FRACTURE

- Presented by Dr.Pravin Verma

FRACTURE, DISLOCATION, SUBLUXATION

- FRACTURE→ When load applied to bone is > intrinsic strength of bone.

- DISLOCATION→ Complete disruption of joint, articular surfaces are no longer in contact.

- SUBLUXATION→ Partial dislocation.

- IMPORTANT FACTORS ABOUT LOAD→
  - Energy directly proportional to massXvelocity2
  - Direction of load(trauma)

- APPROACH TO FRACTURE→
  - Fracture itself
  - Search for more fractures on front & back
  - Multiple trauma/ polytrauma
  - Vital organ inj/ ABC Mx
  - Distal neurovascular compromise

CLASSIFICATION OF FRACTURES

- ON THE BASIS OF BONE IN RELATION TO LOAD
- BY DIRECTION OF FORCE
- BY ANATOMICAL SITE
- CLINICAL→ OPEN/CLOSED, SIMPLE/COMMINUTED
- BY Mx
- INTERNATIONAL CLASSICATION

CLASSIFICATION- BONE Vs LOAD

TYPE	BONE STRENGTH	LOAD
TRAUMATIC	NORMAL	ABNORMAL
PATHOLOGICAL	ABNORMAL	NORMAL
STRESS	WEAKENED WITH TIME-osteoporosis, tomour, steroid etc	NORMAL BUT REPEATED
GREENSTICK (PARTIAL)- one cortex X other N	ABNORMAL-CHILD bone is flexible, so buckles, bends	ABNORMAL

GREEN STICK FRACTURE

GREEN STICK FRACTURE

CLASSIFICATION- BY DIRECTION OF FORCE

1. COMPRESSION X→
- Abnormal load applied along length of bone, so bone collapses on itself.
- Elderly- osteoporotic bone
- Shortening of bone &/or angulation
- Difficult to diagnose clinically/ radiologically
- X-ray→ Overlap of cortical margins & medulla looks diffusely opaque.

2. AVULSION/ DISTRACTION X→
- Two fragments are pulled apart
- Strong muscles insert into small bones e.g. Patella- quadriceps, Olecranon- triceps, Head of fifth metatarsal- peronium terius

3 TRANSVERSE X→ Bone bent along its long axis

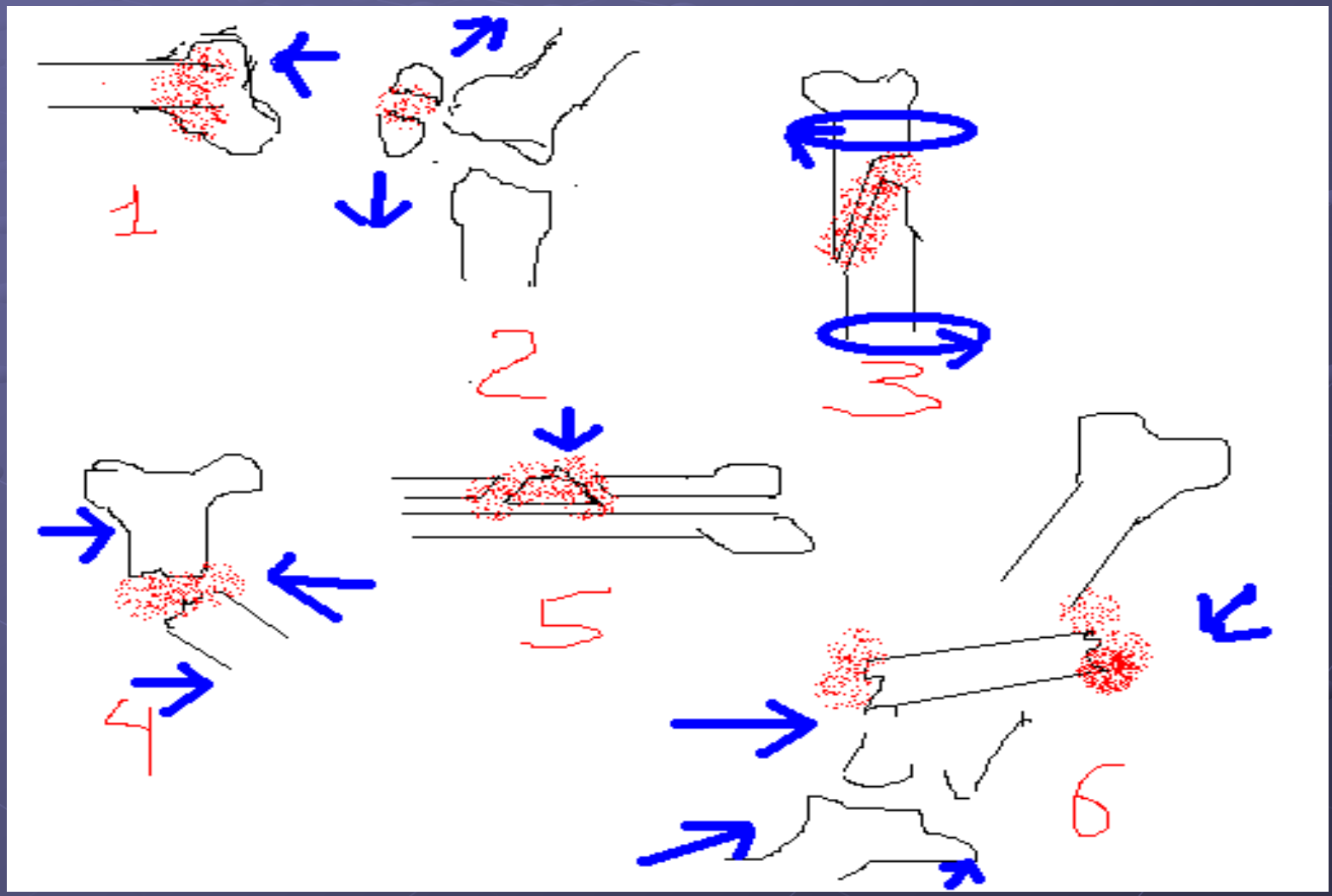
CLASSIFICATION- BY DIRECTION OF FORCE

- SPIRAL X→
- When bone is twisted along its long axis.
- Length may be underestimated, it may extend even to articular surface
- e.g. Tibia in players

- BUTTERFLY X→
- Caused by direct blow on bone
- Two oblique lines spread out obliquely.

- COMMINUTED X→
- When large amount of energy is dissipated into a bone.
- Multiple fragments which may get impacted or displaced.

CLASSIFICATION- BY DIRECTION OF FORCE



comminuted

TRANSVERSE FRACTURE

SPIRAL FRACTURE

WEDGE FRACTURE

COMMINUTED FRACTURE

CLASSIFICATION- BY ANATOMICAL SITE

- DIAPHYSIAL X→ Diaphysis is middle part of long bone & composed of thick cortex & medulla filled with trabecular bone.

- METAPHYSIAL X→ Between diaphysis & groth plate & composed of thinner cortex & medulla filled with trabecular bone.

- GROWTH PLATE (EPIPHYSIAL PLATE)→
- Imp- damage to growth plate may cause deformity, growth arrest & arthritis.

- EPIPHYSIAL X→ Epiphysis covered by thin cortical bone & thin articular cartilage. X may damage growth plate.

- INTRA-ARTICULAR X→ If anatomical reduction not done- arthritis/ deformity may develop.

CLASSIFICATION- BY ANATOMICAL SITE
EPIPHYSIAL FRACTURE CLASSIFICATION
SALTER-HARRIS

- GRADE I→
- Crack along metaphysial side of epiphysial plate
- No compromise to blood supply to epiphysial plate or no effect on anatomy of germinal layer.
- Rare fracture
- good prognosis

- GRADE II→
- X as in grade I + metaphysial fragment
- Problem-while delayed reduction growth plate may get damaged
- Very common
- Good prognosis

CLASSIFICATION- BY ANATOMICAL SITE
EPIPHYSIAL FRACTURE CLASSIFICATION
SALTER-HARRIS

- GRADE III→
- X crosses from metaphysis to epiphysis
- Rare
- Prognosis- poor if not reduced
- Problem- Bony union may occur across epiphysial plate & result in disfiguring

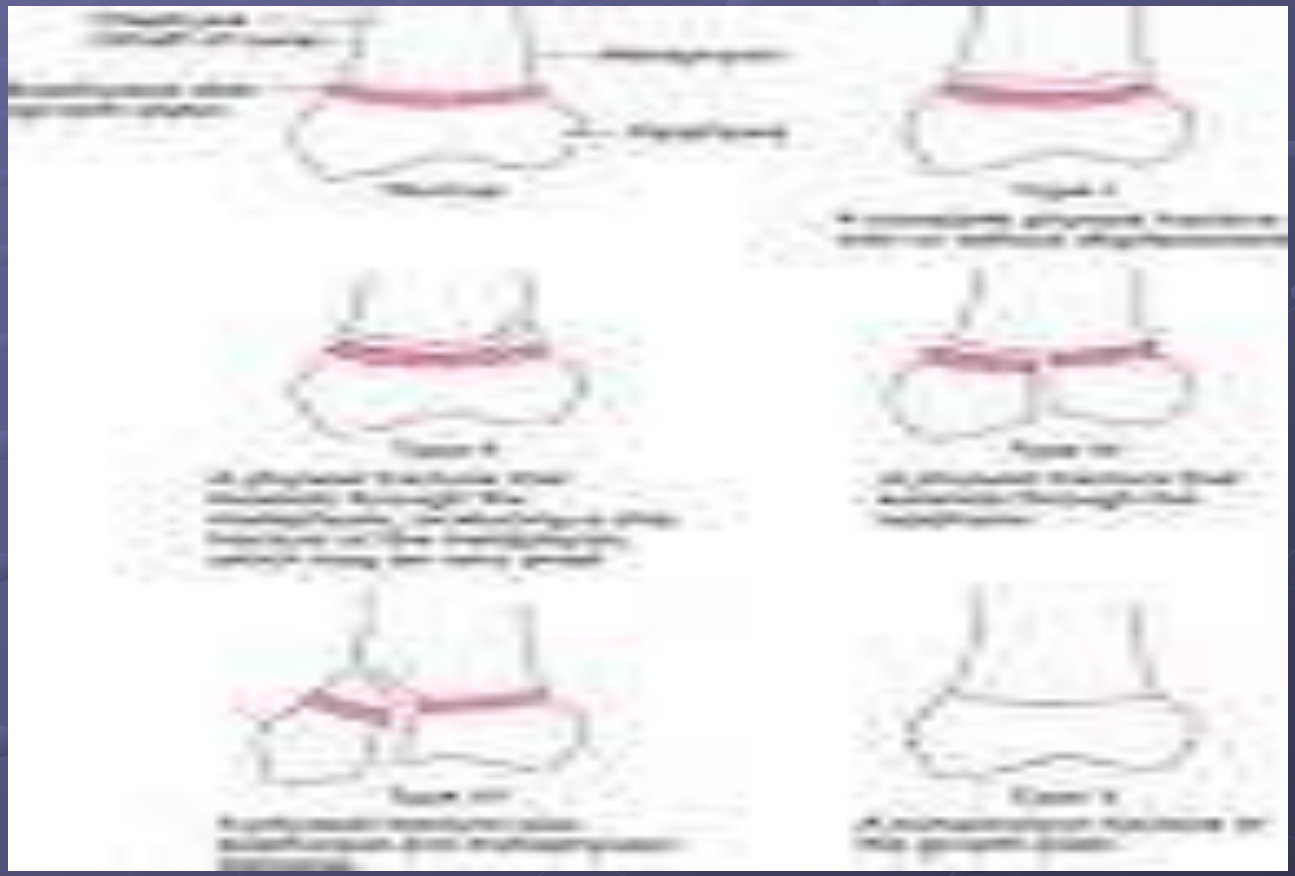
- GRADE IV→
- X line crosses across epiphysial side of growth plate
- Blood supply & anatomical integrity of germinal layer is lost, so anatomical reduction is compulsory
- Rare
- Prognosis- poor if not reduced anatomically

CLASSIFICATION- BY ANATOMICAL SITE EPIPHYSIAL FRACTURE CLASSIFICATION SALTER-HARRIS

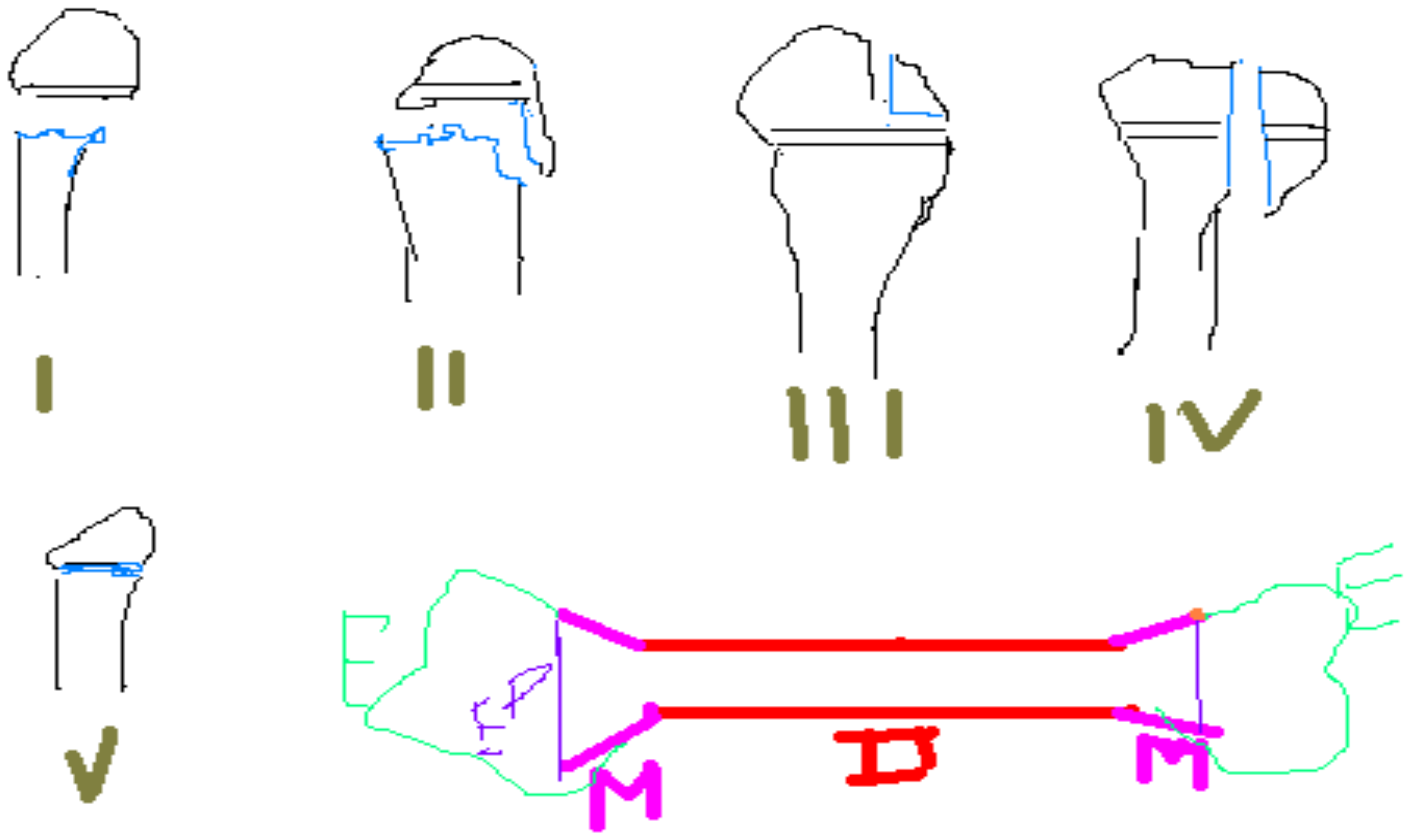
- GRADE V→
- Fracture crushes the epiphysial plate
- Diagnosis difficult, x-ray may look only in retrospect
- Very rare
- Prognosis- very poor

SALTER-HARRIS

SALTER-HARRIS



CLASSIFICATION- BY ANATOMICAL SITE EPIPHYSIAL FRACTURE CLASSIFICATION SALTER-HARRIS



CLASSIFICATION- CLINICAL

- CLOSED
- OPEN→ Chances of infection & foreign body
- SIMPLE
- COMMINUTED→
- IMPACTED
- DISPLACED

DISPLACED FRACTURE

CLASSIFICATION- BY Mx

STABLE OR UNSTABLE

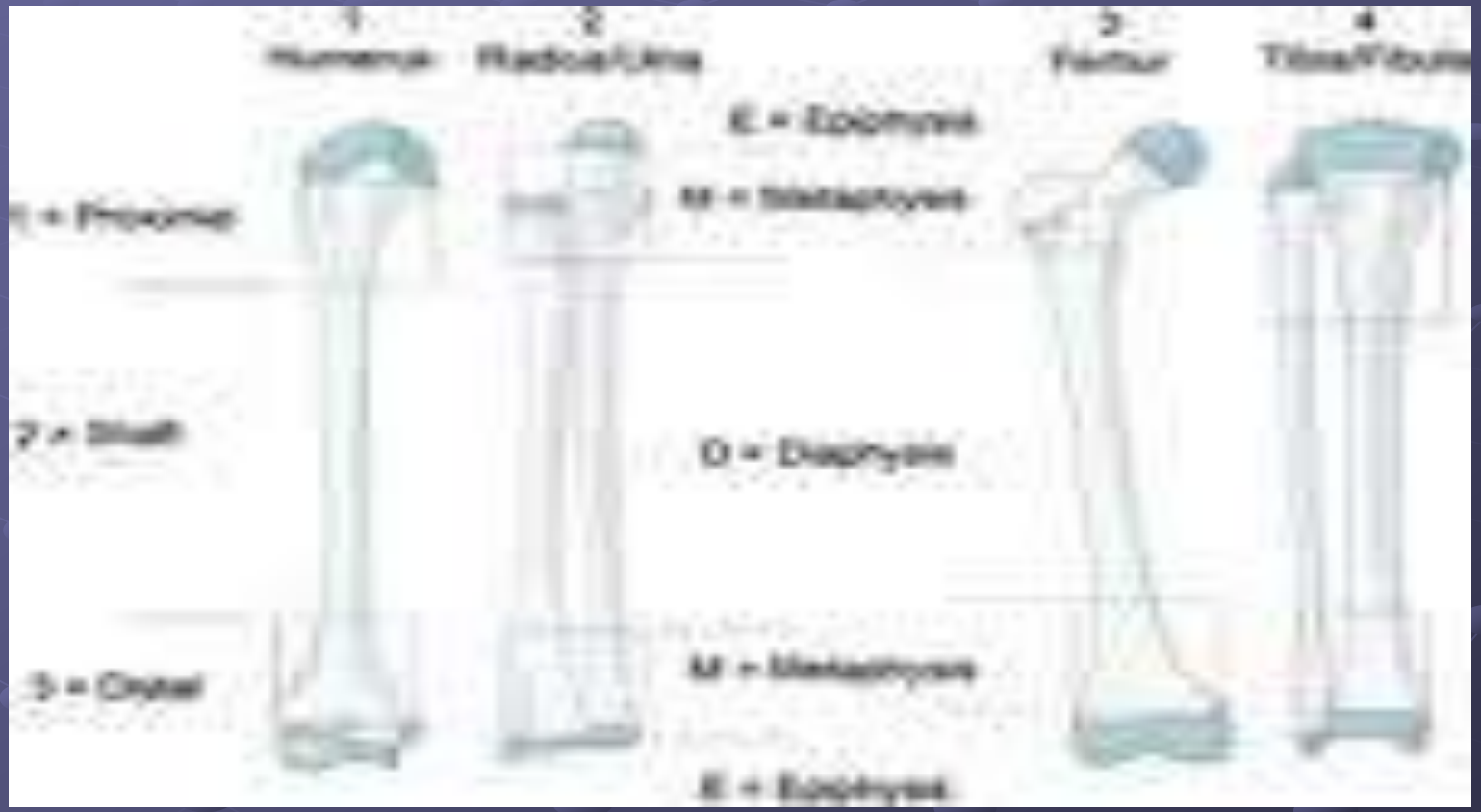
FACTORS AFFECTING STABILITY OF X→

- SITE- X of weight bearing bones are unstable while those of arms are stable
- SHAPE→ Spiral X- unstable, Displaced X- unstable, Impacted X- stable
- DISPLACEMENT- unstable
- BEHAVIOR OF PATiENT- Careful pt- stable X

CLASSIFICATION- INTERNATIONAL

- 1- Humerus, 2- Radio-ulna, 3- Femur, 4- Tibia-fibula
- 1- Proximal-metaphysial, 2- Mid Shaft-diaphysial, 3-distal metaphysial, 4- Malleolar- Ankle Only
- A-Extra-articular, B- Partial Articular, C- Intra-Articular
- A- Simple, B- Wedge-butterfly, C- Complex
- E.G.→ 11AB
- Fallacies→ Doesn't Include
  - Open/Closed
  - Displaced/ Not
  - Doesn't Include Soft Tissue Injury
  - Not Memorable
  - Doesn't Correspond With Rx & Prognosis

INTERNATIONAL CLASSIFICATION



INTERNATIONAL CLASSIFICATION

Mx OF FRACTURES

- HISTORY
- RECORD
- VITALS/ ABC
- DISTAL NEUROVASCULAR DAMAGE
- SEARCH FOR MORE Xs
- LOCAL Mx OF Xs

- PRINCIPLES OF Mx→

- REDUCTION→ Indicated only if displaced & malunion will compromise Fn or cosmosis

- HOLDING→ To prevent redisplacement, comfort, pain relief, early return to Fn

- REHABILITATION→ Reduce stiffness, build muscle power,.

REDUCTION

- NOT REQUIRED→
- If no displacement
- Displaced but delayed reduction may cause damage to growth plate as in c/o Gr II epiphyseal x in children (while if left unreduced malunion will be corrected by remodelling.
- When early return to function is more imp than cosmesis e.g. colle's x (distal radius) in old aged person

- EMERGENCY REDUCTION→
- If compromise to blood supply, nerve injury, soft tissue, skin or open x.
- Done without analgesia, RT aspiration of stomach if anaesthesia required

- PLANNED REDUCTION→
- Give pt splint & analgesics.
- NBM, OT under GA/ Regional anaesthesia

TYPES OF REDUCTION

CLOSED/ OPEN

- CLOSED REDUCTION→

- Best if possible
- relies on periosteum/ ligaments
- no chances of iatrogenic infection/ neurovascular compromise.
- accuracy is judged by X-ray.

- OPEN REDUCTION→ INDICATIONS

- OPEN X- wound needs opened up & washing out
- closed reduction impossible/ failed
- Displaced intra-articular x= perfect anatomical reduction required to prevent arthritis.
- Displaced intra-articular x in children= lack of ossification makes check of accuracy of reduction of x difficult
- Grossly unstable x= Needs internal fixation to provide stability & early mobilisation possible.

PROCEDURE & MANOUEVER OF REDUCTION

- PROCEDURE→
- EMERGENCY
- PLANNED

- MANOUEVER→
- Disimpaction of x
- Engaging the bone ends by ^sing the deformity
- Reduction- rolling x back into reduced position using periosteum to prevent over-correction.

HOLDING FRACTURE

- NON- RIGIT STABILIZATION→ POP CAST
- Allows some movement at x site- stimulates callus formation

- RIGID FIXATIO (IMPLANTS)→SREWS, PLATES, WIRES & NAILS
- No movement at x site- no callus formation (healing only by remodelling)
- Implant supports till x heals, may take upto 1 year.

SCREWS

- Used to fix plates or alone.
- TYPES→
- CORTICAL SCREW- Has fine thdreads to hold cortical bone.
- CANCELLOUS SCEW→ coarse threads to hold cancellous bone.
- LAG SCREW→ Proximal portion isnot having threads. (overdrilling of proximal cortex if cortical screw used acts as lag screw.
- PARTS→ TIP, SHAFT- thread & lag, SHOULDER, HEAD
- Distal fragment is held by tip & proximal by shaft.
- Instruments needed- drills, taps, mallet

PLATES

- BUTTRESS (SUPPORT) PLATES→

- Prevents slip of x fragments e.g. weight bearing bones- tibial condyle

- DCP (DYNAMIC COMPRESSION PLATE)→

- Two or four holes near x are oval, so while tightening screws x fragments are driven to each other= compression
- ADV-

. Better snug of construct

. Faster healing by close approximation

- NEUTRALIZATION PLATE→

- Resists distraction & angulation but less compression & bending
- used in fibula x near ankle.

NAILS

- Can be inserted closely
- anaesthesia is required
- medullary cavity is the guide
- position is checked by x-ray or image intensifier.
- LOCKING NAILS- by screws at proximal & distal ends, prevents twisting movement at x site, so early weight bearing & rehabilitation

wires

- ADV→
- Thin
- less traumatic
- easy & early to insert
- no damage to epiphyseal plate even when paased through it
- removal without anaesthesia

- USE→
- Temporarily on weight bearing bones
- Fixation of small bone x

- SPECIAL→
- TENSION BAND WIRING (FIG OF 8)→ For patella & olecranon

DISADVANTAGES OF IMPLANTS

- Prevents callus formation= delays healing
- Introduction of infection
- Iatrogenic neurovascular damage
- anaesthesia needed
- surgery required
- scar
- toxicity of implant
- allergy to implant material
- carrcinogenic- chromium, valadium
- local osteoporosis & stress

- → REMOVAL- NO, unless likely to compromise growth, as its difficult by periosteal bone growth over implant.

EXTERNAL FIXATORS

TYPE	LOW COST	EASY TO FIT	EASY TO ADJUST	RIGID	CONVINIENCE TO PT
PINS IN PLASTER	YES	YES	NO	NO	FAIR
SINGLE BAR FIXATOR	FAIR	FAIR	FAIR	FAIR	GOOD
TWO BAR FIXATOR	FAIR	FAIR	FAIR	YES	FAIR
RING FIXATOR	NO	NO	NO	YES	NO

USES OF EXTERNAL FIXATORS

- EMERGENCY USE
- PELVIC FRACTURE→

- Stabilizes x→ clots stabilize→ , bld→ , life threatening h'hage
- closes pelvis→ . Intra pelvic pressure→ venous temponade→ bld

n. b. – bar fixator with pins used as low as possible= so, doesn't disturb laparotoy if required.

- NEUROVASCULAR COMPROMISE→ Unstable x with loss of blood supply to limb

- Use external fixator to stabilize x sovascular surgeon may perform early. Disadv- may not be optimum to stabilize x, while . Inf chance if internal fixation required later.

n.b.- another approach is to insert stent to provide temporary blood supply to limb & do definitive ortho fixatn

- NON EMERGENCY USE→
- Extensive soft tissue damage in c/o open x, if bone cover not possible– external fixater with flap surgery.
- leg lenghening & correction of deformity.

DETERMINATION OF BONE UNION

- CLINICAL UNION→
- Load to the x doesn't cause movement/ pain
- x united but strength is < N bone

- RADIOLOGICAL UNION→
- Callus extending continuously without gap from one end to another, medulla may still show x
- x strength < N bone
- N wt bearing & movement may be started, but no heavy work/sporting without protection till consolidation.

- CONSOLIDATION→
- Completion of x healing process
- callus cuff around x > diameter of N bone
- Bone strength N/>N

REHABILITATION- RESTORING FUNCTION

- PREVIOUS PRINCIPLE→ rest & immobilization

- LATEST Mx PRICIPLE→ Stabilizing x & early mobilization of limb & pt to provide early return of fn, power & less stiffness.

- IMP OF PHYSIOTHERAPY→

- Early mobilization of limb with c/o not giving excessive loads to fixation
- instruction & advic eto pt for their own rehab
- builds up pt's confidence
- retrains proprioception– co-ordination between feedback loops of sensors of joint position & tendon load with motor nerve serving muscle

COMPLICATIONS OF FRACTURE

- EARLY LOCAL→
- PAIN
- SWELLING- may make ORIF closer difficult. Rx- RICE- rest, ice, compression=pneumatic, elevation
- FRACTURE BLISTERS- due to soft tissue trauma, fragile & burst quickely, so contaminated, no IF, risk of inf
- DEGLOVING INJURY- to skin & fat due to torn blood vessels from deeper layer- avulsion. Capillary refilling delayed, loss of sensation, remove all dead tissue & cover with flap.
- DISTAL NEUROVASCULAR DAMAGE- c/o tingling/numbness/loss of sensation/pulsation
- COMPARTMENT SYNDROME- tight dressing/ pop cast applied immediately (BETTER SLAB & NEXT DAY CAST), comp bld supply- muscle necrosis & fibrosis- volkemann's ischemic contracture.

COMPLICATIONS OF FRACTURE

- EARLY SYSTEMIC→
- HYPOVOLEMIC SHOCK
- FAT EMBOLISM
- POLYTRAUMA
- VITAL ORGAN DAMAGE- shock lung, liver

COMPLICATIONS OF FRACTURE

- LATE LOCAL→
- INFECTION- cellulitis, osteomyelitis. Prvention- remove all dead necrotic tissue including bone & left open till inf cured
- ATROPHIC NON-UNION- damage to blood supply of bone by energy of x or handelling during surgery. X ends pointed, no callus.
- HYPERTROPHIC NON-UNION- excessive movement at x site. Overabundent callus but persisting cleft.
- MALUNION- union in bad position, ugly look, fn compro. Due to no proper protection/ less frquent follow up.
- EARLY OSTEOARTHRITIS- intraarticular x not reduced anatomically.
- GROWTH ARREST & SHORTENING OF LIMB- Epiphyseal x.

COMPLICATIONS OF FRACTURE

- LATE SYSTEMIC→
- MODS/MOSF- due to hypovolemic shock
- ATN- due to myoglobinuria, due to extensive soft tissue damage.
- INFECTION- Gas gangrene, septicemia
- SHOCKED LUNG- failure & stiffness of lungs after few days. Due to hypovolemic insult
- PSYCHIATRIC DISORDERS- depression due to event/ accident, lost relatives, lost limb, pain, hospitalization