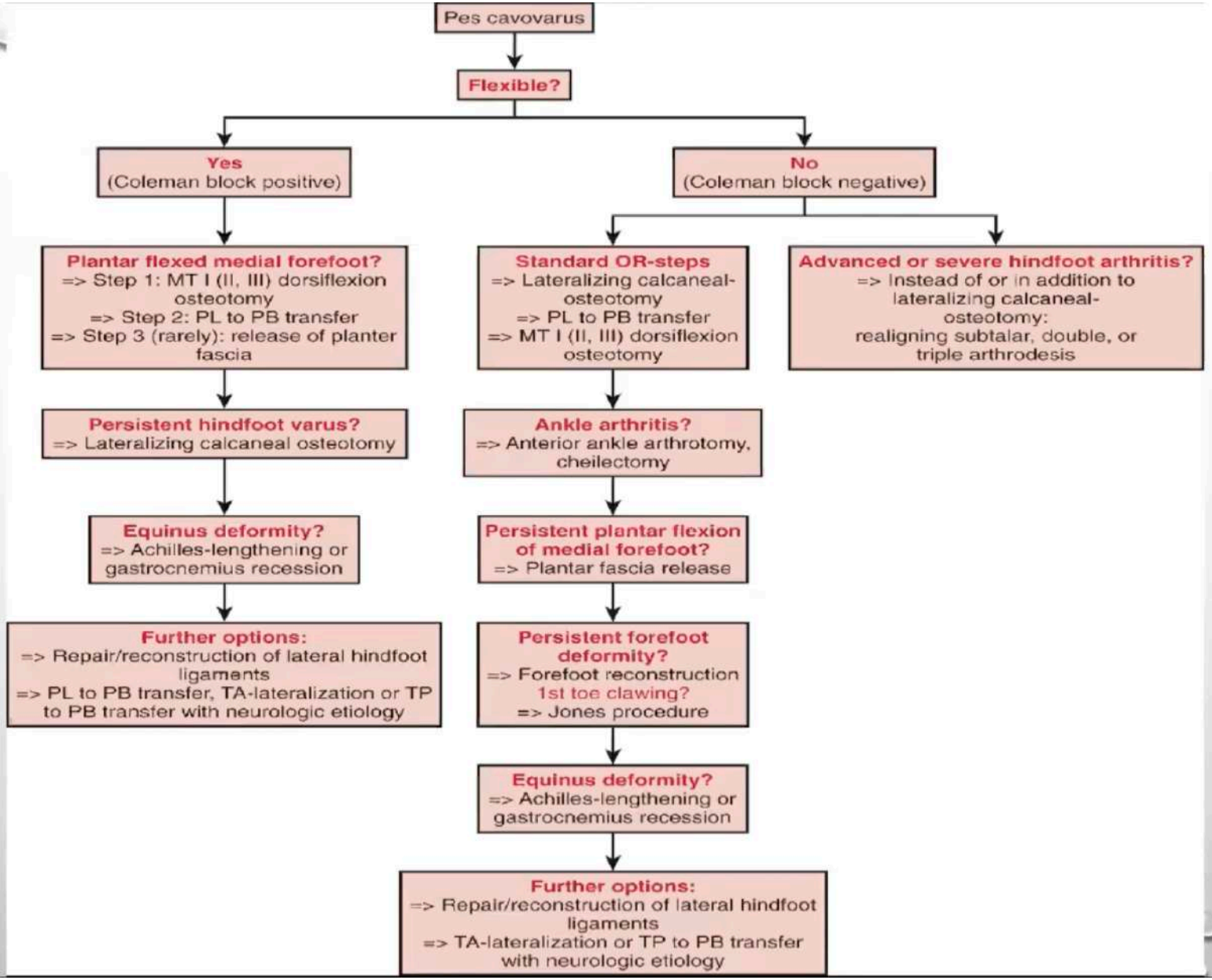


Hindfoot-driven varus

- Forefoot mobile hindfoot rigid
- Hindfoot remains in varus



INVESTIGATIONS



TRIVIA 4

- 16 YEARS OLD BOY
- MIDFOOT CAVUS DEFORMITY, PASSIVELY CORRECTABLE .
- PAIN WHILE WALKING, GAIT ABNORMALITY

a. Orthotic support
b. Calcaneum osteotomy
c. Tendon transfer
d. No intervention.

TRIVIA 4

- 16 YEARS OLD BOY
- MIDFOOT CAVUS DEFORMITY, PASSIVELY CORRECTABLE .
- PAIN WHILE WALKING, GAIT ABNORMALITY

a. Orthotic support
b. Calcaneum osteotomy
c. Tendon transfer
d. No intervention.

TRIVIA 5

- 14 YEAR OLD BOY, CAVOVARUS DEFORMITY
- FOREFOOT DEFORMITY
- PAIN AND DIFFICULTY WHILE WALKING
- COSMETIC AND FUNCTIONAL DIFFICULTY
    a. **Orthotic support**
    b. **Calcaneum osteotomy with gastrocnemius recession**
    c. **Calcaneum + midfoot osteotomy**
    d. **Gastrocnemius release + calcaneum osteotomy+ midfoot osteotomy+ ehl transfer**