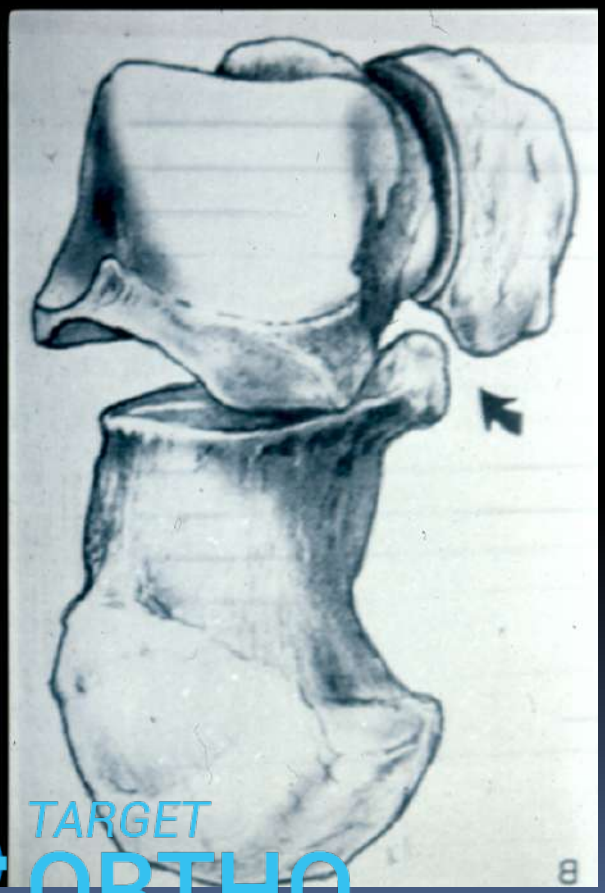
CONGENITAL DEFORMITIES

Sanjay Arora
Consultant Orthopedics
ORTHOMED HOSPITAL
HISAR

Congenital Talipes Equino-Varus
CTEV



GARTLAND (1964)

"We are dealing with a condition,

the cause of which is unknown,

pathoanatomy of which is uncertain,

the behavior of which is unpredictable & treatment remains controversial."

Congenital Talipes Equino-Varus
CTEV

Adaptive Changes

Wolff's Law

" Every change in the use of static function of bone caused a change in the internal form or architecture as well as alteration in its external formation and function according to mechanical law "

Davis Law

" When ligaments and soft tissue are in loose or lax state; they gradually shorten "

INTRODUCTION

Commonly seen deformity in India
(1 in 1000 Live births)

CONGENITAL

TALIPES – Ankle foot [TALI-Ankle, PES-Foot]

EQUINUS – Planter flexion

VARUS – Medial deviation of foot

CTEV

- 1 per 1,000
- M:F = 2.5:1
- 50% bilateral
- Maoris 7 per 1,000
- RISK = 2-5% in siblings,
- Parent and sibling affected = 25%

CLUB FOOT

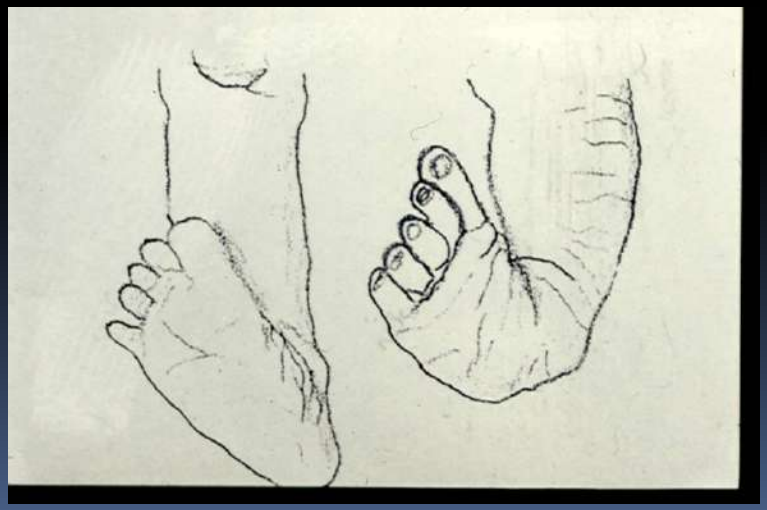
Types

Postural :

Calcaneo-Valgus

Equino-Varus

Look for CDH



ETIOLOGY- ? CONTROVERSIAL

IDIOPATHIC

1. EXTRINSIC
   - POSTURAL- INTRA UTERINE COMPRESSION
   - OLIGOHYDRAMNIOS

2. INTRINSIC
   - **GERM PLASM DEFECT** CAUSING BONY ABNORMALITY
   - ARRESTED DEVELOPMENT AT 5^{TH} WK OF GESTATION
   - ABNORMAL ATTACHMENT OF TENDONS AND LIGAMENTS
   - NEURO MUSCULAR DEFECT
   - HEREDITARY- **AD** WITH INCOMPLETE PENETRANCE
   - VASCULAR ANOMALY / ANOMALOUS MUSCLES

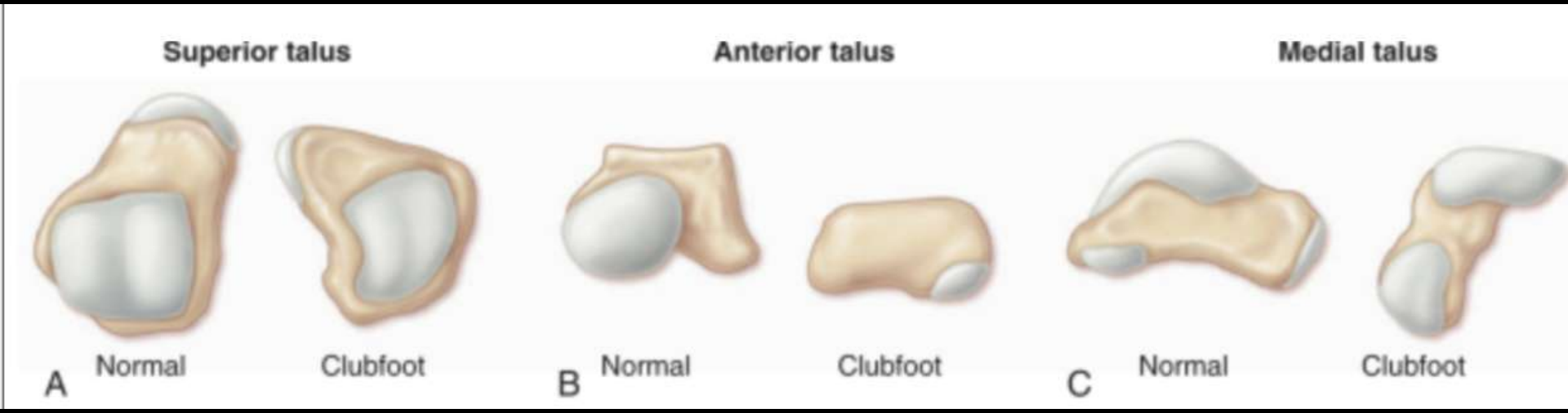
ETIOLOGY- ? CONTROVERSIAL

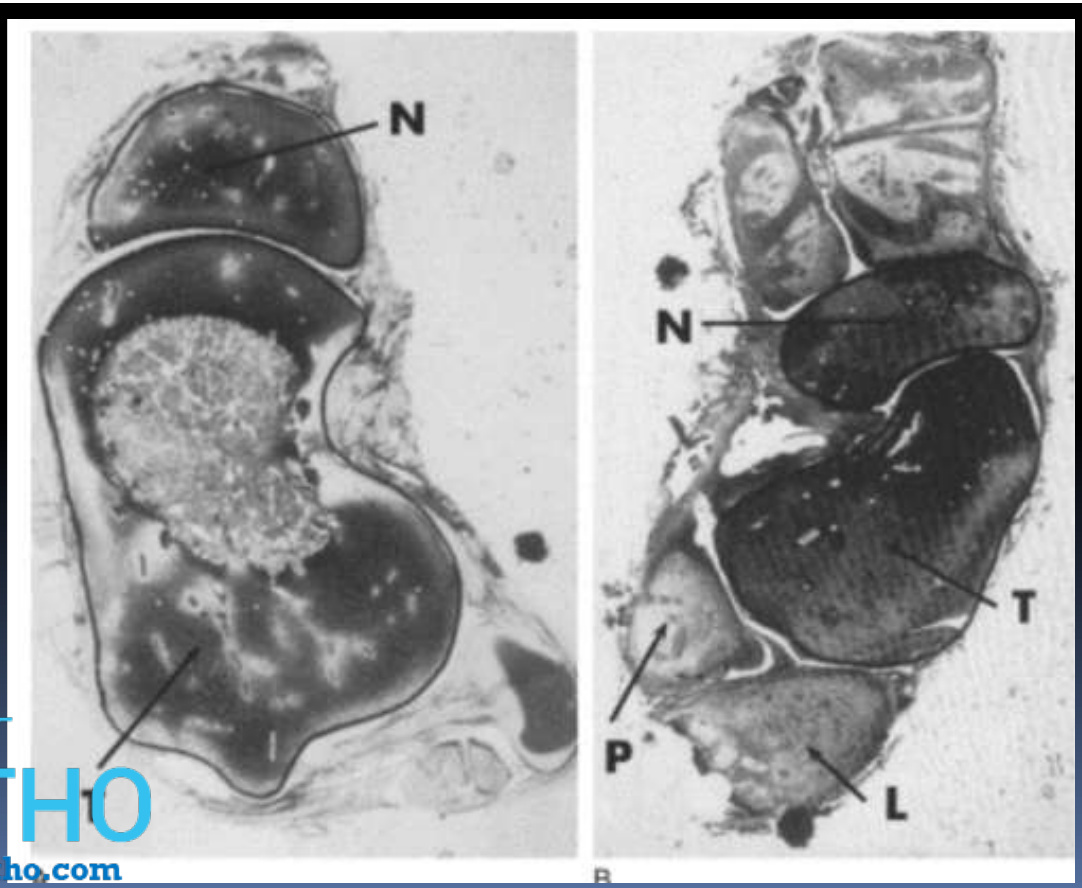
SECONDARY

1. MCC
2. MENIGOMYELOCELE
3. SPINA BIFIDA
4. POLIOMYELITIS

PATHOANATOMY

- **TALUS** –Directed medially, broad sup surface, short neck
- **CALCANEUS**- Small, medially displaced & supinated
- **NAVICULAR** – Small, medially deviated, may articulate with medial malleolus
- All soft tissues contracted posteromedially & plantar aspect at all levels





Congenital Talipes Equino-Varus

Characteristic Deformity

Hind foot

- Equinus (Ankle joint)
- Varus (Subtalar joint)

Fore foot

- Adduction (Med tarsal joint)
- Supination fore foot
- Cavus

CLINICAL FEATURES

- Small, stout foot
- Attitude – TEV
- Small heel
- Medial & posterior deep skin crease
- Dorsolateral bony prominence
- Calf muscle atrophy
- Convex outer border & dimple on lateral aspect of ankle
- TA – Contracture
- Internal tibial torsion
- Posterior displacement of Fibula
- Callosities & Bursae over dorsolateral aspect

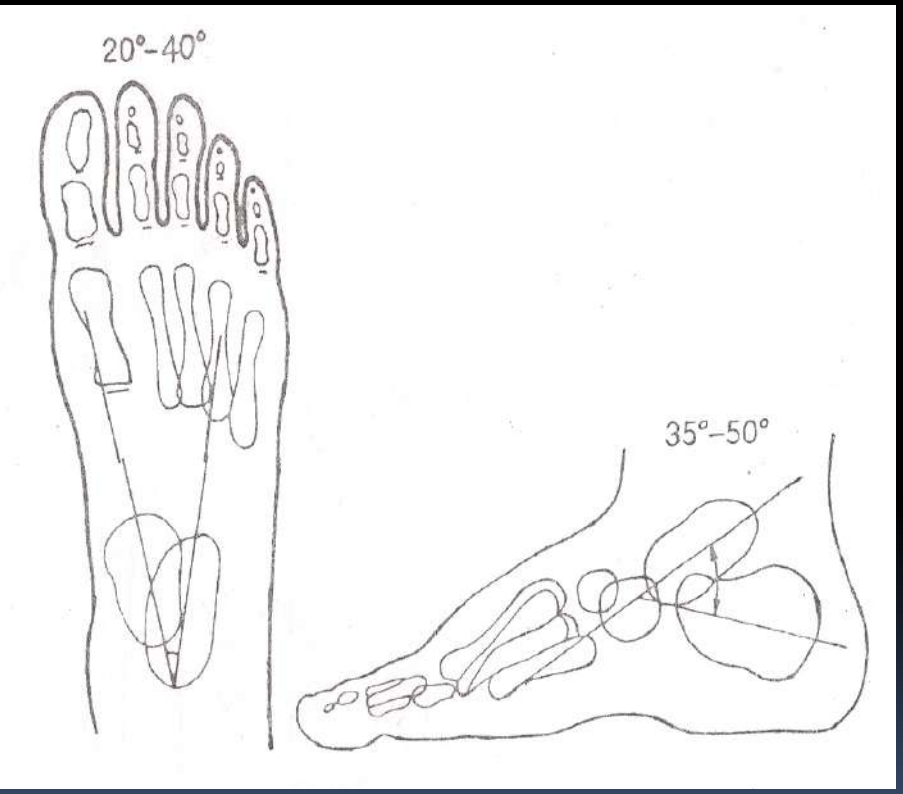
INVESTIGATIONS

RADIOGRAPHS OF FOOT

- AP VIEW
- STRESS DORSIFLEXION LATERAL VIEWS
- AP & LATERAL STANDING VIEWS (OLDER CHILDREN)

RELEVANT RADIOGRAPHS OF SPINE IN SECONDARY CLUB FOOT

NORMAL RANGE OF ANGLES



- **TALO CALCANEAL :**
  AP - 30° – 55°
  DLAT - 25° – 50°
- **TIBIO CALCANEAL :**
  STRESS LAT - 10° – 40°
- **TALUS FIRST METATARSAL:**
  AP 5° -15°
- **TC INDEX :**
  Sum of TALO-CAL
  in AP & LAT >40°

In Club Foot

- Talocalcaneal angle < 20 degrees –
  HEEL VARUS.

- Talo 1st Metatarsal angle becomes negative –
  Fore foot ADDUCTION.

- Tibiotalar angle becomes negative –
  EQUINUS

Soft Tissues

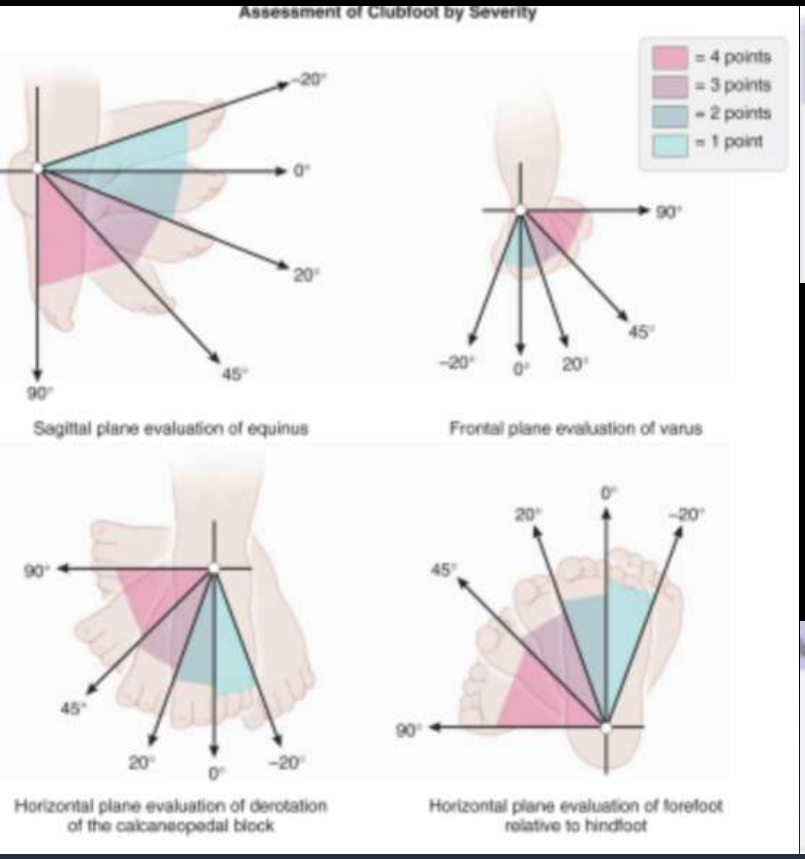
- All structures on medial and posterior aspect of ankle are contracted
  - Muscles (e.g. abductor hallucis)
  - Tendons (e.g. TP, FDL, FHL)
  - Tendon sheaths (e.g. peroneal)
  - Ligaments (e.g. CFL, spring, bifurcate Y)
  - Capsule (e.g. ankle, subtalar)
  - Fascia (e.g. plantar fascia)
  - Vessels
  - Nerves
  - Skin

Bony Relationships

- Talus
  - Equinus
  - Talar dome laterally rotated in mortise
- Navicular
  - Displaced medially and plantarward
- Calcaneum
  - Internally rotated on talus ∴ equinus
- Cuboid
  - Medially displaced

Underlying Diagnoses

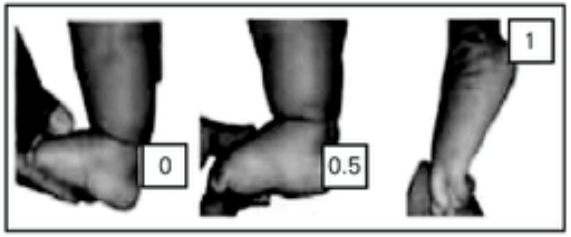
- Dysraphic conditions
- Sacral agenesis
- Arthrogryposis
- Syndromes e.g. Freeman-Sheldon



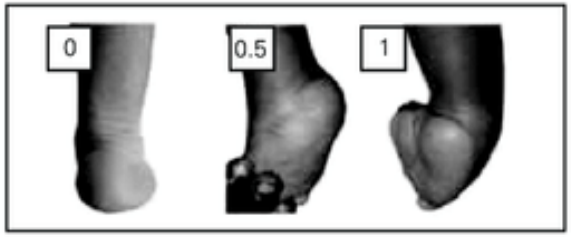
Reducibility	Points	Other parameters	Points
90° to 45°	4	Posterior crease	1
45° to 20°	3	Medial crease	1
20° to 0°	2	Cavus	1
<0° to -20°	1	Poor muscle condition	1

assification grade	Type	Frequency (%)	Score
I	Benign	20	(<5)
II	Moderate	33	(= 5<10)
III	Severe	35	(= 10<15)
IV	Very severe	12	(= 15<20)

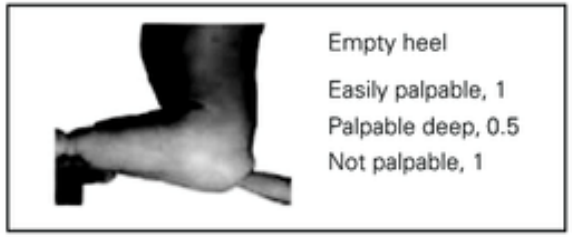
A



Rigid equinus

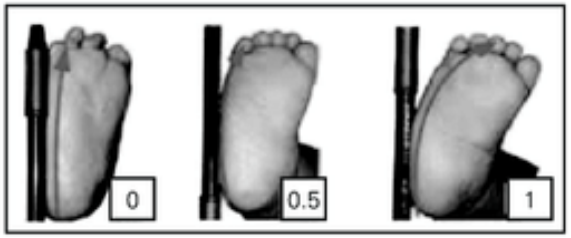


Empty heel

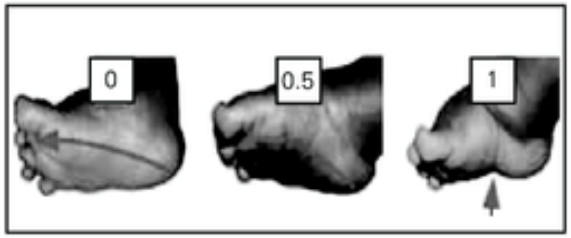


Posterior crease

B



Curved lateral border



Medial crease

Lateral head of talus (LHT)

Physical Examination Findings	Score of 0	Score of 0.5	Score of 1
Curvature of lateral border of foot	Straight	Mild distal curve	Curve at calcaneocuboid joint
Severity of medial crease (foot held in maximal correction)	Multiple fine creases	One or two deep creases	Deep creases change contour of arch
Severity of posterior crease (foot held in maximal correction)	Multiple fine creases	One or two deep creases	Deep creases change contour of arch
Medial malleolar–navicular interval (foot held in maximal correction)	Definite depression felt	Interval reduced	Interval not palpable
Palpation of lateral part of head of talus (forefoot fully abducted)	Navicular completely “reduces”; lateral talar head cannot be felt	Navicular partially “reduces”; lateral head less palpable	Navicular does not “reduce”; lateral talar head easily felt
Emptiness of heel (foot and ankle in maximal correction)	Tuberosity of calcaneus easily palpable	Tuberosity of calcaneus more difficult to palpate	Tuberosity of calcaneus not palpable
Fibula-Achilles interval (hip flexed, knee extended, foot and ankle maximally corrected)	Definite depression felt	Interval reduced	Interval not palpable
Rigidity of equinus (knee extended, ankle maximally corrected)	Normal ankle dorsiflexion	Ankle dorsiflexes beyond neutral, but not fully	Cannot dorsiflex ankle to neutral
Rigidity of adductus (forefoot is fully abducted)	Forefoot can be overcorrected into abduction	Forefoot can be corrected beyond neutral, but not fully	Forefoot cannot be corrected to neutral
Long flexor contracture (foot and ankle held in maximal correction)	MTP joints can be dorsiflexed to 90 degrees	MTP joints can be dorsiflexed beyond neutral but not fully	MTP joints cannot be dorsiflexed to neutral

Pirani

- Midfoot Contracture (MFC)
  - Lateral Border 1
  - Medial Crease 1
  - Lateral head of taalus 1
- Hindfoot Contracture (HFC)
  - Posterior Crease 1
  - Rigid Equinus 1
  - Empty Heel 1
- Total Score 6

Congenital Talipes Equino-Varus

Treatment

The goal of treatment for clubfoot is to obtain a plantigrade foot that is functional, painless, and stable over time

A cosmetically pleasing appearance is also an important goal sought by the surgeon and the family

Management

- Objectives
  - Produce a mobile foot with "normal" function and weight bearing
  - Reduction of talo-calcaneo-navicular joint and maintain reduction
  - Establish muscle balance

Congenital Talipes Equino-Varus

Treatment

Non surgical treatment should begin shortly after birth

1. Gentle manipulation

2. Immobilization
   - Strapping ????
   - POP or synthetic cast

Congenital Talipes Equino-Varus

Manipulation and serial casts

- **Technique "Ponseti"**
- **Avoid false correction**
- **When to stop ?**
- **Maintaining the correction**
- **Follow up to watch and avoid recurrence**

Congenital Talipes Equino-Varus

Ponseti technique

1. Always use long leg casts, change weekly.
2. First manipulation raises the 1st metatarsal to decrease the cavus
3. All subsequent manipulations include pure abduction of forefoot with counter-pressure on neck of talus.
4. Never pronate !
5. Never put counter pressure on calcaneus or cuboid.

Congenital Talipes Equino-Varus

Ponseti technique (cont.)

6. Cast until there is about 60 degrees of external rotation (about 4-6 casts)
7. Percutaneous tendo Achilles tenotomy in cast room under local anesthesia, followed by final cast (3 weeks)
8. After final cast removal, apply Normal last shoes with Denis Browne bar set at 70 degrees external rotation (40 degrees on normal side)
9. Denis Browne splint full time for two months, then night time only for two-four years.
10. 35% need Anterior Tibialis tendon transfer at age 2-3

Treatment

TARGET ORTHO

Congenital Talipes Equino-Varus
CTEV

Surgical Treatment

- Types (soft tissue and bony operations)
- Time of surgery
- Selection of the procedure and the incision
- Post operative care
- Follow up
- Complications

SURGICAL

INDICATIONS

- NON RESPONSIVE TO CONSERVATIVE Rx
- RECURRENCE AFTER TREATMENT
- NEGLECTED
- RESISTANT

Surgery

Do only what is necessary to get a good

correction of the foot

-Bensahel et al

Surgery

AGE Early / Late

Size of foot > 8cm long

Incision: a.Turco-Postero-medial

b.Cincinnati -circumfrential

c.Caroll - Two incision

Postero Medial Soft Tissue Release

- TENDONS

  TA, TP, FHL, FDL - Z LENGTHENING

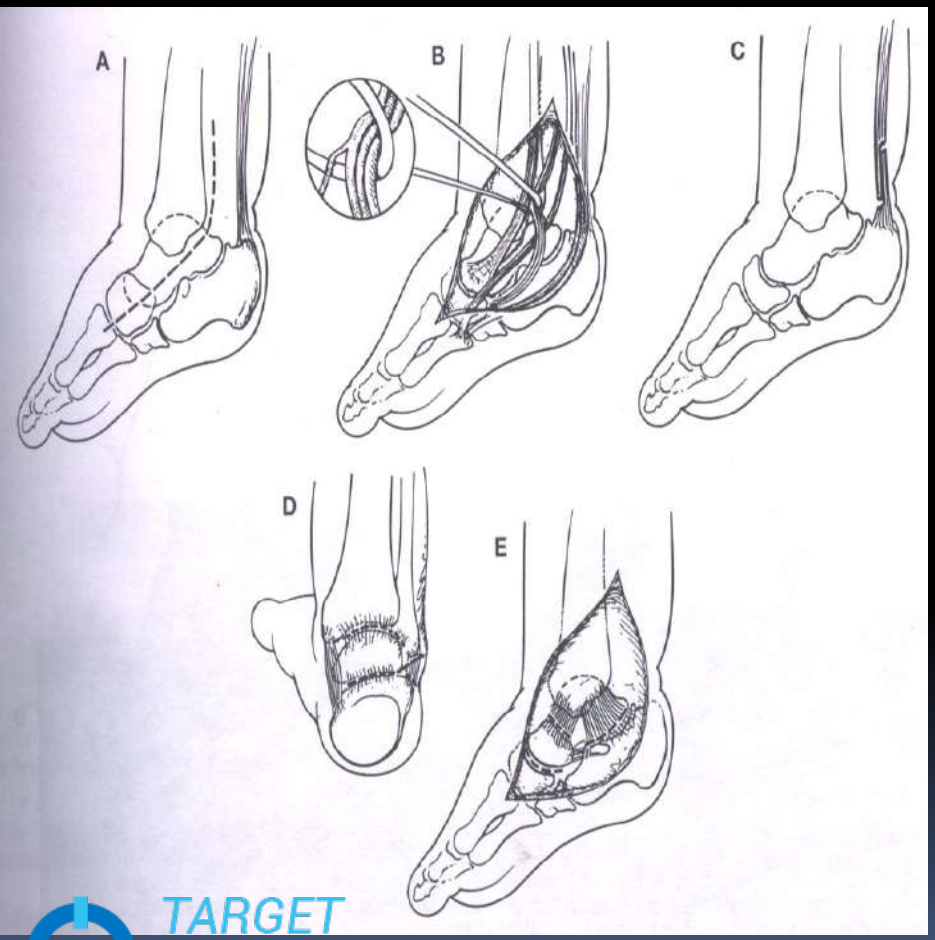
- CAPSULOTOMIES

  ANKLE, SUBTALAR, TALO NAVICULAR JTS

- LIGAMENTS RELEASED

  SPRING, SUPERFICIAL DELTOID, HENRY'S KNOT, TALO FIBULAR, CALCANEO FIBULAR

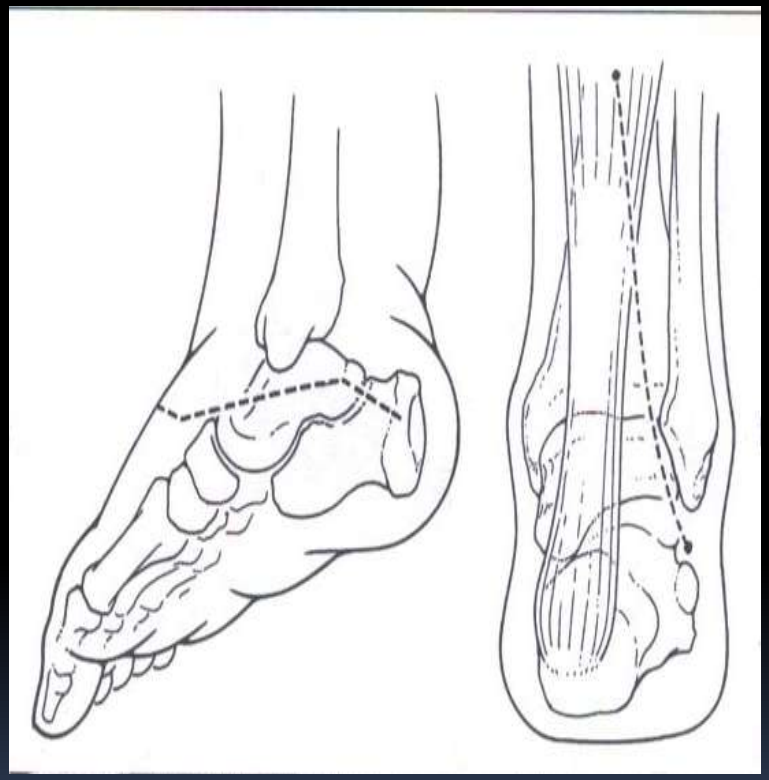
TURCO'S PMSTR



- MEDIAL INCISION
- Disadvantage: Difficult to reach postero lateral structures

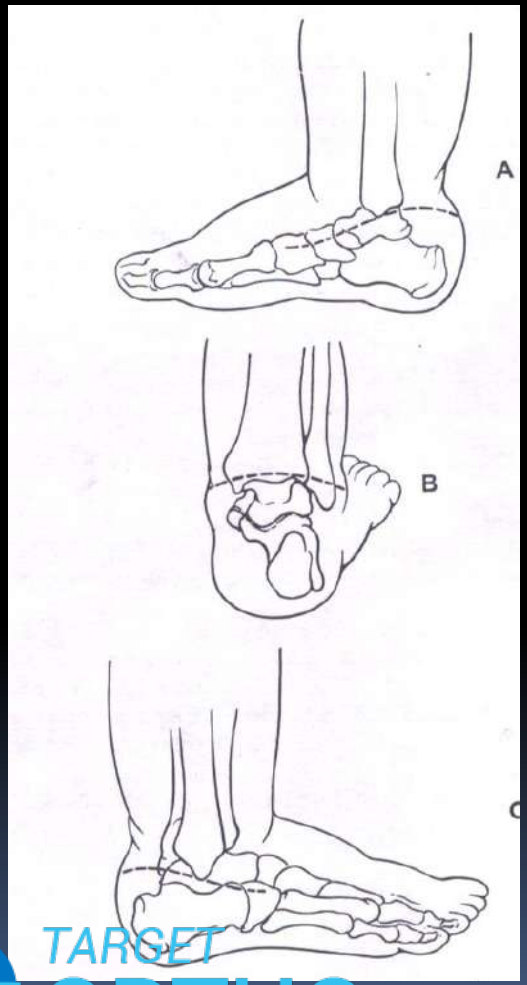

TARGET
ORTHO
(C) www.targetortho.com

CARROL'S TWO INCISION



- Medial incision
- Posterolateral incision
- Limitation-correction of equinus and varus deformity due to skin tether on postero-medial side

CINCINNATI INCISION



- Transverse circumferential incision
- Advanatages : Excellent subtalar exposure,useful in severe int. rotation deformity of calcaneus
- Disadvantage: Tension on suture line

SPLIT TRANSFER OF TA TENDON TO 5TH METATARSAL

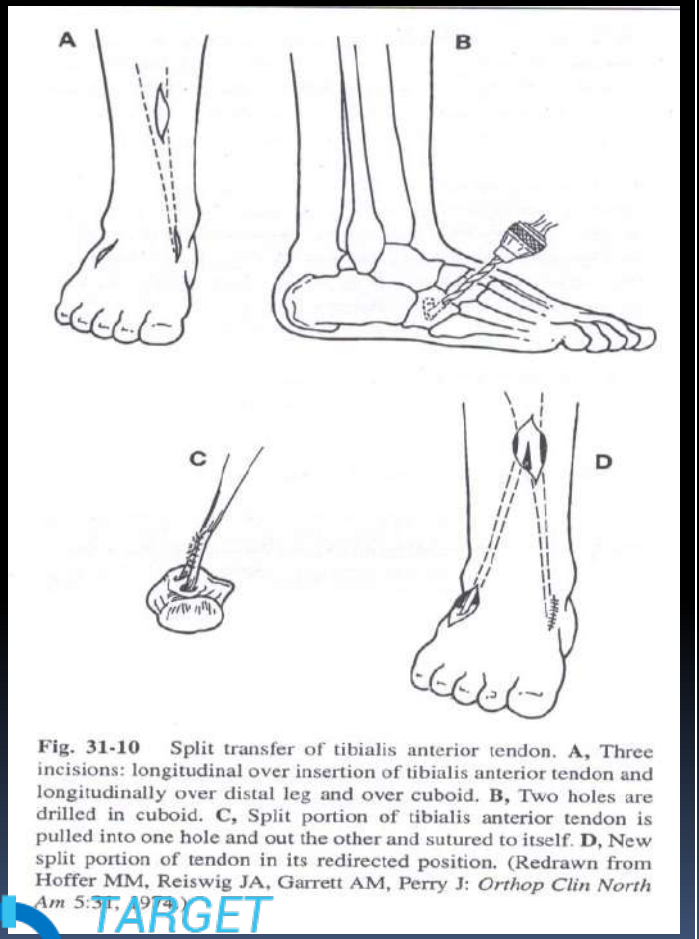


Fig. 31-10 Split transfer of tibialis anterior tendon. **A,** Three incisions: longitudinal over insertion of tibialis anterior tendon and longitudinally over distal leg and over cuboid. **B,** Two holes are drilled in cuboid. **C,** Split portion of tibialis anterior tendon is pulled into one hole and out the other and sutured to itself. **D,** New split portion of tendon in its redirected position. (Redrawn from Hoffer MM, Reiswig JA, Garrett AM, Perry J: *Orthop Clin North Am* 5:31, 1974.)

Indication

-Supple recurrent clubfoot.

-< 6 yrs of age

-Passively correctable deformity

-No active abd or eversion

Contraindication

-Stiff joints and strong peronei

ANT TRANSFER OF TP TENDON

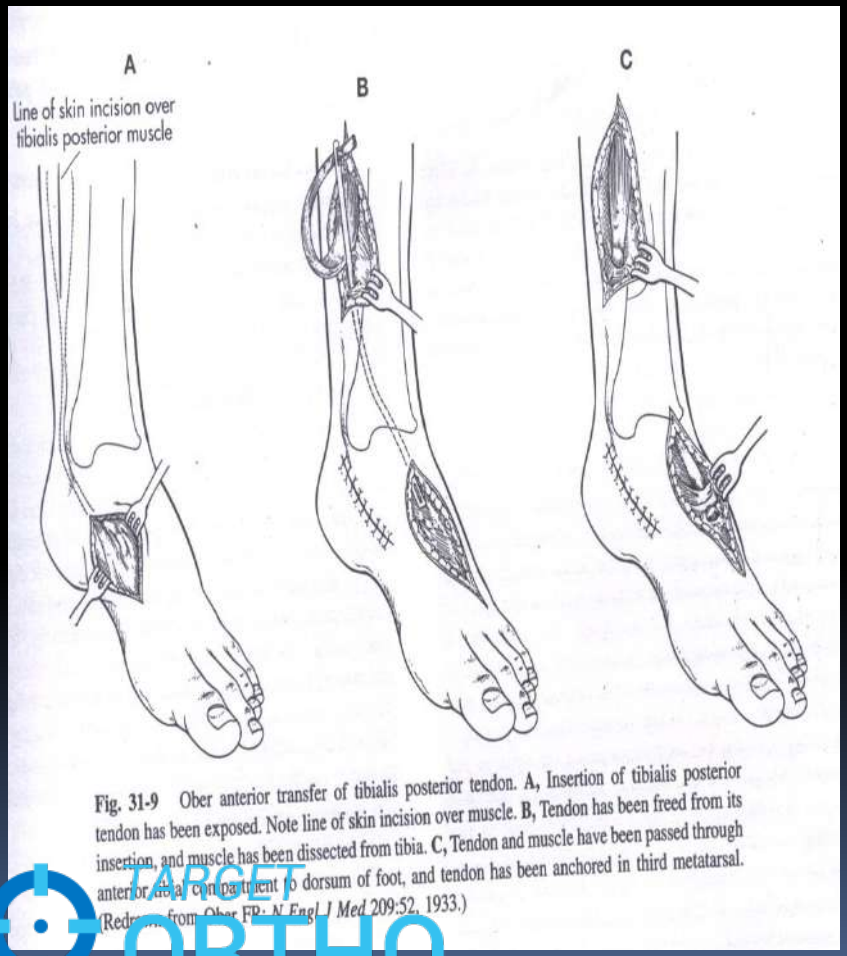


Fig. 31-9 Ober anterior transfer of tibialis posterior tendon. A, Insertion of tibialis posterior tendon has been exposed. Note line of skin incision over muscle. B, Tendon has been freed from its insertion, and muscle has been dissected from tibia. C, Tendon and muscle have been passed through anterior tibial compartment to dorsum of foot, and tendon has been anchored in third metatarsal. (Redrawn from Ober FR: *N Engl J Med* 209:52, 1933.)

Tendon is transferred anteriorly through interosseous space to 3rd cuneiform.

Primary correction is more effective

TREATMENT OF RESISTANT CLUB FOOT

DEFORMITY	TREATMENT
Metatarsus ADDUCTUS	>5yrs: Metatarsus Osteotomy
Hind Foot VARUS	< 2- 3yrs : modified McKay procedure 3 – 10 yrs: • Dwyers Osteotomy (isolated heel varus) • Dillwyn Evans procedure (short medial columns) • Lichtblau procedure (long lateral column) 10 -12 yrs : Triple Arthrodesis
EQUINUS	• TA lengthening + Posterior Caspsulotomy of Subtalar & ankle joint (mild – moderate def.) • Lambrinudi procedure (severe deformity, skeletal immaturity)
All 3 deformities	> 10yrs Triple Arthrodesis

TRIPLE ARTHRODESIS

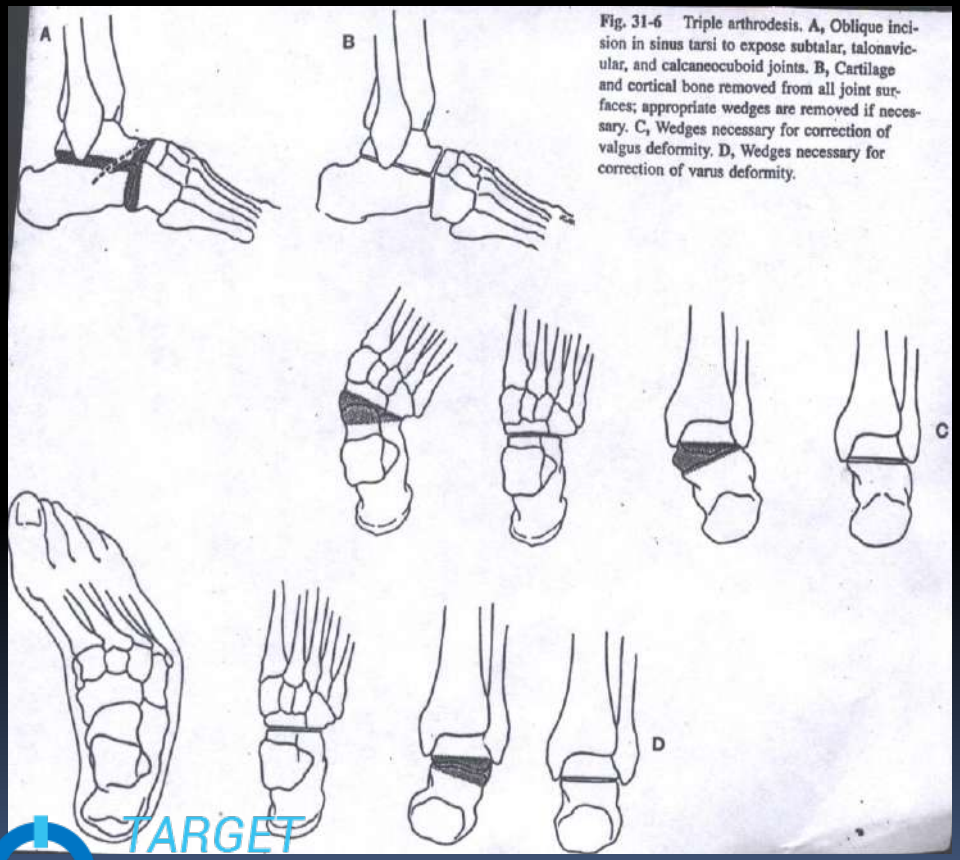
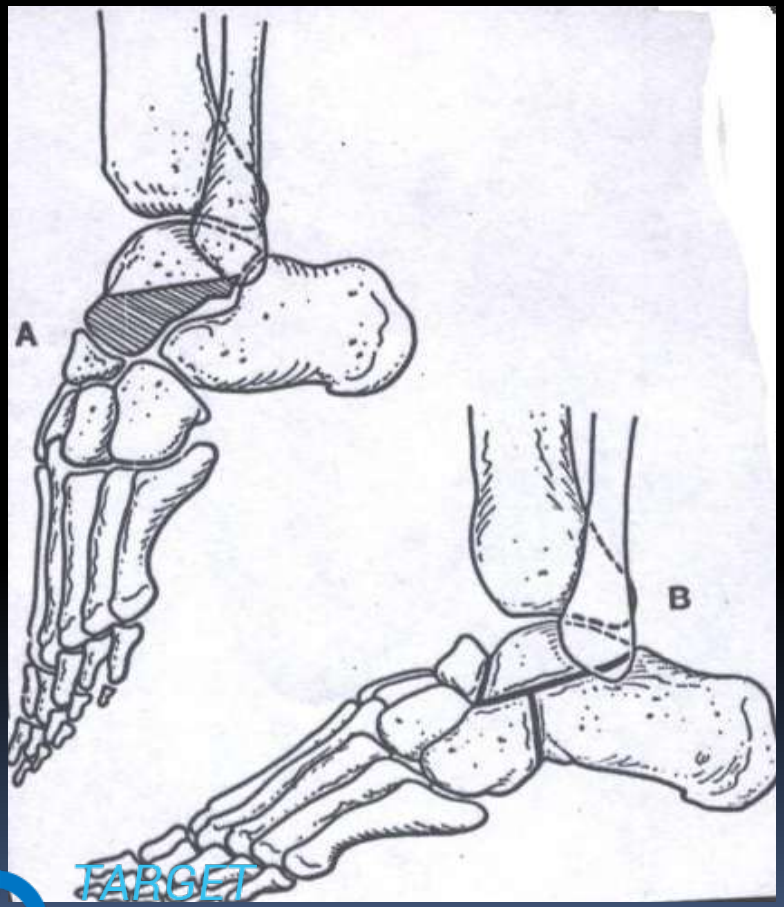


Fig. 31-6 Triple arthrodesis. A, Oblique incision in sinus tarsi to expose subtalar, talonavicular, and calcaneocuboid joints. B, Cartilage and cortical bone removed from all joint surfaces; appropriate wedges are removed if necessary. C, Wedges necessary for correction of valgus deformity. D, Wedges necessary for correction of varus deformity.

Fusion of subtalar, talonavicular and calcaneocuboid joints.

Salvage procedure in neglected and resistant CTEV of >12 yrs of age.

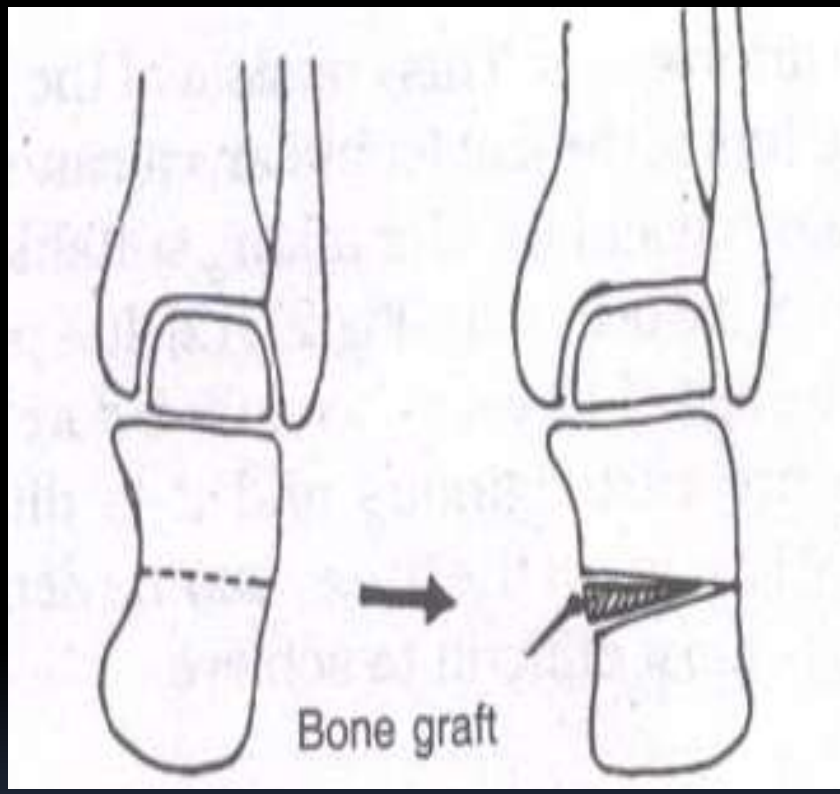
LAMBRINUDI PROCEDURE



-Wedging of talus from plantar and distal part.

-Indication- Fixed equinus deformity of >10 yrs of age.

DWYER'S OSTEOTOMY (OPEN WEDGE)

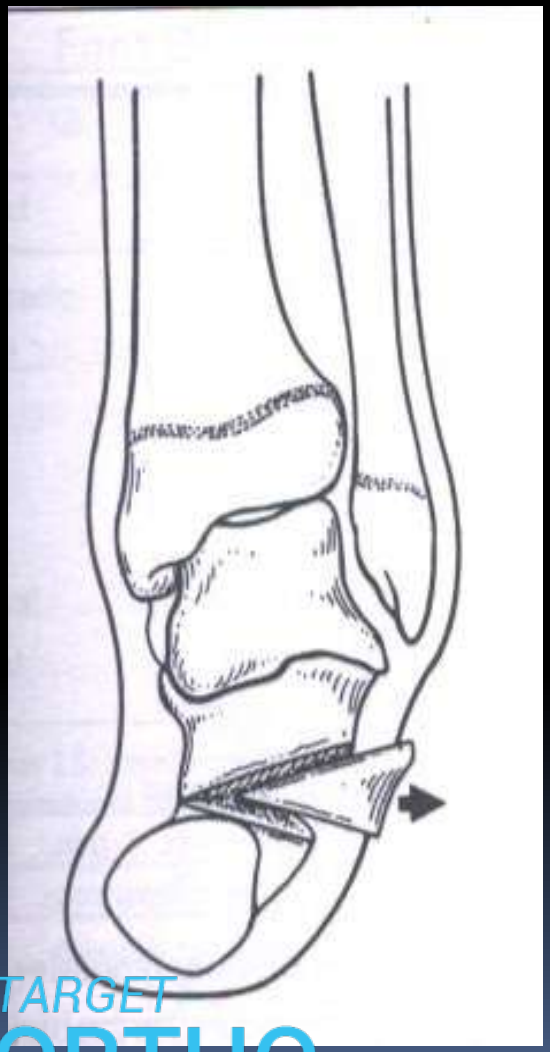


Medial open wedge osteotomy of calcaneus.

To correct varus deformity of the heel.

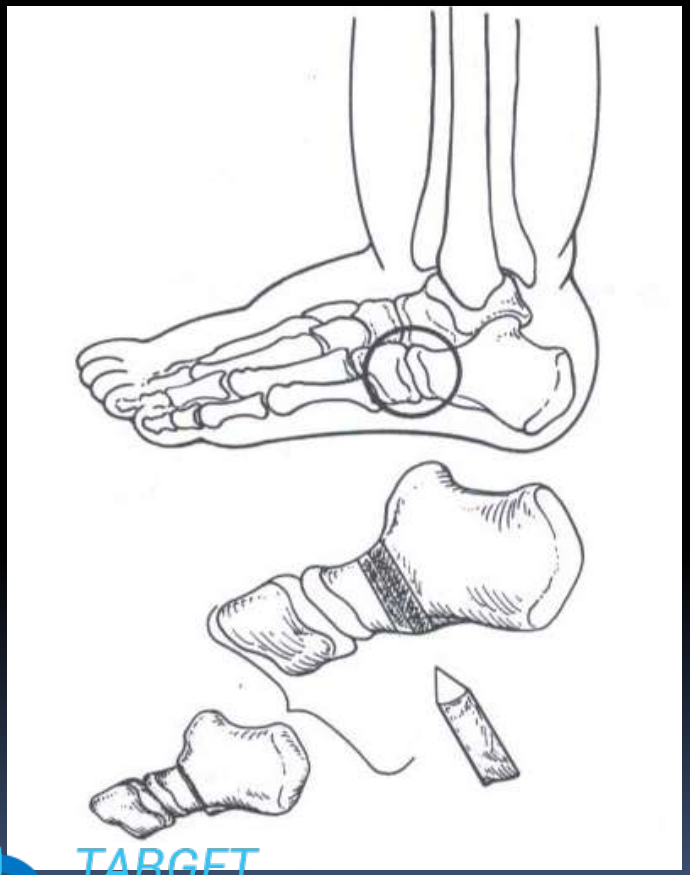
Indication- >3 yrs

Lateral Closing Wedge Osteotomy



- Closed wedge osteotomy of lateral calcaneus.
- Avoids sloughing of medial skin.

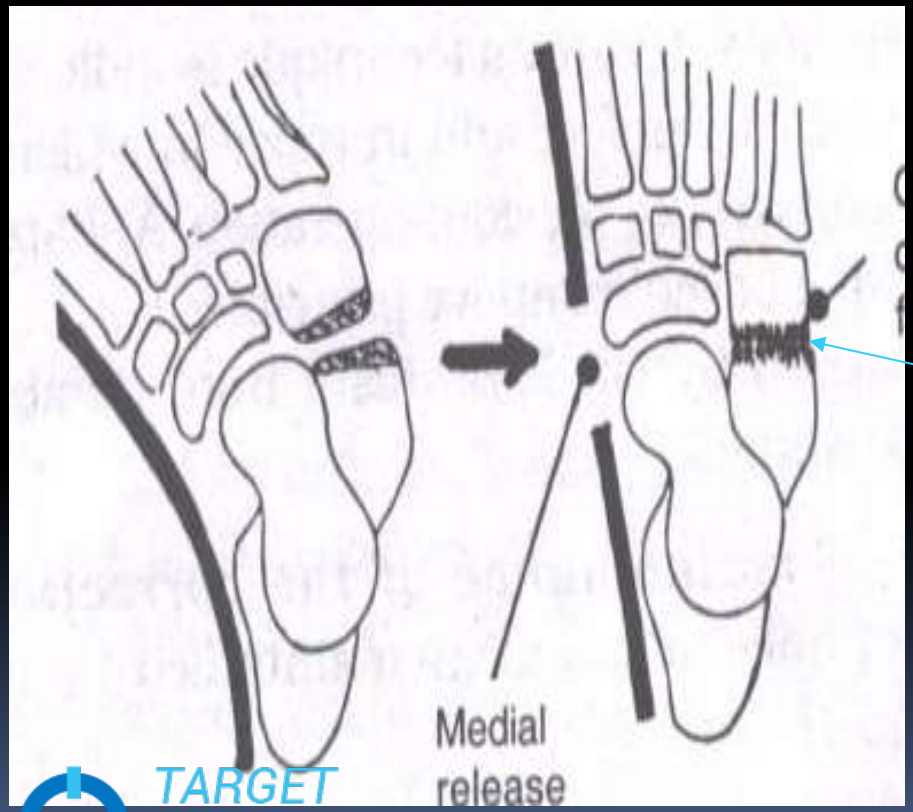
LICHTBLAU PROCEDURE



Medial release with
osteotomy of distal calcaneus.

Osteotomy distal-
1cm lateral border.
2mm of medial border

DILWYN EVAN'S OPERATION



- Age - 4 to 8 yrs

EXTERNAL FIXATORS

Principles : Based on distraction Histeoneogenesis by ILIZAROV

- Controlled
- Fractional
- Differential
- Distraction

EXTERNAL FIXATORS

Indications-

- Neglected Club Foot
- Recurrent
- Resistant

EXTERNAL FIXATORS

- Joshi's External Stabilization System (JESS)

  3 months to 6 yrs

- Ilizarov External Fixator

  > 6 yrs

Radioulnar synostosis

- The first reported case is said to be by Sandifort in 1793,
- approximately a century before Roentgen.
- Morrison described the classic clinical findings in 1892, 3 years before the discovery of x-rays

Congenital Radioulnar synostosis

- Boys>girls 3:2
- Bilateral 80%
- Diagnosis is often delayed
- 30% a/with other syndromes
- 20% with positive family history

Congenital Radioulnar synostosis

- For a short time, the radius and ulna share a common perichondrium.
- Abnormal events at this time can lead to a failure of segmentation.
- Usually it's not discover until early adolescence.
- About one third of cases are associated with general skeletal abnormalities.

Associated syndromes

- Apert syndrome
- Arthrogryposis
- Mandibulfascial dysostosis
- Klinefelter's syndrome

Presentation

- Asymtomatic
- Difficulty with special tasks

- Average age of diagnosis is 6 years
- Elbow flexion preserved
- Average position is 30’ pronation

- Wrist hypermobility

Classification

- Type I: True congenital radioulnar synostosis, or headless type. Here the radial head is absent and a bony fusion of the radius to the ulna is present. The distal ends are fused and the radius is bowed, is thicker than the ulna, and is not attached to it distally.
- Type II: Dislocated radial head type. The malformed radial head is posteriorly dislocated and the proximal end of the radius is fused with the ulna just below.
- Type III: No bony synostosis is present, but a thick fibrous interosseous ligament forms and attaches to each bone just distal to their proximal ends and prevents rotation. This is the rarest type in Tachdjian's classification

Cleary and Omer's cllassification

- Type I: Fibrous synostosis, with no bony change but a stiff and smaller forearm (6/35, or 17%)
- Type II: Osseous synostosis, radial head present and reduced (3/35, or 19%)
- Type III: Osseous synostosis, radial head present and posteriorly dislocated (20/35, or 57%)
- Type IV: Osseous synostosis, radial head present and anteriorly dislocated (6/35, or 17%)

Treatment

- Observation

- Surgical intervention has been recommended by most surgeons only when significant amounts of pronation (usually more than 60 degrees) are associated with functional limitations and complaints
- Recommendations for the optimal postoperative forearm position vary

Treatment

- Synostosis excision with soft tissue interposition
- Excision alone without graft interposition results in nearly 100% recurrence of synostosis

Forearm derotation osteotomy

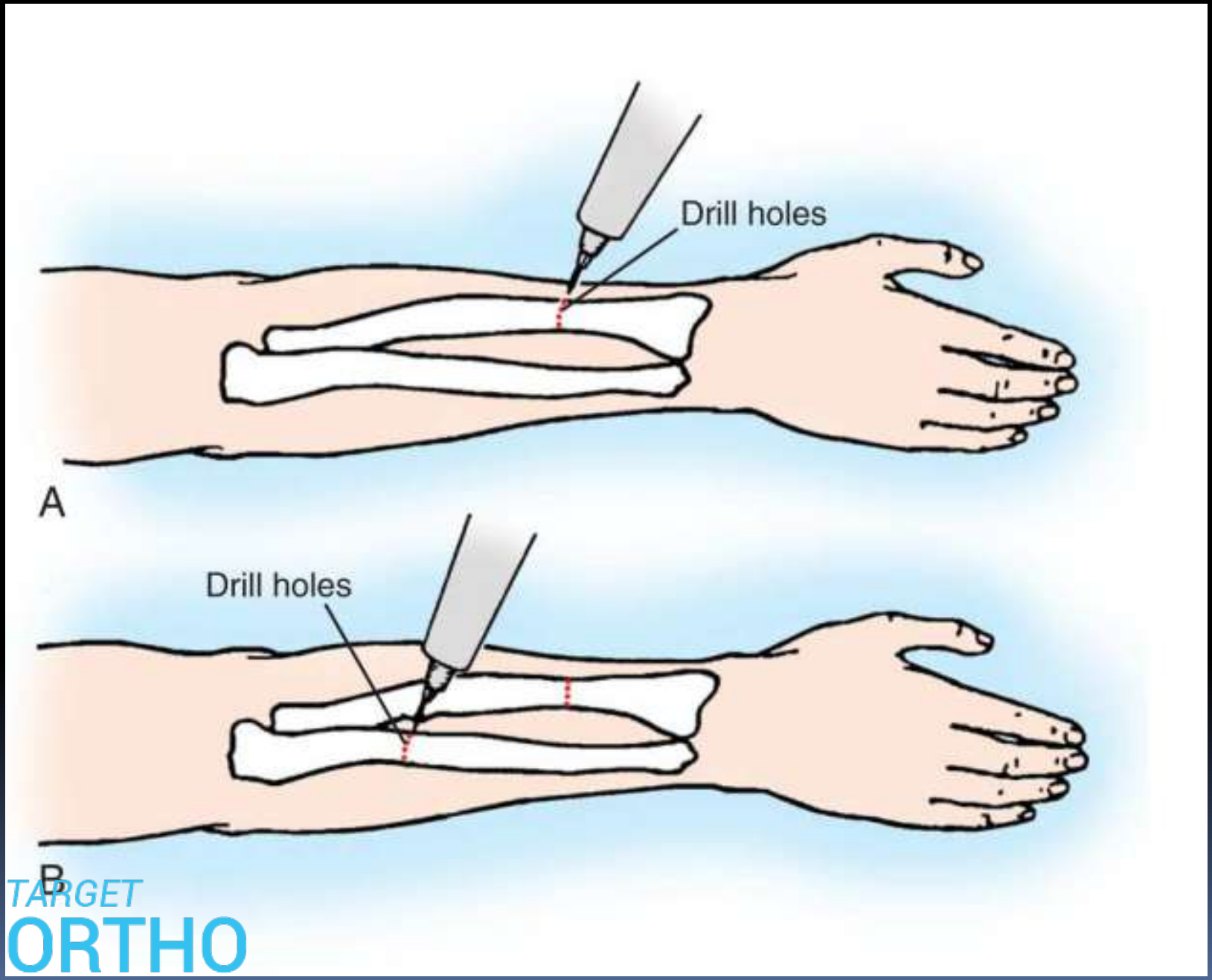
- Goal: place the forearm in more functional resting position

- Green and Mital recommended 20 degrees of supination.
- Simmons and Waters recommended 20 degrees of pronation in unilateral cases and 20 degrees of pronation in bilateral cases for the dominant arm and neutral position for the nondominant arm

- Ogino and Hikino have noted the need for supination in Asian populations who use chopsticks rather than a knife and fork.
- They consider the degree of wrist compensatory mobility critical and try to obtain full supination of the palm (disregarding the true position of the forearm bones) in the nondominant hand in their Japanese patients.
- This may require as little as 20 degrees of true forearm supination.
- For Ogino and Hikino, 70 degrees of palmar supination in the dominant arm in bilateral cases is adequate. They favor an osteotomy through the fusion mass but emphasize shortening the arm by resection of 0.5 cm of bone at the osteotomy site.

Forearm derotation osteotomy

- Lin et al. described a two-stage technique.
- Percutaneous drill-assisted osteotomies of the radius and the ulna are performed and are followed 10 days later by manipulation of the forearm into the desired functional position.
- No internal or external fixation is used; long-arm cast immobilization is used for 6 to 8 weeks



Congenital muscular torticollis

- CMT is characterized by U/L shortening of the SCM muscle resulting in lateral inclination of the neck a/with contra lateral torsion.
- fibromatosis within the sternocleidomastoid muscle
- A mass either is palpable at birth or becomes so, usually during the first 2 weeks

Congenital muscular torticollis

- CMT is more common on the right side than on the left side
- It may involve the muscle diffusely, but more often it is localized near the clavicular attachment of the muscle.
- The mass attains maximal size within 1 or 2 months and may remain the same size or become smaller; usually, it diminishes and disappears within 1 year.
- If it fails to disappear, the muscle becomes permanently fibrotic and contracted and causes torticollis.

- CMT is commonly a/with other congenital abnormalities such as DDH with a coexistence rate estimated as high as 14.9%
- Tibial torsion, clubfoot, calcaneovalgus foot, pesplanus, metatarsus adductus and hallux valgus.
- If torticollis persists, patient will develop scolisosi and the fascial/head asymmetry known as plagiocephaly.

Aetiology

- Postulated that fetal position abnormalities, intrauterine or perinatal compartment syndromes and birth trauma ensuing a difficult delivery ambody the main causes.

- Other possible caused encountered are hereditary and venous or arterial occlusion which may create fibrous tissue within the SCM

Classification

- Cheng et al. divided the patients into three clinical groups:
- sternomastoid tumor group (patients with a clinically palpable sternomastoid tumor),
- muscular group (patients with clinical thickening and tightness of the SCM muscle),
- postural torticollis group.

- Analysis of their results showed that the clinical group (sternomastoid tumor), an older age at presentation, difficulties with the birth, involvement of the right side, and rotation deformity of more than 15 degrees all were significantly associated with longer duration of treatment.
- Subsequent surgical treatment was required in 8% of patients in the sternomastoid tumor group, 3% of patients in the muscular torticollis group, and none of the patients in the postural torticollis group

- Any permanent torticollis slowly becomes worse during growth. The head becomes inclined toward the affected side and the face toward the opposite side.
- Surgery performed before age 6 to 8 years may allow remodeling of any facial asymmetry and plagiocephaly.

Non operative treatment

- Manual passive stretching of the SCM muscle before the age of 12 months.
- A program of gentle stretching exercise should include flexion-extension, lateral bending away from involved side and rotation toward it
- Stretching exercise should be continued until full neck rotation achieved
- Cervical orthosis

Non operative treatment

- Botulinum toxin(Botox) could enhance the effectiveness of stretching on the side of the contracture and allow strengthening of overstretched and weakened muscles on the opposite side of the neck.

Operative treatment

- Children older than 12-18 months of age
- Resistant to conservative treatment
- In case of facial asymmetry and plagiocephaly development
- Highly recommended when a restriction of movement upto 30’ is present as well in case complicated with deformities of facial bones.

- Optimal time 1-4 years, although favourable results have been also described for patients 10 years or older at the time of surgery.
- Surgical techniques

  unipolar release

  bipolar release

  endoscopic release

  subperiosteal lengthening

Preoperative planning

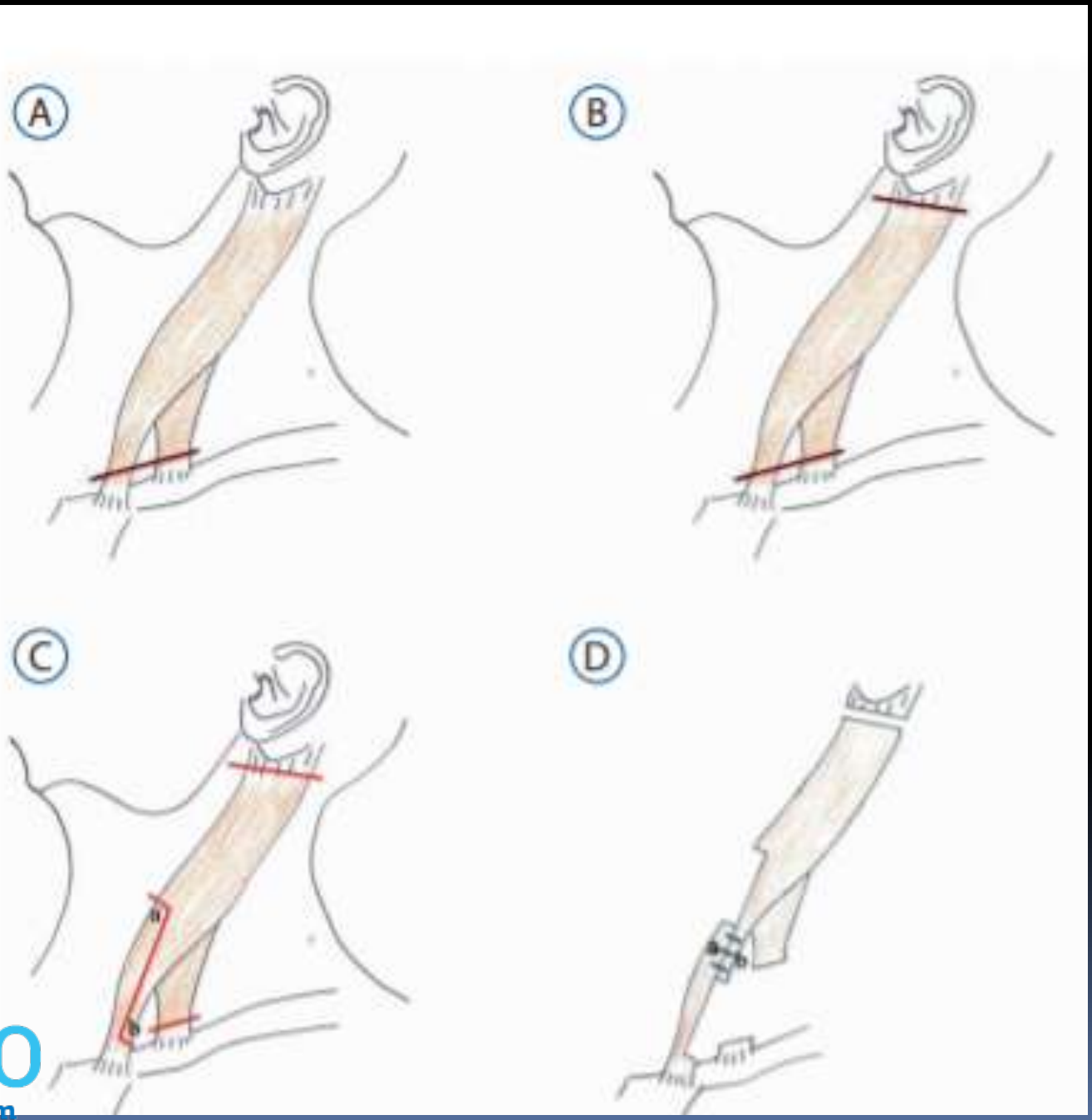
- Cervical spine should be reviewed for any fixed deformity.
- Other associated congenital abnormality should be looked for carefully
- The ear taped anteriorly and hair around the mastoid process is shaved

Unipolar release

- Release of SCM At distal end.
- Transverse incision 3-4 cm, 1 cm superior to the clavicle.
- Release the clavicular head with lengthening of the sternal head by Z plasty provide symmetrical appearance post opertaively.

Bipolar release

- Release of the mastoid insertion of SCM muscle along with the distal released.



Post operative care

- Immobilization of the neck in a slightly over corrected position with a thermoplastic custom made cervical collar for 3 months.

- the collar is removed intermittently and passive stretching is recommended as a=well as strengthening exercise

Sprengel shoulder

Sprengel Deformity congenital elevated scapula

- Rare congenital anamoly which arises from interruption of normal caudal migration of the scapula and is characterized by elevation and medial rotation of scapula

- complex anomaly that is associated with malposition and dysplasia of the scapula

History

- 1863 Eulenberg- first description
- Willet and walsham reported 2 cases with anatomic descriptions of this clinical entity (1883)
- It is named after Otto Gerhard Karl Sprengel(1852-1915), a German surgeon who described 4 cases in 1891.

Frequency

- M.C. Congenital malformation of the shoulder girdle
- Equal distribution boys:girl

- Side- left side more common than right, bilateral only in 10%.

Genetics

- Sporadic
- Rarely, autosomal dominant

Embryology

- Scapula normally differentiates opposite C4,5,6 vertebrae at about 5 weeks gestation
- Normally descends to the thorax by the end of the third month of intrauterine life
- Interruption in the normal caudal migration of the scapula.
- This produces both cosmetic and functional impairment

Pathophysiology

- Occurs b/w the 9th and 12th wks of gestation
- An arrest in the development of bone, cartilage and muscle also occurs
- The trapezius, fhomboid or levator scapule muscle may be absent or hypoplastic. The serratus anterior muscle may be weak, leading to winging of scapula. Other muscles such as P major, L. dorsi or the SCM may be hypoplastic and similarly involved.

Omovertebral bar

- Fibrous, cartilaginous or bony
- Present in about one third of cases
- Superomedial angle of the scapula to the spinous process, lamina, or transverse process of the cervical vertebra
- Primary cause of restricted shoulder motion

Classification Cavendish (JBJS 1972)

- Grade 1- very mild

  shoulder joints are level deformity not visible when patient dressed

- Grade 2 - mild

  shoulder joints almost level but deformity visible as lump in even with patient dressed

- Grade 3 - moderate

  shoulder joint is elevated by 2-5 cm, deformity easily visible

- Grade 4 – severe

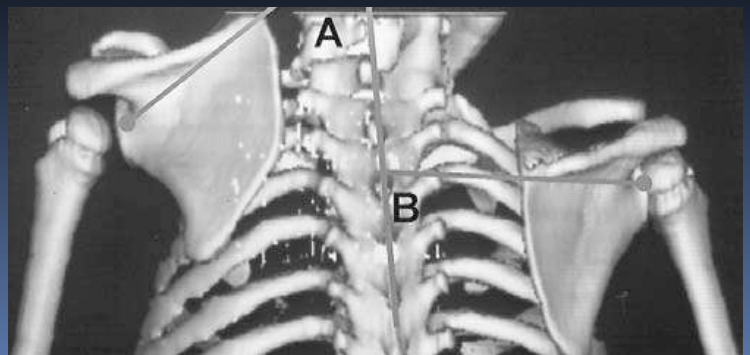
  shoulder joint near the occiput with or without web neck

Clinical features

- Shoulder asymmetry with elevated scapula (Lt > Rt)
- Limited shoulder abduction (active)
- Palpable bony bar
- Hypoplasia of the muscles (pect major)
- Hypoplastic scapula but actually height to width ration is low (Cho et al, JBJS B 2000)

Investigations

- Xrays (chest, shoulder, spine)
- 3D recostruction CT
- Other anomalies



Associated anomalies

- Scoliosis
- Spina bifida
- Rib anomalies
- Klippel-Feil syndrome
- Torticolis
- Facial asymmetry

Treatment factors to be considered

- Cosmetic grade
- Age of patient
- Unilateral or bilateral
- Functional impairment
- Associated anomalies
- Medical fitness

Optimal age

- Not recommended in less than 3 yrs
- Difficult to bring scapula down above 6 yrs and chances of brachial plexus injury are high

Procedured described

- Excision of the omovertebral bar
- Excision of the superomedial part of the scapula
- Scapular relocation
- Subtotal scapulectomy
- Combination of above

Woodward (1961 JBJS Am)

- Transfer of the origin of the trapezius muscle to a more inferior position on the spinous processes.
- Better results

- the muscles are incised farther from the scapula, which lowers the risk of formation of a scar-keloid that may fix the scapula in poor position;
- larger mobilization is possible;
- the postoperative scar is not as thick as with Green's procedure

Green procedure (JBJS 1957)

- Surgical release of muscles from the scapula Excision of the supraspinatus portion of the scapula
- Excision of omovertebral bar if any
- Scapula is moved inferiorly to a more normal position and the muscles are reattached.
- Modified Green procedure

  suturing the scapula into a pocket in the latissimus dorsi after rotating the scapula and moving it caudad to a more normal position

Mears

JPO 2001

- Partial resection of the scapula
- Removal of any omovertebral communication
- Release of the long head of the triceps from the scapula

Complications

- Brachial plexus injury

  more common in older children and severe deformty
- Keloid formation

  was found more with Green procedure
- Shoulder stiffness

  muscle atrophy and surgicle resection

Clavicle Morcelization

- Whenever surgery is done in older children clavicle osteotomy is combined along with.
- It reduces pressure over brachial plexus.
- MC nerve affected : Radial nerve