BONE GRAFT SUBSTITUTE

RAJAGOPALAN,

PROF & HEAD, DEPT OF ORTHOPAEDICS,

RAJA RAJESWARI MEDICAL COLLEGE & HOSPITAL,

BANGALORE.

Bone Graft Function

- Structural support of articular fracture
  - Tibial plateau fracture
  - Prevent post-op collapse
- Void filler to prevent fracture
  - Cyst excision
- Improved healing of fracture and nonunions
  - Speed healing
  - Fewer nonunions

Mechanisms of Bone Growth

- **Osteoconduction**
  - **Provides matrix for bone growth**
- **Osteoinduction**
  - **Growth factors encourage mesenchymal cells to differentiate into osteoblastic lineages**
- **Osteogenesis**
  - **Transplanted osteoblasts and periosteal cells directly produce bone**

Bone Grafting Physiology

- Several processes are involved in the successful reconstitution of a bone defect.
- ***Osteogenesis*** is the formation of new bone by cells derived from precursors, such as mesenchymal stem cells or pre-osteoblasts, in the grafting material (Cypher, Burchardt).
- In appropriate host conditions, these precursors proliferate and differentiate and then generate new bone.
- **Cellular elements within a donor graft, which survive transplantation and produce new bone at the graft site.**

Osteoconduction

- ***Osteoconduction*** is the provision of a scaffold over which new bone formation can be propagated.
- This facilitates the development of new bone, and also integration with the host skeleton.
- The effectiveness of an osteoconductive material is dependent on a number of factors such as porosity and surface roughness (Muschler).

Osteoinduction

- ***Osteoinduction*** is the proliferation and differentiation of bone-producing cells from precursors such as mesenchymal stem cells in the surrounding host tissues.
- This is stimulated by a number of molecules such as inflammatory cytokines and bone morphogenetic proteins that can be contained in the grafting material.

Types of Bone Grafts

- Autograft
- Allograft
- Bone graft substitutes
  - Most have osteoconductive properties
- Osteoinductive agents
  - rhBMP-2 (Infuse) and rhBMP-7 (OP-1)

Autogenous Bone Graft

- "Gold standard"
  - Standard by which other materials are judged
- May provide osteoconduction, osteoinduction and osteogenesis
- Drawbacks
  - Limited supply
  - Donor site morbidity

Bone Graft Substitutes

- Need for bone graft alternatives has lead to development of numerous bone graft substitutes
- Avoid morbidity of autogenous bone graft harvest
- Mechanical properties vary
- Most offer osteoconductive properties
- Some provide osteoinductive properties

Bone Graft Substitutes
Potential Roles

- Extender for autogenous bone graft
  - Large defects
  - Multiple level spinal fusion
- Enhancer
  - To improve success of autogenous bone graft
- Substitute
  - To replace autogenous bone graft

Ideal Bone Graft Substitute

- The most effective grafting material would provide signaling molecules, osteoprogenitor cells, and a supporting scaffold to support osteoinduction, osteogenesis, and osteoconduction.
- An ideal material would also be readily available in a range of quantities at low cost, and have minimal toxicity and morbidity associated with its use.
- No bone graft material currently available meets all of these requirements.

Classification of Bone Graft Substitutes

- Bone graft substitutes consist of several types and encompass various materials, material sources, and origins (natural vs synthetic).
- Many are formed from composites of one or more types of material; however, the composite is usually built on a base material.

Bone Graft Substitutes

Class	Description	Examples
Allograft based	Allograft bone, used alone or in combination with other materials	AlloGro, OrthoBlast, Opteform, Grafton
Growth factor based	Natural and recombinant growth factors, used alone or in combination with other materials	TGF-beta, PDGF, FGF, BMP
Cell based	Cells used to generate new tissue alone or seeded onto a support matrix	Mesenchymal stem cells
Ceramic based	Includes calcium phosphate, calcium sulfate, and bioglass, used alone or in combination	Osteograf, Norian SRS, ProOsteon, Osteoset
Polymer	Both degradable and	Cortoss, OPLA, Immix,

Factor-Based Bone Graft Substitutes

- The signaling molecules involved in osteoinduction have been extensively investigated.
- Bone morphogenetic proteins (BMPs) are part of the TGF-beta super-family, and some (BMP-7 and BMP-2) are now produced and sold commercially.
- Platelets are a rich source of signaling molecules such as PDGF, TGF-beta, VEGF and EGF.
- Commercially available products isolate the patient's platelets and allow them to be transplanted into grafting sites to supplement the levels of growth factors.

Cell-Based Substitutes - Bone marrow aspirates

- Bone marrow aspirates have been used, but they are an inefficient method of obtaining osteoprogenitor cells; most of what is obtained is red blood cells.
- Devices to concentrate the cells have not been proven effective.

Cell-Based Substitutes - mesenchymal stem cells

- Modern culture techniques allow mesenchymal stem cells to be isolated from a bone marrow aspirate and cultured in vitro, expanding the number of cells and discarding the non-bone cell precursor cells such as hematopoietic cells.
- In the presence of dexamethasone, ascorbic acid and beta-glycerophosphate, mesenchymal stem cells will differentiate into osteoblasts in culture.
- This application is not yet widely available for clinical purposes, but is the focus of much research.

Ceramic-Based Bone Graft Substitutes

- The primary inorganic component of bone is hydroxyapatite, and calcium phosphate-based ceramics attempt to mimic this material.
- They include hydroxyapatite itself, beta-TCP, and bioactive glass.
- They have been used since the 1980s.
- Ceramics have no osteogenic or osteoinductive properties, and most provide only minimal structural strength.
- Osteoid is laid down directly on the ceramic, and then remodeled into bone.
- Injectable forms are available commercially.

Polymer-Based Bone Graft Substitutes

- Polymers represent a broad group of bone graft substitutes with varying properties.
- They can be natural or synthetic, degradable and non-degradable.
- By and large they are not osteoinductive, but can be osteoconductive.
- Some provide a degree of mechanical support.

Miscellaneous

- Substitutes such as coral are difficult to classify.
- Coral calcium phosphate can be converted to coralline hydroxyapatite.
- This has a similar structure and pore size to human bone, and has also been used as a carrier for bone growth factors.

Ceramic-based bone graft substitutes

- Approximately 60% of the bone graft substitutes currently available involve ceramics, either alone or in combination with another material.
- This area of bone graft research has grown tremendously over the past 5 years and has a promising outlook.
- Ceramic substitutes can be divided into 3 main categories, including calcium sulfate, bioactive glass, and calcium phosphate

Ceramic-based bone graft substitutes

- The use of ceramics, especially calcium phosphates, is driven in part by the fact that the primary inorganic component of bone is calcium hydroxyapatite, a subset of the calcium phosphate group.
- In addition, calcium phosphates are osteoconductive, osteointegrative (the newly formed mineralized tissue forms intimate bonds with the implant material), and, in some cases, osteoinductive.
- This material often requires high temperatures for scaffold formation and has brittle properties; therefore, it is

Calcium sulfate

- Calcium sulfate is biocompatible, bioactive, and resorbable after 30-60 days.
- Significant loss of its mechanical properties occurs upon its degradation; therefore, it is a questionable choice for load-bearing applications.
- Osteoset is a tablet for use for defect packing.
- It is degraded in approximately 60 days.

Bioactive glass (bioglass)

- Bioactive glass (bioglass) is a biologically active silicate-based glass.
- Its high modulus and brittle nature make its applications limited, but it has been used in combination with polymethylmethacrylate to form bioactive bone cement and with metal implants as a coating to form a calcium-deficient carbonated calcium phosphate layer.
- This layer facilitates the chemical bonding of the implant to surrounding bone.

Calcium phosphates

- Calcium phosphates account for most of the ceramic-based bone graft substitutes currently available.
- Several types of calcium phosphates exist, including tricalcium phosphate, synthetic hydroxyapatite, and coralline hydroxyapatite, and are available in pastes, putties, solid matrices, and granules.

Bone Graft Substitutes

- Resorption rates vary widely
  - Dependant on composition
    - Calcium sulfate - very rapid
    - Hydroxyapatite (HA) – very, very slow
    - Some products may be combined to optimize resorption rate
  - Also dependant on porosity,

Bone Graft Substitutes

- Mechanical properties vary widely
  - Dependant on composition
    - Calcium phosphate cement has highest compressive strength
    - Cancellous bone compressive strength is relatively low
    - Many substitutes have compressive strengths similar to cancellous bone
    - All designed to be used with internal fixation

Calcium Phosphate

- Injectable pastes of calcium and phospate
- Very high compressive strength once hardens
- Some studies of its use have allowed earlier weightbearing and range of motion

Calcium Sulfate

- Osteoconductive void filler
- Low compressive strength – no structural support
- Rapidly resorbs
- May be used as a autogenous graft extender
  - Available from numerous companies

Calcium Sulfate

- Pellets
  - Pellet injectors
- Bead kits
  - Allows addition of antibiotics
- Injectable
  - May be used to augment screw purchase

Collagen Based Matrices

- Highly purified Type 1 bovine dermal fibrillar collagen
- Bone marrow is added to provide bone forming cells

Demineralized Bone Matrix

- Prepared from cadaveric human bone
- Acid extraction of bone leaving
  - Collagen
  - Noncollagenous proteins
  - Bone growth factors
    - BMP quantity extremely low and variable
- Sterilized which may decrease the availability of BMP

Demineralized Bone Matrix

- Available in multiple preparations
  - Gel
  - Putty
  - Strip
  - Combination products with cancellous bone and other bone graft substitute products

Demineralized Bone Matrix

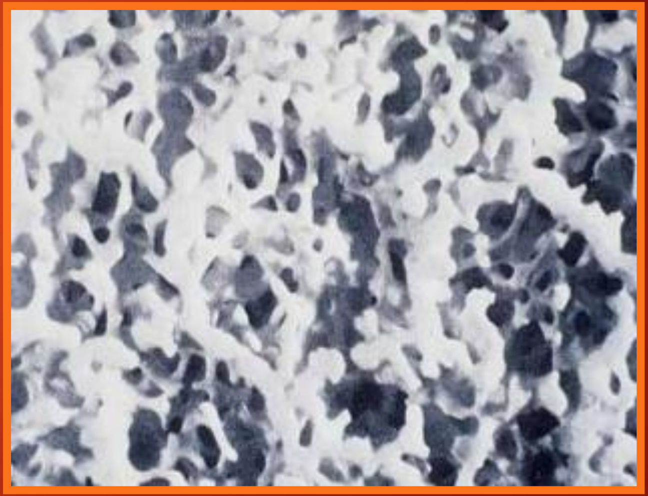
- Growth factor activity varies between tissue banks and between batches
- While they may offer some osteoinductive potential because of available growth factors, they mainly act as an osteoconductive agents

Han B et al. J Orthop Res. 21(4):648-54, 2003.
Blum B, et al. Orthopedics. 27 (1 Suppl): S161 – S165, 2004.

Hydroxyapatit e

- Produced from marine coral exoskeletons that are hydrothermically converted to hydroxyapatite, the natural mineral composition of bone
- Interconnected porous structure closely resembles the porosity of human cancellous bone

Cancellous Bone



Coralline hydroxyapatite

Hydroxyapatite

- Available in various size blocks & granules
  - Very slow resorption

Tricalcium Phosphate

- Wet compressive strength slightly less than cancellous bone
- Available as blocks, wedges, and granules

Bone Morphogenetic Proteins

- Produced by recombinant technology
- Two most extensively studied and commercially available
  - BMP-2 (Infuse) Medtronics
  - BMP-7 (OP-1) Stryker Biotech

BMP-2 for Open Tibial Fractures

- Prospective, randomized study
- 450 patients

- All received IM nail (vast majority with **UNREAMED** technique) and appropriate soft tissue management
- Randomized to 3 treatments at time of definitive wound closure
  - Placebo
  - 0.75 mg/ml BMP-2/ACS
  - 1.50 mg/ml BMP-2/ACS

BESTT Study Group, et al. J Bone Joint Surg 84A: 2123, 2002.

Results

- 44% reduction in risk of nonunion/delayed union with high dose BMP-2
- Significantly faster fracture healing
- Significantly fewer
  - invasive interventions
  - hardware failures
  - infections

BESTT Study Group, et al. J Bone Joint Surg 84A: 2123, 2002.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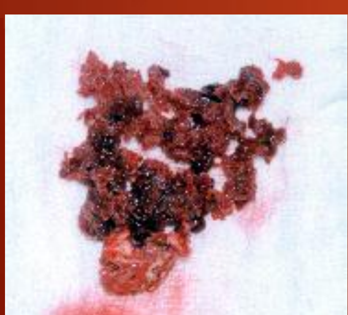





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New materials and approaches

- Despite the many advances in bone graft substitutes, new materials and approaches to bone healing continue to be investigated.
- One exciting area that is emerging as an approach to musculoskeletal tissue repair is regenerative engineering.
- Regenerative engineering is the integration of tissue engineering, advanced material science, stem cell science, and areas of developmental biology for the regeneration of complex

Recent Advances

- Recently, there has been a strong push toward specialization of bone graft materials.
- Companies have transitioned from nonspecific bone graft substitutes to products designed for specific clinical situations.
- As a result, there has been an impetus to create a greater variety of bone grafts and ways to introduce them into the body.
- Consequently, more nonsetting pastes and putties have been introduced.
- The production of these materials is often less complex than their cement counterparts, and their biological responses are often better.

Recent Advances

- Finally, there has been a trend to add slight amounts of foreign ions into ceramic bone graft substitutes to improve their biological behavior.
- Most efforts have been set on silicon, but other ions have been looked at, such as magnesium, sodium, strontium, or zinc.
- As more materials are adapted and discovered, preexisting products are finding new applications and effectiveness in combination with newly emerging technology.
- In addition, as investigators continue to find

Conclusions

- Despite many recent studies evaluating alternative options for treating bone defects, autograft remains the gold standard.
- Many exciting products are now available as alternatives to autograft. ‘
- I'hese products do not cause the morbidity associated with autograft but they have not been shown to have equal effectiveness in repairing bone defects.
- It appears that no single material may be sufficient to replace autograft bone.
- Perhaps a combination of materials is necessary to allow for adequate

Current trends in management of Shoulder Instability

MOC 2013

Dr Sudarshan Bhandary
Professor & HOD
A.J.Institute of Medical Sciences

Limit the talk to…..

Traumatic Chronic Anterior Instability

Management of shoulder instability

Understanding the pathology

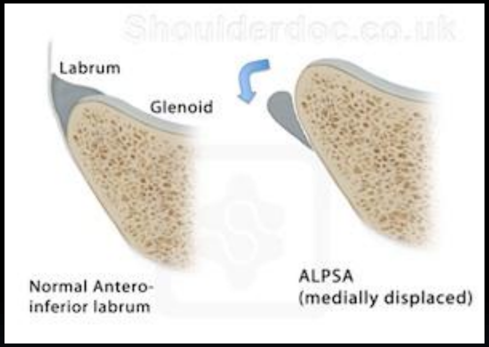
Recognizing the pathology

Management protocols for specific pathology

Understanding the pathology

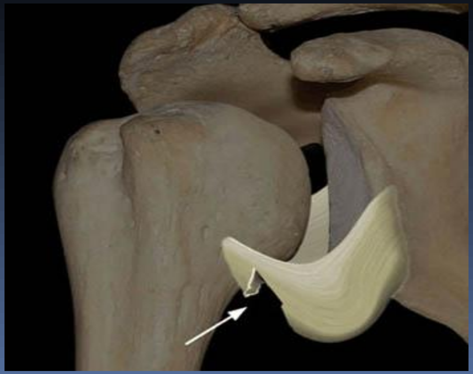
Glenoid Pathology

Bankart and Bony Bankart
ALPSA
Capsular laxity
Glenoid bone loss

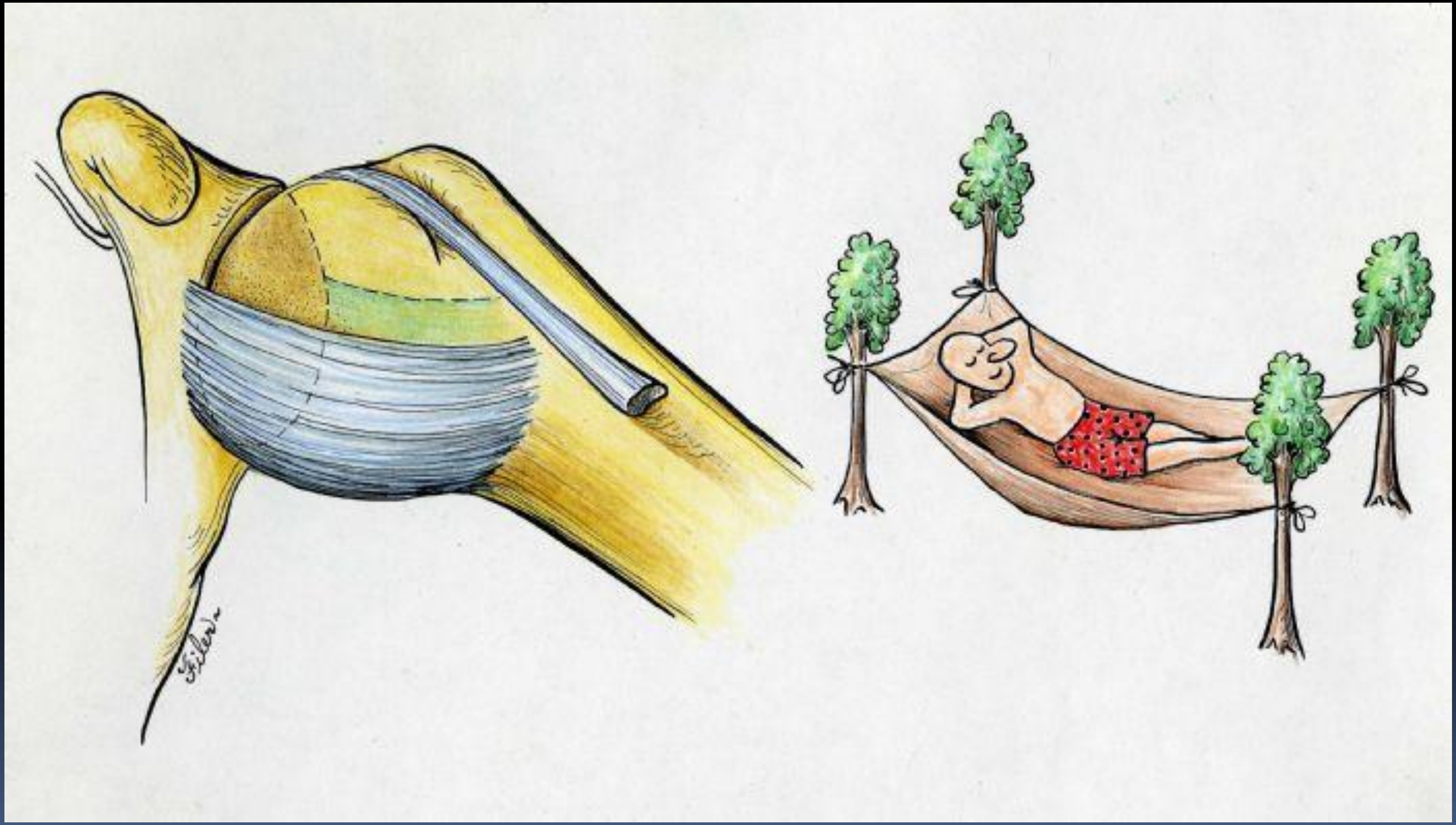


Humeral Pathology

HAGL
Hill Sachs

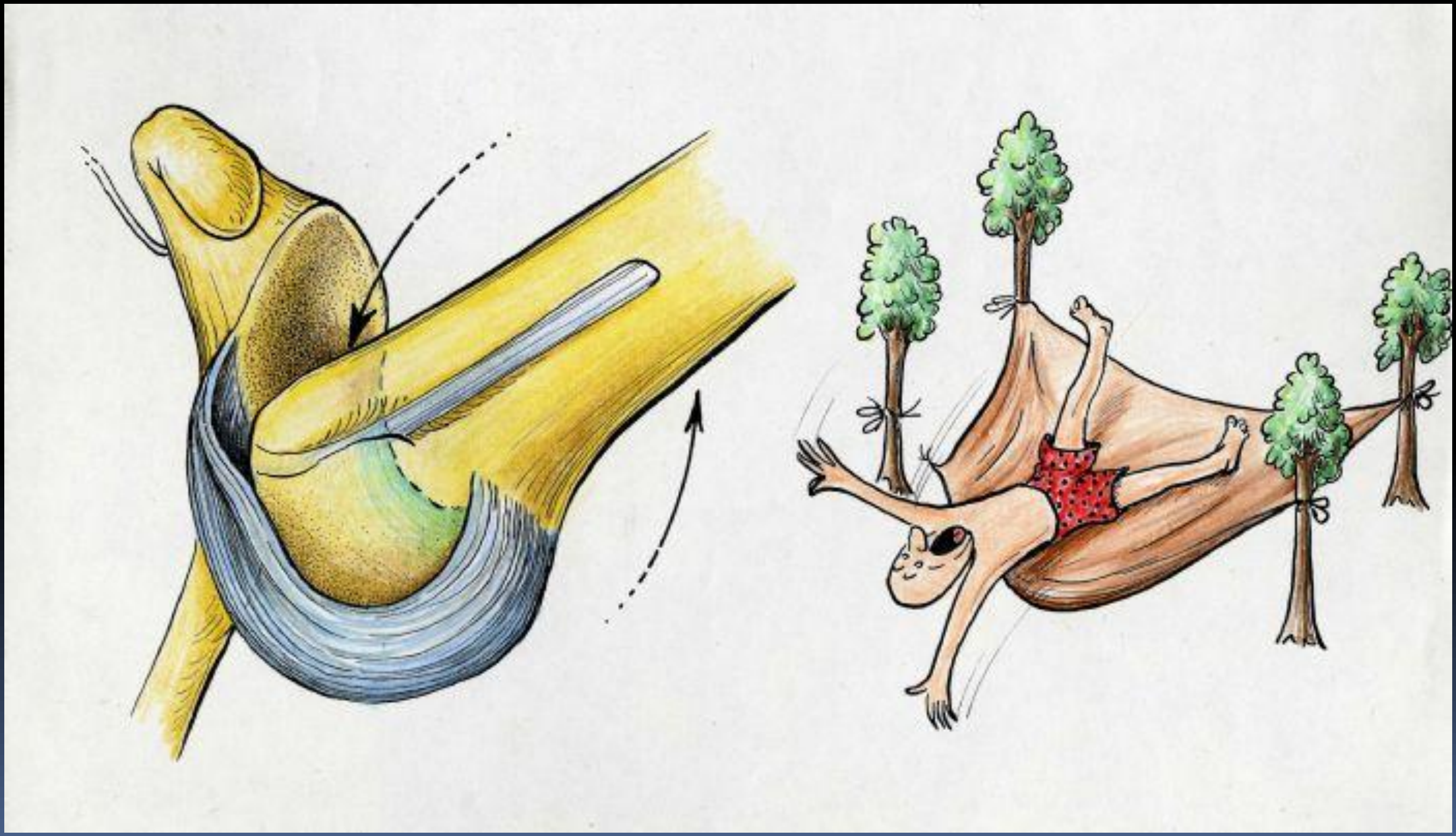


Capsule / IGHL = Hammock



Bankart Lesion

Detachment of the hammock on labral side



Former gold standard

Open Bankart repair

Recurrence rates : < 10%

Early and Mid 1990
Emerging technology
Arthroscopic stabilization

Procedure	Recurrence rates
2 pronged staple (Johnson)	3% to 33%
Transglenoid sutures (Caspari and Morgan)	0% to 49%
PGA bio tags	0% to 20%

Late 1990s and 2000s

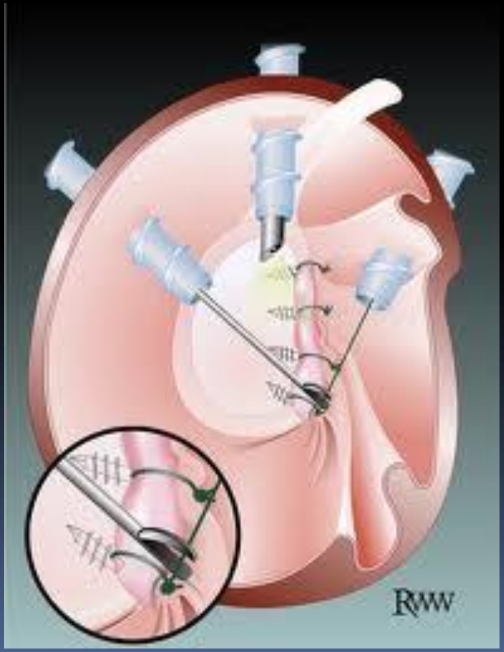
Suture anchor repairs

Better Implants

Better understanding of indications

Arthroscopic Bankart repair
The new gold standard

- Standard procedure = 3 - 4anchors
- Capsular shift
- Bumper effect

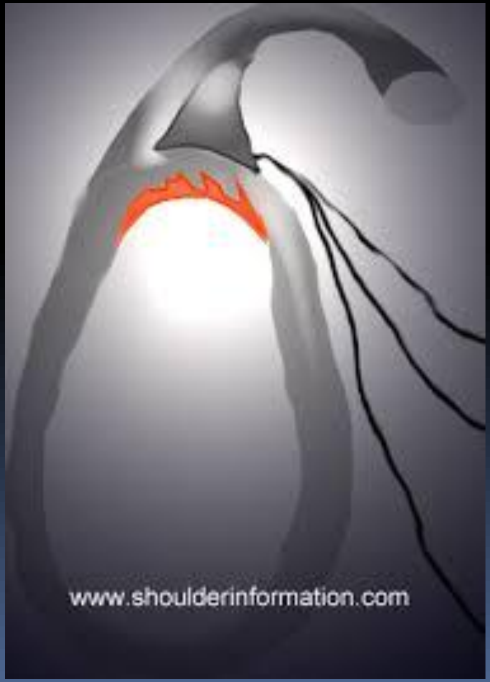


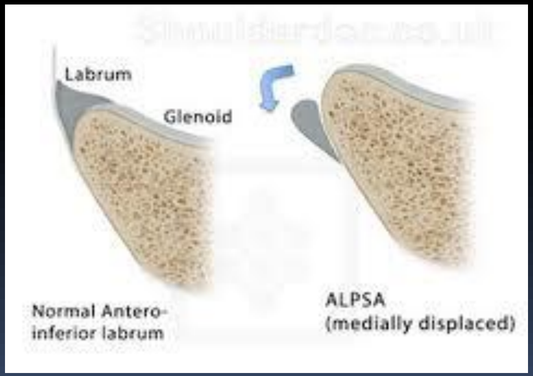
Recognize Associated lesions

SLAP

ALPSA

HAGL

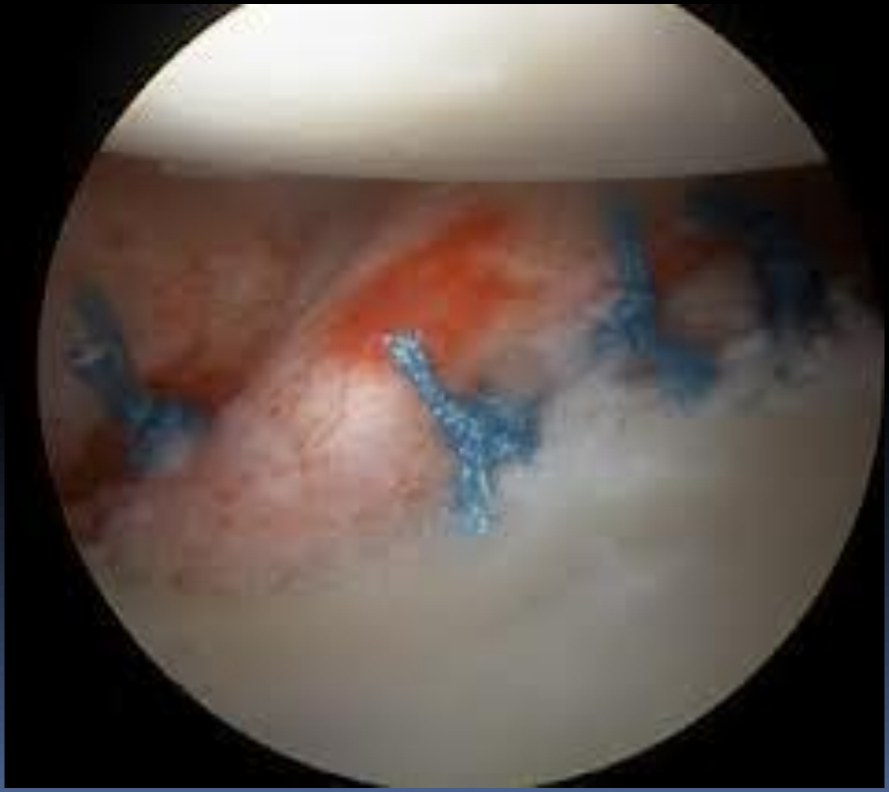




Technique

Arthroscopic Bankart repair

Standard for all instability ?



Problem = Bankart repairs fail

Cause of failure ??

Our incompetence to select the

- Right procedure …..
- For the Right patient

Who are the patients at risk for failure after Bankart repair ?

Risk factor for recurrence – 1

Age at surgery < 20yrs

20 yrs or younger	=	31%
Older than 20 yrs	=	4-7 %

Risk factor for recurrence - 2

Contact or forced overhead sports

Contact sports = 33%

Other sports = 13%

Risk factor for recurrence - 3

Level of sport practice

Competition = 50%

Recreational sports = 3%

Risk factor for recurrence - 4

Hyper laxity (Ant or Inf)

Ant = ER > 85*

Inf = Differential Hyperabduction > 20*

Risk factor for recurrence - 5

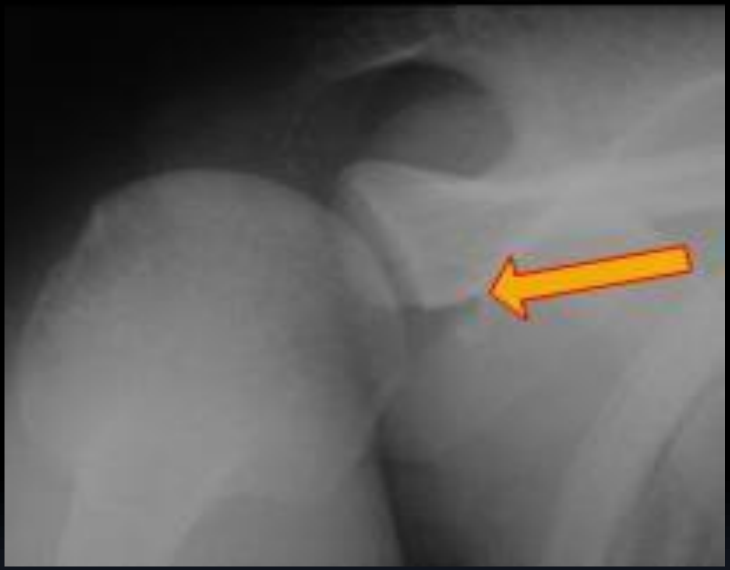
Hill Sachs lesion in AP view in ER

Recurrence

No lesion	= 5%
Lesion in any view	= 10%
Lesion in ER	= 30%

Risk factor for recurrence - 6

Glenoid bone loss in AP view



Recurrence

No lesion or avulsion	=	10 %
Loss of sclerotic contou r	=	37%

How to select a patient for Arthroscopic Bankart repair

Instability severity index score (ISIS)

Age at surgery	< 20yrs	=	2
	> 20 yrs	=	0
Sport activity	Competition	=	2
	Liesure	=	0
Type of sport	Contact	=	1
	Other	=	0
Hyperlaxity	Ant or Inf	=	1
	No hyperlaxity	=	0
Hill sachs lesion	Visible in ER	=	2
	Not visible in ER	=	0
Osseous Glenoid	Bone loss	=	2
	No bone loss	=	0
	Total	=	10

ISIS Score

No Recurrence = 2.7

Recurrence = 5.3

Acceptable

ISIS score < 3 = Bankart

ISIS score > 3 = Contraindication for Bankart

How to select the right procedure for the right patient ?..

You must answer two questions

What kind of lesions do we face ?

- Soft tissue lesions ?
- Bony lesions ?
- Both ?

In case of bony lesions, where are they located?

- Humerus ?
- Glenoid ?
- Both ?

1. The problem is a weak capsule

Poor Capsule

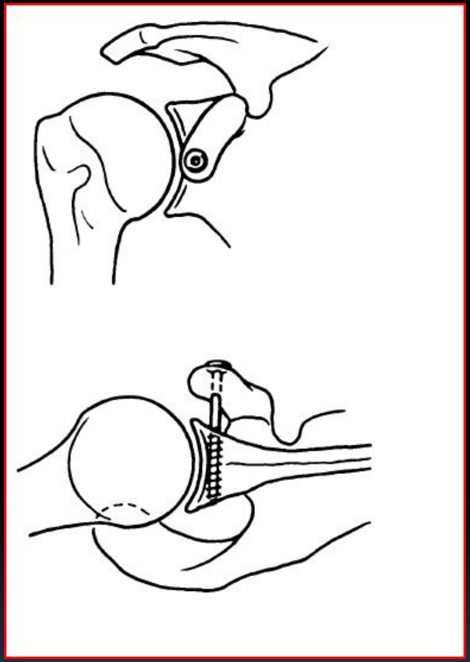
- Capsular Tears

- HAGL Lesion

How to solve this problem ?

Trillat Procedure

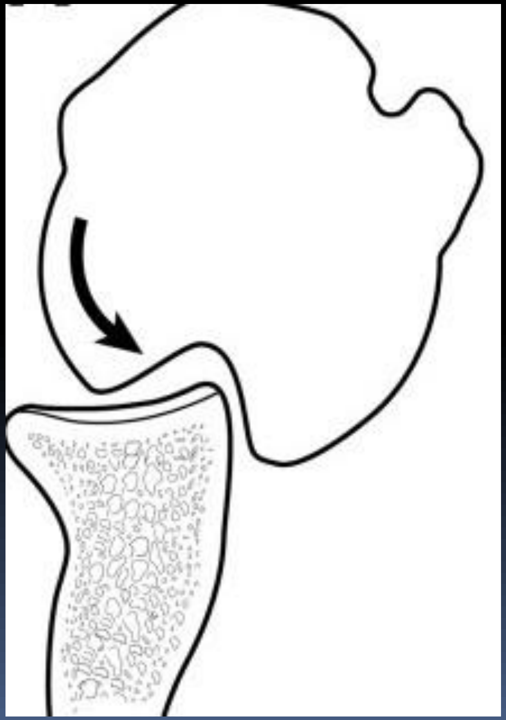
Lowering the subscpularis provides anterior stability



By reinforcing the anteroinferior weak capsule

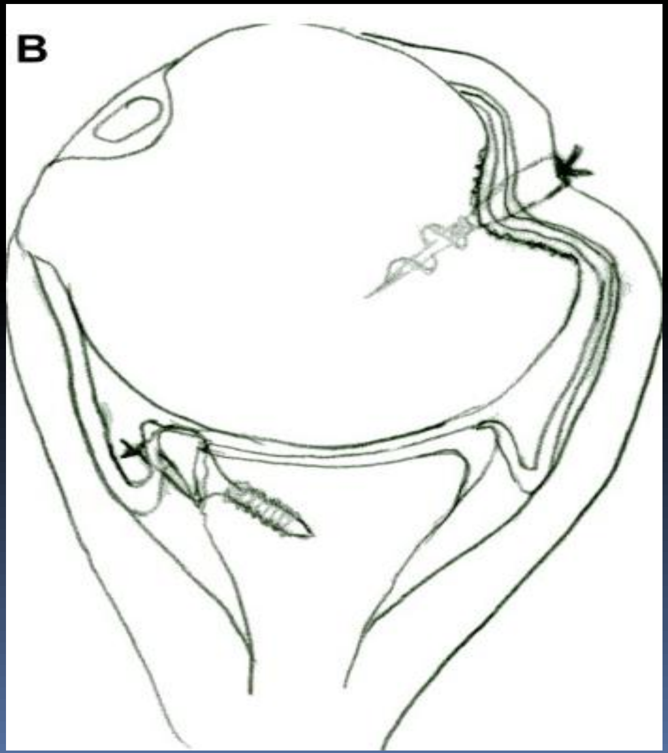
2. Problem = Isolated Large/Engaging Hill-Sachs lesion

(Without Glenoid bone loss)



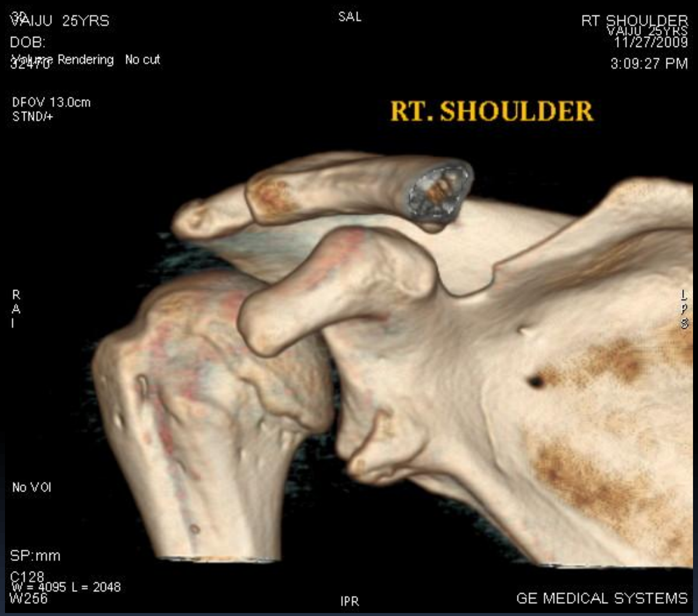
Hill-Sachs Remplissage

Rationale : Filling the defect with capsule / infraspinatus prevents anterior engagement



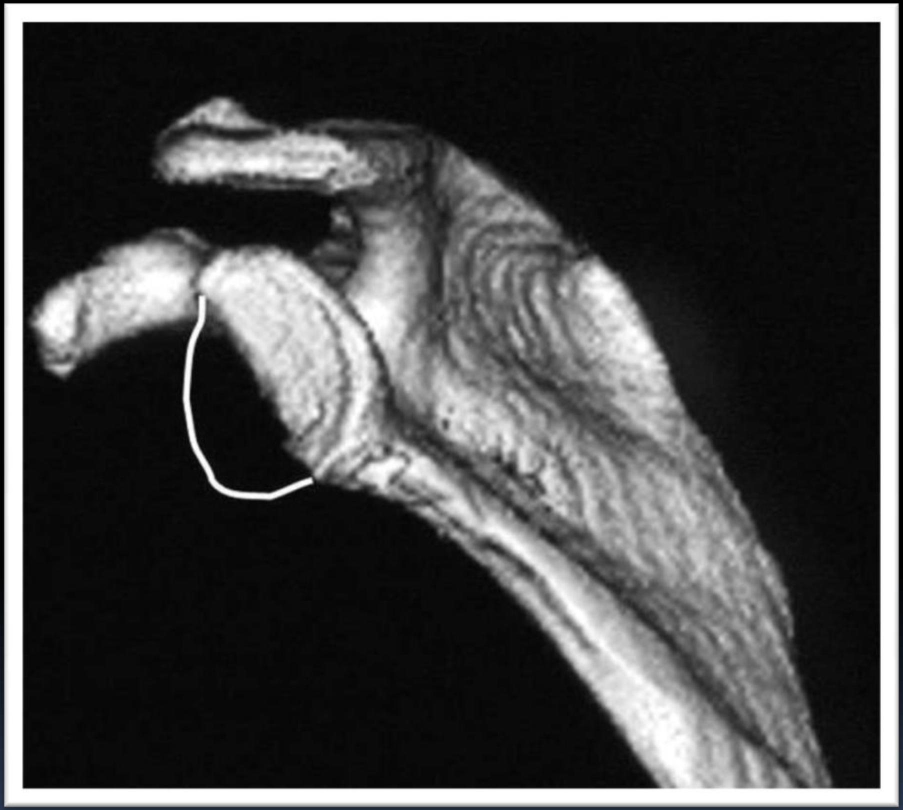
3. Problem = Glenoid Bone Loss

(with or without Hill – Sachs lesion)

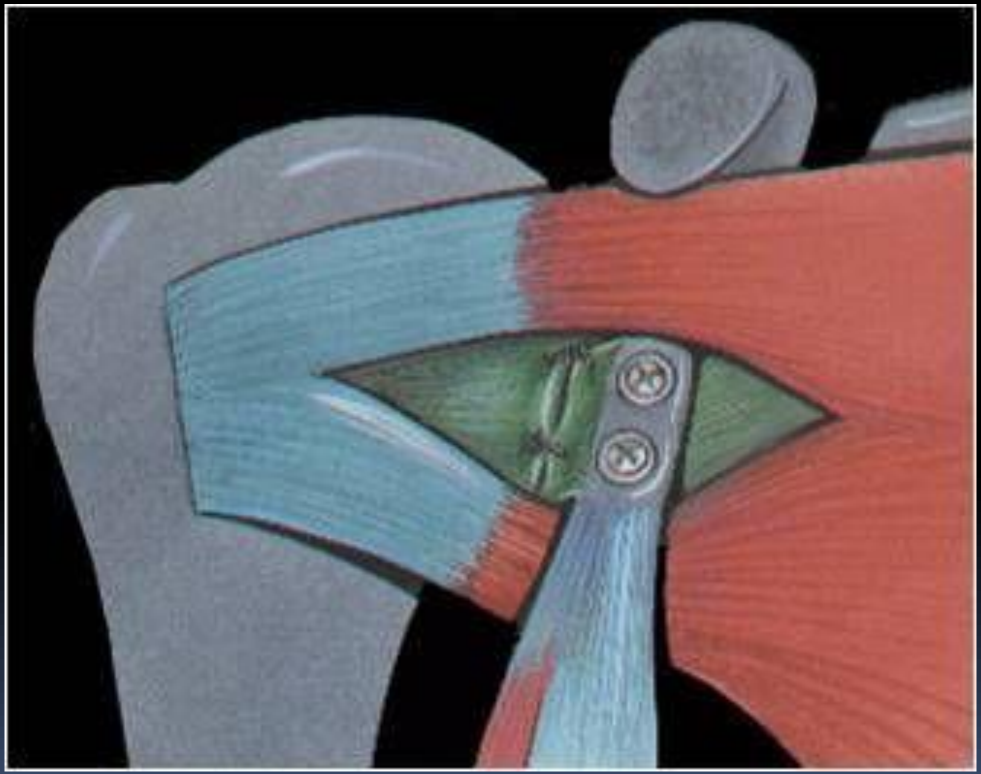


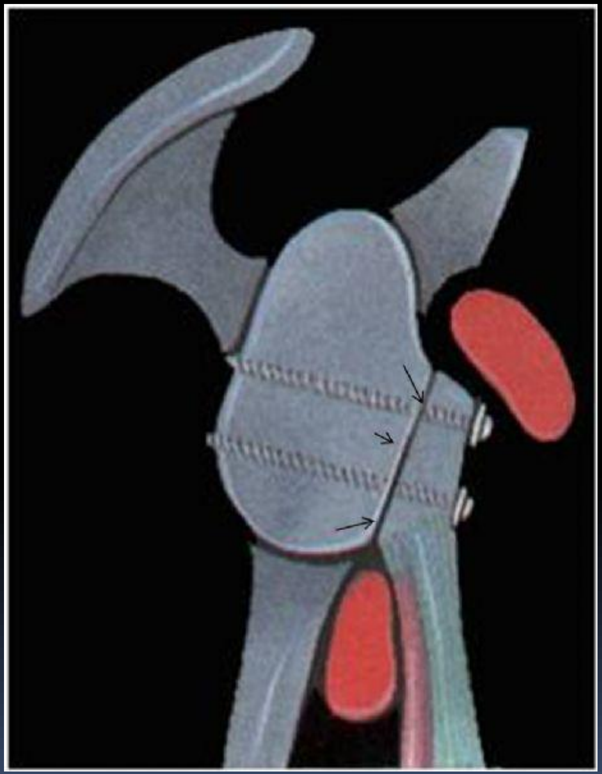
- <u>Glenoid bone loss is often underestimted</u>

Reverse pear sign / Glenoid index

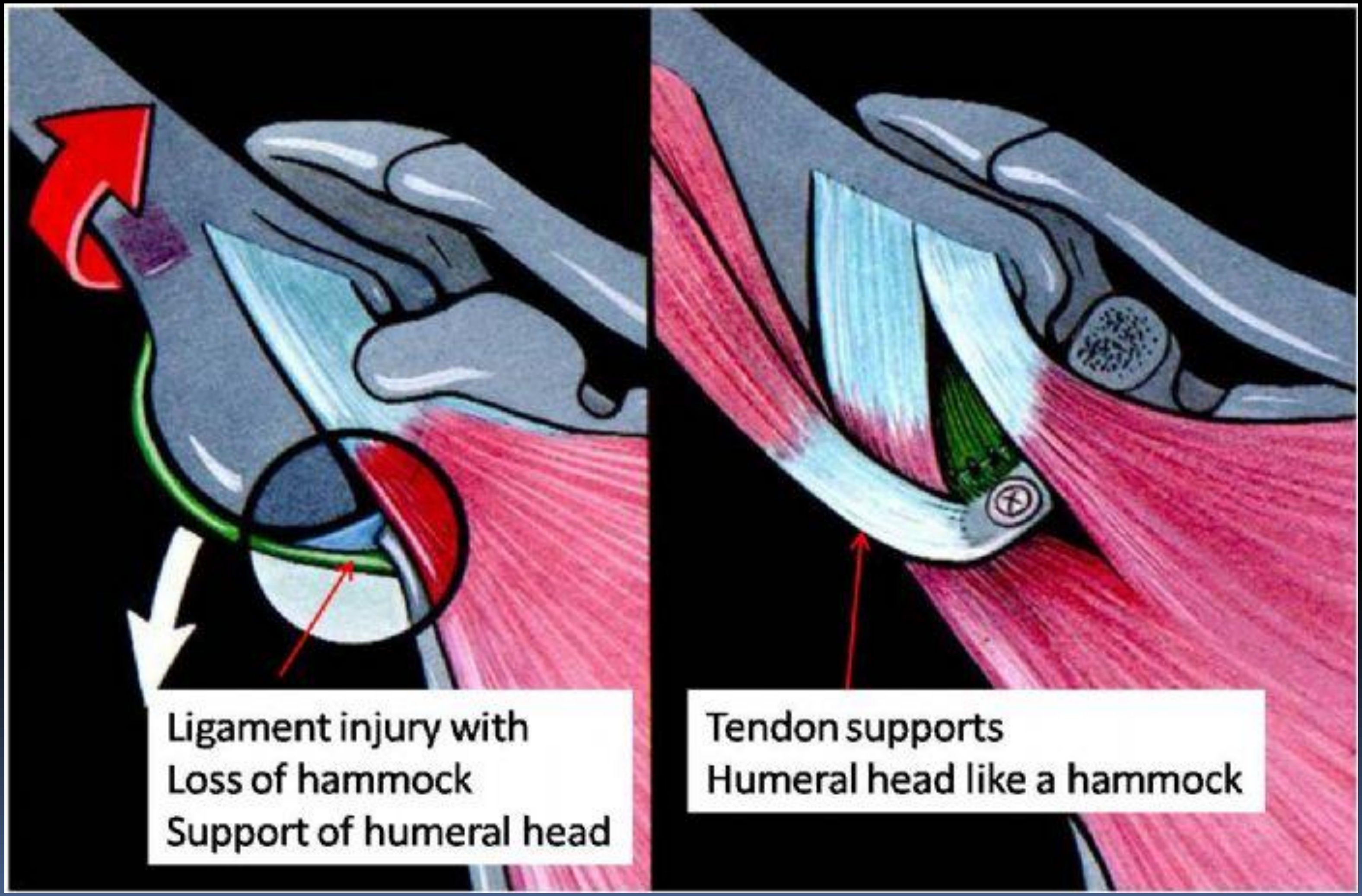


Modified Latarjet Procedure





Modified Latarjet Procedure



Actual Indications

ISIS Score < 3

- Bankart

ISIS Score > 3

No bony lesion

- Bankart / Trillat

Large Hill Sachs

- Remplissage

Glenoid bone loss

- Latarjet

Summary

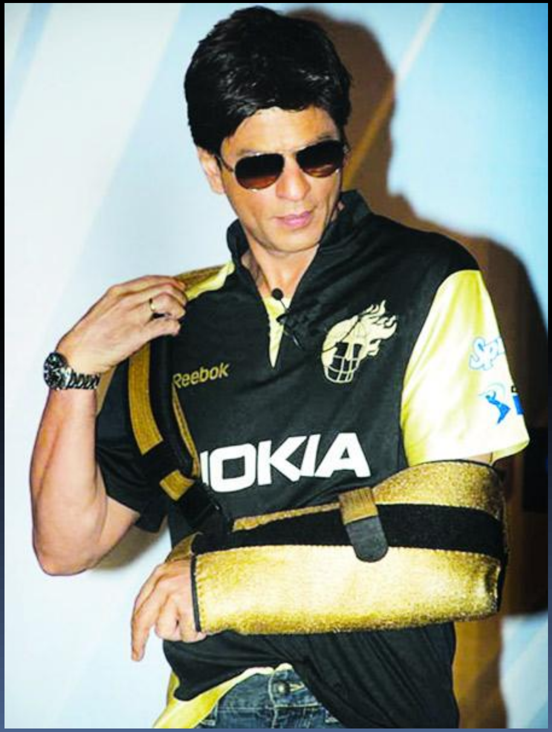
Identify the lesion

Image accordingly

ISIS score

Use a procedure judiciously

Thank You



Limb length discrepancy in children

Hitesh Shah
Pediatric Orthopaedics Services
Kasturba Medical College, Manipal

Objectives

- What is the significance of LLD?
- Etiology of LLD
- Diagnosis and evaluation of LLD
- Clinical assessment
- Radiological assessment
- Variables to be assessed for correction
- Treatment methods

What is the significance of LLD?

- Compensatory gait abnormalities
- Degenerative arthritis of the lower extremity
- Lumbar spine arthritis- backache, scoliosis

Etiology

- Congenital
- Acquired

Congenital

- DDH, congenital coxa vara
- Longitudinal defect- hemimelia
  - PFFD
  - Tibial hemimelia
  - Fibula hemimelia
- Hemiatrophy
- Hemihyertrophy

- Bone disease
  - Skeletal dysplasia
  - Neurofibromatosis
  - Enchondromatosis
  - Diaphyseal aclasia

DDH

Coxa vara

Congenital pseudarthrosis of the tibia

Hemimelia

Tumor

Skeletal dysplasia

Hemihypertrophy/hypoplasia

Acquired

- Traumatic- fracture, growth plate injury
- Infection
- Neurological – polio, cerebral palsy
- Iatrogenic injury to physis

Traumatic

Infection

Vascular

Idiopathic

Growth stimulation

- Congenital- vascular malformation
- Tumor- neurofibromatosis
- Trauma- femoral fracture
- Chronic inflammation- COM, JRA

Clinical assessment

Evaluation of LLD

- Is the discrepancy real?
- What is the cause?
- Where is the discrepancy?

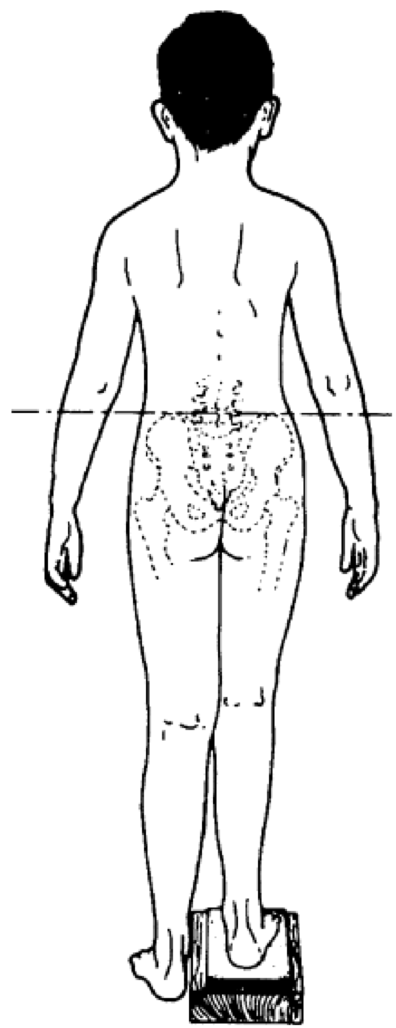
History

- Determine the etiology
- Age of the child
- Progressive with growth or static LLD
- Presence of low backache, functional disability
- Previous surgery

Standing examination

- Look for: scoliosis, pelvic obliquity, and joint (hip, knee, ankle) contracture (each of these can give the false sense of leg length inequality)
- Look for: hairy patches, vascular markings, muscle wasting, neurofibromas
- Stand on pre-measured blocks and reassess any scoliosis or pelvic obliquity

Standing examination -Block method



Standing examination

- Look for: scoliosis, pelvic obliquity, and joint (hip, knee, ankle) contracture (each of these can give the false sense of leg length inequality)
- Look for: hairy patches, vascular markings, muscle wasting, neurofibromas
- Stand on pre-measured blocks and reassess any scoliosis or pelvic obliquity
- Is lateral bending symmetrical?
- Gait

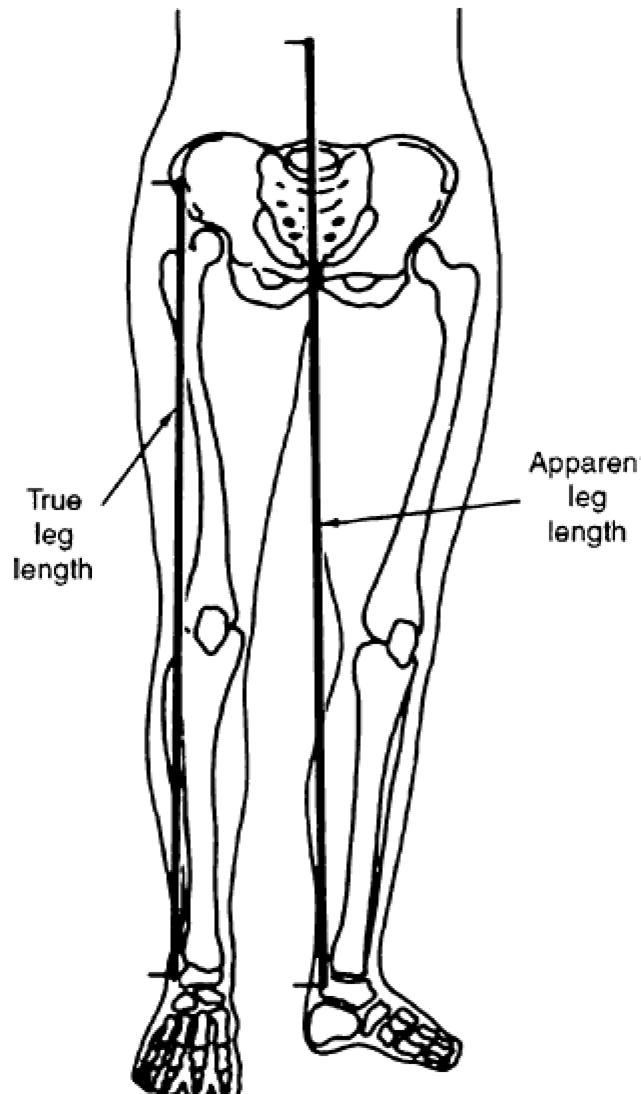
Sitting examination

- Does any scoliosis correct? (yes = functional)

Supine examination

- **Galleazzi's test** – place heels together with knees flexed & assess where the shortening is.
- Tape measure (Real & Apparent)

Supine examination–Tape measure



Supine examination

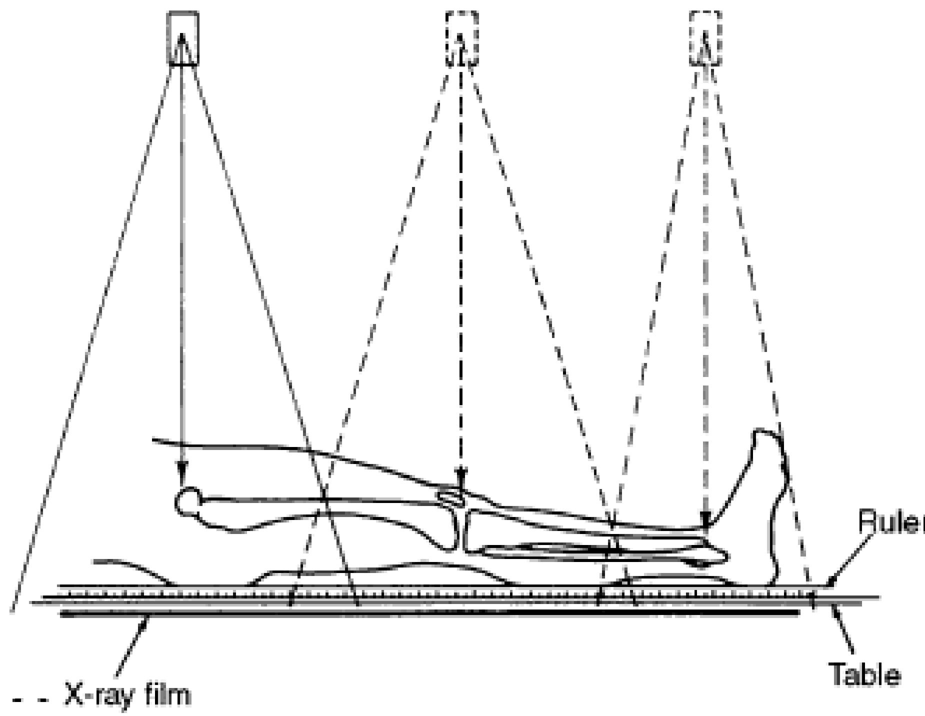
- Galleazzi's test – place heels together with knees flexed & assess where the shortening is.
- Tape measure (Real & Apparent)
- Joint movements
- Abdominal masses (Wilm's tumour)

Radiological assessment

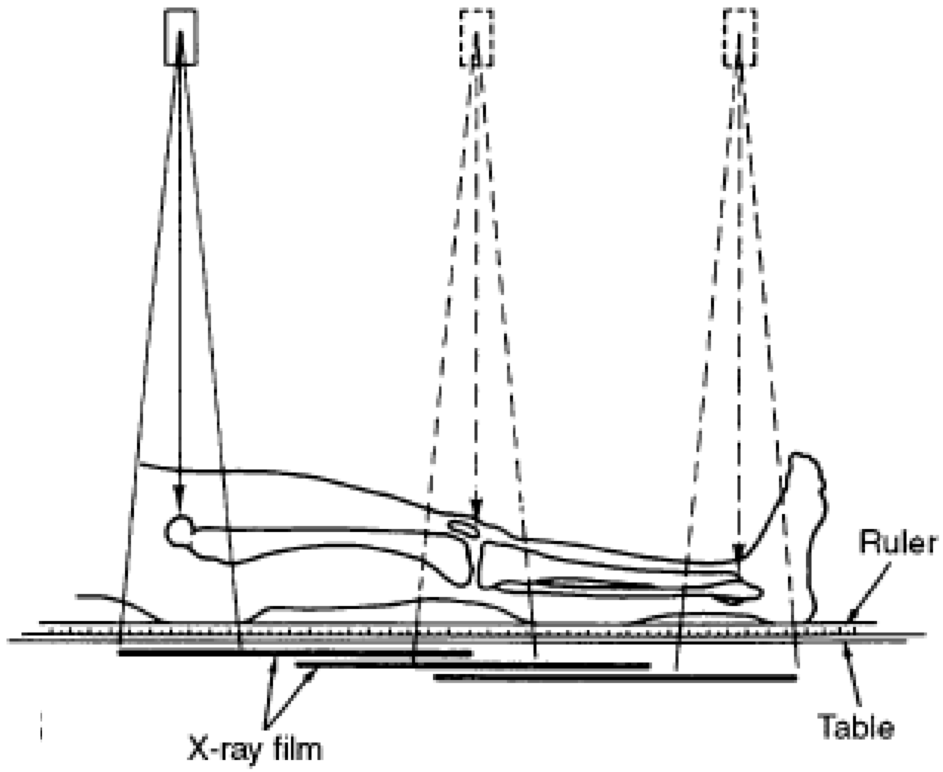
Radiological assessment

- Accurate
- Reliable
- No magnification
- Low radiation
- Low cost
- Convenience

Orthoroentgenogram



Scanogram



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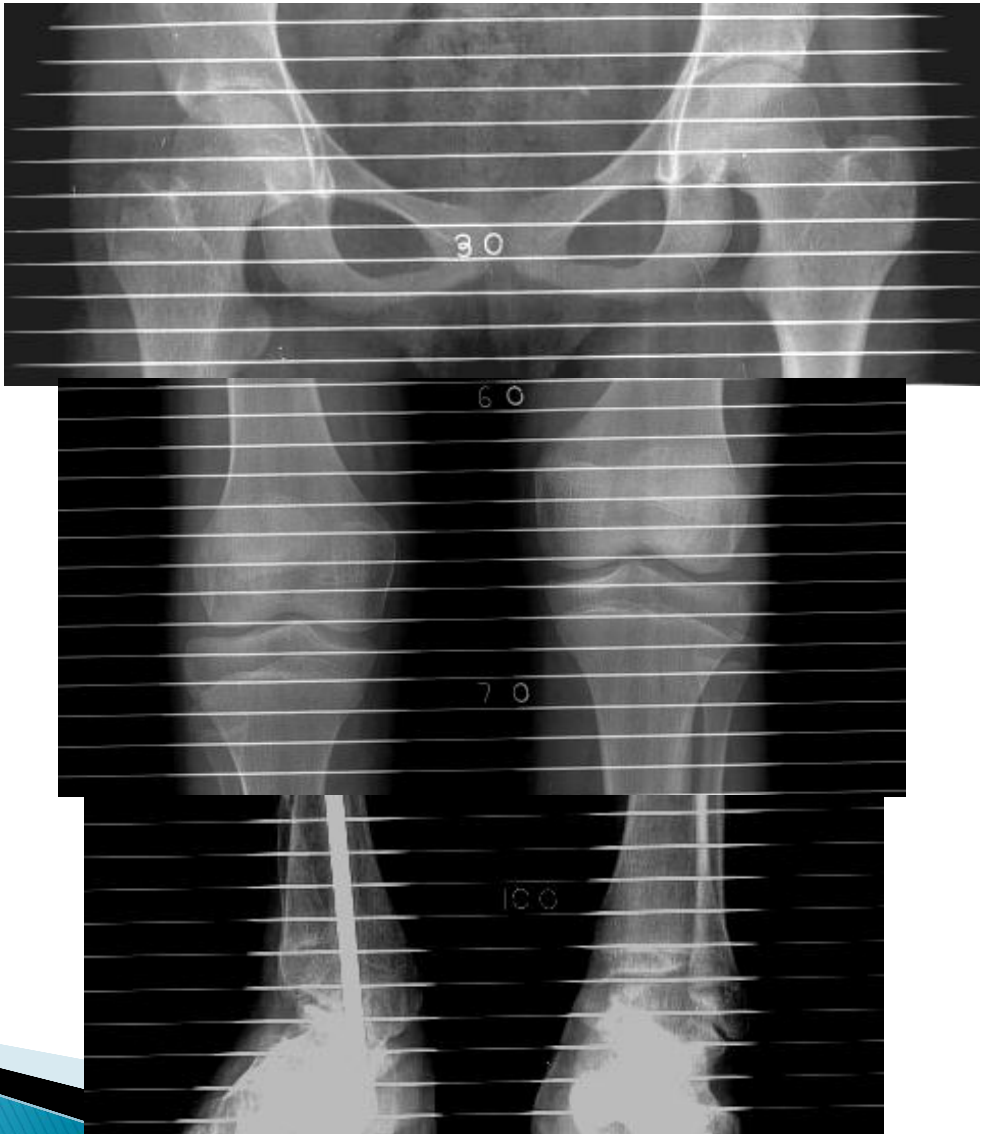
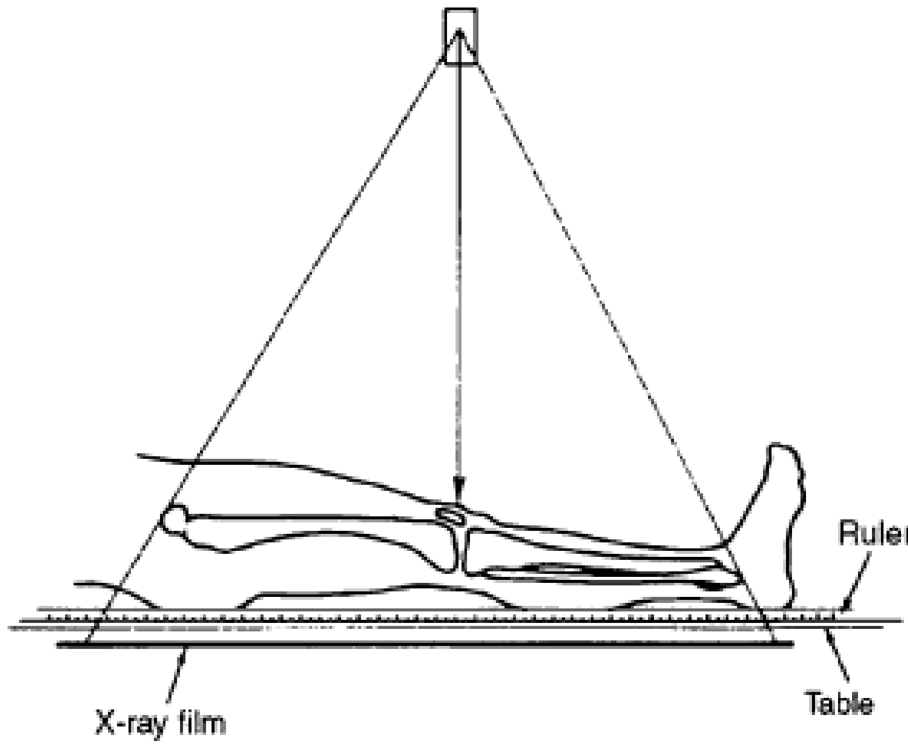
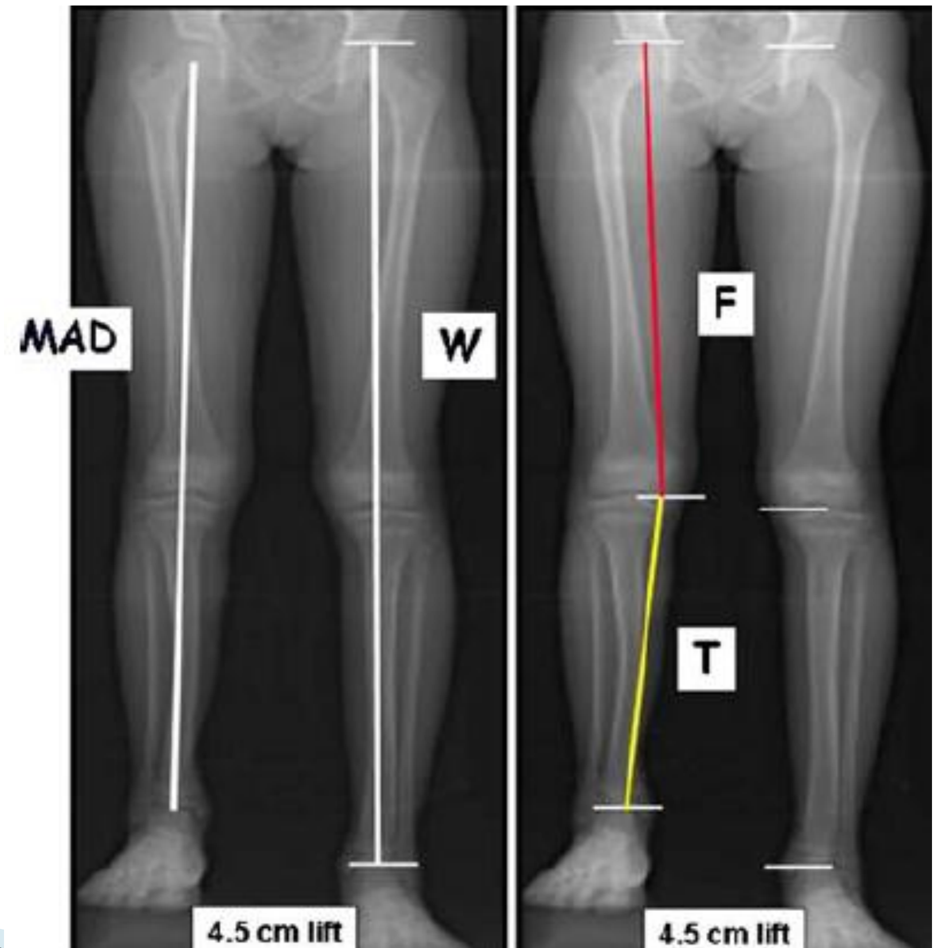


Teleoroentgenogram



Teleoroentgenogram



CT scan

Prediction of LLD at skeletal maturity

- The White- Menelaus arythmetic method
- The Green–Anderson method
- The Eastwood and Cole method
- The Moseley straight line
- Multiplier technique

Treatment goal

- Equal length at skeletal maturity
- A level pelvis
- A correct mechanical axis

Variables to be considered

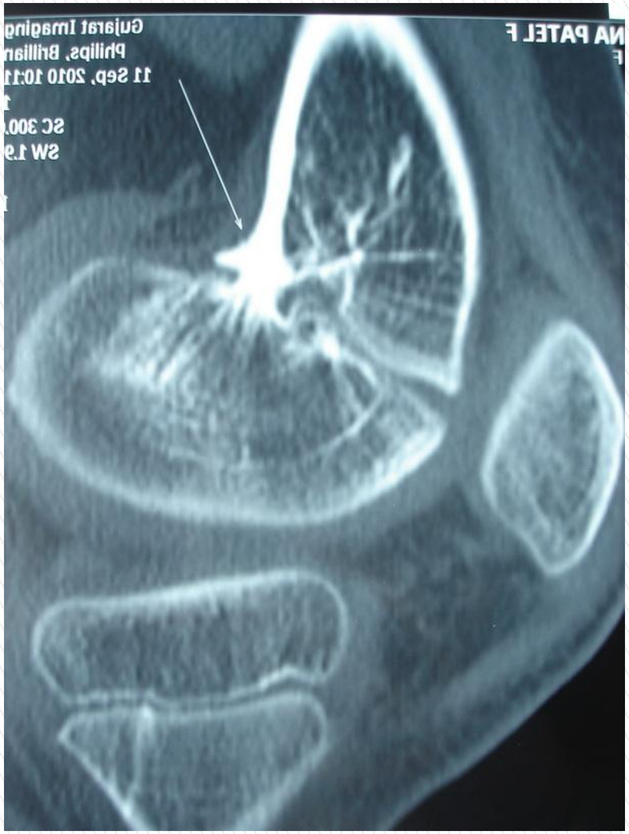
- Etiology of LLD
- Age at presentation (growth remaining)
- Anatomical site (femur, tibia etc)
- Amount of shortening at present and skeletal maturity
- Lower extremity function
- Angular / rotational deformity
- Status of the patient and family support

Options available for treatment

- Treat the cause
- Observation
- Shoe lift
- Contralateral epiphyseodesis
- Limb lengthening
- Contralateral shortening
- Combination of shortening + lengthening
- Limb ablation

Etiology of LLD

Physeal bar



Physeal bar

Physeal Bar Resection – Indications

- Traumatic etiology
- >2 years remaining growth
- <25% physeal involvement (cross-sectional)

Observation

- 0-2 cm LLD at skeletal maturity
- No angular or rotational deformity

Shoe lift

- 2-5 cm LLD

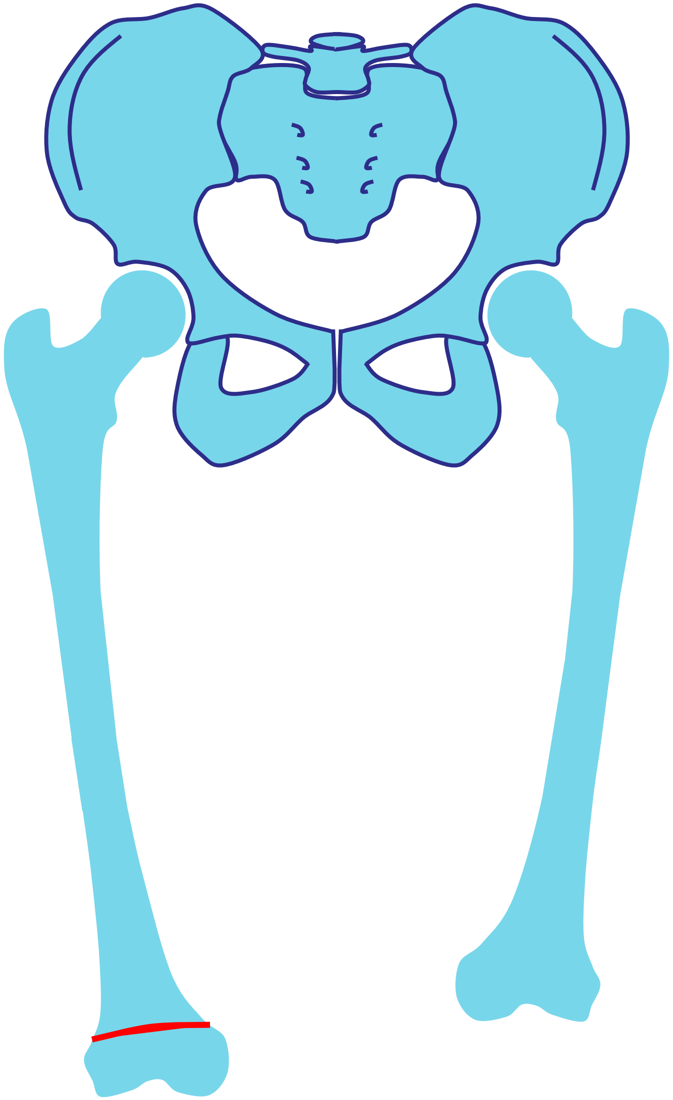
Site of correction

- Perform surgery on the deformed segment.
- Maintain the symmetry of the lower limbs
- Knee height variation is acceptable up to 5 cm

Epiphyseodesis

- >2 years growth
- <4 cm shortening
- No angular deformity

Epiphyseodesis



- >2 years growth
- <4 cm shortening
- No angular deformity

Technique

Permanent

Temporary

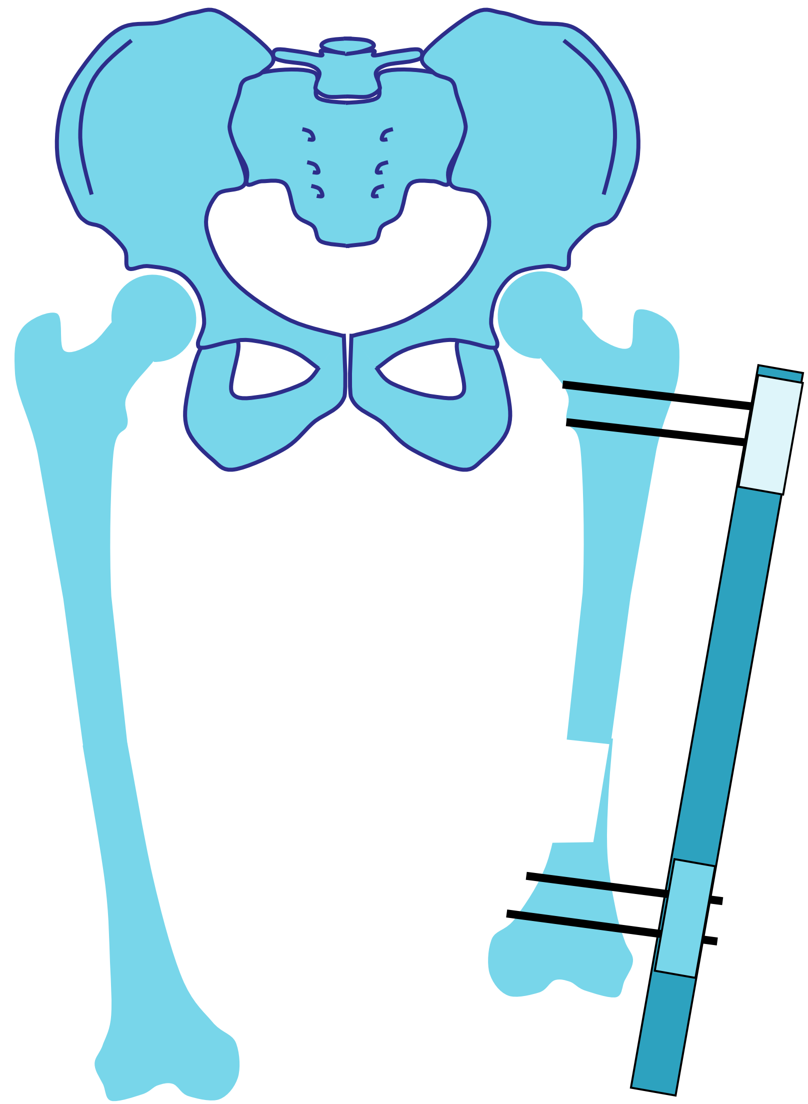
Epiphyseodesis

Advantages	Disadvantages
Simple Easy No morbidity Less complications	Final height decreased Short stature Affect the normal side

Limb lengthening

- <2 years growth
- 4-8 cm shortening
- No angular deformity

Limb lengthening



- <2 years growth
- 4-8 cm shortening
- No angular deformity

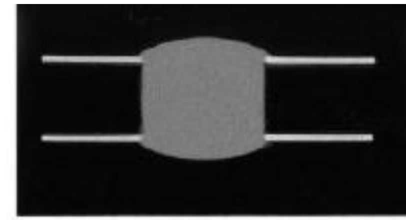
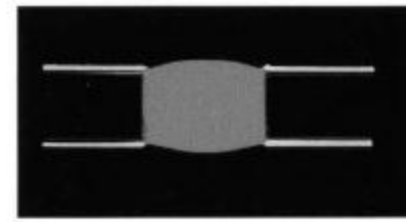
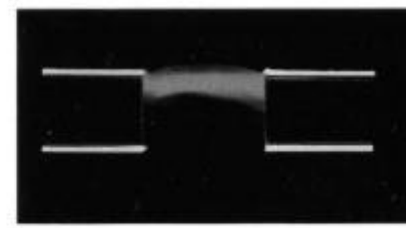
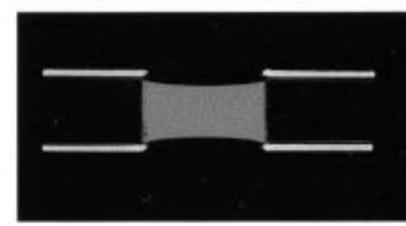
Technique

- Monolateral fixator
- Multiplane fixator
- Ring fixator
- Lengthening over an intramedullary rod
- Intramedullary distraction

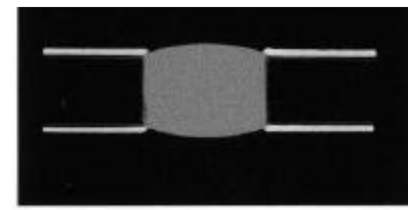
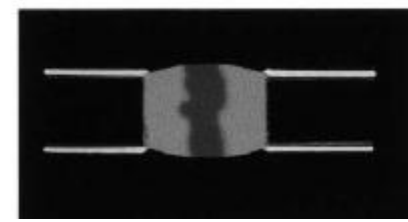
Principles

- Location of lengthening
- Delay before distraction
- Rate of distraction
- Rhythm of distraction
- Amount of lengthening
- Quality of regenerate bone

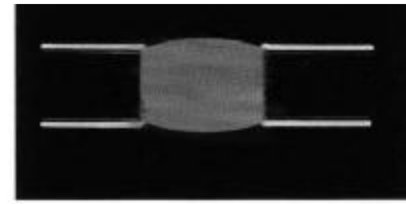
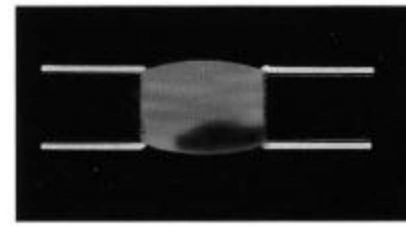
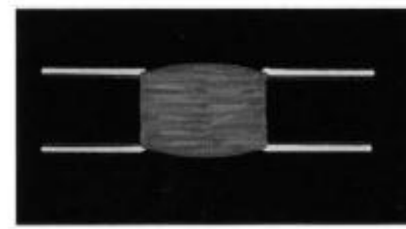
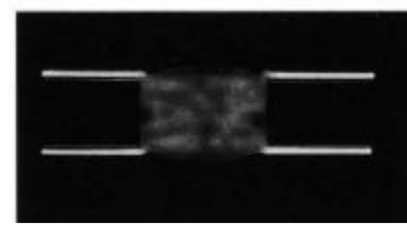
Regenerate shape

Fusiform	wider than the original bone	
Contained	same width as the original bone	
Opposite	only apparent on the side opposite the fixator	
Attenuated	narrower than the original bone	

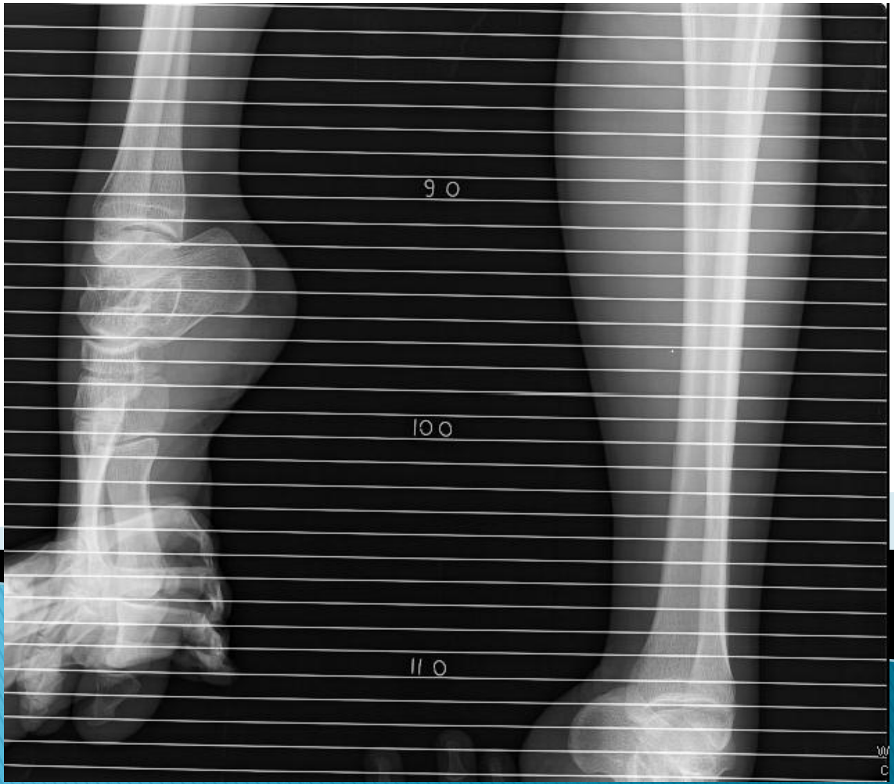
Regenerate polarity

Non-polarized	continuous bridge between the two ends of the osteotomy	
Polarized	radiolucent space in the midzone	

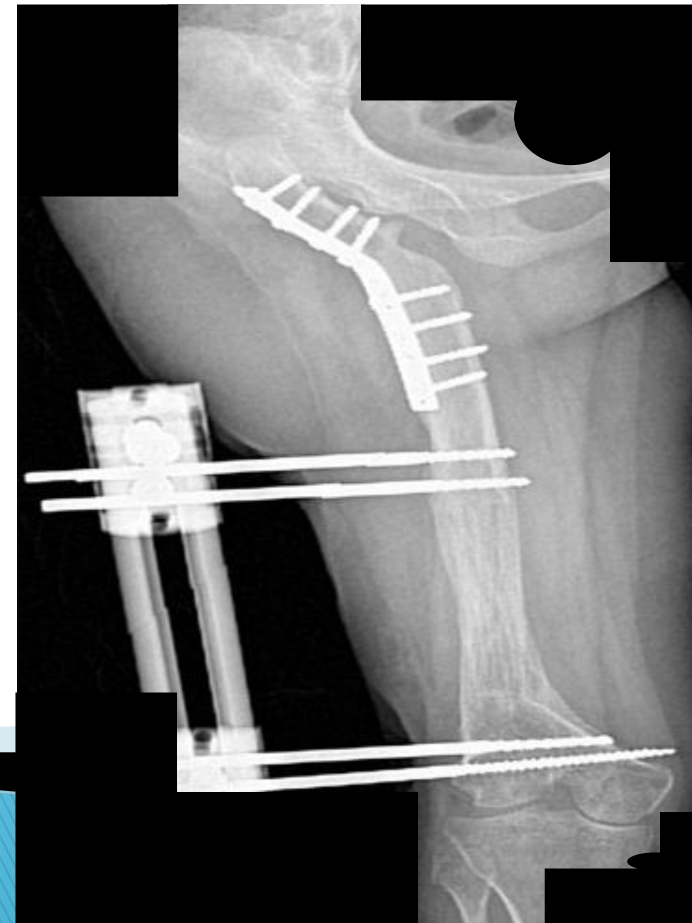
Regenerate consistency

Homogeneous	appears solid on the radiograph (includes differentiation into cortical and medullary zones)	
Lucency	an osteopenic area within the regenerate column	
Striated	longitudinal columns of regenerate	
Speckled	small islands of regenerate not contiguous with each other	

Example



Unilateral external fixator

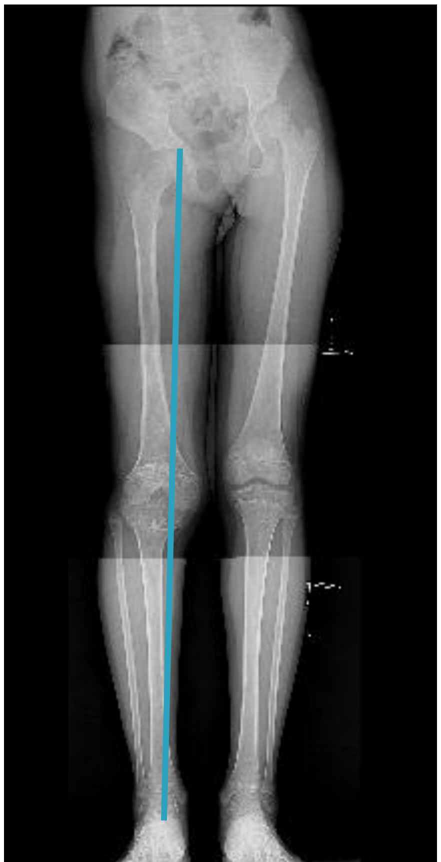


Final follow up

Example

Limb lengthening

Advantages	Disadvantages
Can correct deformity simultaneously	

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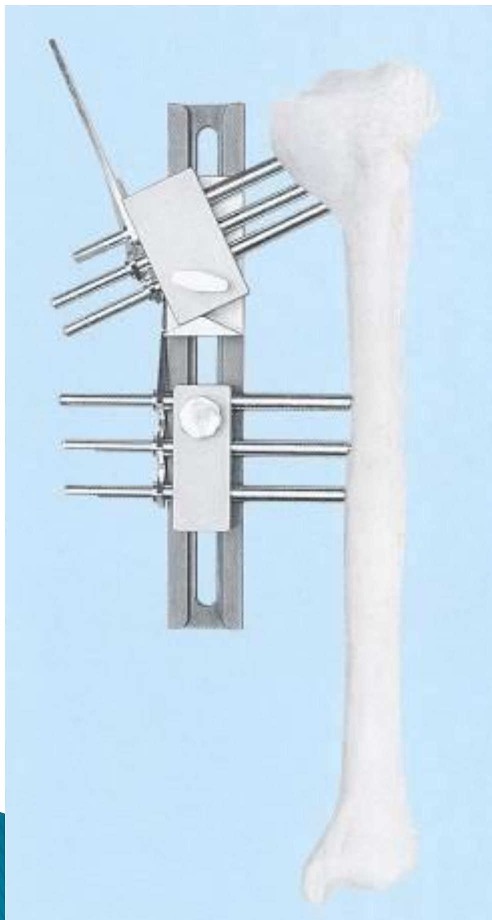
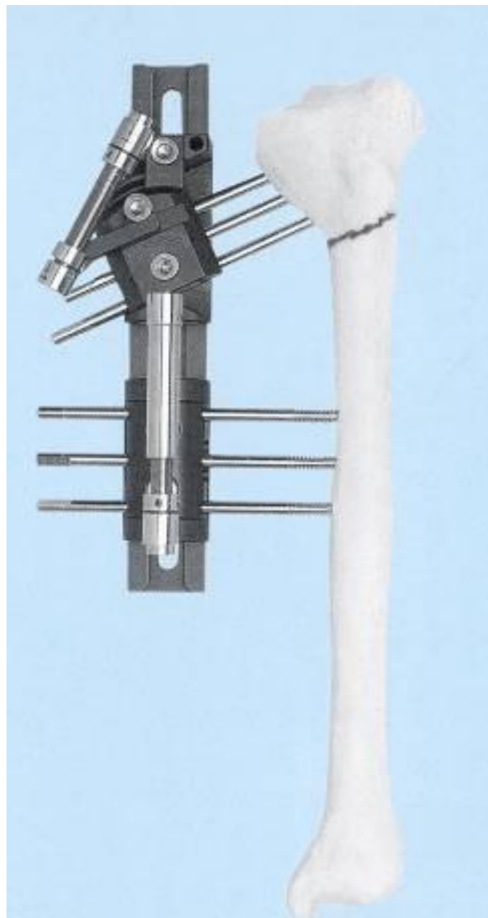
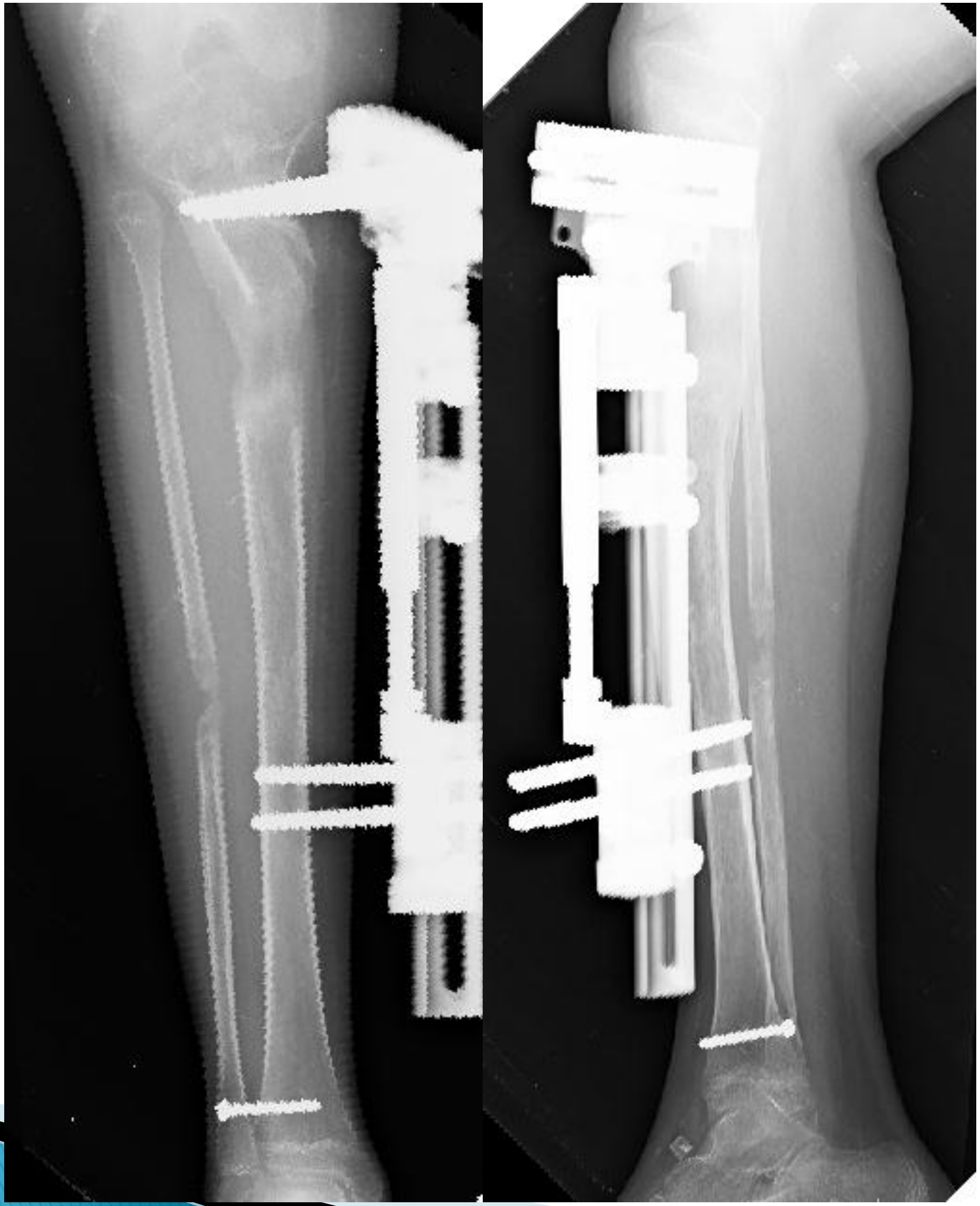



Limb lengthening

Advantages	Disadvantages
Can correct deformity simultaneously	Complex
No affect final height	Significant morbidity
Doesn't affect normal side	High chances of complications

Complications of lengthening

- Pin tract infection
- Deformity due to soft tissue tension
- Mechanical failure
- Subluxation/dislocation of nearby joint
- Delayed union
- Nerve and artery damage
- Affect subsequent growth
- Hypertension

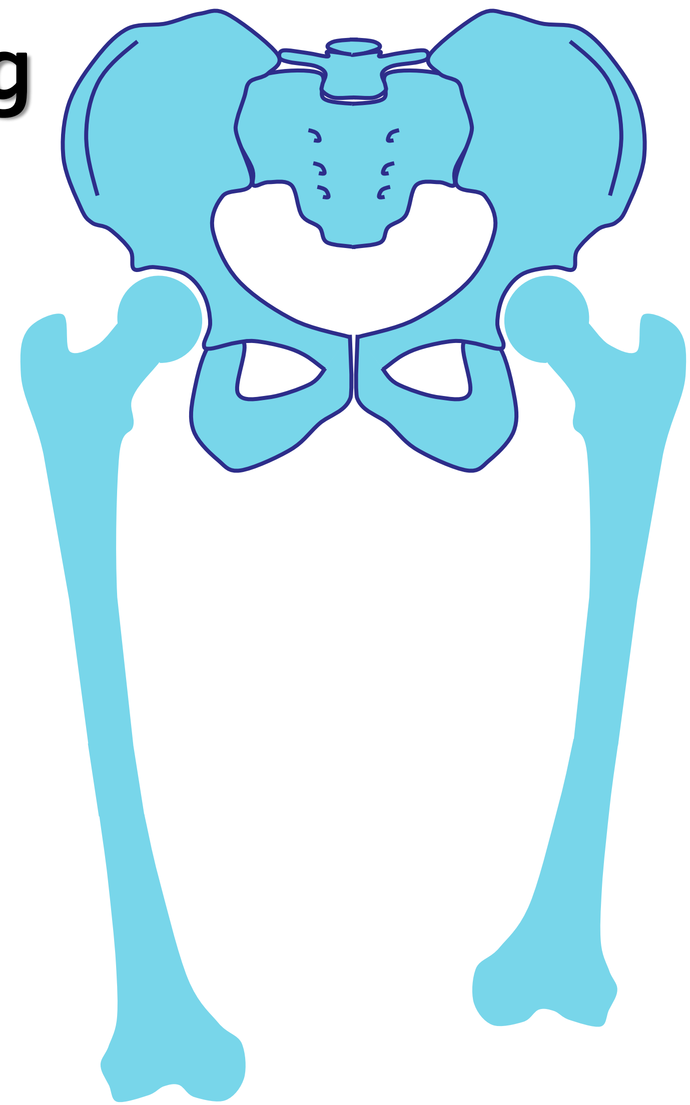
High complications rate

- Lengthening exceeding 25% of the initial bone length.
- Repeated lengthening
- Pre existing severe soft tissue tension

Contralateral shortening with ipsilateral lengthening

- <2 years growth
- 8-15 cm shortening
- No angular deformity

Contralateral shortening with ipsilateral lengthening



- <2 years growth
- 8-15 cm shortening
- No angular deformity

Contralateral shortening

Advantages	Disadvantages
- Relatively easy - less morbidity - Less complications	- Final height decreased - Short stature - Affect normal side

Limb ablation

- Very large discrepancies (> 15 cm LLD at SM)
- Deformed and functionally useless feet

- Common in severe limb deficiency

Limb ablation

Advantages	Disadvantages
Single hospitalization	Have to change the prosthesis with the growth of the child
Simple, less morbid	Less acceptable to parents
Lesser complications	
Less financial burden	

Conclusion

Limb length discrepancy must be assessed and treated in reference to

- Etiology of LLD
- Lower extremity function
- Angular / rotational deformity
- Amount of LLD at maturity
- Need of patient and family

Biomechanics of hip joint in relation to THR

Vikram Shetty

K S Hegde Medical Academy, Mangalore

NITTE
Nitte University

Biomechanics of hip?

- Science concerned with int & external forces acting on hip joint & the effects produced by these forces

Biomechanics of hip: components

1. Kinematics
2. Kinetics
3. Free body analysis & diagrams
4. Determinants of JRF (joint reaction forces)
5. Applied biomech in hip disorders

Biomechanics of arthroplasty

- design philosophy
- offsets, frictional torque force & volumetric/linear wear
- hip instability, component alignment

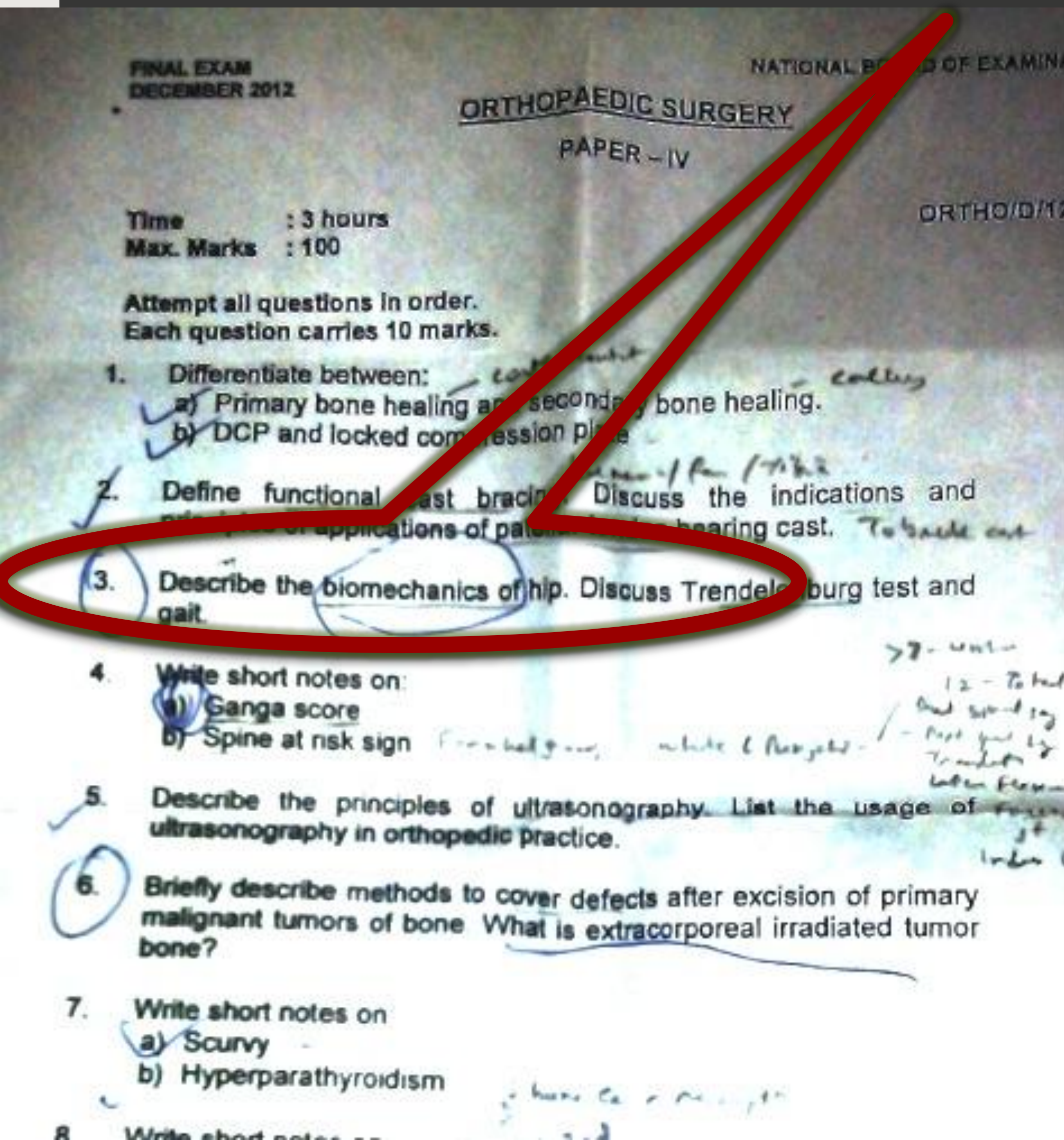
More complicated

- More variables viz joint center, offset, lever arms

Why we should know?

- vital in advancing the diagnosis & treatment of many pathologic conditions.
- benefits
  - evaluation of joint function
  - development of therapeutic programs for treatment of joint problems
  - Design & development of total hip prosthesis

Why we should know?



FINAL EXAM
DECEMBER 2012

NATIONAL B... OF EXAMINA...

ORTHOPAEDIC SURGERY

PAPER – IV

ORTHO/D/12

Time : 3 hours
Max. Marks : 100

Attempt all questions in order.
Each question carries 10 marks.

1. Differentiate between:
   a) Primary bone healing and secondary bone healing.
   b) DCP and locked compression plate
2. Define functional cast bracing. Discuss the indications and principles of applications of patellar tendon bearing cast.
3. Describe the biomechanics of hip. Discuss Trendelenburg test and gait.
4. Write short notes on:
   a) Ganga score
   b) Spine at risk sign
5. Describe the principles of ultrasonography. List the usage of ultrasonography in orthopedic practice.
6. Briefly describe methods to cover defects after excision of primary malignant tumors of bone. What is extracorporeal irradiated tumor bone?
7. Write short notes on
   a) Scurvy
   b) Hyperparathyroidism
8. Write short notes on

History

- Julius Wolff: addressed relation b/n inner architecture of bone & functional loading in 19th century

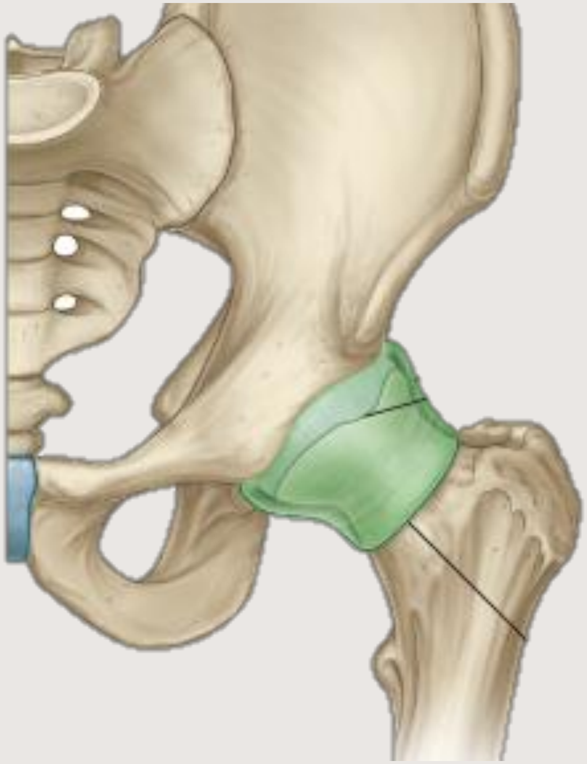
- Friedrich Pauwels: built foundation for a mech approach to understand joint loading 65 yrs later

History

- Concept of low frictional arthroplasty
- Surgical alteration of hip biomechanics
- Lubrication
- Materials
- Design
- Operating room environment

Anatomy of hip joint

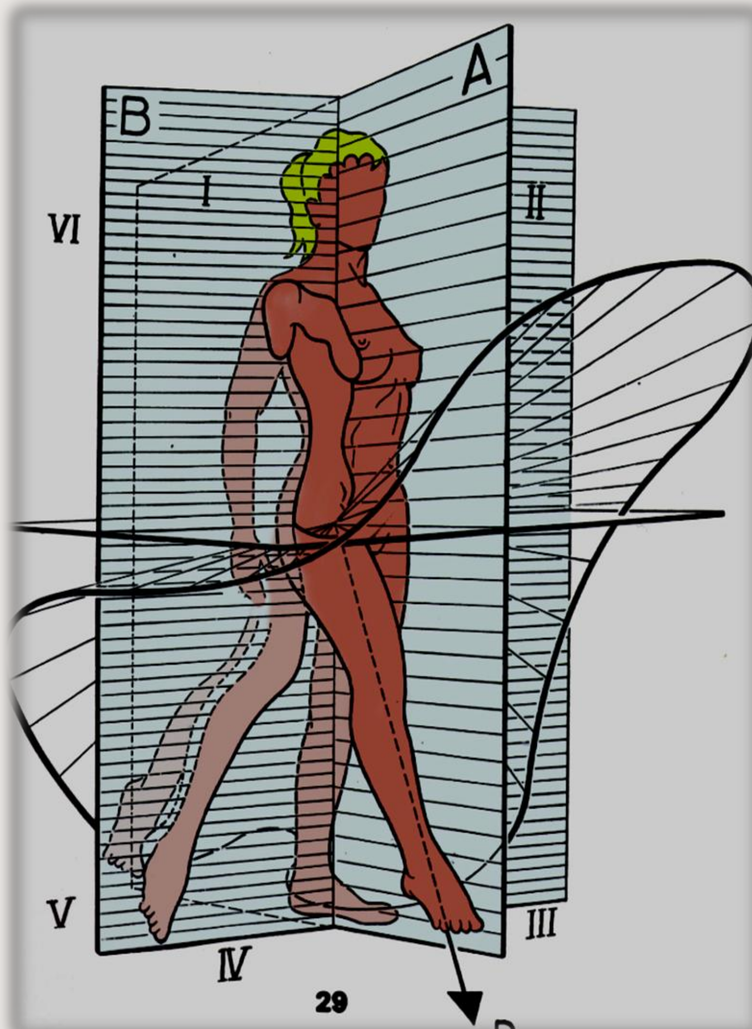
- Motion b/n trunk & lower extremity
- Intrinsic stability: Ball & Socket
- High forces
- Strongest muscles & lig of body



1. Kinematics

- Kinematics is the branch of biomechanics concerned with the study of movement from a geometrical point of view

- Range Of Movements
  - Flex - extn – 120˚ -0-10˚
  - Abd - Add– 50˚ -0-30˚
  - Ext - Int Rot – 45˚ -0-30˚



2. Kinetics

- Its concerned with what causes a body to move.
- Dynamic forces on hip are enormous

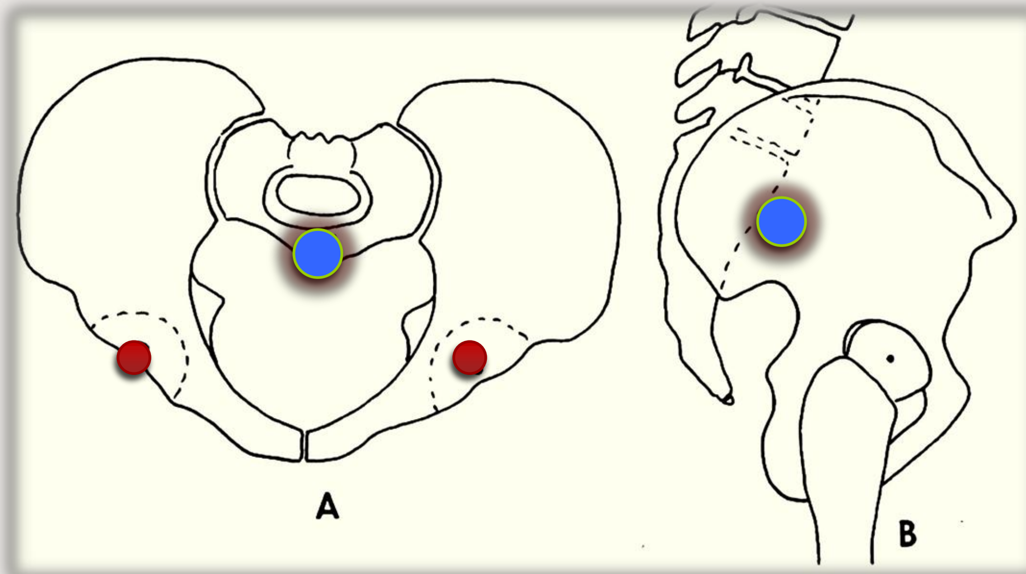
3X

7X

9X

- SLR 2X BW

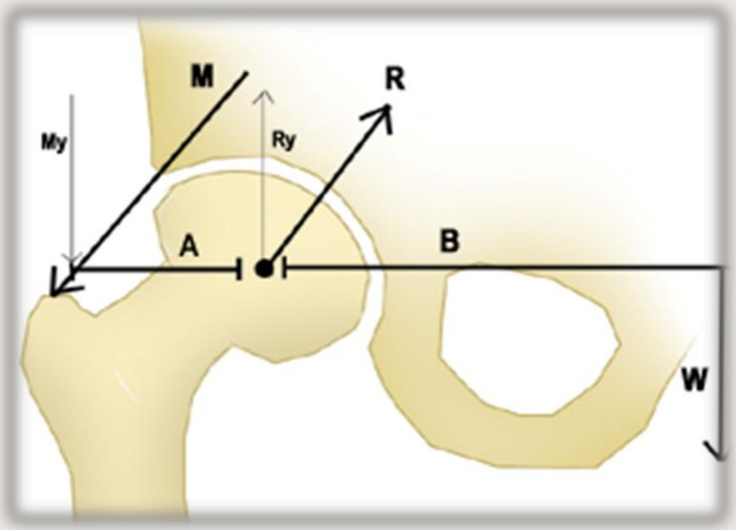
Center of rotation



- Center of rotation of hip joint is the geometrical center of femoral head.
- Center of gravity: opp S_2

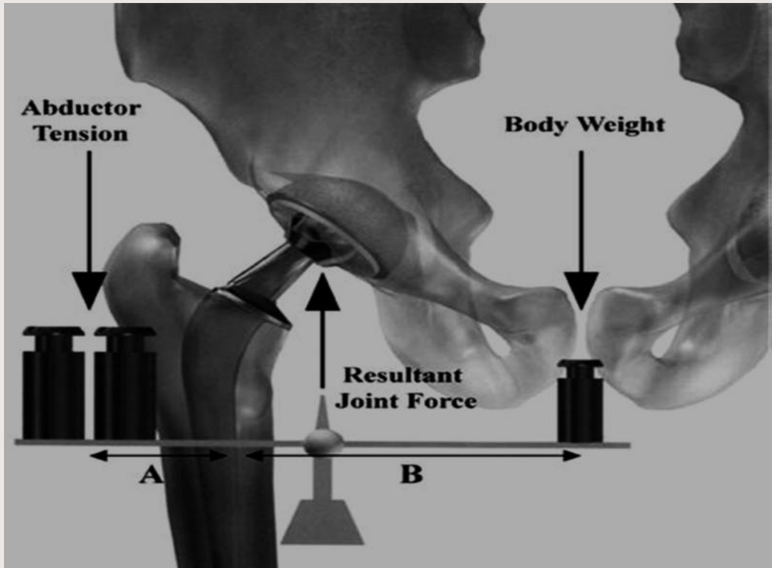
3. Free body analysis

- Drawings used to show location & direction of all known forces & moments acting upon an object in a given situation
- Assumptions: Single leg stance
  - Wt of leg is $1/6^{th}$ of body wt

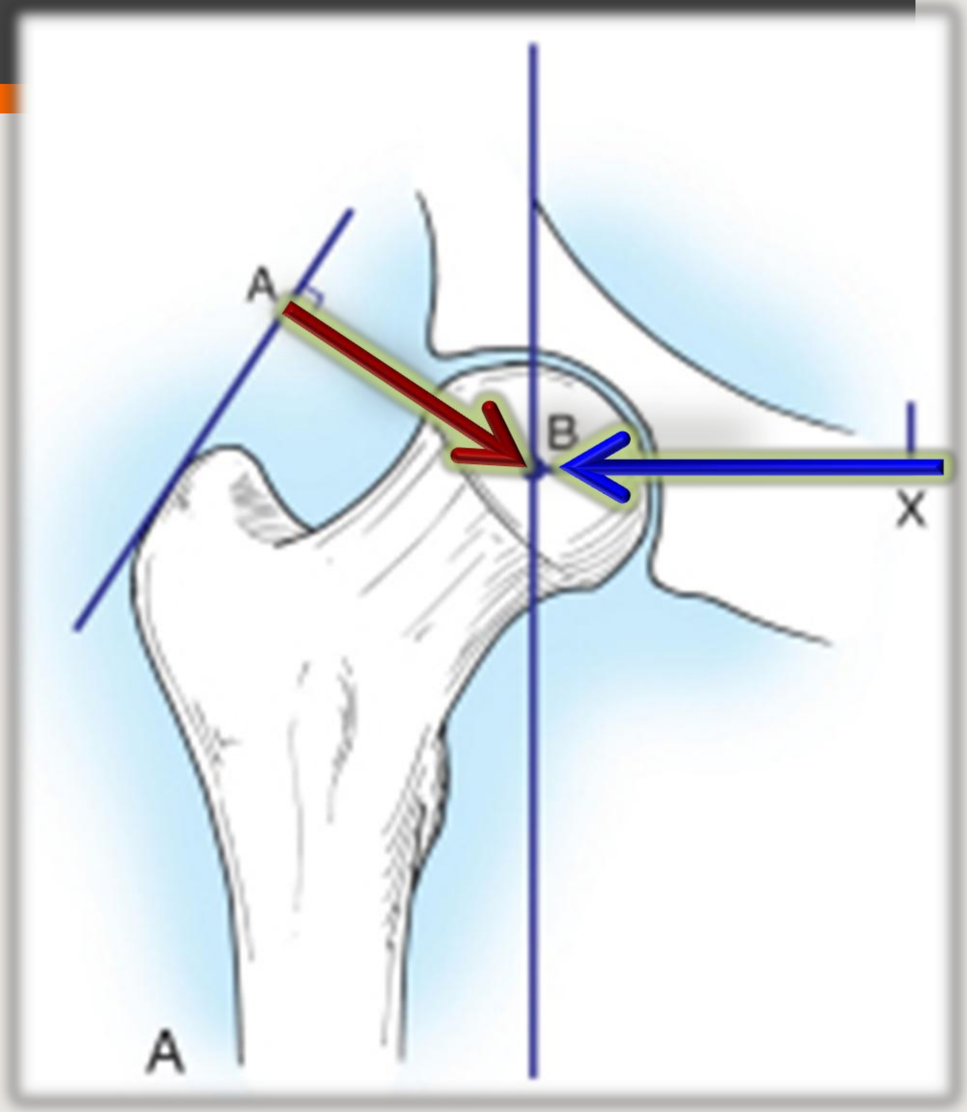


4. Joint reaction force - JRF

- force generated within a joint in response to forces acting on the joint
- In hip, its result of need to balance the moment arms of body weight(BW) & abd tension
- maintains a level pelvis
- JRF= body wt + Abd force

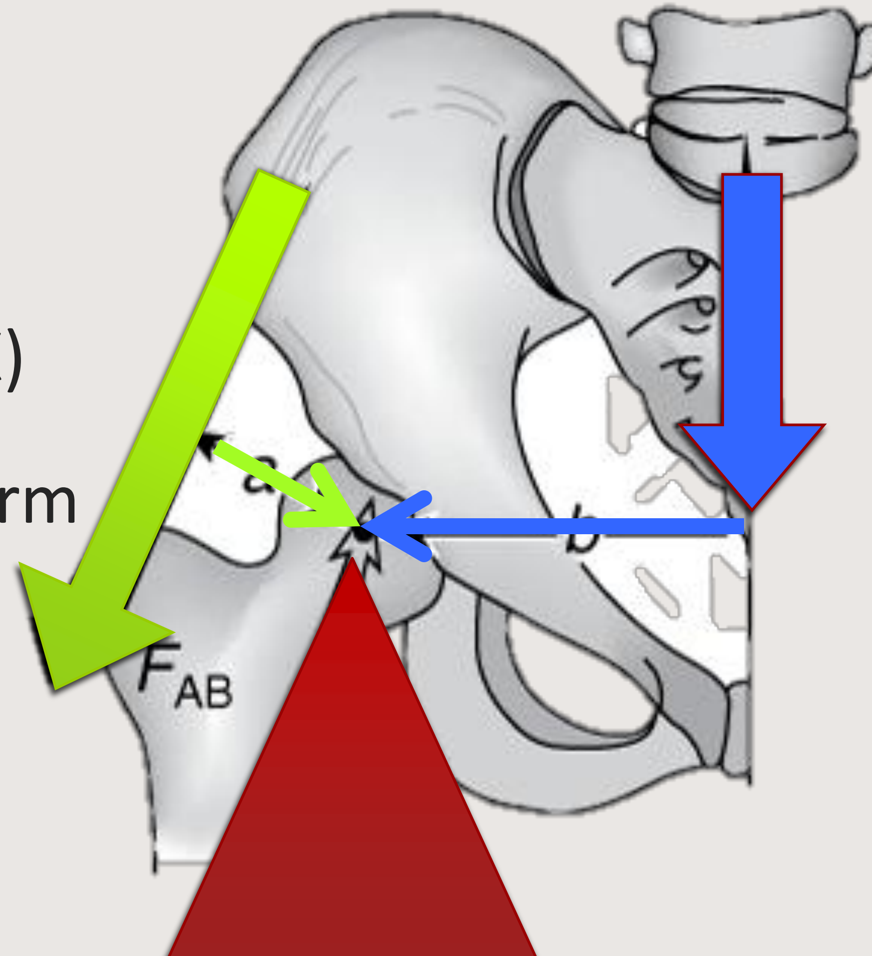


Forces acting on the hip joint



Key elements in JRF

- Body wt (W)
- Body wt moment arm
- Abductor(muscle) force (X)
- Abductor force moment arm



One legged stance : JRF?

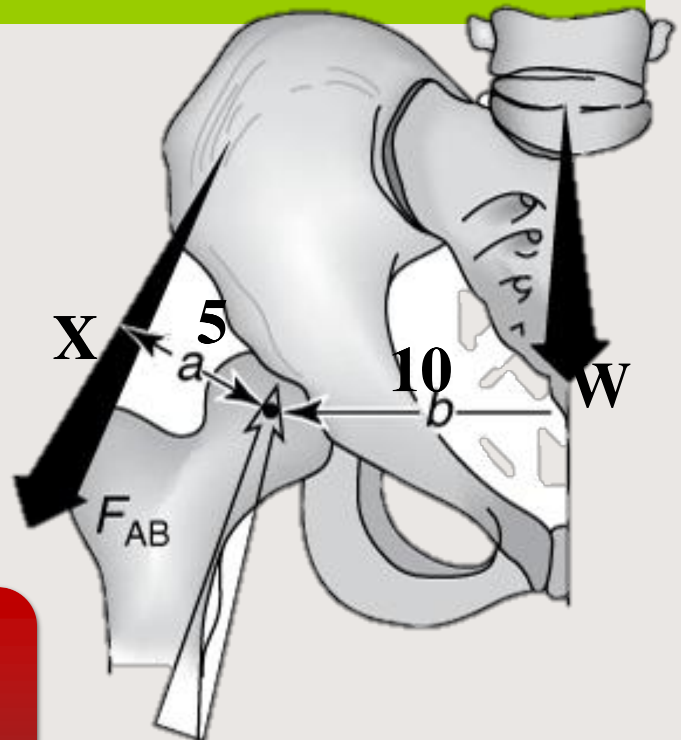
70 kg man on a single leg

70 x 10=X x 5

X=140kgs

JRF = W + X = 210 Kg

- = 3 x Body wt



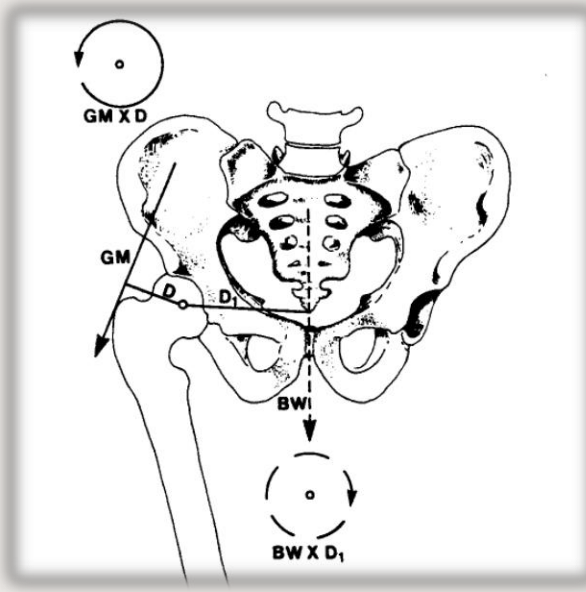
Increased body wt: JRF?

80 kg man on a single leg

80 x 10=X x 5

X=160kgs

JRF = W + X = 240 Kg



⑩ ↑ 1kg
W= ↑ 3kg
JRF

Increased JRF=

- Higher loads on acetabular component
- Increased risk
  - high wear
  - early loosening

Decrease JRF: best adv?

Medialising hip center or lateralising GT: JRF?

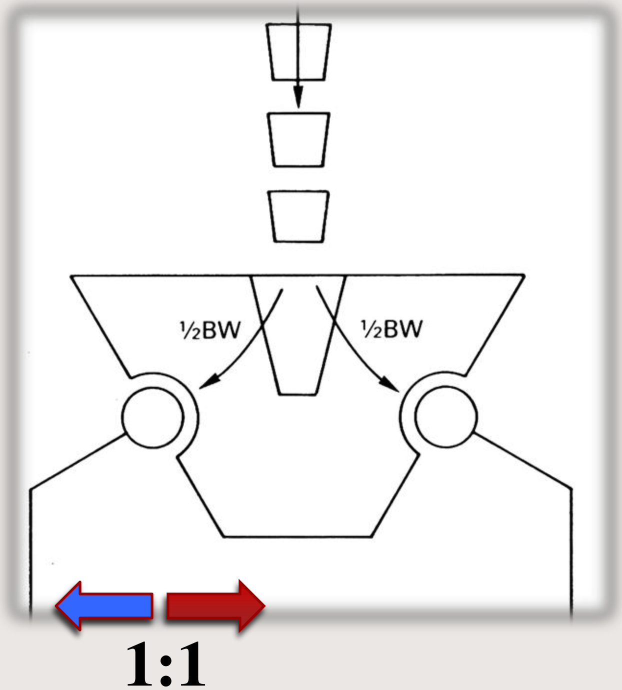
70 kg man on a single leg

70 x 5=X x 5

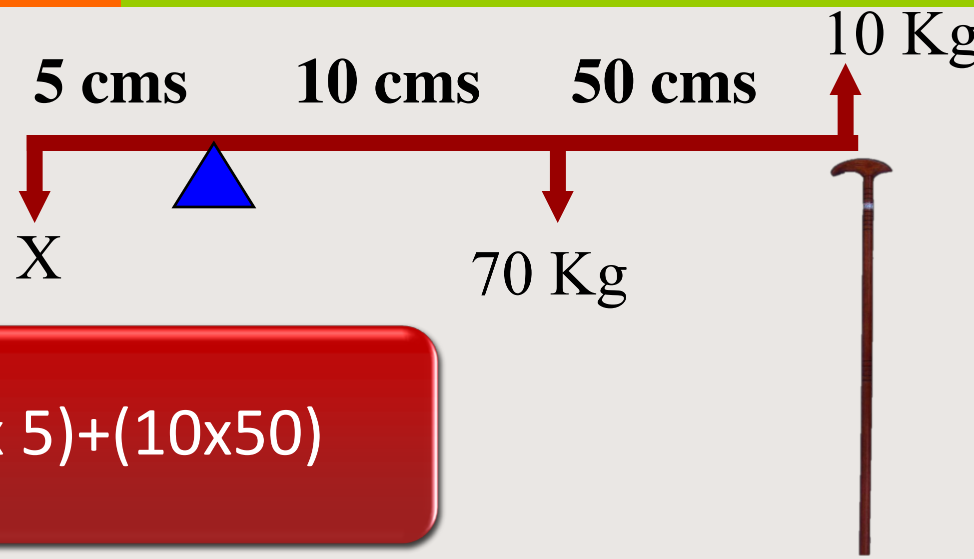
X=70kgs

JRF = W + X = 140 Kg

- = 2 x Body wt



Cane on opp side: JRF?



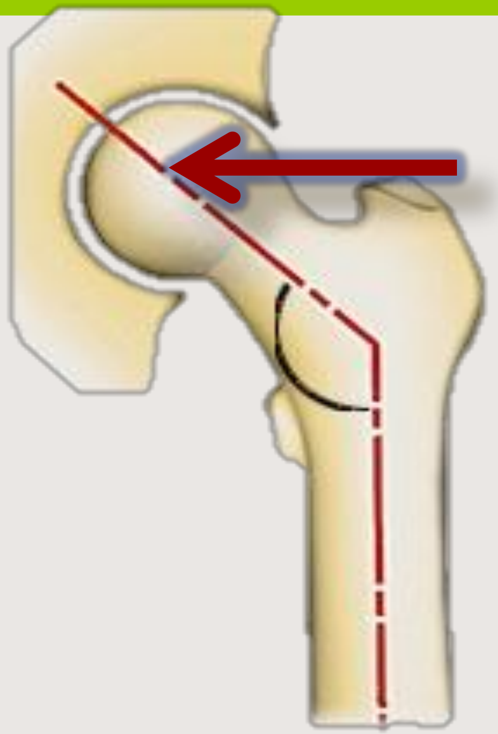
70 kg man on a cane

70 x 10=(X x 5)+(10x50)

X=50kgs

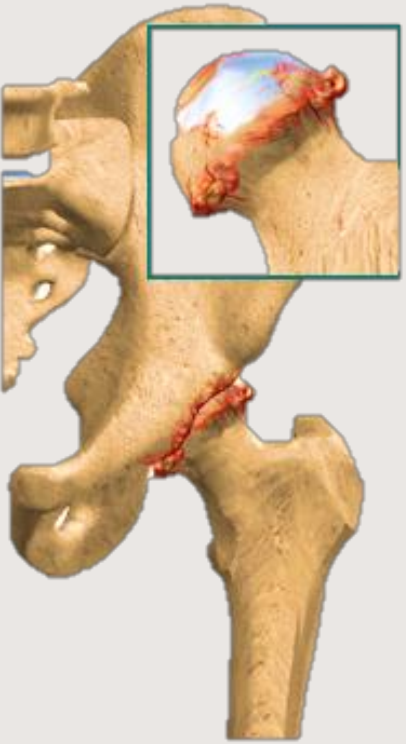
JRF = W + X-10 = 100 Kg

Coxa valga



- Abductor arm ↓
- Body weight lever arm remains same
- ↑JRF in hip during single leg stance
- Higher muscle force required to equalize the moment

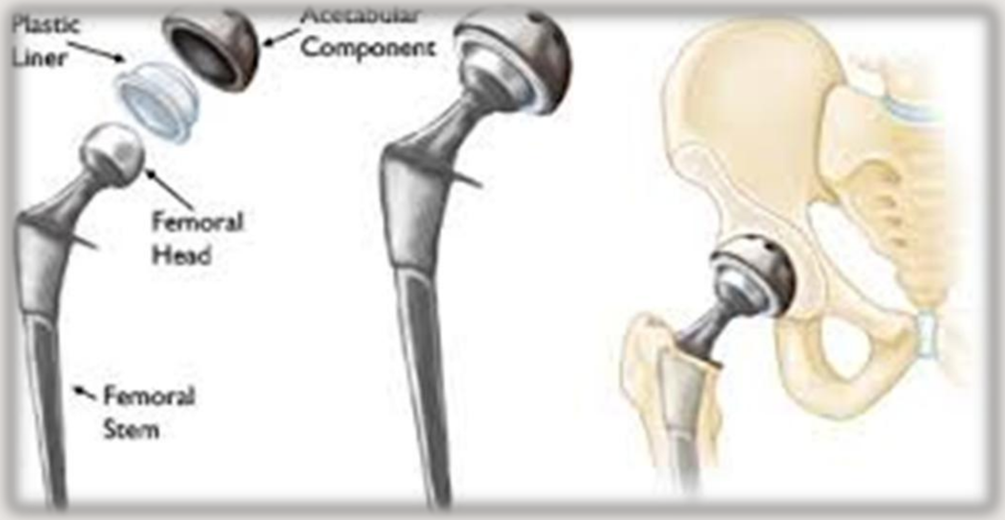
Arthritic hip



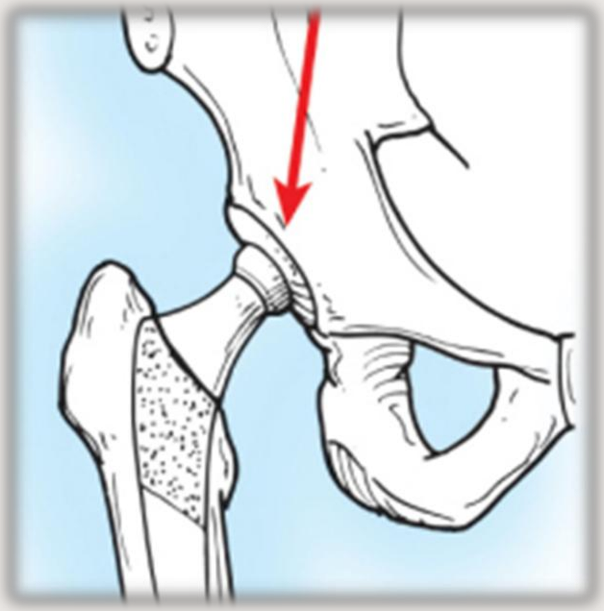
- Abductor lever arm will be shortened
  - Part of the head is lost
  - neck is shortened
- BW lever arm : abd lever arm ratio may be 4 : 1
- JRF ↑

5. Total hip components

- Must withstand many years of cyclic loading of > 3 times BW
- Some times can be subjected to overloads of 10-12 times BW



Forces acting on hip with prosthesis



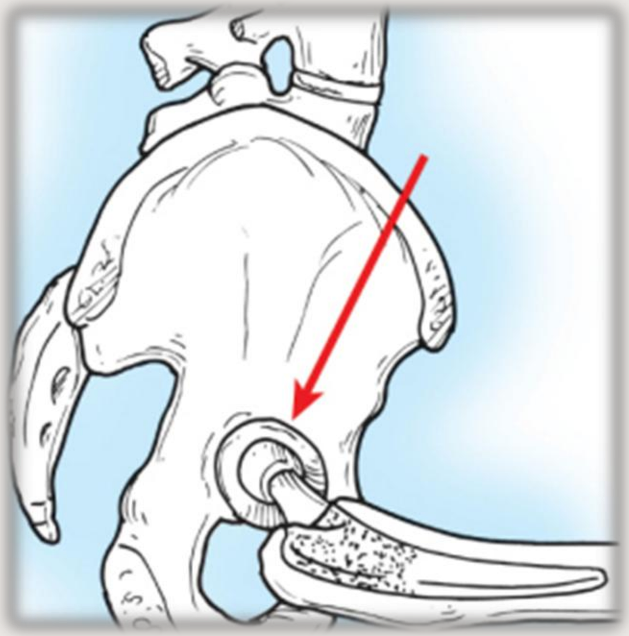
Coronal plane

- ↑ JRF during normal gait
- 10 times BW- lifting, running, or jumping
- Excess body weight
- Increased physical activity
- Can lead to Loosening, bending or breaking of stem

Forces acting on hip with prosthesis

Sagittal plane

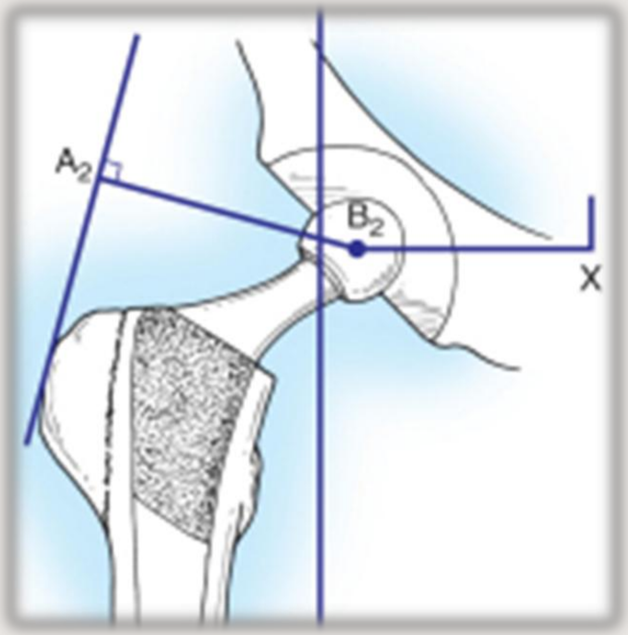
- ↑ force on the loaded hip when flexed
  - Out of plane forces - 0.6 - 0.9 times BW
- Forces are directed at an angle of 15- 25° to sagittal plane



= post deflection / retroversion of femoral component

Charnley principles of low friction arthroplasty

- Medialization of actabulum
- Lateralization of GT
- Small diameter femoral head
- Thick HMWPE socket



Stress transfer to femur

- Normal stress transfer to femur is desirable -
  - Physiological stimulus for maintaining bone mass
  - Preventing disuse osteoporosis
- Depends on -
  - Material of stem
  - Geometry & size of the stem
  - Method & extent of fixation

Stress transfer @ acetabulam

- Peak stresses develop in
  - Cemented polyethylene cup
  - Thin walled polyethylene cup
  - When more subchondral bone is removed
- Reduce the peak stress levels
  - Use of a metal-backed cup
  - Thick-walled polyethylene cup
  - Preservation of subchondral bone

Stress transfer @ acetabulam

- Uncemented metal backing should have a wide area of contact with acetabular subchondral bone
  - to prevent stress concentration
  - to maximize the surface area available for biological fixation
- When cup is impacted into acetabulum - forces generated by elastic recoil of bone stabilize the implant

Acetabular components

Cemented Acetabular Component

- External grooves – interlock of cement
- Bevelled mouth – avoids impingement ->ROM
- Flange – cement compression

Metal Backed Polyethylene Component

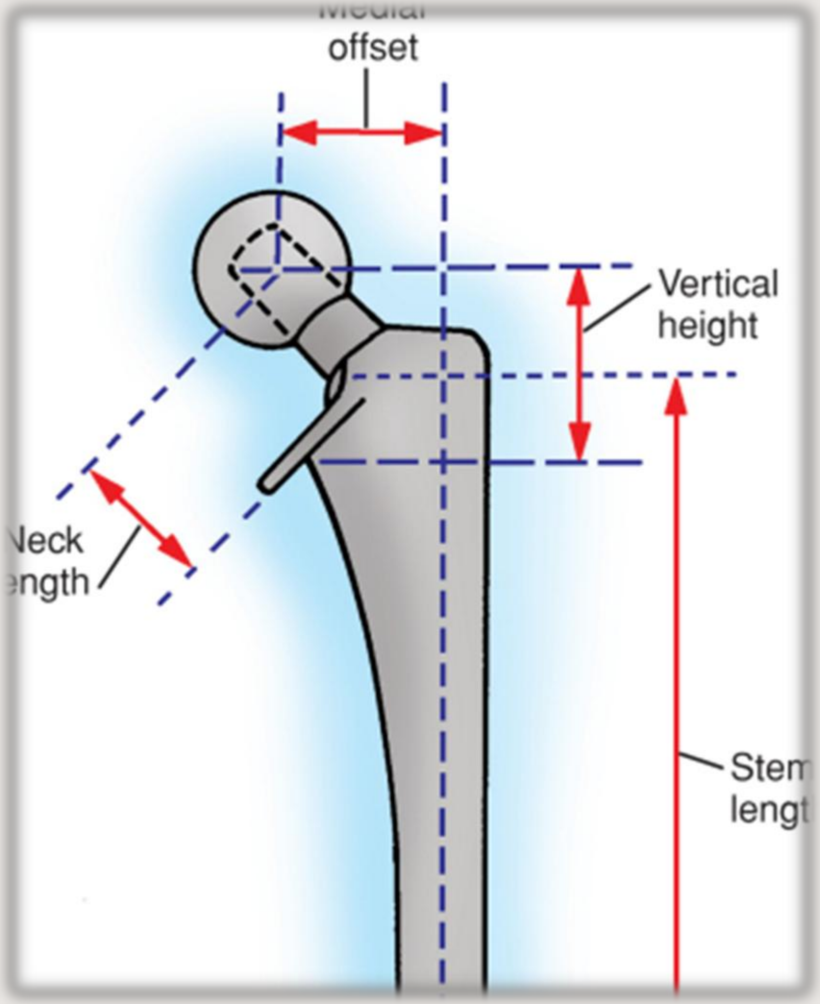
- Uniform distribution of stress
- Thin polyethylene liner

Femoral component

- Restoration of normal center of rotation of femoral head is very important
- Determines if the hip is
  - Biomechanically sound
  - Stable

Center of rotation

- Determined by
  - Vertical height (offset)
  - Medial (horizontal) offset
  - Version of femoral neck (anterior offset)

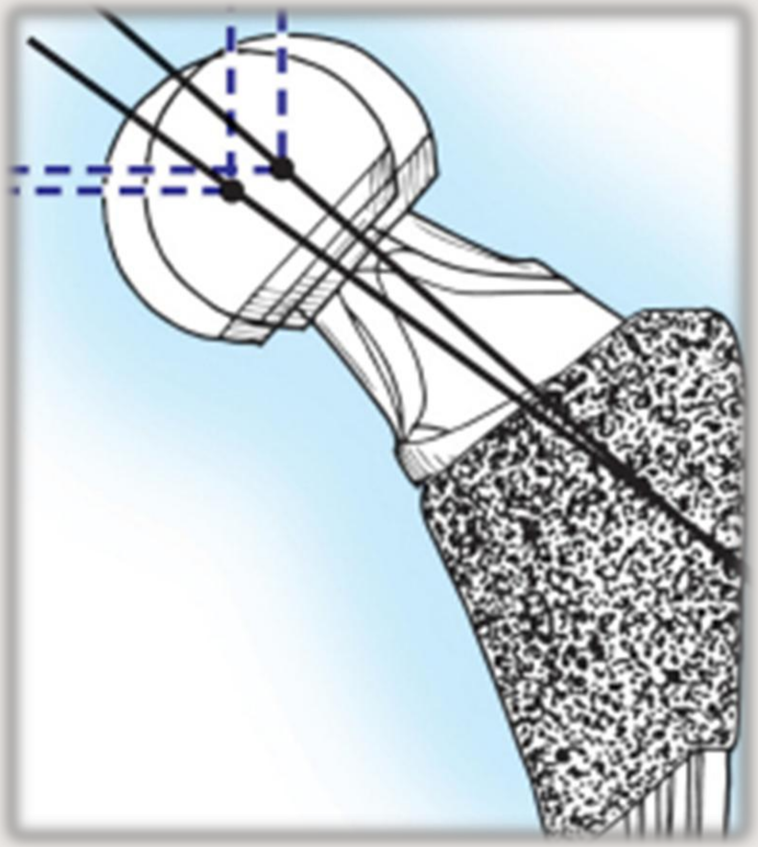


Medial or horizontal offset

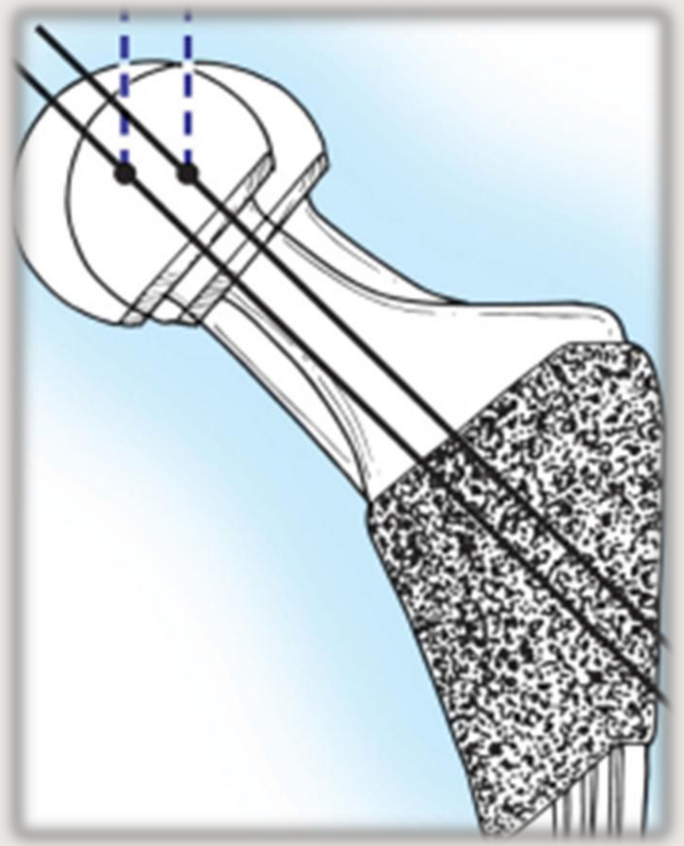
- What is it?
- Is restoration imp?
- Shortens abd lever arm =
  - Increased JRF
  - Limp
  - Bony impingement which may result in dislocation

Medial or horizontal offset

Reducing the neck-stem angle



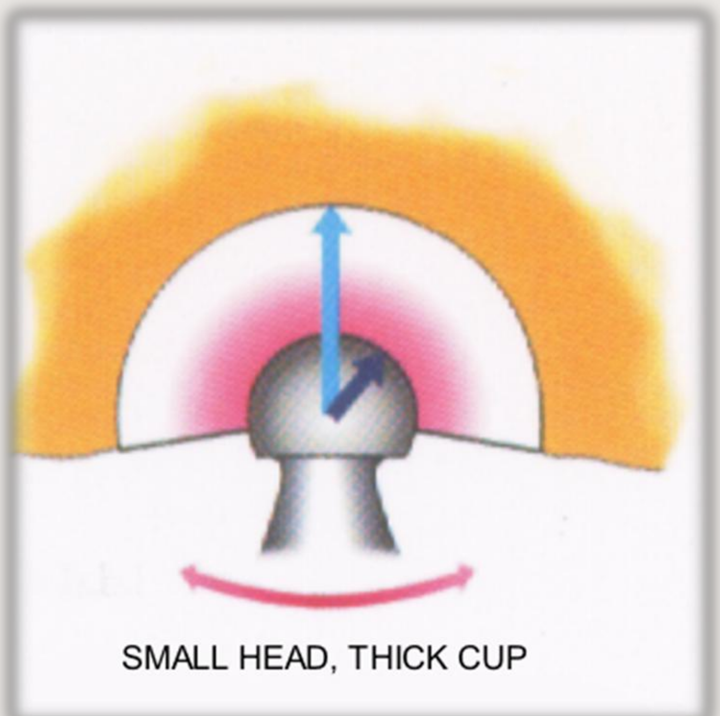
Attaching long neck / + heads



Head size

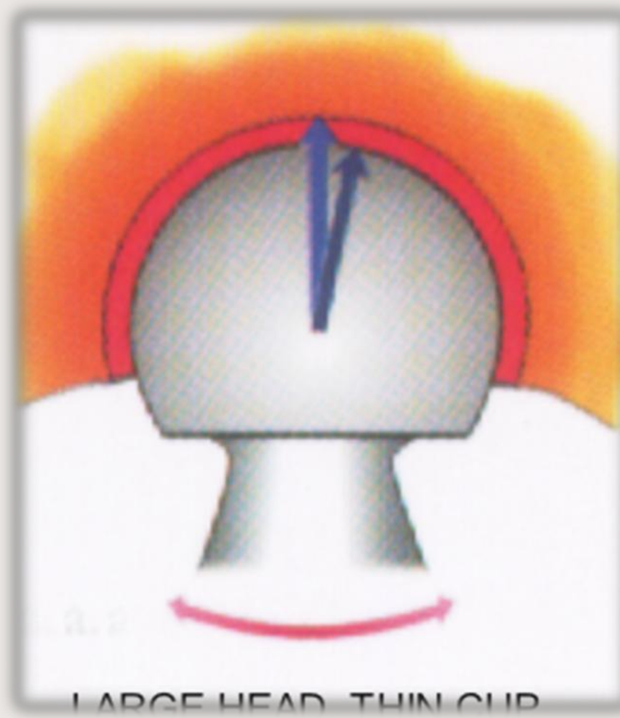
22mm head*

↓ frictional torque / ↓ friction



32mm head

Greater frictional forces – greater stress at cup / cement/ bone interface



Head size

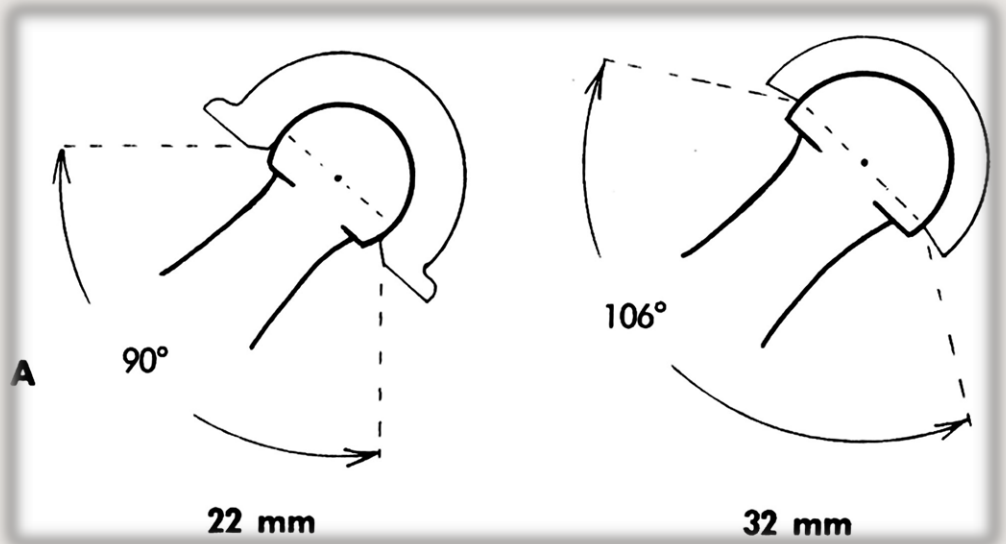
22mm head*

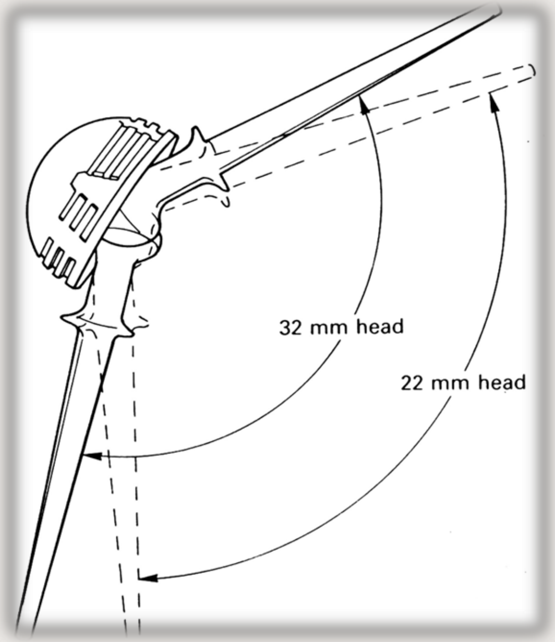
- Allows use of thicker poly
- ↓ volumetric wear
- ↑ Dislocation :

  Impingement of the neck

32mm head

- ↑ROM
- Stable





femoral components: cemented

- Noncircular shapes

 (rounded rectangle / an ellipse

- Surface irregularities

(grooves / longitudinal slot)

- improve rotational stability of

  stem within cement mantle

femoral components: uncemented

- Biological fixation of femoral components
- Prerequisites for bone ingrowth
  - immediate mechanical stability @ time of surgery
  - intimate contact b/n porous surface & viable host bone

The effect of cement on load transfer

- Cement allows good contact between the bone and the stem

Therefore…..

- avoiding high stress concentrations

Mechanical properties of bone cement

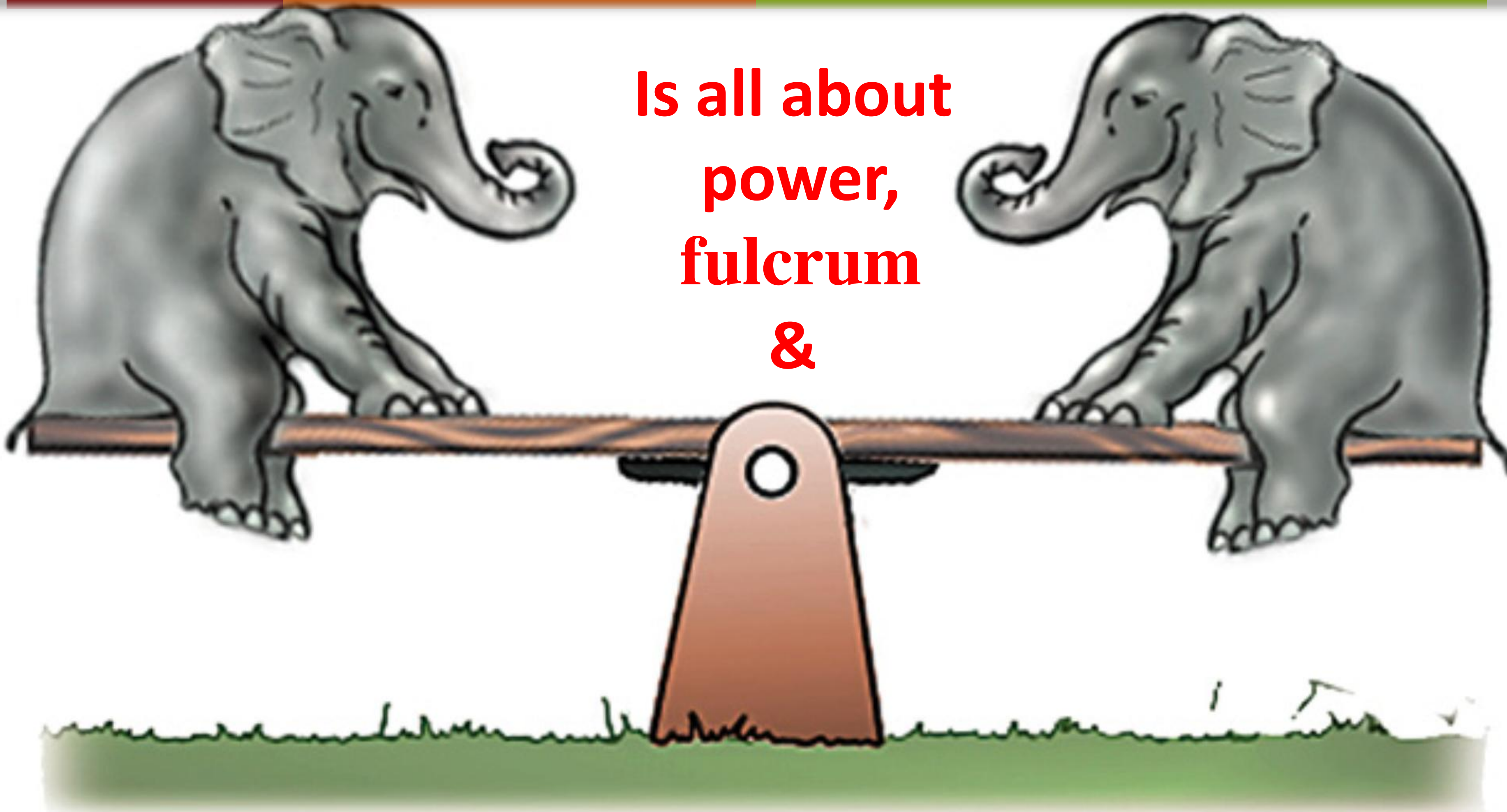
Strong in Compression

Weak in Tension

Weak in Shear

PMMA is 3 times stronger in compression than tension

To summarise; Biomechanics



Is all about
power,
fulcrum
&

The balance

Thanks

Safe surgery in HIV and HBsAg patients

Vivek Pandey

Associate prof., KMC Manipal

Aim

- Safe surgery for patient
- Safe surgery for surgeon
- Safe surgery for health care workers

Patient history and serological testing

- Complete medical history patient prior to surgery

  -injecting drug use

  -high risk sexual behavior

  -sexually transmitted disease

  -hepatitis
- Serological testing of HBV,HCV,HIV

Risk of Transmission – Blood borne viruses

Human immunodeficiency virus (HIV)		
	Percutaneous exposure	0.33%
	Mucocutaneous	0.09%
Hepatitis B virus (HBV)		
	Percutaneous exposure	
	sAg	1 – 6%
	eAg	22 – 31%
Hepatitis C virus (HCV)		
	Percutaneous exposure	1.9%

Standard Precautions (SP)

- ***Rationale:***

  blood, and, certain other body fluids ……..are potentially infectious!

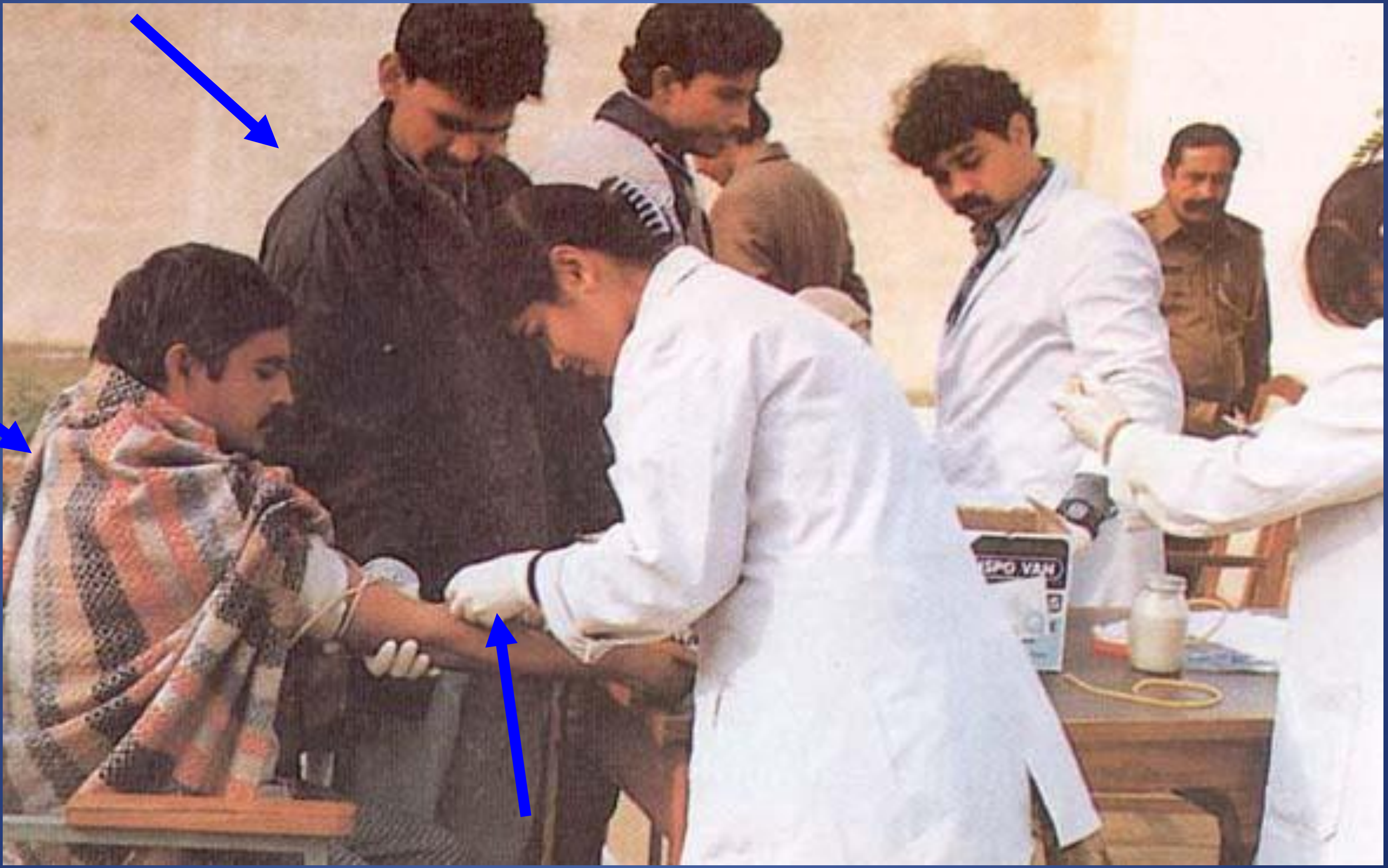
- ***Aim:***

  to protect Health Care Workers and patients from blood borne pathogens.

Spot all the wrongs…

Spot all the potential wrongs…

Relative ‘safety’



Standard Precautions - Indications

- Applies to <u>all patients.</u>

- <u>No consideration</u> to diagnosis or presumed infection status (irrespective of HIV status).

Fluids to which Standard Precautions APPLY

- Blood
- Semen
- Vaginal secretions
- Amniotic fluid
- Cerebrospinal fluid
- Pericardial fluid
- Peritoneal fluid
- Pleural fluid
- Synovial fluid

Fluids to which Standard Precautions <u>DONOT apply</u>

- Tears
- Nasal Secretions
- Sweat
- Faeces
- Urine
- Sputum
- Vomitus
- Saliva

<u>UNLESS</u>

<u>Blood stained</u>

Standard Precautions -Components

- Hand washing
  - (Running water, liquid soap preferred)

    - Single most important measure.
- Gloves
  - (Protective barrier, prevents gross contamination, change when contaminated and as soon as possible if they are torn or punctured, Vinyl or latex gloves offer similar protection.)

Hand-washing

Single most important ‘Standard Precaution’


Step 1
Wash palms and fingers
Step 2
Wash back of hands
Step 3
Wash fingers and knuckles
Step 4
Wash thumbs
Step 5
Wash finger tips
Step 6
Wash wrists

Standard Precautions -Components

- Gowns, Mask and eyewear
  – (To be worn during procedures likely to generate splashes, Changed when heavily soiled, Mask - Covers nose and mouth, Protection for eyes - goggles/face shield)
- Aprons
- Use of appropriate disinfectants

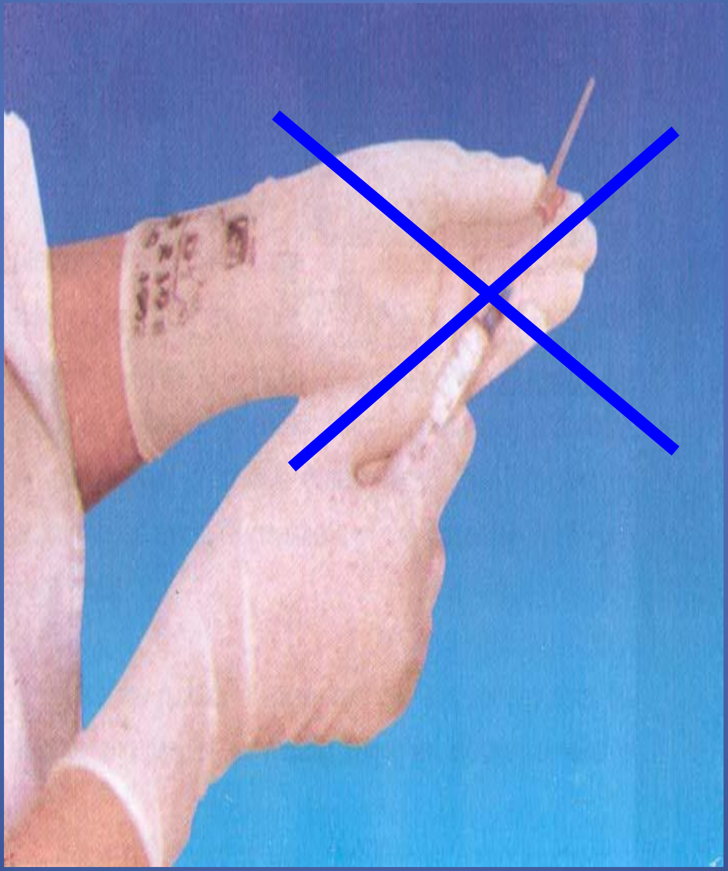
Selection of Protective Barriers

Type of exposure	**Protective barriers**	
Low risk Contact skin, no visible blood	- Gloves helpful but not essential	Injections, minor wound dressing
Medium risk Probable contact with blood, splashing unlikely	- Gloves - Gowns and apron, may be necessary	insertion or removal of intravenous cannula, handling of laboratory specimens, large open wounds dressing, venepuncture spills of blood.
High risk Probable contact with blood, splashing or uncontrolled bleeding	- Gloves - Waterproof gown or apron - Eye wear, Mask	Major surgical procedures particularly in orthopedic surgery and oral surgery, vaginal delivery.

Protection from needles and sharps

- No Re-capping (needles)
- Not to pass sharp instruments from 'hand to hand'
- Reduce the risk by providing good visibility
- Protection - use forceps to pick up objects.
- Sharps disposal containers to be located close to the point of use
- Used sharps to be disposed in puncture resistant container.

Commonest mistake is re-capping needles….



Needle cutter in use…





Facts about Sharps and Needles

- At least 1/3rd of all percutaneous injuries are related to disposal of sharp objects.
- Common mistake is re-sheathing needles.
- Overfilled, poorly designed or poorly placed sharp disposal unit.

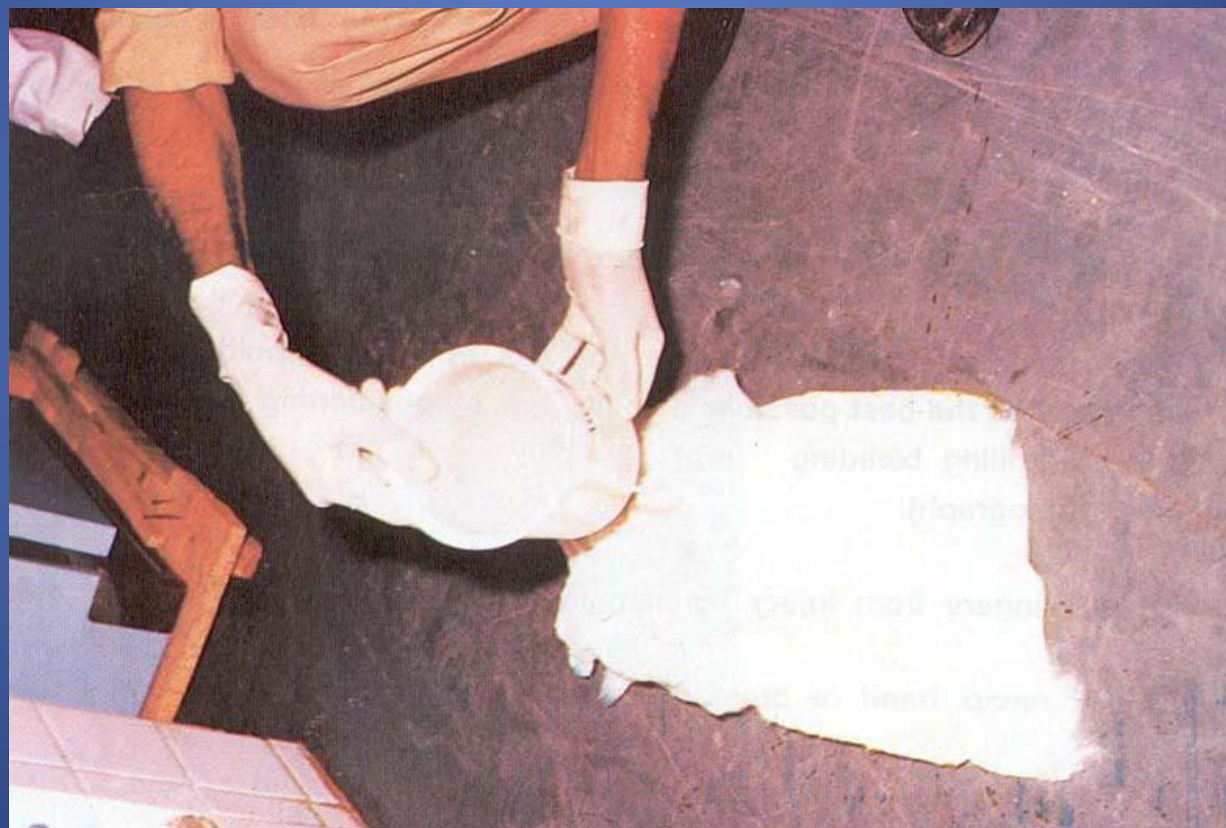
Do's	Don'ts
Pass syringes & needles in a tray. Use a needle cutter.	Pass syringe & needle by hand
Put needle & syringes in 2% hypochlorite solution, if needle cutter not available	Bend/break used needle with hands
Remove cap of needle near the site of use	Touch needle with bare or gloved hand
Use forceps to pick up sharps/ needles from tray/drum.	
Destroy syringes by burning their tips if cutters not available	Break syringe with hammer/ stone.

Handling of linen

- Risk minimal, if handled properly
- Soiled linen to be handled as less as possible.
- Workers should wear barriers.

Spill, wear gloves

Cover spill with adsorbent material, pour bleach around and over material



After 30 minutes wipe spill using absorbent material, place in container

Wipe surface again with bleach cloth

Other Disinfectants

- Ethanol - 70%
- Isopropyl Alcohol - 70%
- Povidone-Iodine - 2.5%
- Formalin - 4%
- Glutaraldehyde - 2%
- Hydrogen peroxide - 6%
- Sodium Hypochlorite - 0.5-1%

<u>Boiling = 20 minutes</u>

Sterilization

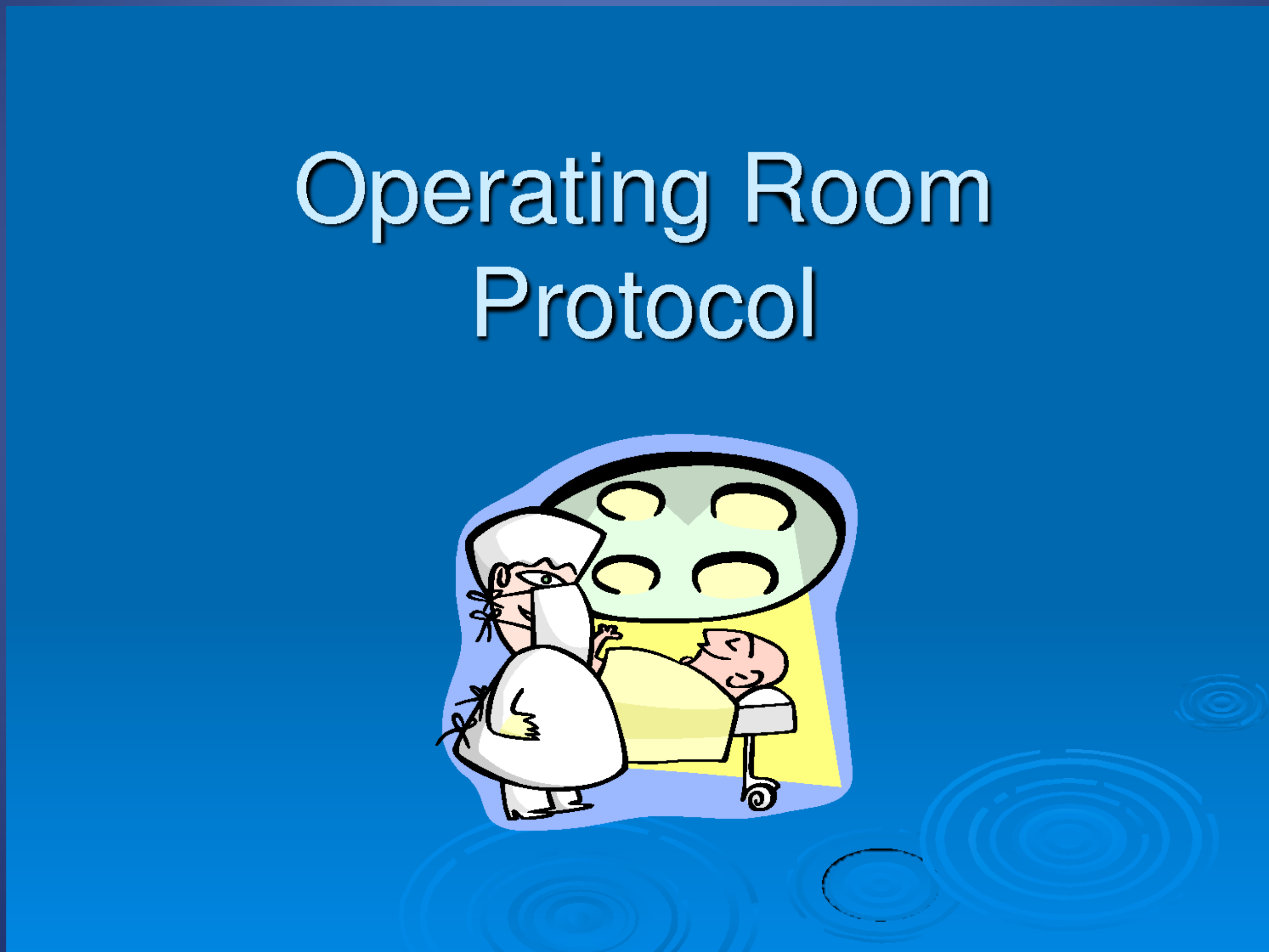
- "destroys all microorganisms"
  - Autoclaving 121 deg C x 20 min @ 15lbs pressure
  - Dry Heat 170 deg C X 60 min
  - Boiling 20-30 min

Accidental exposure to blood
What to do?

- Needlestick, cuts – wash with soap and water, encourage bleed
- Nose, mouth, skin splash – flush with water
- Eyes – irrigate with clean water or saline
- DONOT put in mouth to suck!

- Report exposure to authority to decide on PEP.
- Document facts

Operating room protocol



Safe surgery

- Protect yourself

Double glove reduces inner glove perforation rate by 70%

Safe surgery

- Test conforming the status of patient
- Protect yourself
- Ensure your supporting staff are protected
- Inform anesthetist about the status

Safe surgery

- Minimum OT staff
- Avoid surgery in odd hours in patient of known status
- Care not to contaminate outside the OT area

Safe surgery

- Protective gear
- Safe handling of sharp instrument and implant
- No touch technique
- Announce transfer and placement of sharp instrument

Safe surgery

- Safe disposal of soiled linen
- Appropriate sterilization of OT thereafter



CAUTION
EYE
PROTECTION
REQUIRED


EP THE MASK ON
S KEEP THE DOOR CLOSED


Management of infected health care personnel

- The united states centers for disease control and prevention(CDC) Guidelines

- Immediate treatment
- Post exposure prophylaxis

Immediate treatment

- Immediate reporting and serological testing
- Initial washing of contaminated area
- Post exposure prophylaxis.

Immediate reporting

- Incidents of percutaneous, mucous membrane or non intact skin exposure to blood should be reported immediately to a person designated by health care institution
- Relevant information documented

-activity in which health care personnel engaged at the time of incident

-extent to which safe workplace practices and protective equipment used

-details of exposure, mode, volume and type of contaminant

severity of exposure

-both the source and the contaminant should be tested for

HBsAg, HCV antibody ,HIVantibody

- If blood or other fluids contaminate a health care personnel(HCP)'S skin
- Contaminated area immediately washed with soap and water
- If the skin is cut or punctured, gloves should be removed and the wound washed with soap and water
- Exposed mucous membrane flushed with water(5)

- Serological testing done for HBS ag,HCV antibody,
  HIV antibody

Appropriate pre test and post test counseling

(5)Updated US public health Guidelines for the management of occupational exposure to HBV,HCV and HIV and recommendations for post exposure prophylaxis.MMWR Recomm Resp

Post exposure prophylaxis-HCV

-Currently no post exposure prophylaxis available

-Exposed tested and monitored for seroconversion

--Evidence based medicine suggests Interferon treatment higher rates of resolved infection

-**Interferon** currently FDA Approved only for treatment of chronic HCV Infection.

-Combination of Interferon+Ribavirin more effective and FDA approved

Post exposure prophylaxis-HIV

- June 1996 the US Public Health Services(PHS) Recommendation for post exposure prophylaxis

Exposures that pose high risk includes

-deep injury

-visible blood on the device that caused the injury

-injury from a needle that placed in a source patient’s vein or artery

-exposure from a source patient who died of AIDS within 60 days after exposure(indicating high titers)

Post exposure prophylaxis

- Two drug basic regime (zidovudine and lamivudine) or (lamivudine and tenofovir)

- Enhance regimen

basic regime with two or more drus in addition,generally a protease inhibitor alone or “boosted” proteaseinhibitor such as lopinavir/ritonavir for high risk exposures

- It should be started promptly, preferably with in few hours of exposure
- It should be given for four weeks if tolerated

प्रज्ञानं ब्रह्म

Manipal

INSPIRED BY LIFE

THE KASTURBA MEDICAL COLLEGE

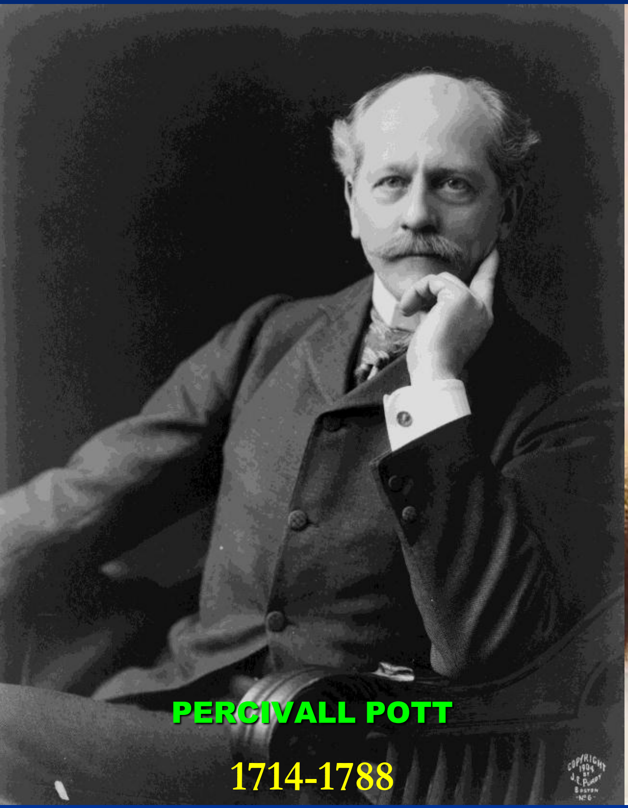
LIVE TO SERVE

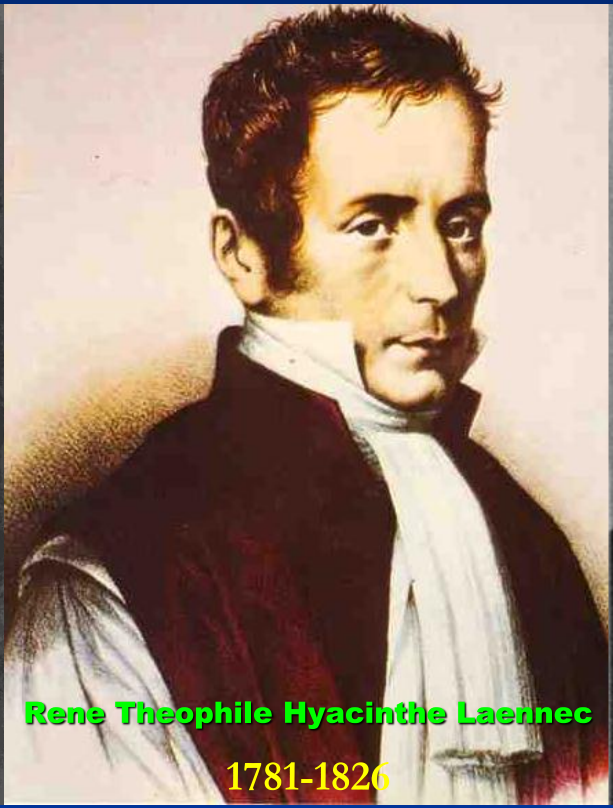
POTT'S PARAPPLEGIA

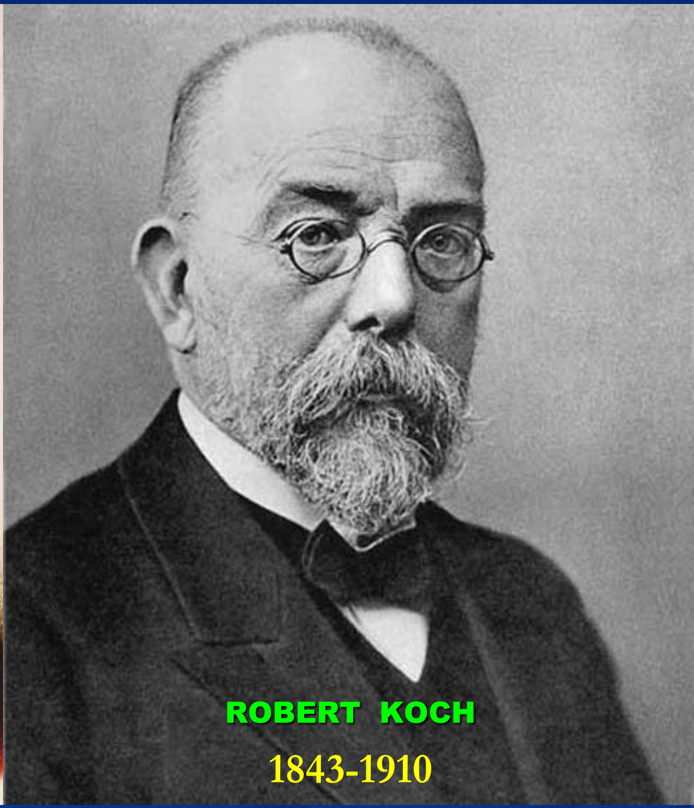
Dr. S.P. Mohanty
Kasturba Medical College, Manipal

Although spinal caries is now termed as **Pott's disease**, Percivall Pott did not describe the disease or its tuberculous nature

Garrison







"The useless state of the lower limbs in consequence of a curvature of the spine"
Percivall Pott, 1782

Described "Tubercle"

Identified the organism (1882)
Acid fast – gram positive

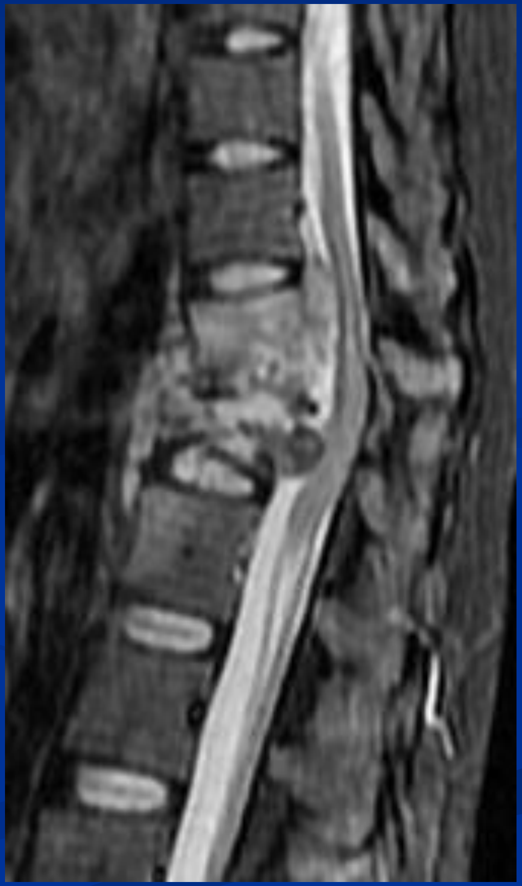
WHY WE SHOULD LEARN ABOUT POTT'S PARAPLEGIA?

- Spinal TB is the most common (50%) form of osteoarticular tuberculosis
- Neurological complications are the most dreaded, however when treated appropriately and early, the prognosis is good.
- Incidence of paraplegia is about 10 to 30%

WHAT DO WE MEAN BY POTT'S PARAPLEGIA?

- Paraplegia in Pott's disease is the result of interference with the conductivity of the pyramydal tracts of the spinal cord and most often is associated with the tuberculosis of the dorsal spine(10-30%)

- Compressive myelopathy is usually progressive and is due to the varied causes.



Pott's Paraplegia Classification -Kumar & Tuli

Stage		Clinical features
I	Negligible	Patient unaware of neural deficit, physician detects plantar extensor and/or ankle clonus.
II	Mild	Patient aware of deficit but manages to walk with support, clumsiness of gait.
III	Moderate	Paralysis in extension, sensory deficit less than 50%
IV	Severe	III + flexor spasm/ paralysis in flexion/ flaccid/ sensory deficit more than 50%/ sphincters involved.

AIS/ ASIA and FRANKEL'S grading are other classification systems

DIFFERENT TYPES OF PARAPLEGIA SEEN IN SPINAL TUBERCULOSIS

- EARLY ONSET PARAPLEGIA

  Paraplegia of active disease. It occurs within 2 years of onset and carries good prognosis

- LATE ONSET PARAPLEGIA

  Paraplegia of healed disease. It occurs two years after the onset. Carries poor prognosis

Causes of early onset paraplegia (Griffith and Seddon)

- **INFLAMMATORY CAUSES**

1. Granulation tissue
2. Inflammatory edema
3. Cord infiltration

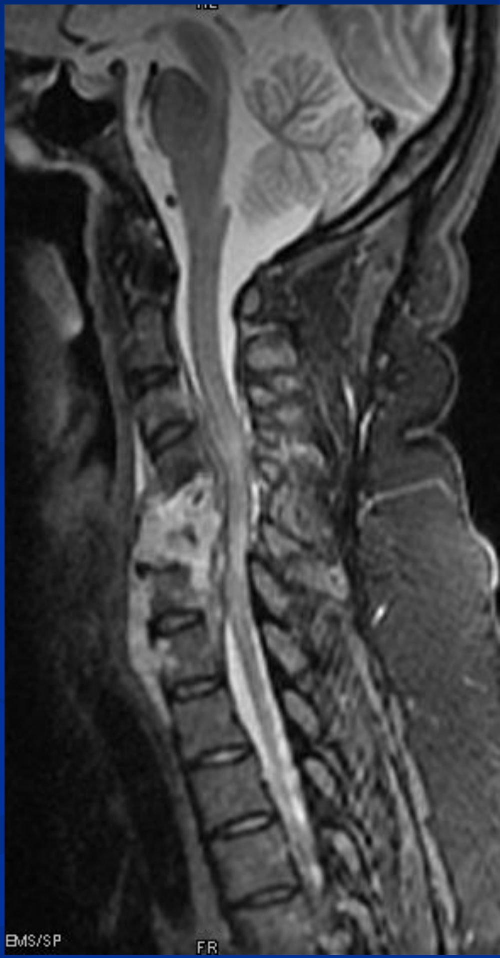
- **MECHANICAL CAUSES**

Causes of early onset paraplegia (Griffith and Seddon)

- **INFLAMMATORY CAUSES**

- **MECHANICAL CAUSES**

1. Extradural abscess
2. Necrotic debris and sequestra
3. Angulation of diseased spine
4. Spinal tumor syndrome
5. Thrombosis of spinal artery- rare



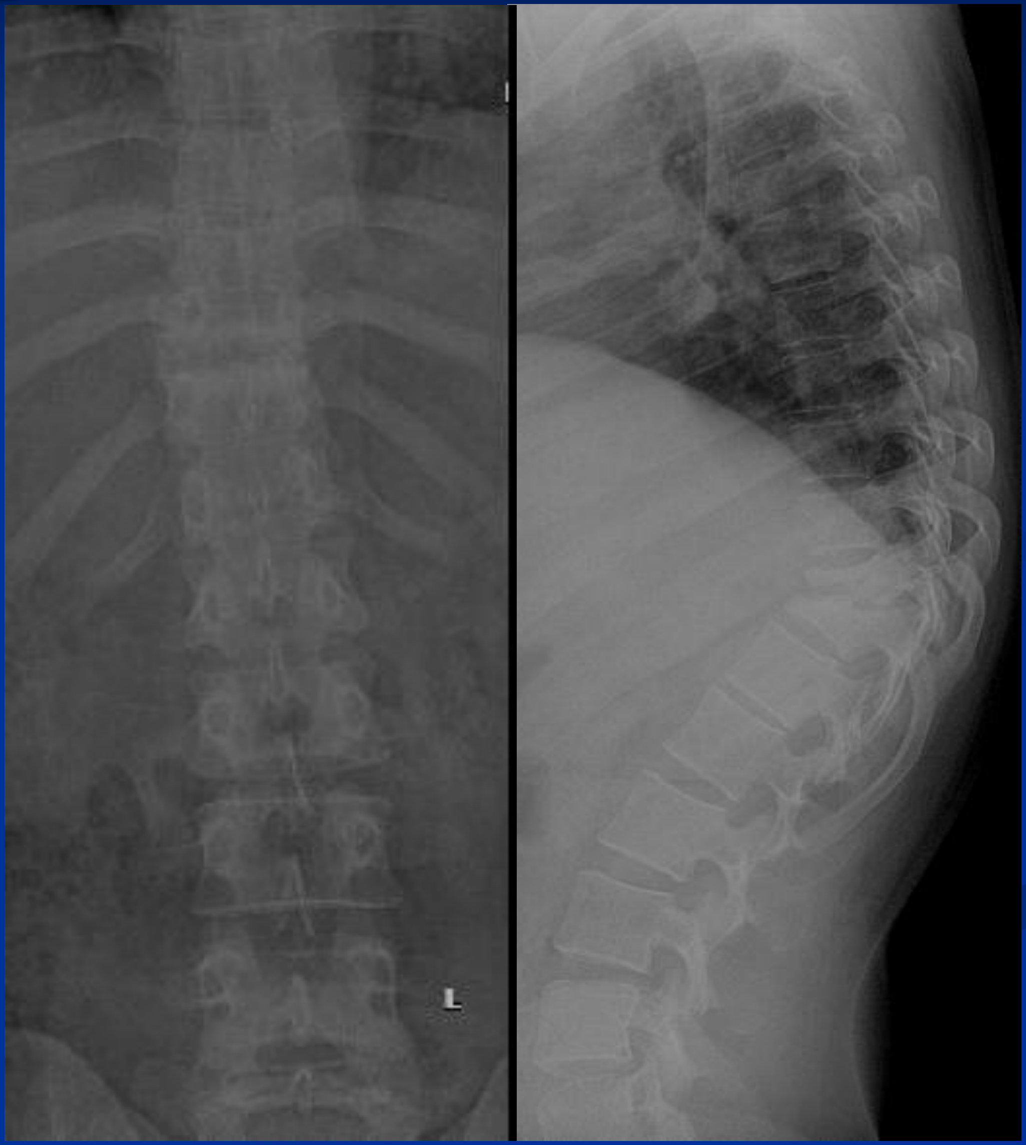
Causes of late onset paraplegia (Griffith and Seddon)

- **INFLAMMATORY CAUSES**
  Reactivation of the disease

- **MECHANICAL CAUSES**
- Stretching of cord due to kyphosis
- Extradural fibrosis
- Tubercular debris and sequestra

Imaging Modalities

- X-rays
- Ultrasound scan
- CT
- MRI
- Bone scan

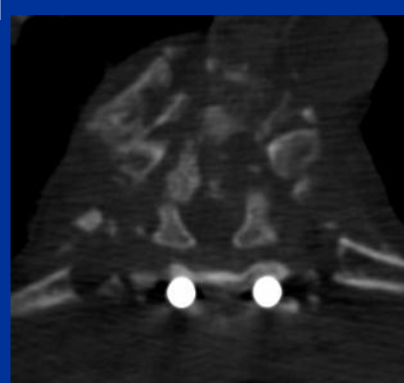


CURRENT TRENDS IN IMAGING

ROLE OF CT SCAN

CT IMAGING

- Posterior element lesions
- Early erosions
- Missed lesions
- Amount of bone destruction



CURRENT TRENDS IN IMAGING

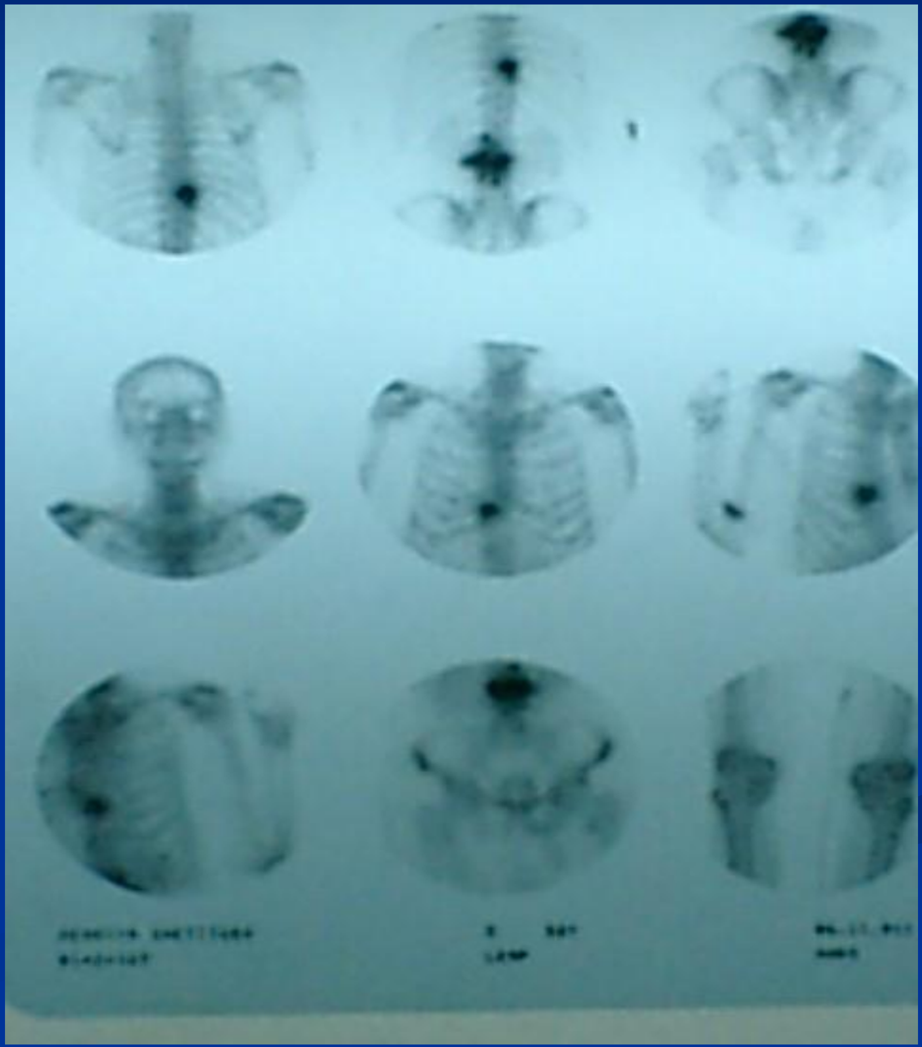
ROLE OF MRI SCAN

- **MR IMAGING IDENTIFIES**
  - Cord compression / changes
  - Soft tissue shadows and intraosseus abscesses
  - Skip lesions
  - Sub ligamentous spread of infection and epidural extension
  - The Imaging **Method Of Choice**

CURRENT TRENDS IN IMAGING

ROLE OF BONE SCAN

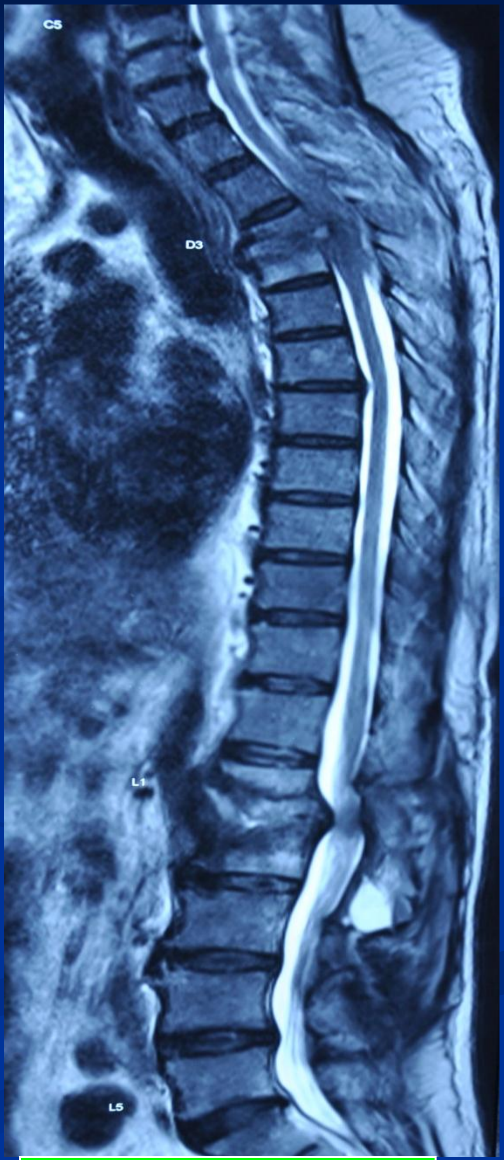
- Helpful in the diagnosis of skip lesions and in cases where radiographs seem to be normal



ADVANTAGE OF BONE SCAN

Jan 2011

Feb 2011



May 2011

CONVENTIONAL TREATMENT OF SPINAL TUBERCULOSIS (TULI)

- Anti tubercular drugs are the most important therapeutic measure
- ATT must be continued for about 18 months (must include Isoniazide)
- Patients with early disease can achieve full clinical healing
- Surgical indication is mainly for complications than for disease control

BRITISH MEDICAL RESEARCH COUNCIL

When appropriate facilities and expertise are available radical surgeries have definite advantage over non-operative treatment

J Bone Joint Surg 60 (B), 61 (B) 64 (B) and 67 (B)

CONVENTIONAL INDICATIONS FOR SURGERY (Griffith and Seddon)

- ABSOLUTE INDICATIONS:
  - Paraplegia during conservative treatment
  - Paraplegia worsening during treatment
  - Complete motor loss for 1 month despite treatment
  - Paraplegia with uncontrolled spasticity
  - Severe and rapid onset paraplegia
  - Severe flaccid paraplegia/ sensory loss
- RELATIVE INDICATIONS
- RARE INDICATIONS

CONVENTIONAL INDICATIONS FOR SURGERY (Griffith and Seddon)

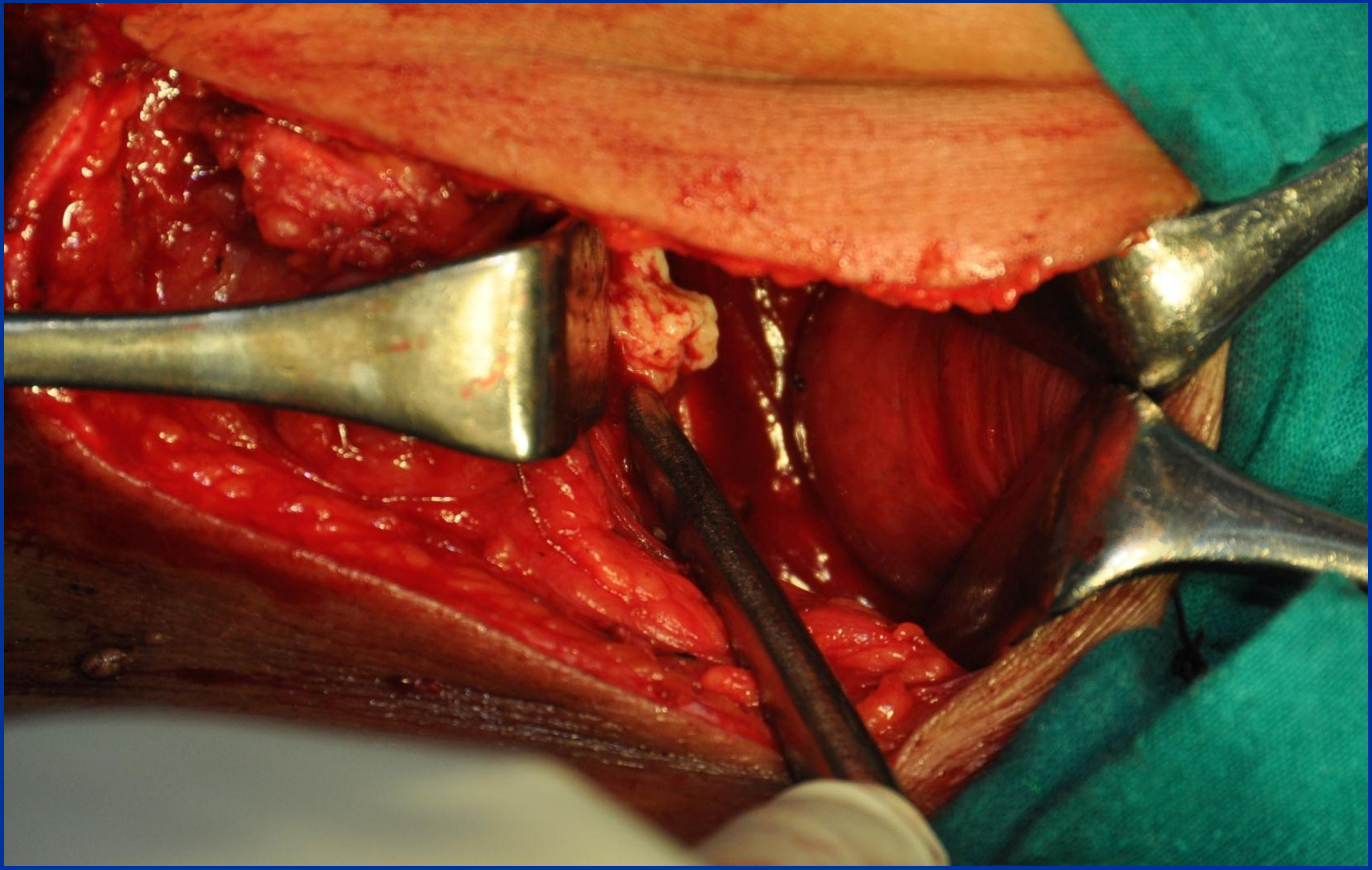
- RELATIVE INDICATIONS
  - Recurrent paraplegia
  - Paraplegia in elderly
  - Painful and spastic paraplegia
  - Paraplegia with complications (UTI)
- RARE INDICATIONS
  - Posterior element disease & Spinal tumor syndrome
  - Severe cervical lesion with paraplegia
  - Cauda equinopathy

CONVENTIONAL SURGERIES IN POTT'S DISEASE

- Limited surgeries
- Radical surgeries
- Controversial surgeries

LIMITED SURGERIES IN TUBERCULOSIS OF SPINE

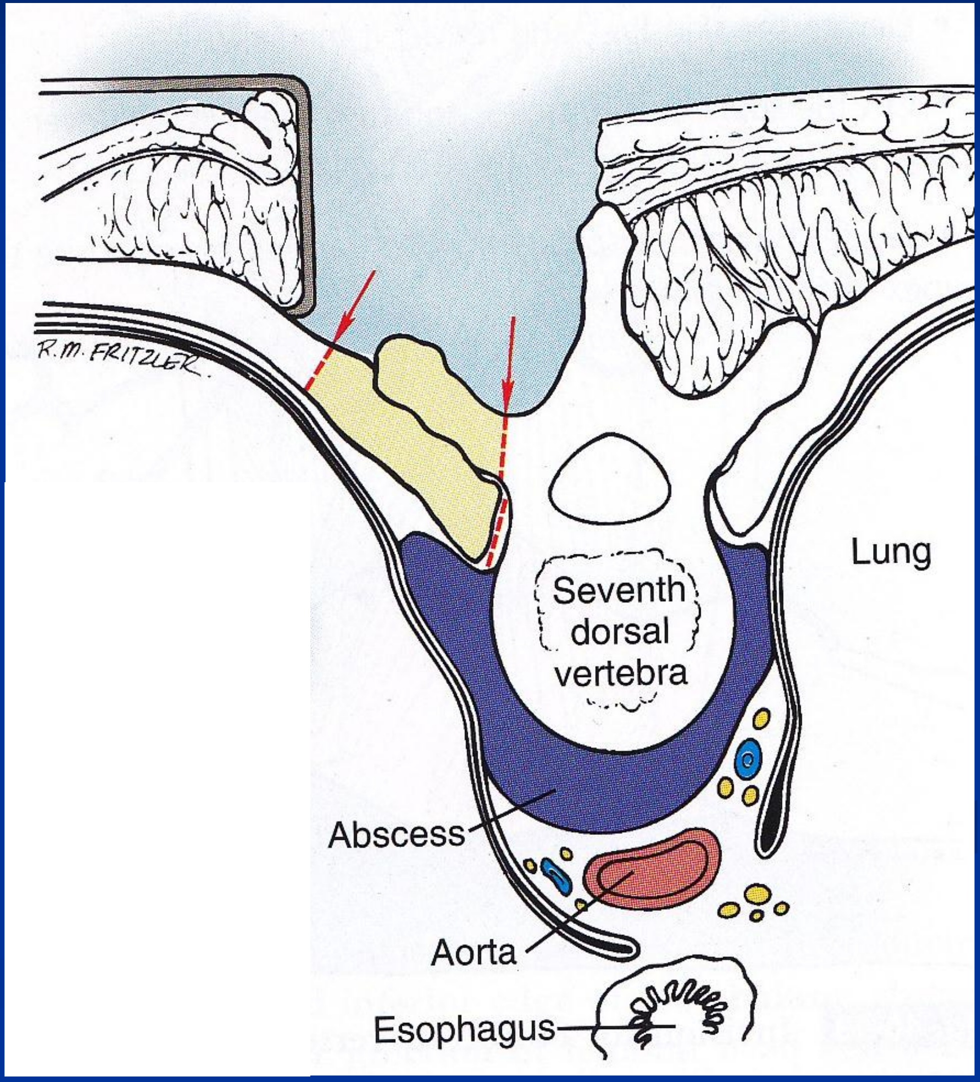
DRAINAGE OF COLD ABSCESS



LIMITED SURGERIES IN TUBERCULOSIS OF SPINE

- **COSTO-TRANSVERSECTOMY**

  Excision of portion of a rib and the articulating transverse process

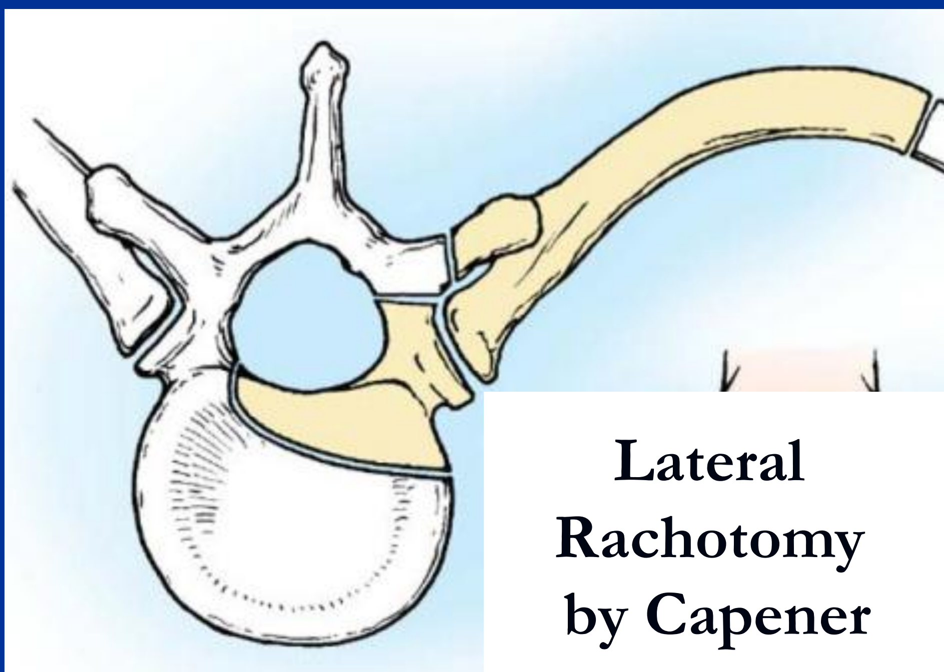


CONVENTIONAL RADICAL SURGERIES

- **ANTERO-LATERAL DECOMPRESSION**

First described by Capener (1933)

Only operation in which decompression of the cord is performed by removing the actual cause of compression

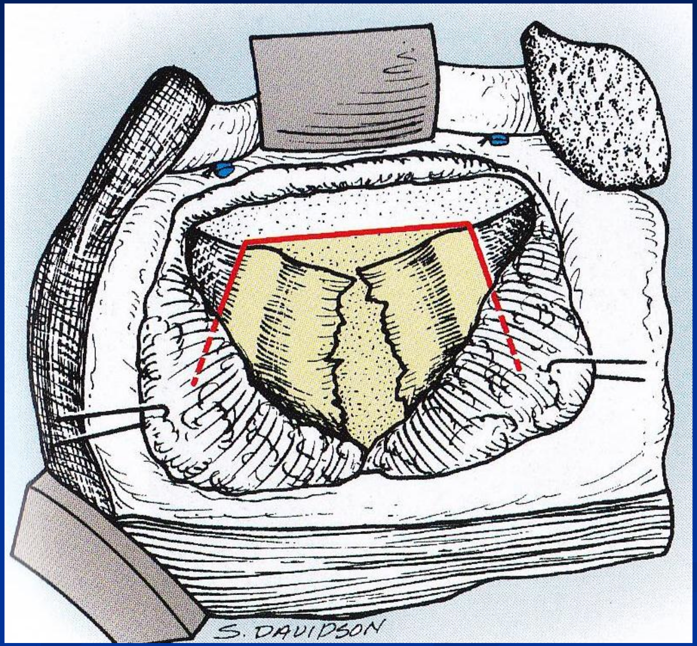


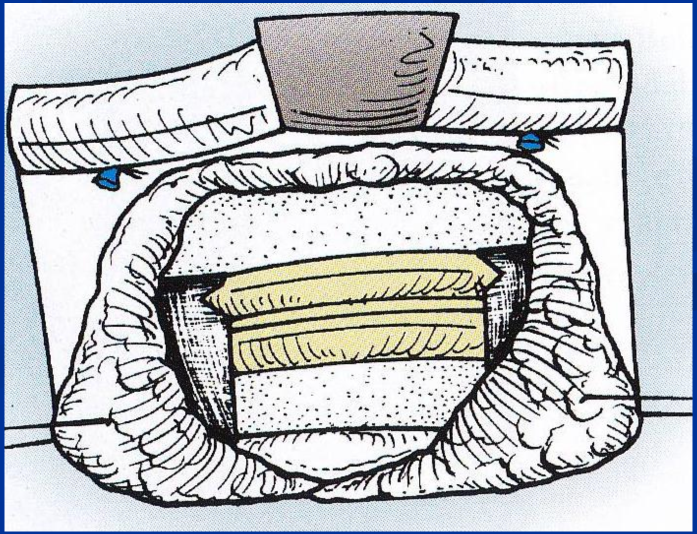
Lateral Rachotomy by Capener

CONVENTIONAL RADICAL SURGERIES

Hodgson et al (1960)

- Developed the concept of radical excision of the diseased vertebral bodies and their replacement by bone grafts in all cases of spinal tuberculosis





THE MIDDLE PATH REGIMEN OF TULI

SURGICAL INDICATIONS IN POTT'S PARAPLEGIA

- No neurological recovery after 4 weeks of ATT
- Development of neurological deficit during the course of chemotherapy
- Recurrence of neurological deficit after initial improvement
- Worsening of neurological deficit while on chemotherapy
- Advanced case of neurological involvement

CURRENT TRENDS IN THE MANAGEMENT OF POTT'S PARAPLEGIA

- Anti tubercular therapy with bed rest has shown recovery in 30% of patients with stage I/II paraplegia
- However, an absolute non operative approach is not considered justifiable
- A combination of conservative therapy with surgical decompression gives the most favourable outcome

CURRENT TRENDS IN THE SURGICAL MANAGEMENT OF POTT'S PARAPLEGIA

- Surgical decompression confirms the diagnosis, removes fibrous barrier and when combined with bone grafting and fixation achieves deformity correction and leads to early fusion

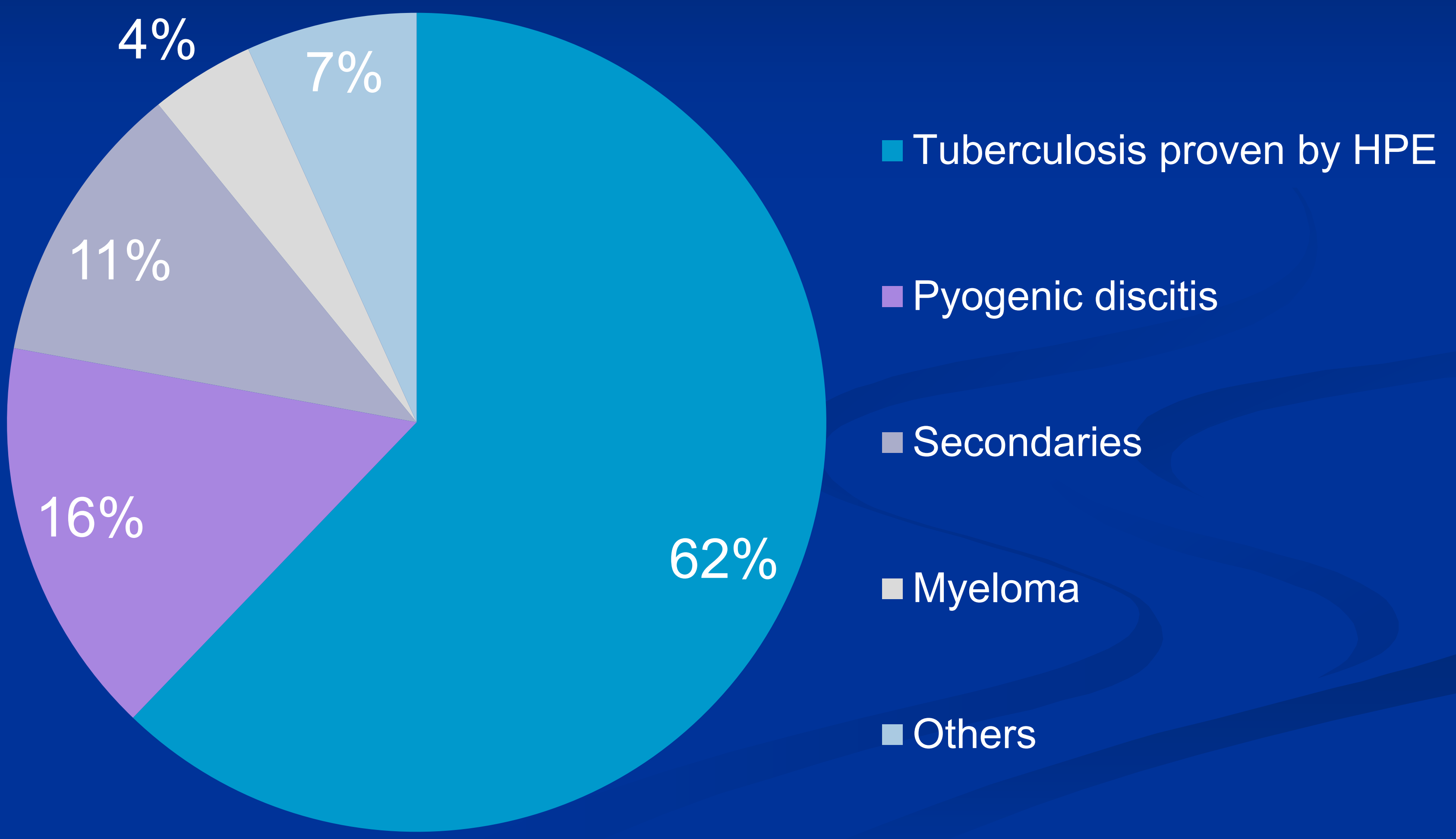
- The outcome of treatment becomes more predictable

Even though, classical clinical and radiological features have been described in the literature, spinal tuberculosis does mimic other lesions

Can be

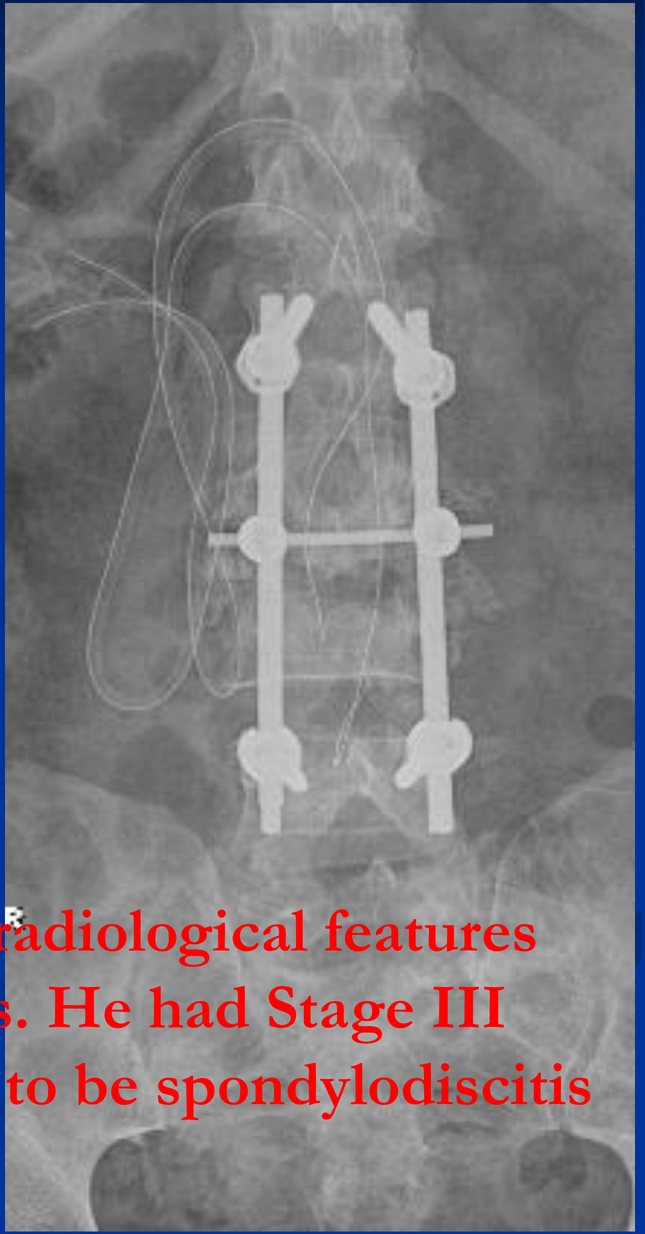
MISSED, MISTAKEN or MISDIAGNOSED

DISTRIBUTION OF PATIENTS WITH VERTEBRAL LESIONS (267 CASES)



PYOGENIC SPONDYLODISCITIS MIMICING POTT'S PARAPLEGIA





A 46 years gentleman presented with clico-radiological features suggestive of tuberculous spondylodiscitis. He had Stage III paraplegia. Bacteriological and HPE proved to be spondylodiscitis due to MRSA

THE MISTAKEN LESION

X- Ray

MRI

CT

DIAGNOSIS : NON-HODGKINS LYMPHOMA

CURRENT TRENDS IN THE SURGICAL MANAGEMENT OF POTT'S PARAPLEGIA

AIMS

- Early recovery
- Better healing with fusion
- Optimal correction of kyphosis
- Prevention of progression of deformity, thereby preventing late onset paraplegia
- To achieve a more predictable outcome

PRINCIPLES OF SURGICAL TREATMENT

CURRENT TRENDS

- DECOMPRESSION
- DEBRIDEMENT
- CORRECTION OF KYPHOSIS
- BONE GRAFTING
- INTERNAL FIXATION

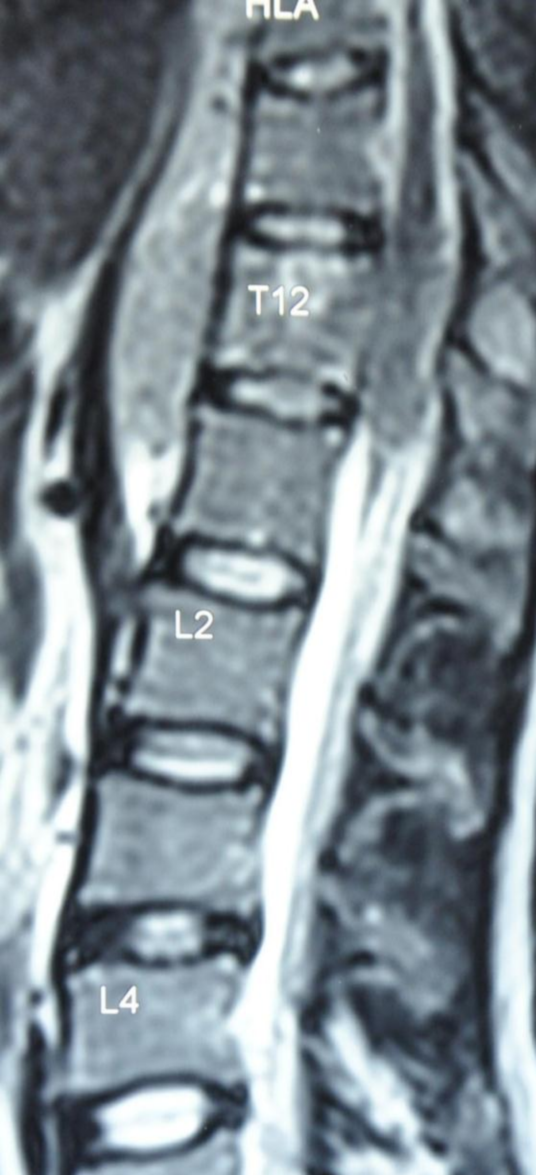
PRINCIPLES OF SURGICAL TREATMENT (CURRENT TRENDS)

DECOMPRESSION

- Anterior
- Posterior

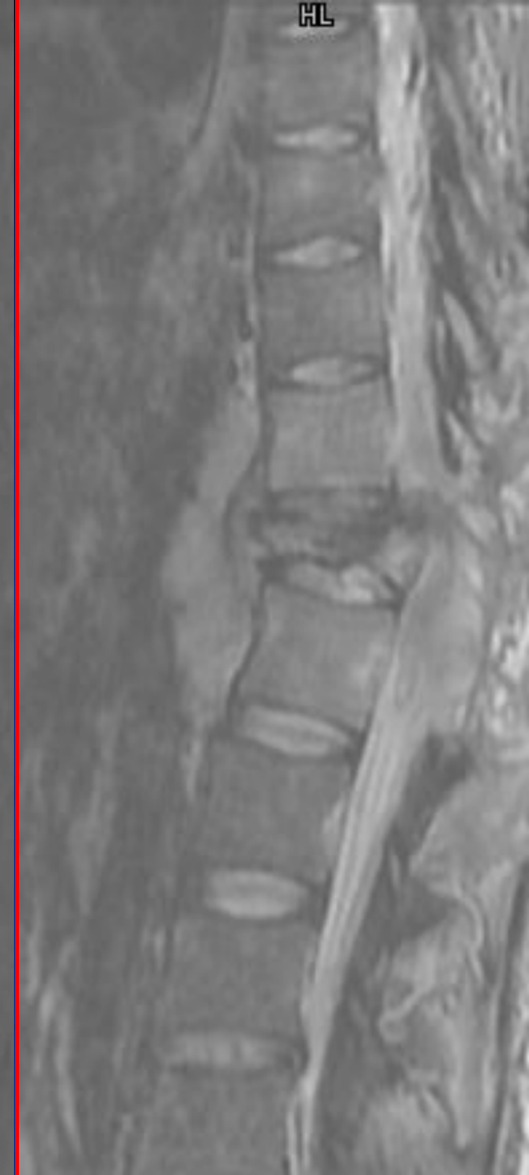
LAMINECTOMY is **contraindicated** in spinal tuberculosis because the disease is present anteriorly and by doing a posterior decompression, the spine becomes completely unstable

It is only indicated in cases of posterior element disease and spinal tumour syndrome



Pre-laminectomy MRI

Post-laminectomy CT

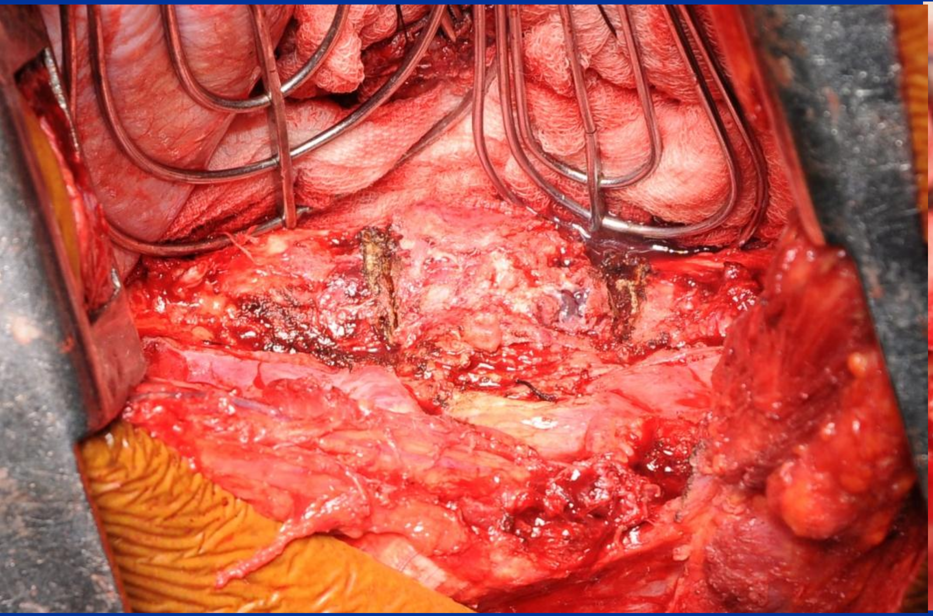


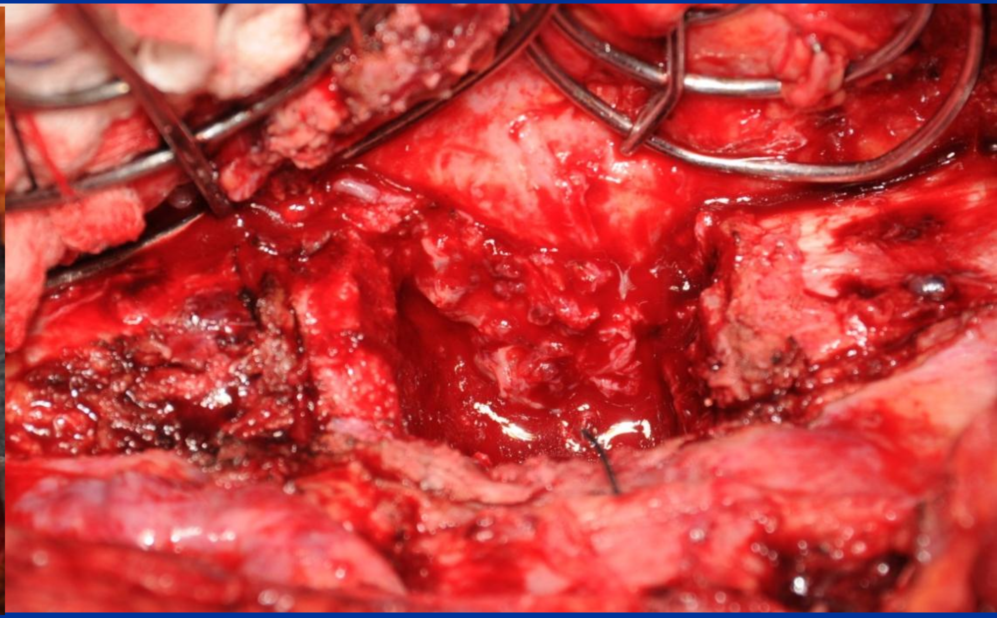
Post-laminectomy MRI

PRINCIPLES OF SURGICAL TREATMENT (CURRENT TRENDS)

DEBRIDEMENT

- Through anterior approach
- Through posterior approach

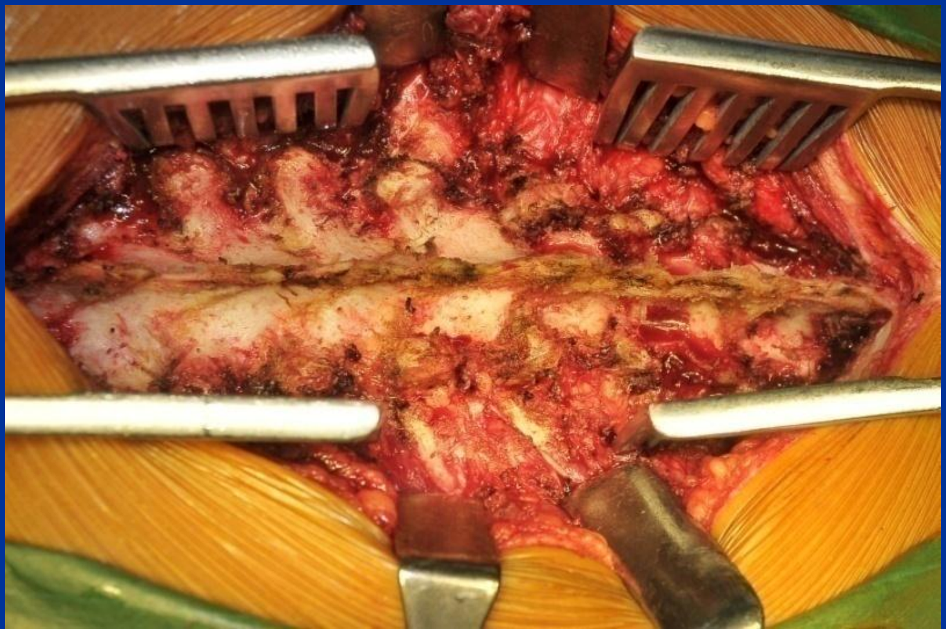


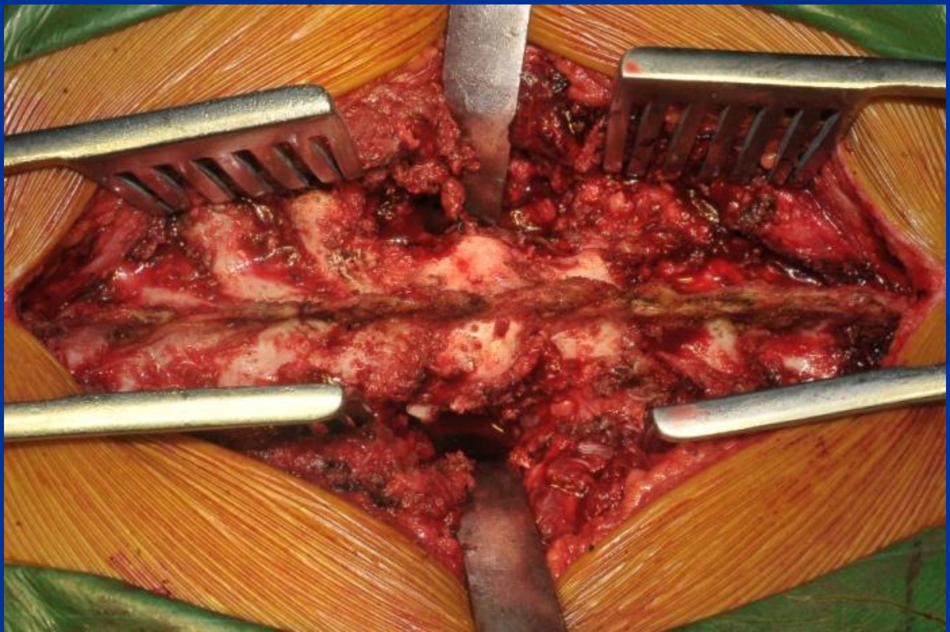


PRINCIPLES OF SURGICAL TREATMENT (CURRENT TRENDS)

DEBRIDEMENT

- Through anterior approach
- Through posterior approach





PRINCIPLES OF SURGICAL TREATMENT (CURRENT TRENDS)

DEBRIDEMENT
- Through anterior approach
- Through posterior approach

Excision up to the healthy bleeding bone can only be achieved through the anterior approach.

Through posterior/anterolateral approach, debridement is mostly partial.

PRINCIPLES OF SURGICAL TREATMENT (CURRENT TRENDS)

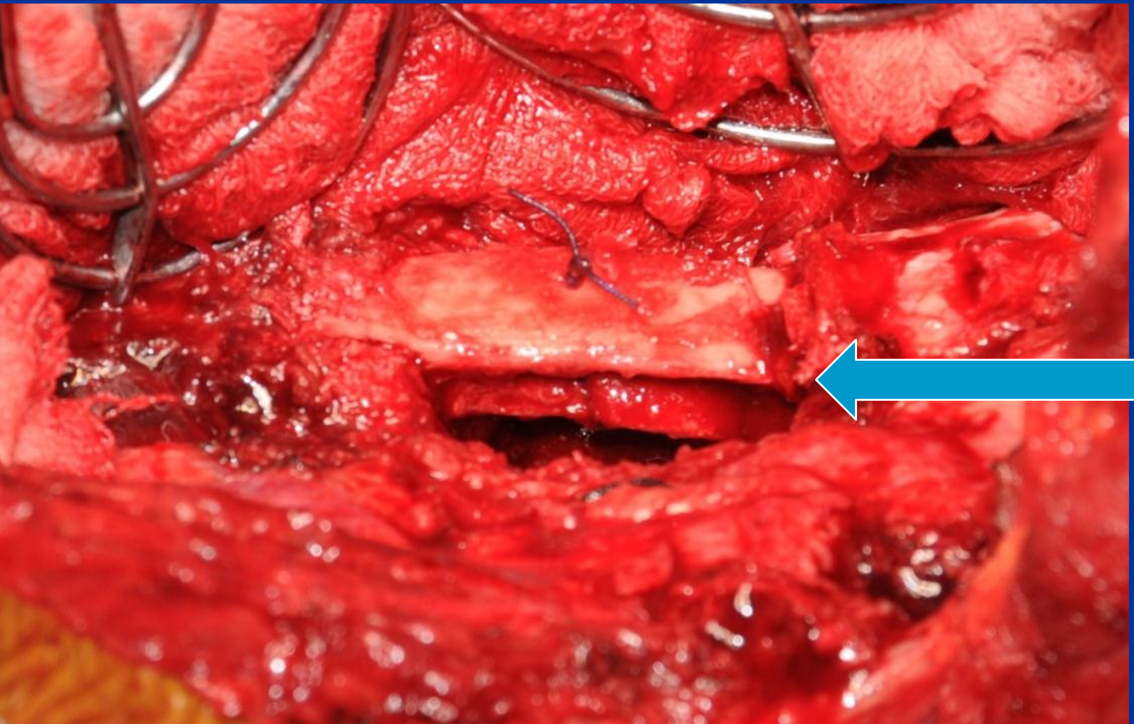
DEBRIDEMENT
- RADICAL
- PARTIAL

There is not much advantage of radical debridement over the partial debridement as the former would leave a large gap which has to be bridged by a longer graft, whereas the later leaves behind a relatively more stable spine

PRINCIPLES OF SURGICAL TREATMENT (CURRENT TRENDS)

ANTERIOR COLUMN RECONSRUCTION

- BONE GRAFT
- CAGE



However long term follow up of radical surgeries showed considerable loss of correction and failure of the bone graft

(32% Kemp et al, 62% Rajasekaran et al)

leading to progression of kyphosis

Kemp et al JBJS 1973, 55: 715-34

Parthasarathy et al J Bone Joint Surg 81 (B),

Rajashekaran et al JBJS 1989, 71: 1314-23,

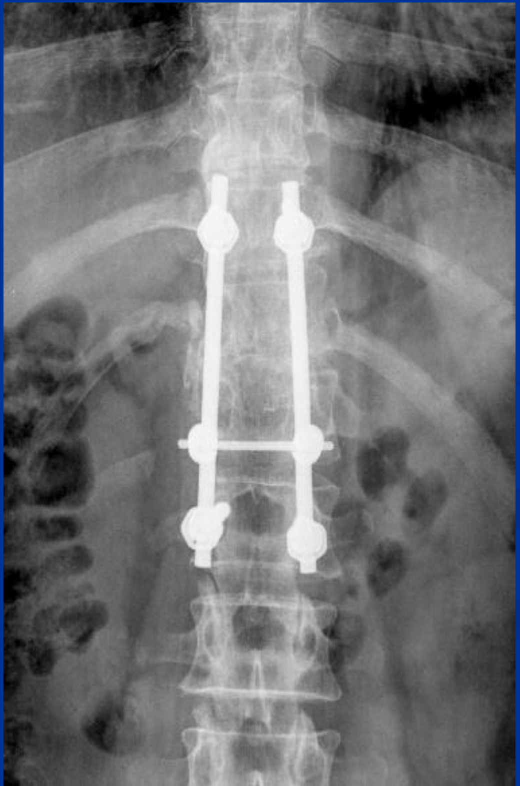
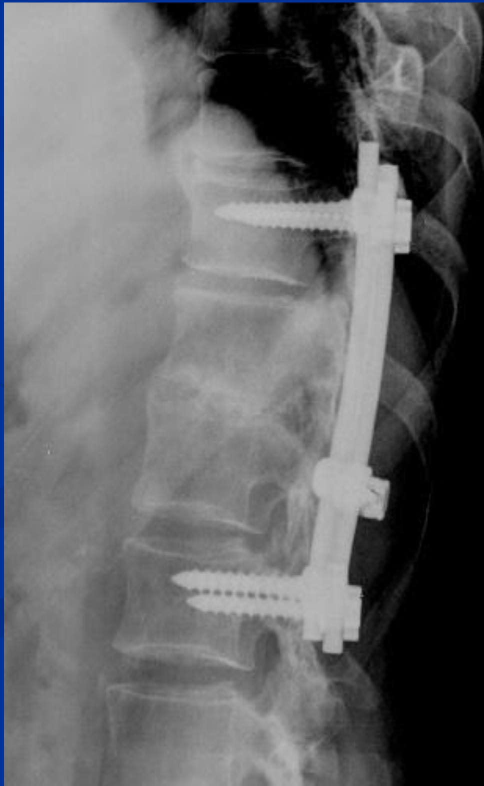
Sundararaj et al J Bone Joint Surg 85 (B) and

Moon et al Spine 20;1995

ROLE OF INSTRUMENTATION IN POTT'S DISEASE

- Correction of deformity
- Maintains the correction
- Prevents graft failure
- Prevents late onset paraplegia



IS IT SAFE TO USE IMPLANTS IN POTT'S SPINE?

- Oga and co-workers evaluated the adherence capacity of M. tuberculosis to stainless steel and demonstrated that its adherence is negligible and the use of implants in regions with active tuberculosis is safe. **Oga M et al (1993), Spine, 18:1890-4**

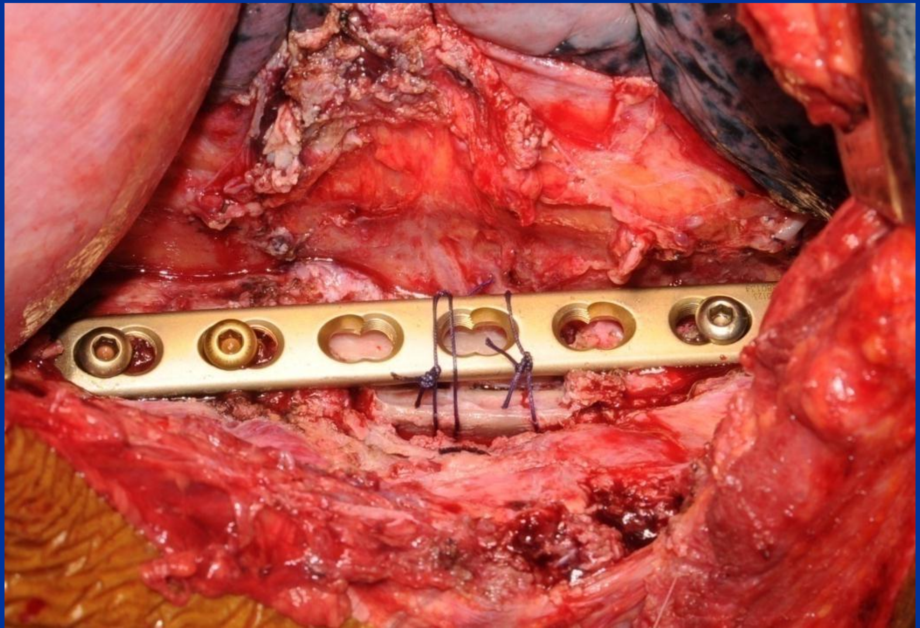
- M. tuberculosis contamination following instrumented spine surgery might lead to less occurance of infection than S. aureus.

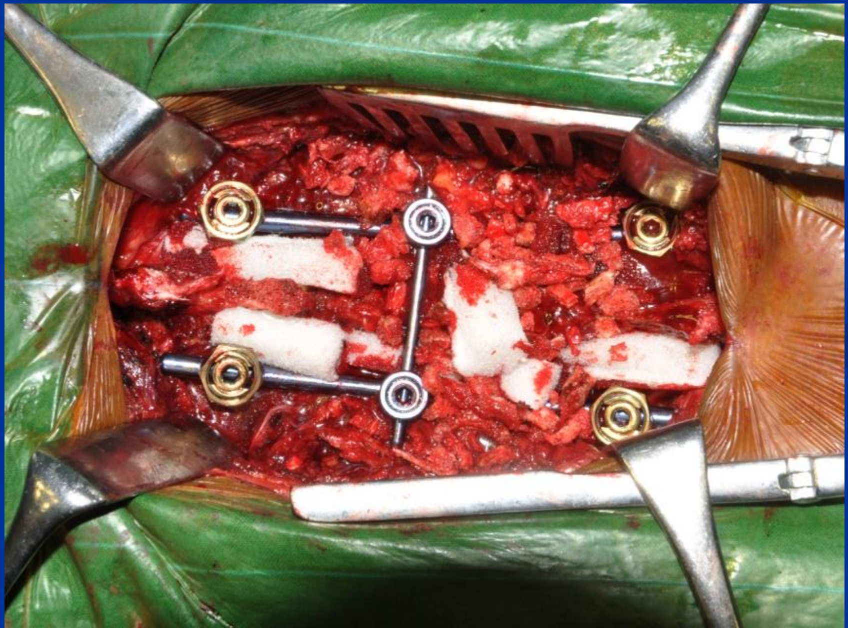
Chen, Wei-Hua; Jiang, Lei-Sheng; Dai, Li-Yang 2011 *Spine*,36(2)

PRINCIPLES OF SURGICAL TREATMENT (CURRENT TRENDS)

CORRECTION OF KYPHOSIS WITH INSTRUMENTATION

- ANTERIOR
- POSTERIOR
- GLOBAL

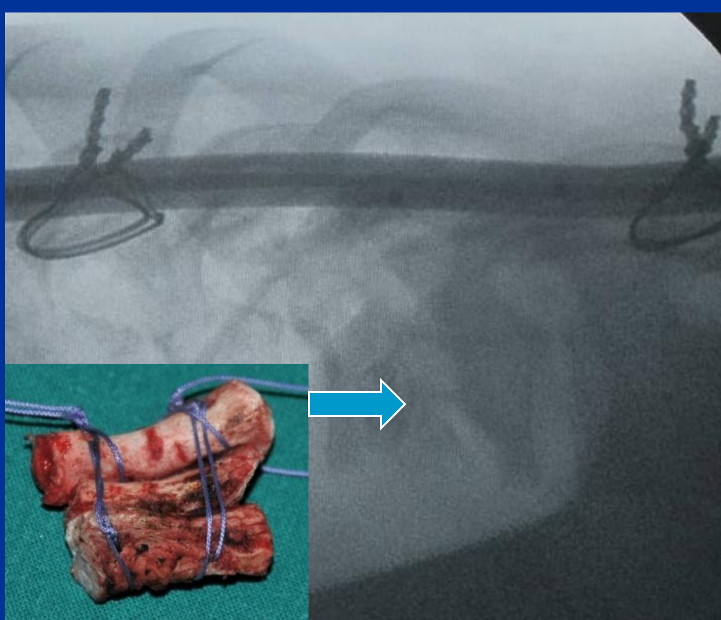




PRINCIPLES OF SURGICAL TREATMENT
(CURRENT TRENDS)

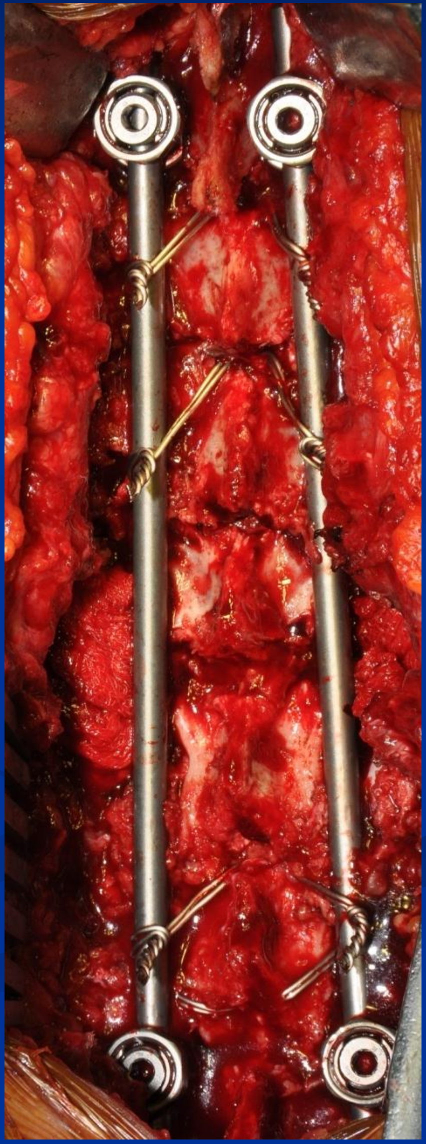
BONE GRAFTS WITH INSTRUMENTATION TO ACHIEVE EARLY FUSION

- ANTERIOR
- POSTERIOR
- GLOBAL

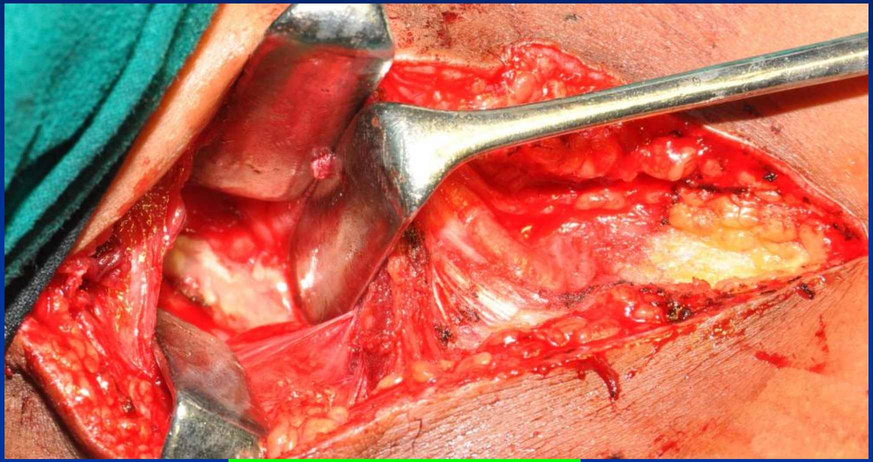


ROLE OF POSTERIOR INSTRUMENTATION AND FUSION

- Better correction of kyphosis can be achieved than anterior instrumentation
- Prevents recurrence of kyphosis
- Not beneficial without anterior debridement and fusion

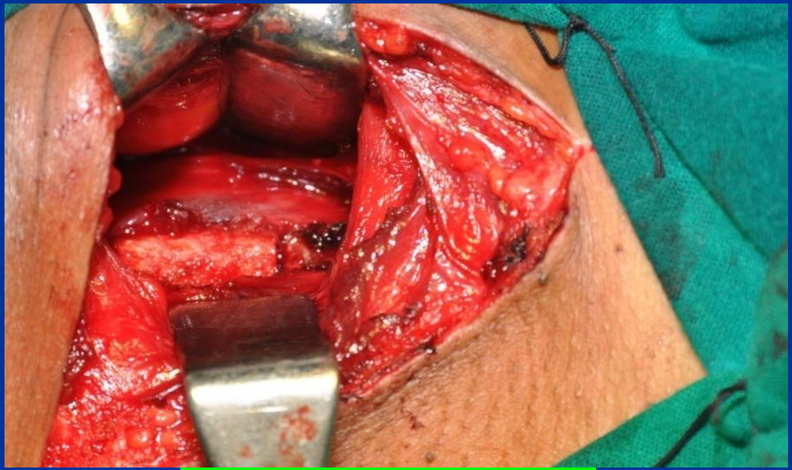


PREFERRED METHOD IN CERVICAL SPINE

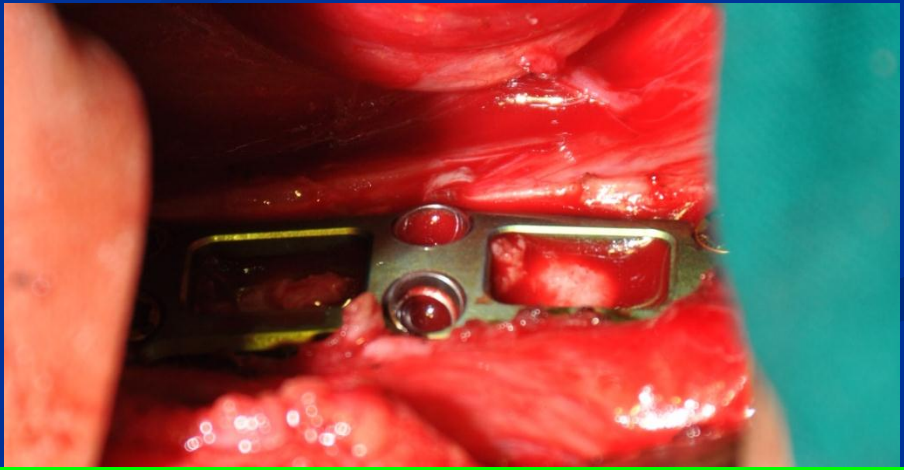


Exposure

Debridement



Bone graft



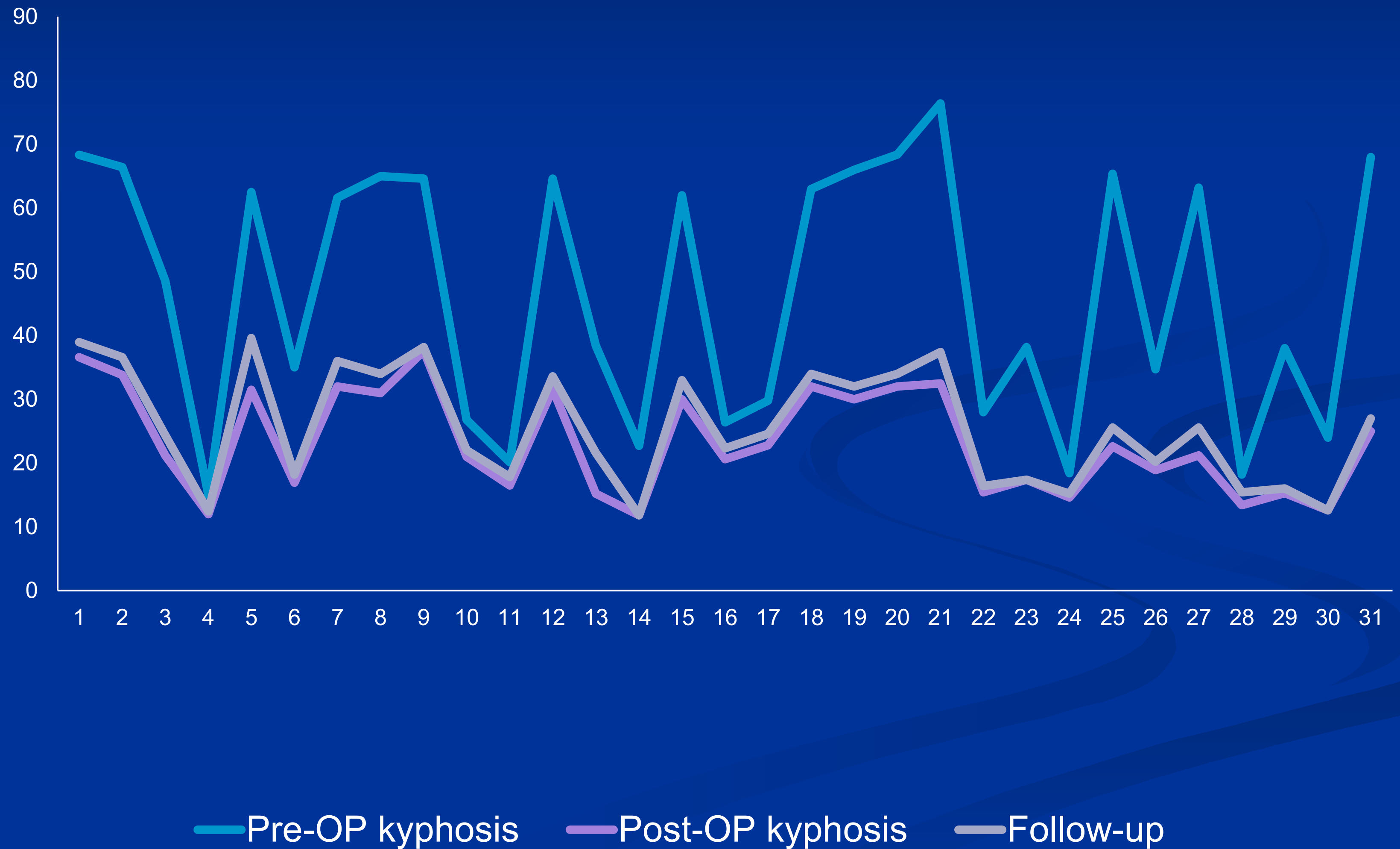
Stabilization: anterior plating

FOLLOW UP RADIOGRAPH

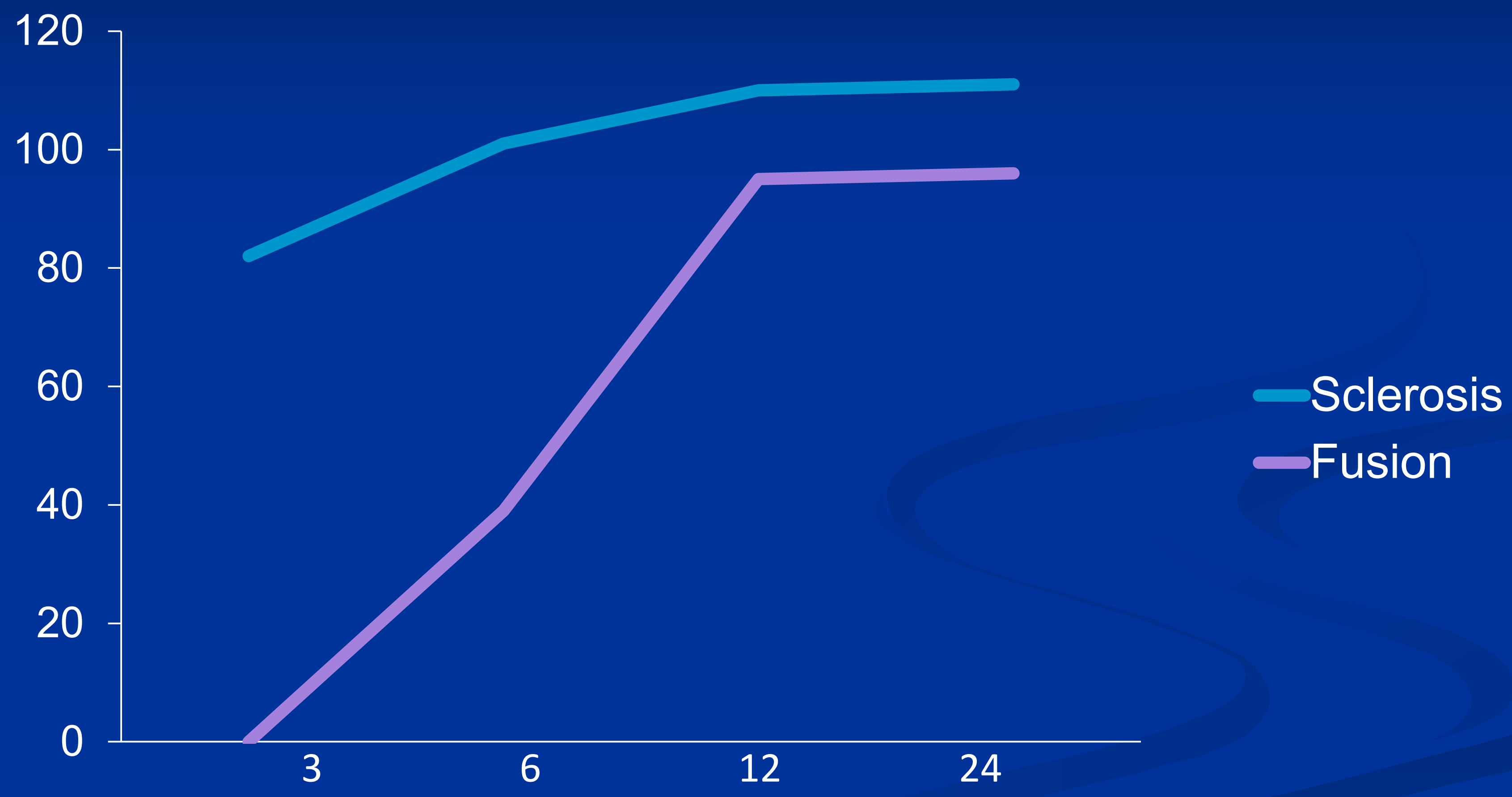
ANTERIOR DECOMPRESSION, POSTERIOR INSTRUMENTATION WITH GLOBAL FUSION

Neurological recovery from AIS C at admission to AIS E at three months follow up

KYPHOSIS CORRECTION ACHIEVED AND MAINTAINED

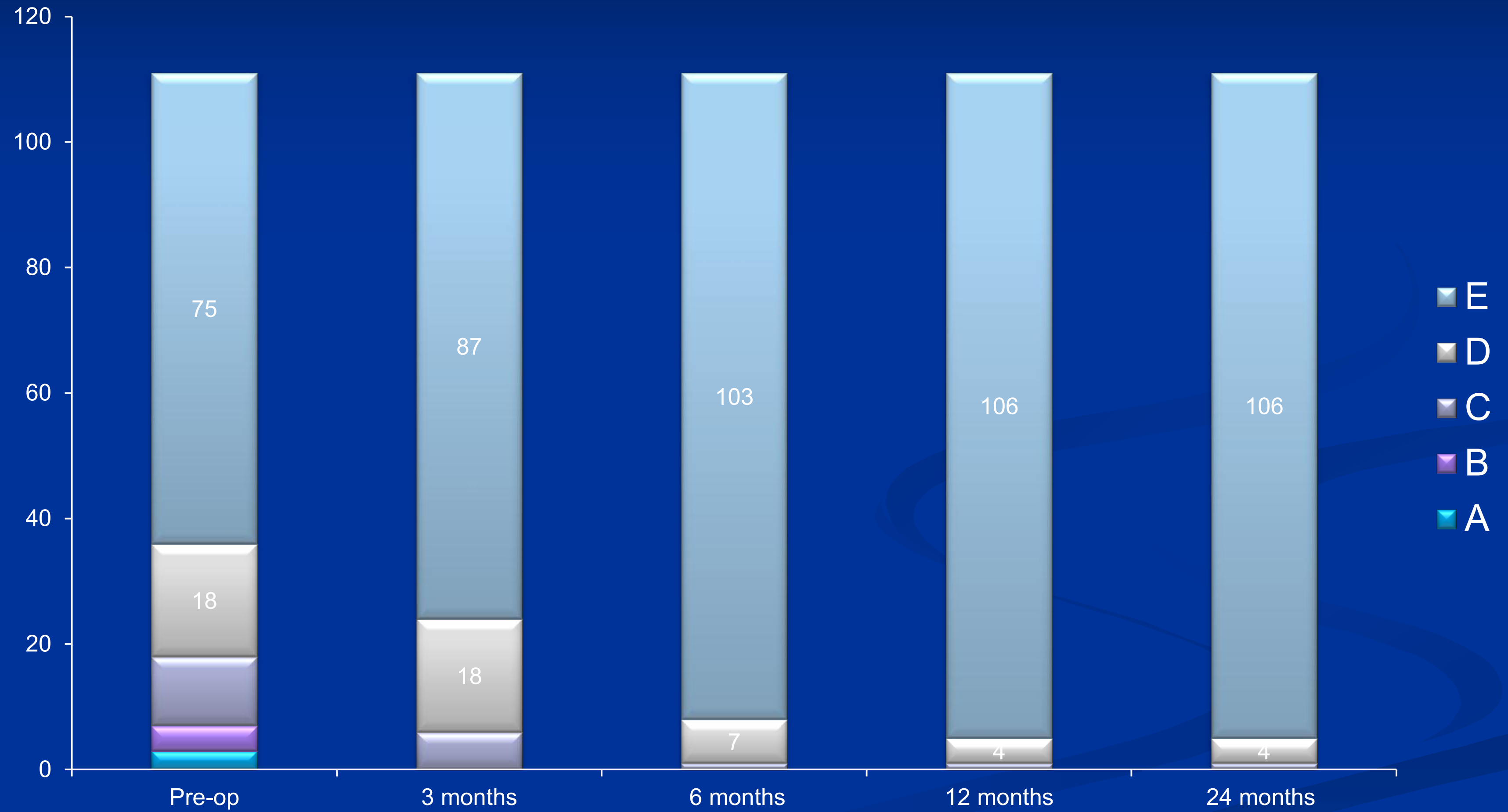


PROGRESSION OF SCLEROSIS AND INTERBODY FUSION



Interbody fusion started appearing at the end of three months and peaked at one year

NEUROLOGICAL STATUS AT ADMOSSION AND AT 2 YEARS FOLLOW UP



Thirty one patients recovered to AIS E, 3 from AIS B to D, one from AIS C to D and one from AIS A to C

FACTORS ASSOCIATED WITH BETTER NEURAL RECOVERY

- Young patient with good nutritional status
- Incomplete paraplegia of short duration
- Early onset paraplegia with slow progression
- Typical anterior vertebral disease with minimal kyphosis
- Disease involving the lumbar spine

FACTORS RESPONSIBLE FOR POOR NEURAL RECOVERY

- Elderly patients/ poor general condition
- Rapid onset progressive paraplegia (significant mechanical pressure due to disc/ sequestrum, pathological subluxation/ dislocation)
- Stage IV paraplegia
- Cervicodorsal junction and upper dorsal spine tuberculosis affection (narrow spinal canal)

FACTORS RESPONSIBLE FOR POOR NEURAL RECOVERY

- Patients with severe kyphosis
- Grossly unstable pan-vertebral lesions
- Long standing compression with myelomalacia
- Vascular causes- worst prognosis
- MDR/ ExDR and immuno-compromised status
- Late onset paraplegia

CONCLUSION

- Anti tubercular drugs are the most important therapeutic measure
- In recent times, there has been increased number of cases with MDR and ExDR TB
- ATT should consist of 3 months of intensive phase and at least 12 months of continuation phase
- Patients with early disease can achieve full clinical recovery

CONCLUSION

- Even though non operative treatment with rest produces neurological improvement, absolute conservative approach in Pott's paraplegia is considered to be unjustifiable
- A judicious combination of operative treatment and aggressive anti tubercular therapy achieves the best results
- In recent times, there has been a trend towards more aggressive operative treatment

CONCLUSION

RECENT TREND IN THE SURGICAL MANAGEMENT

- Anterior debridement, fusion with instrumentation
- Anterior debridement and anterior column reconstruction using **bone graft or CAGE** with anterior or posterior instrumentation
- Anterior debridement, posterior instrumentation and global fusion

प्रज्ञानं ब्रह्म
Manipal
INSPIRED BY LIFE

ACL RECONSTRUCTION

- INDICATIONS FOR ACL RECONSTRUCTION

  ACL TEAR !!!

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CHRONIC KNEE PAIN

MRI SCAN

REPORT—ACL TEAR

- NO RELIEF NSAID –NOT AN INDICATION FOR MRI
- MRI REPORT OF ACL TEAR-NOT AN INDICATION FOR ACL RECONSTRUCTION

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WRONG

RIGHT

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DIAGNOSIS OF ACL TEAR

- HISTORY
- CLINICAL EXAMINATION

- MRI
- EXAMINATION UNDER ANAESTHESIA
- ARTHROSCOPY

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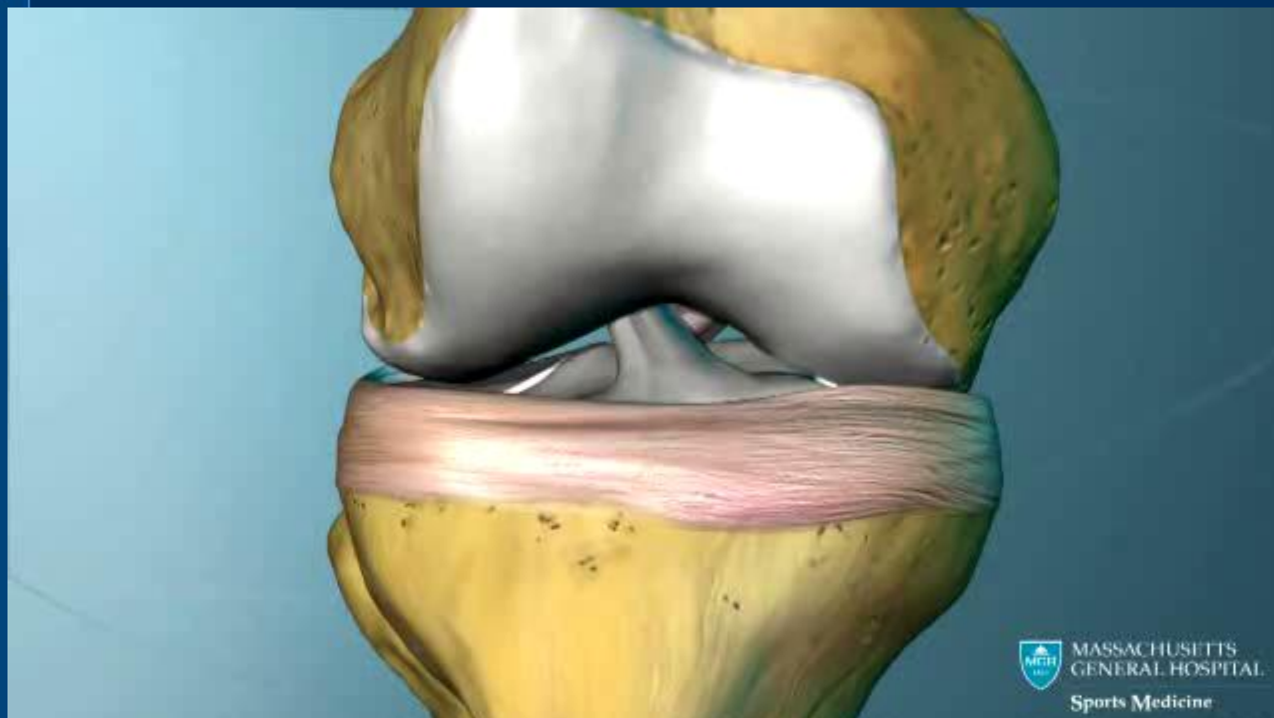
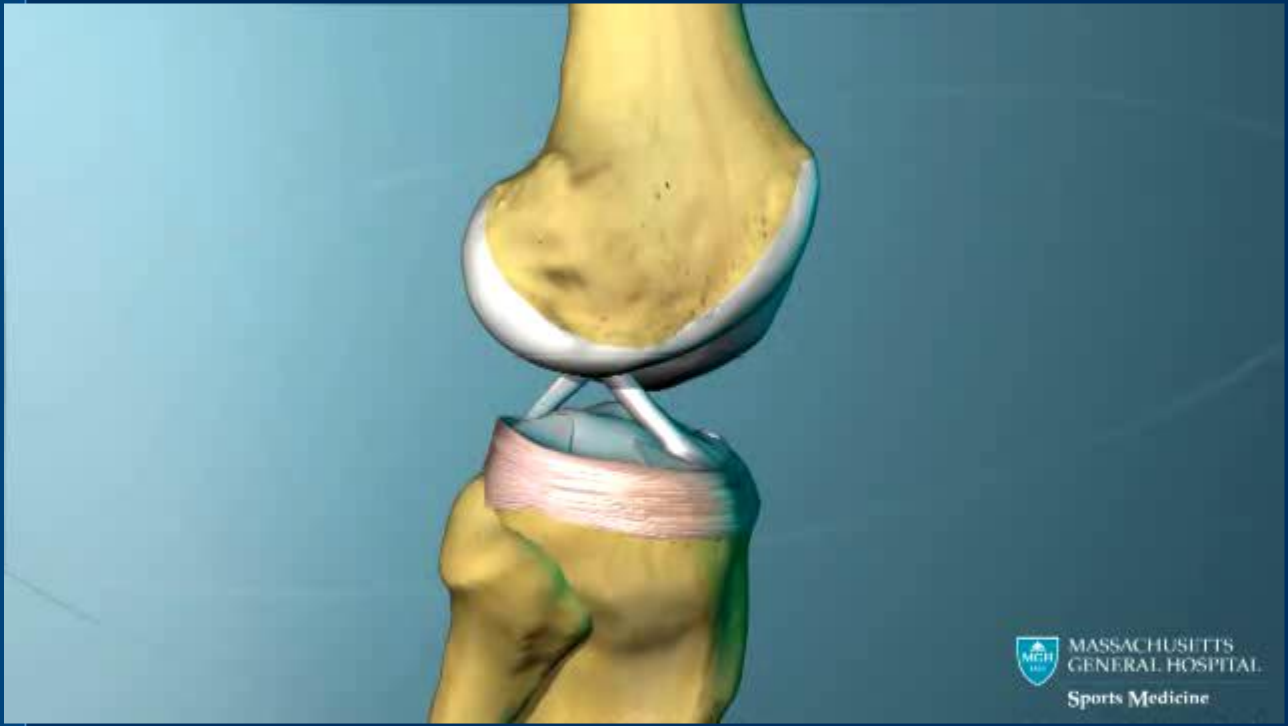
ANATOMY OF ACL



ANATOMY OF ACL



MECHANISM OF INJURY

- FLEXION VALGUS EX ROTATION
- DECELERATION/HYPERX TENSION
- FLEXION VARUS INT ROTATION

MECHANISM OF INJURY

- HISTORY

  MECHANISM OF INJURY

  AUDIBLE POP

  DELAYED SWELLING

  INSTABILTY

EXAMINATION

HEMARTHROSIS

LACHMAN TEST

ANTERIOR DRAWER TEST

PIVOT SHIFT TEST

RABBI ZIDNI 'ILMA

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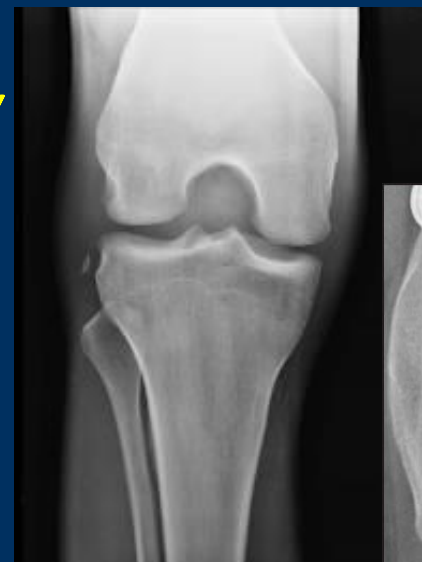
INVESTIGATION

- DO NOT FORGET XRAY
- SEGOND FRACTURE
- TIBIAL SPINE AVULSION
- OSTEOARTHRITIS



INVESTIGATION

- MRI- INTERPRETED BY AN EXPERT IN MUSKULOSKELETAL RADIOLOGY – IDEAL

- MAY BE MISLEADING

- TRAIN YOURSELF TO READ MRI

RABBI ZIDNI 'ILMA
YENEPOYA UNIVERSITY

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DIAGNOSIS

- RELY ON YOUR CLINICAL FINDINGS

DIAGNOSIS

- EXAMINATION UNDER ANAESTHESIA
  SHOULD BE ROUTINELY DONE

  VERY HELPFUL WHEN IN DOUBT

- GOALS

INSTABILITY

1. REDUCE DEGENERATION

2.REDUCE SECONDARY MENISCAL TEAR

3. PROMOTE NORMAL ACTIVITY

ACL RECONSTRUCTION

- AGE
- PHYSICAL ACTIVITY LEVELS
- SYMPTOMATIC (INSTABILITY,PAIN)
- EXAMINATION UNDER ANAESTHESIA
- ARTHROSCOPY   FINDING

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- ARTHROSCOPY

  FINAL EVIDENCE TO CONFIRM

DIAGNOSTIC AND THERAPEUTIC SCOPY

ARTHROSCOPY

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ARTHROSCOPY

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ARTHROSCOPY

ANTEROMEDIAL PORTALS--VISUALISING

ANTEROLATERAL PORTAL--WORKING

MEDIAL PORTAL---FEMORAL TUNNEL
(ANATOMICAL RECON)

ARTHROSCOPY

- DIGNOSTIC SEQUENCE

  SUPRA PATELLAR POUCH

  LATERAL GUTTER

  LATERAL COMPARTMENT

  INTERCONDYLAR NOTCH

  MEDIAL GUTTER

  MEDIAL COMPARTMENT

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STEPS OF ACL RECONSTRUCTION

- GRAFT HARVESTING AND PREPERATION
- MENISCAL SURGERY
- TIBIAL TUNNEL
- FEMORAL TINNEL
- GRAFT PREPERATION
- GRAFT PASSAGE

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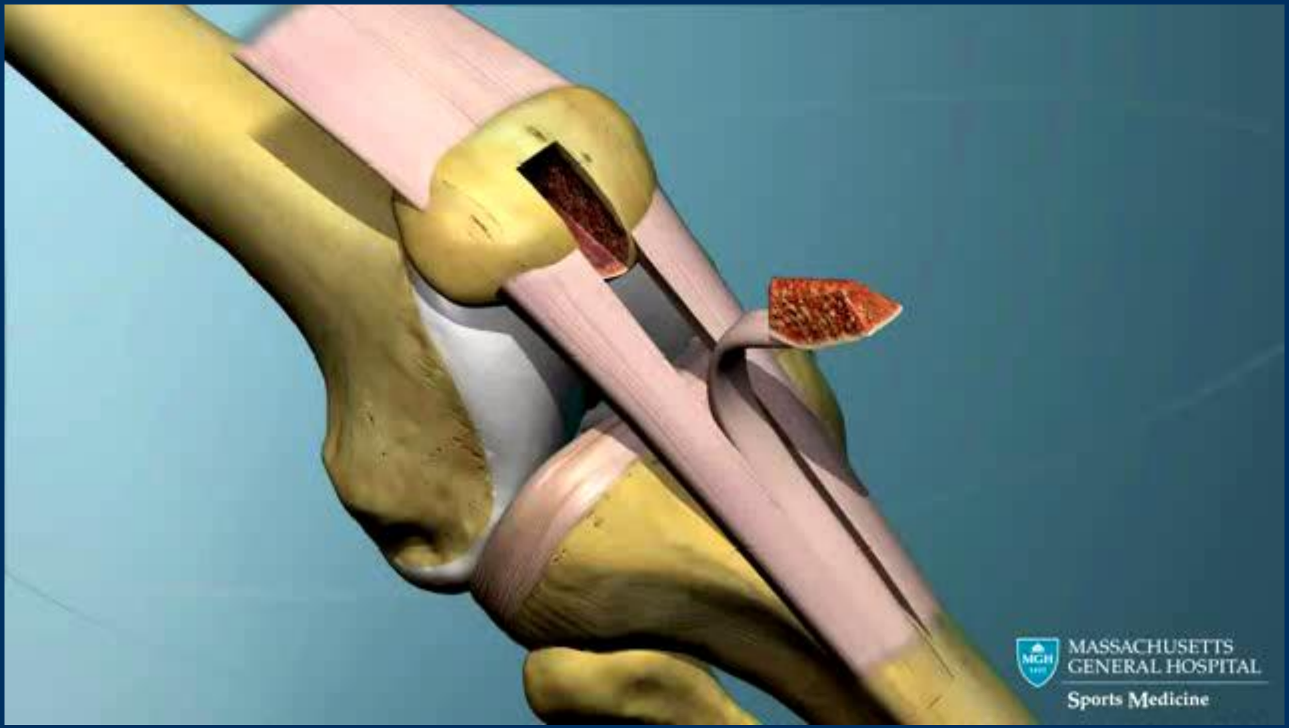
ACL RECONSTRUCTION

- GRAFT HARVEST



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ACL RECONSTRUCTION

- GRAFT OPTIONS

HAMSTRINGS –MOST COMMON

PATELLAR TENDON BONE

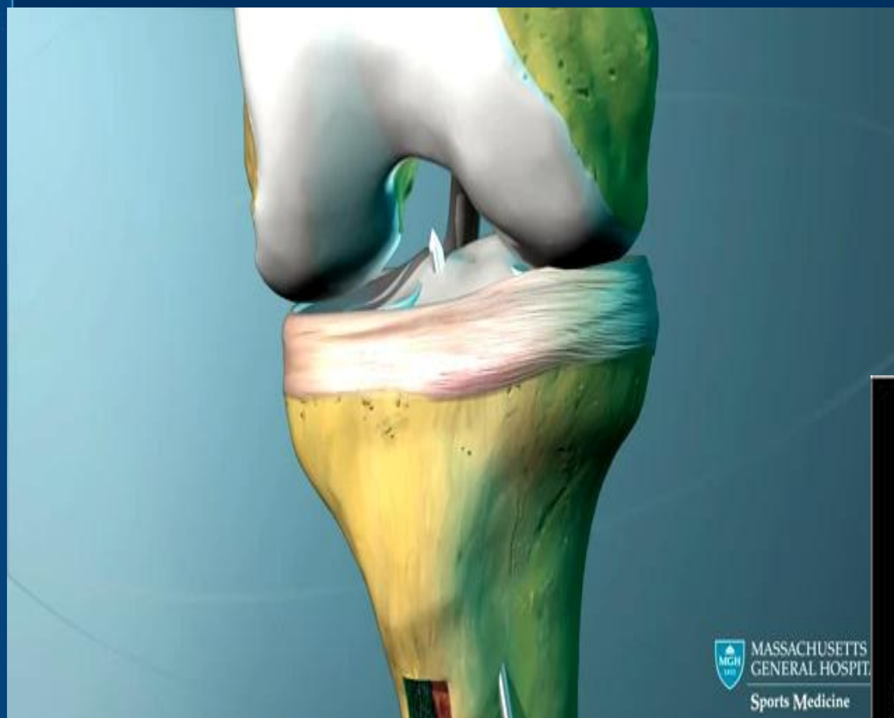
QUADRICEPS TENDON

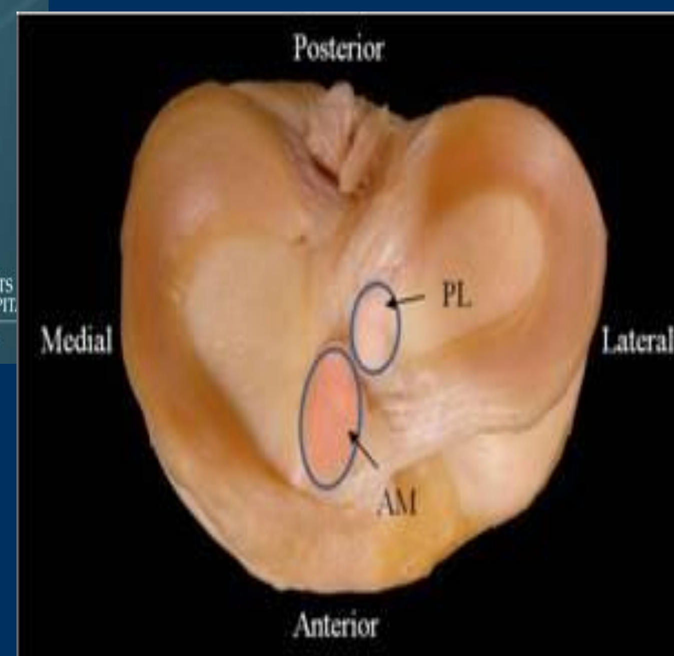
ALLOGRAFT

ARTIFICIAL

ACL RECONSTRUCTION

- TIBIAL TUNNEL





ACL RECONSTRUCTION

- TIBIAL TUNNEL

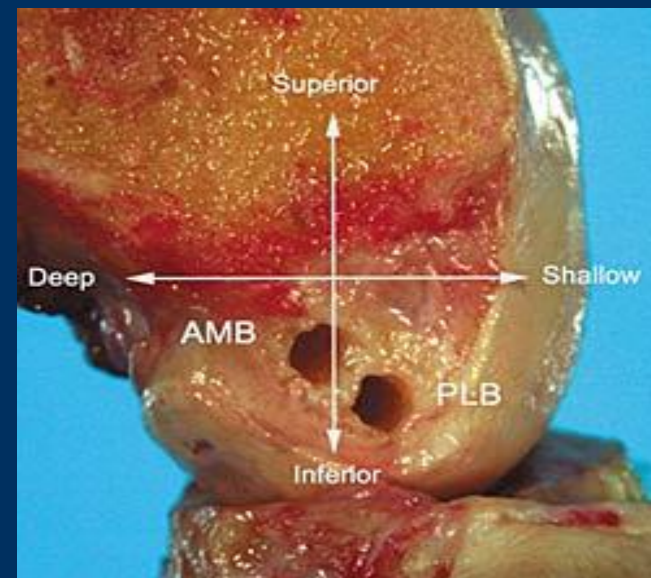
  45-60 DEG FLEXION

FEMORAL TUNNEL

100-110 DEG FLEXION

ACL RECONSTRUCTION

- FEMORAL TUNNEL



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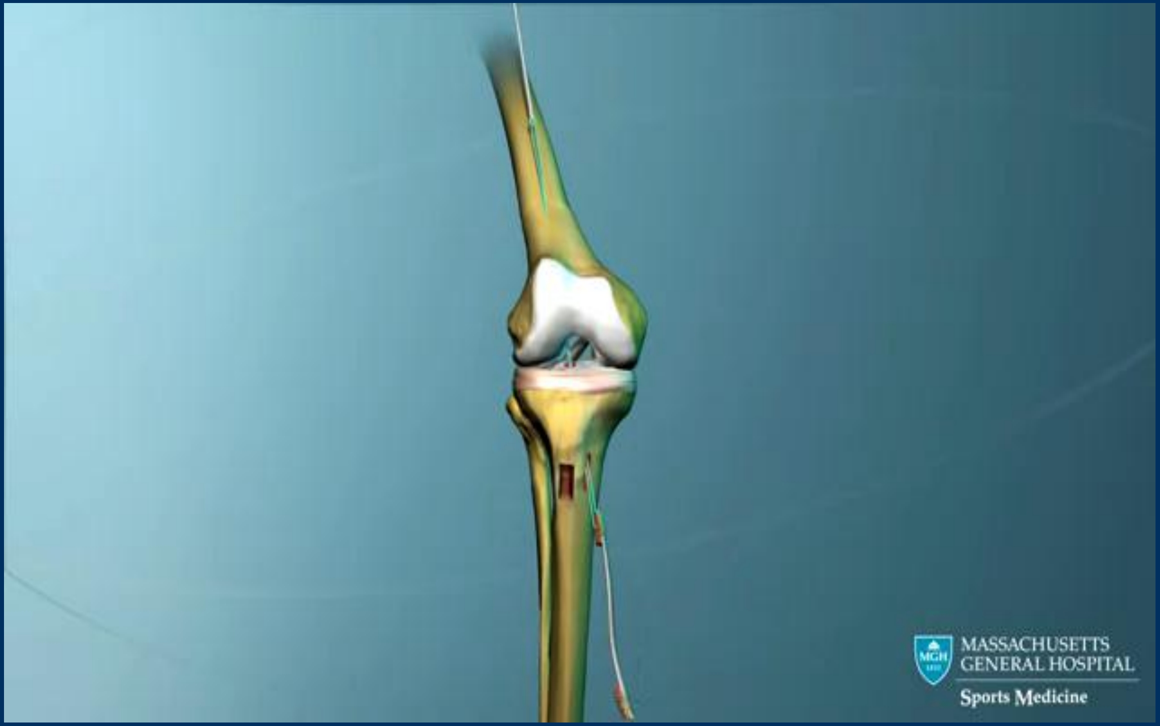
ACL RECONSTRUCTION

- GRAFT TENSIONING

- GRAFT PREPERATION

ACL RECONSTRUCTION

- GRAFT PASSAGE AND FIXATION



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THANK YOU