

FRACTURE HEALING

DR M F BHAT



HOW FRACTURES HEAL

THE PROCESS OF
FRACTURE REPAIR VARIES
ACCORDING TO THE TYPE
OF BONE INVOLVED AND
AMOUNT OF MOVEMENT
AT THE FRACTURE SITE



HEALING BY CALLUS

- THIS IS NATURAL FORM OF HEALING IN TUBULAR BONES IN THE ABSENCE OF RIGID FIXATION , IT PROCEEDS IN 5 STAGES

1. TISSUE DESTRUCTION AND HAEMATOMA FORMATION

=VESSELS ARE TORN—
HEMATOMA AROUND &
WITHIN # .

=BONE AT # SITE DEPRIVED
OF BLOOD SUPPLY DIES
BACK FOR FEW MM



2. INFLAMMATION AND CELLULAR PROLIFERATION

- WITHIN 8 HRS OF # THERE'S ACUTE INFLAMMATORY RXN WITH MIGRATION OF INFLAMMATORY CELLS— PROLIFERATION & DIFFERENTIATION OF MESENCHYMAL CELLS OF FROM PERIOSTEUM, MEDULLARY CANAL AND MUSCLES.
- =ENDS ARE SURROUNDED BY CELLULAR TISSUE CREATING SCAFFOLD ACROSS #
- =INFLAMMATORY MEDIATORS INVOLVED[CYTOKINES ; GROWTH FACTORS
- =HEMATOMA ABSORBED & FINE CAPILLARIES GROW IN THE AREA]



3. CALLUS FORMATION

- DIFFERENTIATING STEM CELLS PROVIDE CHONDROGENIC & OSTEOGENIC CELLS AND THEY LL START FORMING BONE OR CARTILAGE DEPENDING ON BIOLOGICAL AND BIOMECHANICAL ENVIRONMENT
- =CELLS INCLUDED OSTEOCLASTS WHICH MOP UP DEAD BONE
- =THICK CELLULAR MASS, WITH ITS ISLANDS OF IMMATURE WOVEN BONE & CARTILAGE, FORMS THE CALLUS OR SPLINT ON THE PERIOSTEAL & ENDOSTEAL SURFACE.
- =AS THE IMMATURE BONE BECOMES DENSELY MINERALISED, MOVEMENT AT # SITE DECREASES AND FRACTURE UNITES.



4. CONSOLIDATION

- WITH CONTINUING OSTEOCLASTIC AND O'Blastic ACTIVITY WOVEN BONE IS TURNED INTO LAMELLAR BONE.
- =OSTEOCLASTS BURROW THROUGH THE DEBRIS AT # LINE
- OSTEOBLASTS FILL IN THE REMAINING GAP
- PROCESS CONTINUES FOR MONTHS



5 REMODELLING

- CRUDE WELD IS RESHAPED BY A CONTINUOUS PROCESS OF OSTEOCLASTIC AND OSTEOBLASTIC ACTIVITY
- THICKER LAMELLA ARE LAID WHERE STRESS IS HIGHER, UNWANTED BUTTRESSES ARE CARVED AWAY AND MEDULLARY CANAL IS REFORMED



HEALING BY DIRECT UNION

- IF THE FRACTURE IS ABSOLUTLY IMMOBILE LIKE IN IMPACTED FRACTURE OR AFTER RIGID FIXATION
- THERE'S NO MOVEMENT AND NO EXTERNAL CALLUS
- OSTEOLASTIC BONE FORMATION OCCURS DIRECTLY BETWEEN BONE ENDS
- GAP AT # SITE IS INVADED BY NEW CAPILLARIES & OSTEOPROGENITOR CELLS GROWING FROM THE ENDS AND NEW BONE IS LAID DOWN ON EXPOSED SURFACE —GAP HEALING

- IN NARROW CREVICES [<200 microm] lamellar bone is laid, wider gaps are initially filled with woven bone which is replaced by lamellar bone
- By 4 weeks osteoclastic CUTTING CONES penetrate the area followed by osteoblasts .
- Where surfaces are in intimate contact and held rigidly from the outset-contact healing occurs i.e without intermediate stage

- Healing by callus has distinct advantage
- It ensures mechanical strength while bone ends heal
- With increasing stress callus grows stronger and stronger
- With rigid fixation absence of callus means , there's a long period during which bone depends entirely on implant for integrity

UNION

CONSOLIDATIO N AND NON- UNION



UNION

UNION IS INCOMPLETE REPAIR
UNSHEATHING CALLUS IS
CALCIFIED.

=TENDER & PAINFUL TO
ANGULATION

=X RAY SHOWS # LINE

=REPAIR IS INCOMPLETE AND
UNPROTECTED STRESS IS UNSAFE



CONSOLIDATION

- COMPLETE REPAIR
- =CALCIFIED CALLUS
OSSIFIED
- NON TENDER
ANGULATION PAINLESS
- X RAY BRIDGING
TABECULLAE
- WEIGHT BEARING SAFE



NON-UNION

- PROCESS FAILS TO START OR IS THWARTED
- CAUSES COULD BE EXTERNAL OR INTERNAL
- SEPTIC OR ASEPTIC
- TREATMENT IS CASE AND CAUSE SPECIFIC



THANKS

