Principle of orthopedic implants

Present:

Mr. M. Bahrami

Compiler:

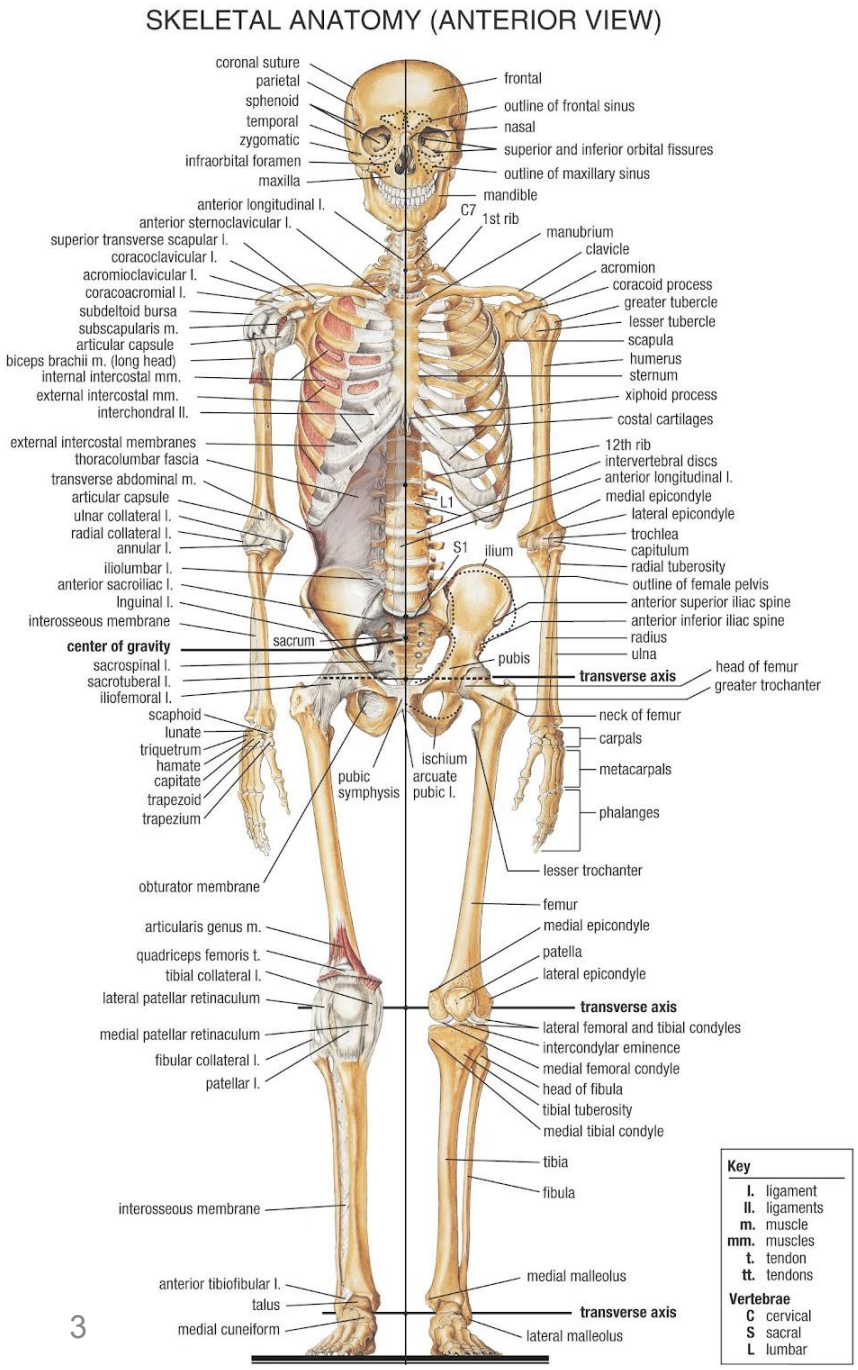
MS.L.Taheri

Autumn2015

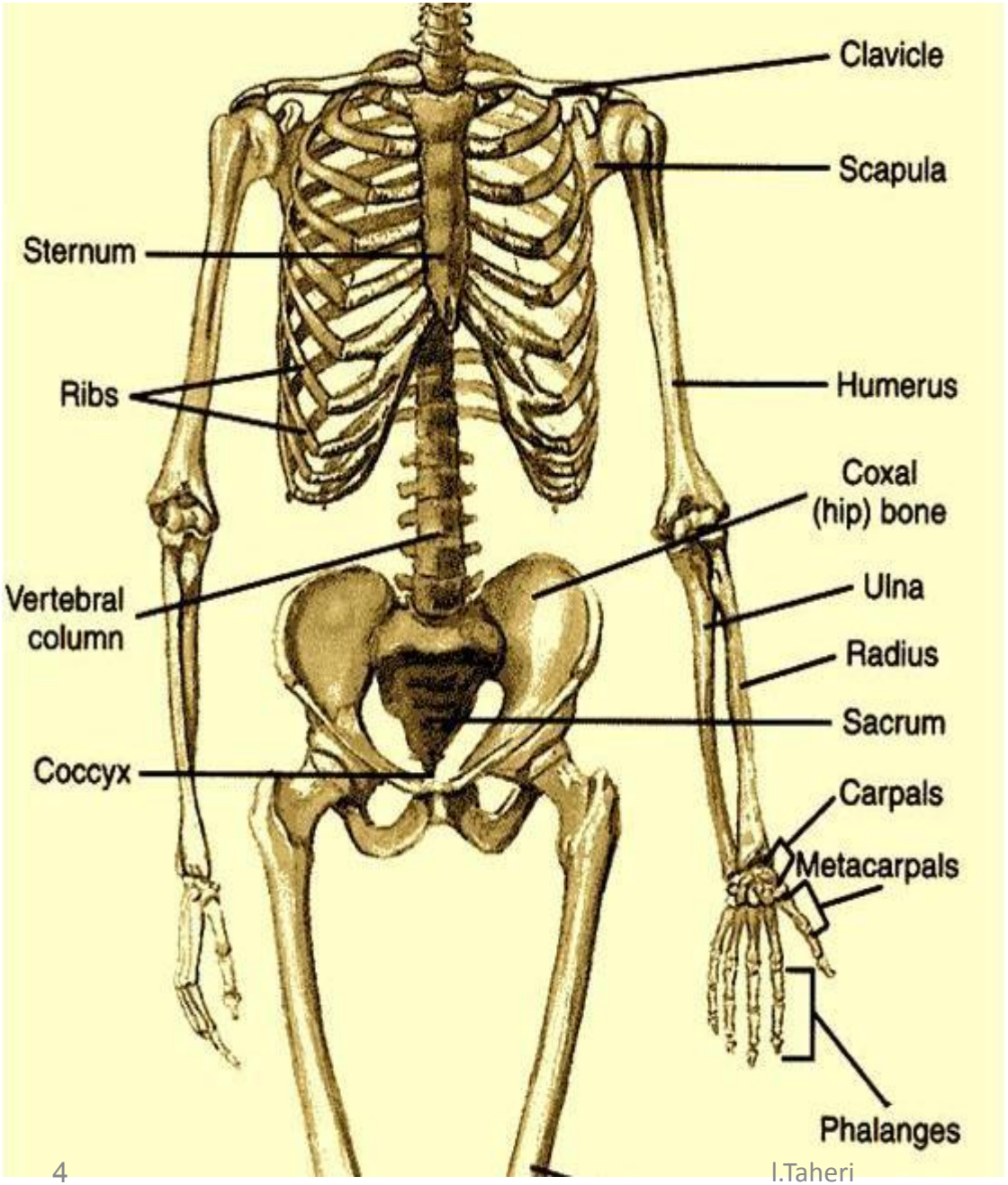
Orthopedic Implants

- Bone anatomy
- Screws
- Plates
- Nails
- External fixator
- Arthroplasty
- Bone grafts
- Bone cement

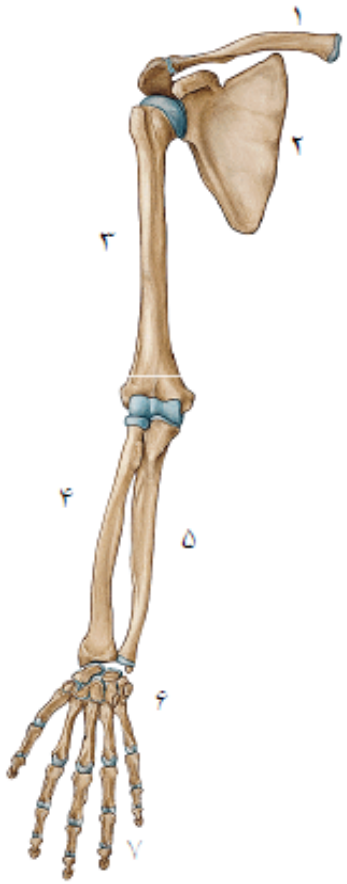
Bone Anatomy



Bone Anatomy



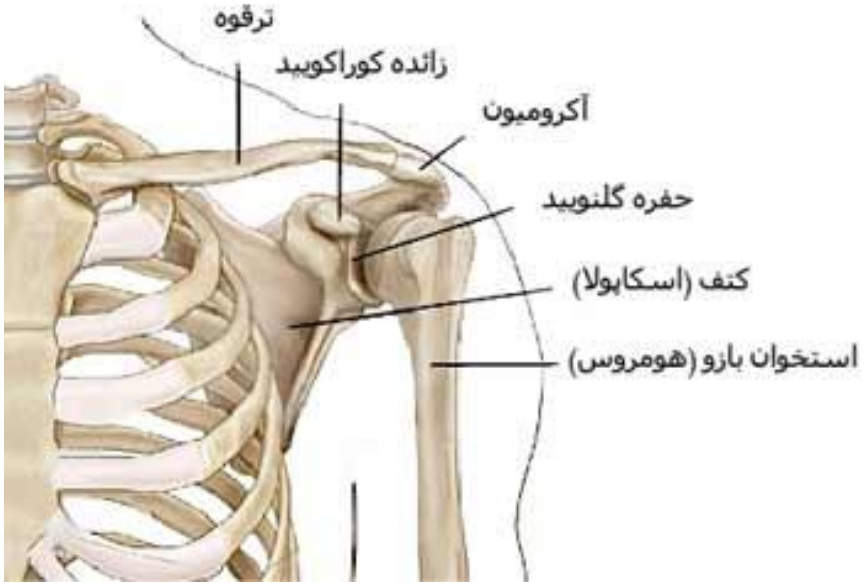
اسکلت اندام فوقانی



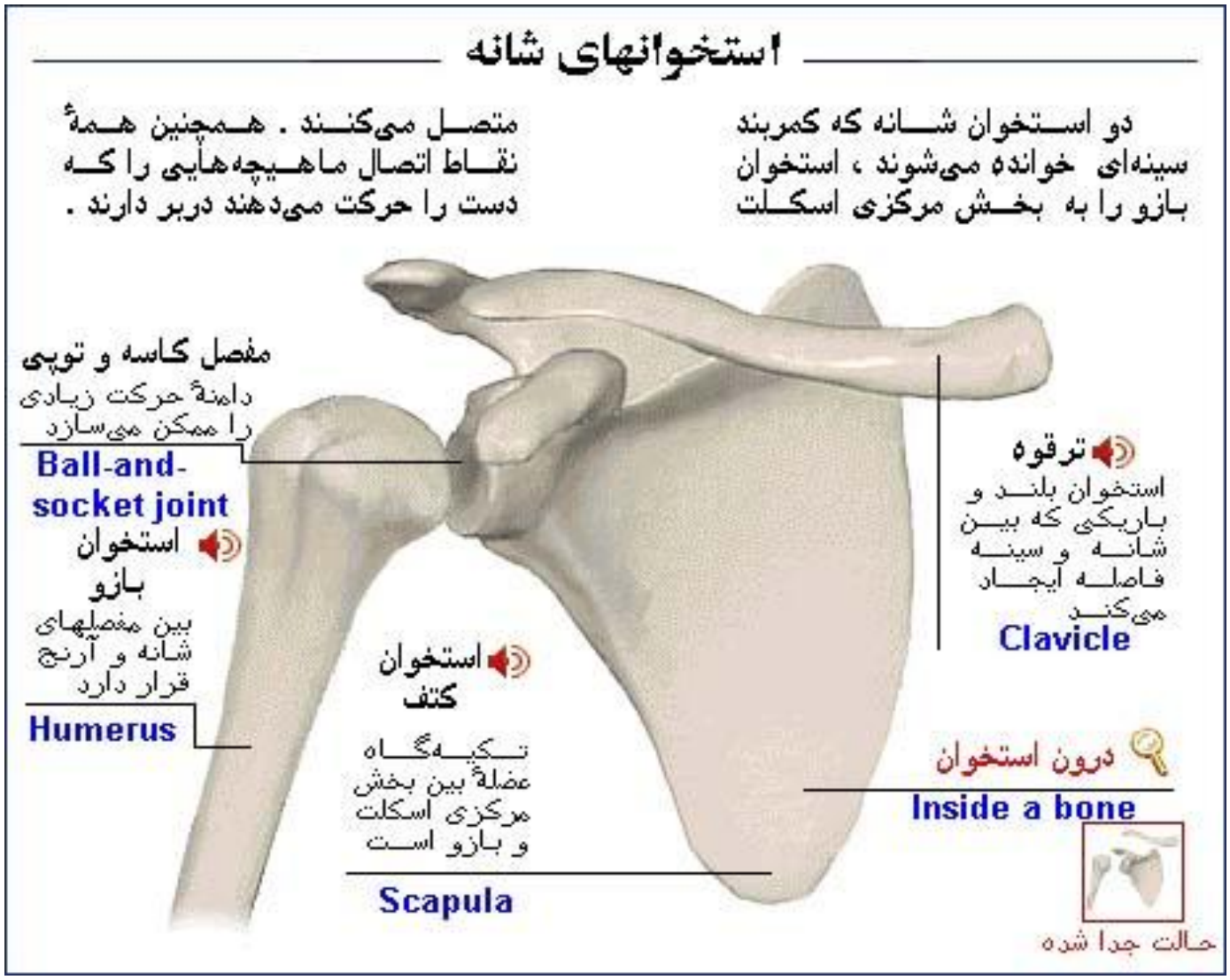
- استخوان چمبر (ترقوه) Clavicle
- استخوان شانه Scapula
- استخوان بازو Humerus
- استخوانهای ساعد: زند زبرین Radius و زند زیرین Ulna
- استخوانهای مچ دست Carpus
- استخوانهای کف دست Meta Carpus
- استخوانهای انگشتان Phalanx

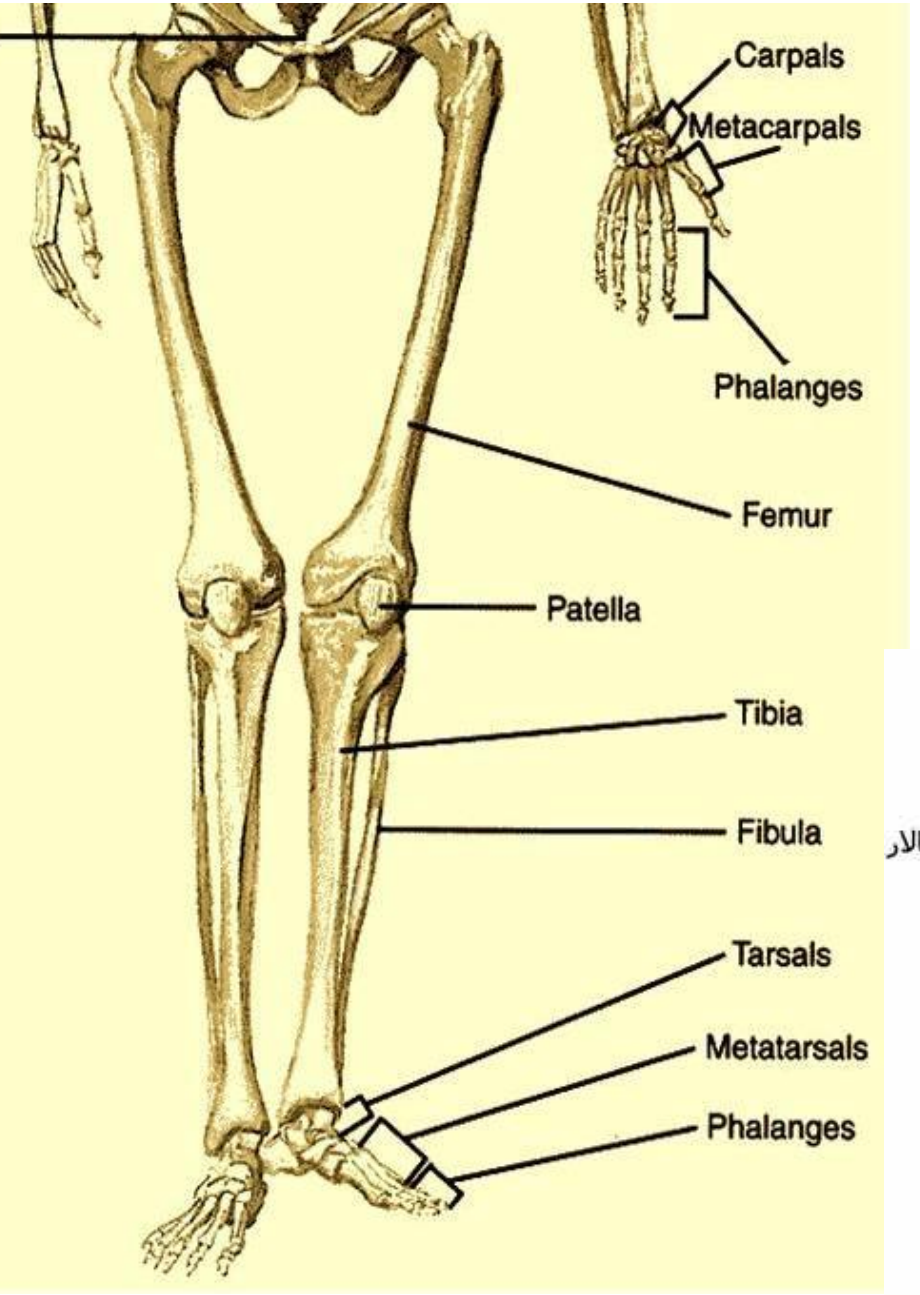
استخوان ترقوه

ترقوه یا کلاویکل Clavicleاستخوانی است به شکل Sالبته با انحنای کمتر که در جلوی قفسه سینه قرار گرفته است. این استخوان از طرف داخل با استخوان جناق مفصل میشود و در طرف خارج با زائده آکرومیون از استخوان کتف مفصل آکرومیوکلاویکولر را بوجود میاورد

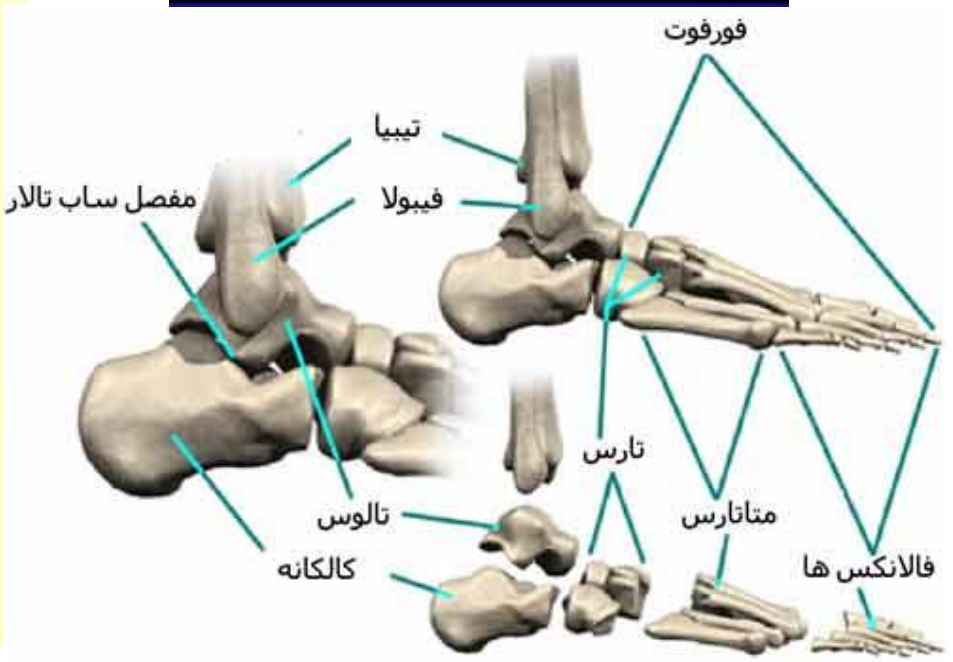


Bone Anatomy

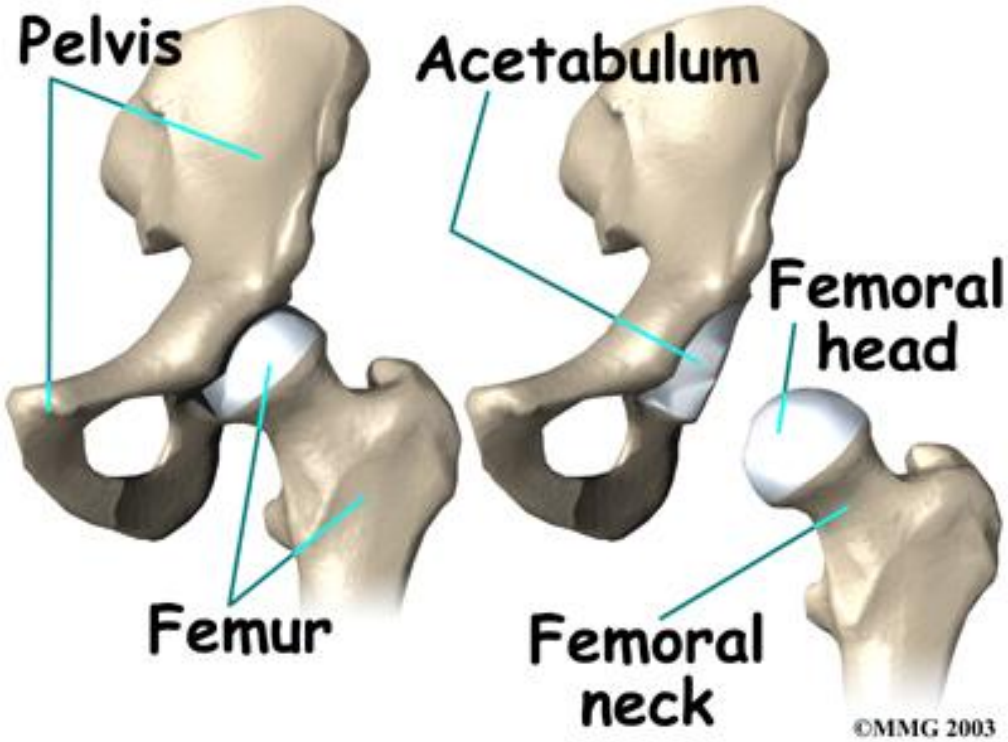


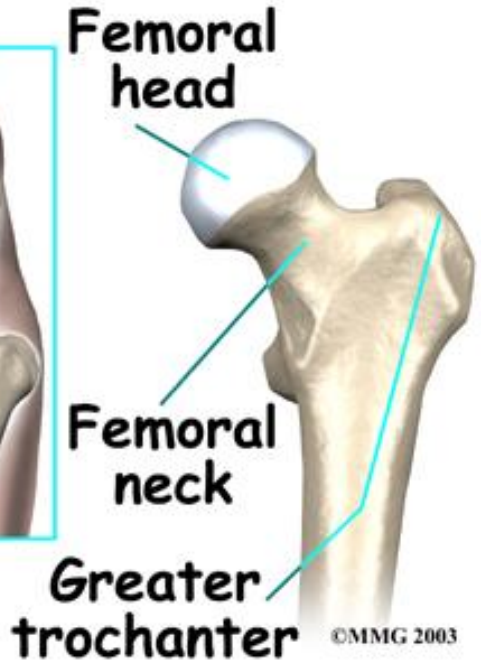

Carpals
Metacarpals
Phalanges
Femur
Patella
Tibia
Fibula
Tarsals
Metatarsals
Phalanges


تیبیا
فیبولا
تالوس
پاشنه

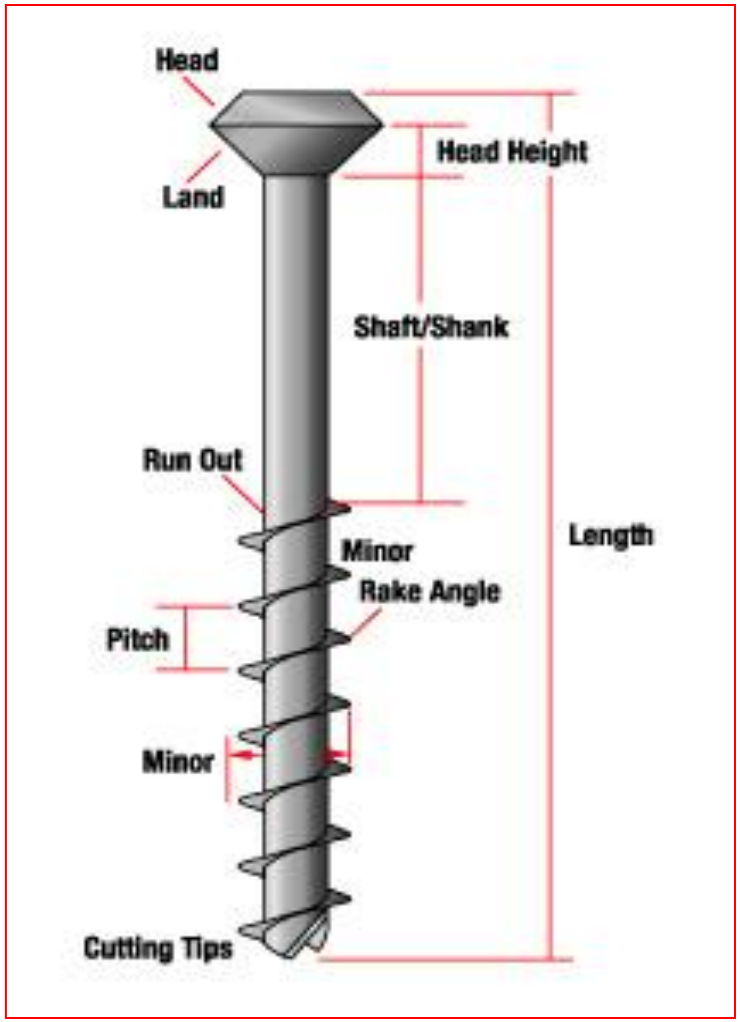

فورفوت
تیبیا
مفصل ساب تالار
فیبولا
تارس
تالوس
متاتارس
کالکانه
فالانکس ها

Bone Anatomy

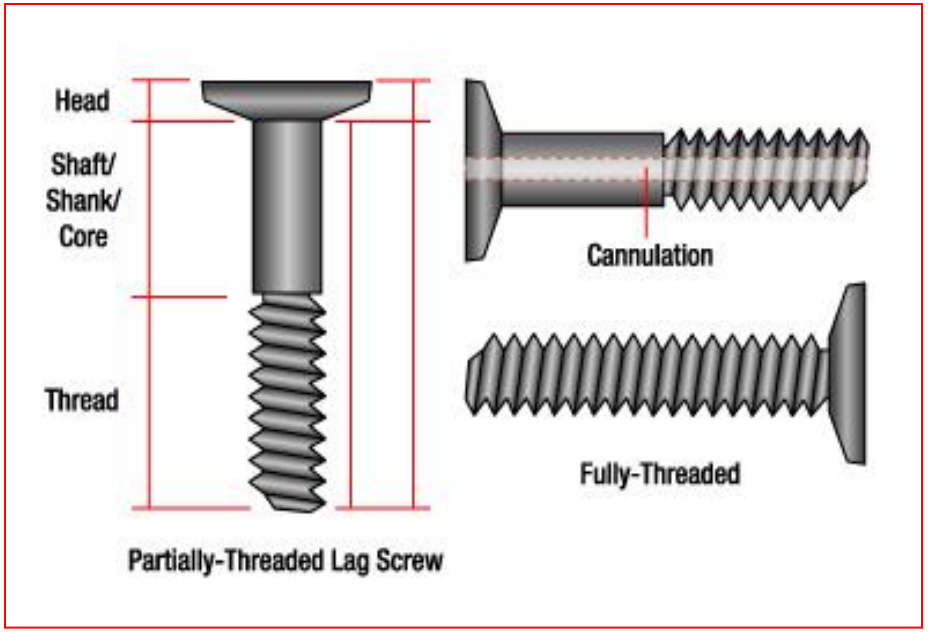




SCREWS



ANATOMY



Screws

- **PARTS**
- **Head** :- spherical

  - 8mm

  - hemispherical undersurface (allows optimal annular contact even at angle

  - hexagonal socket of 3.5mm dia
- **Thread** : design – factor determing the holding power

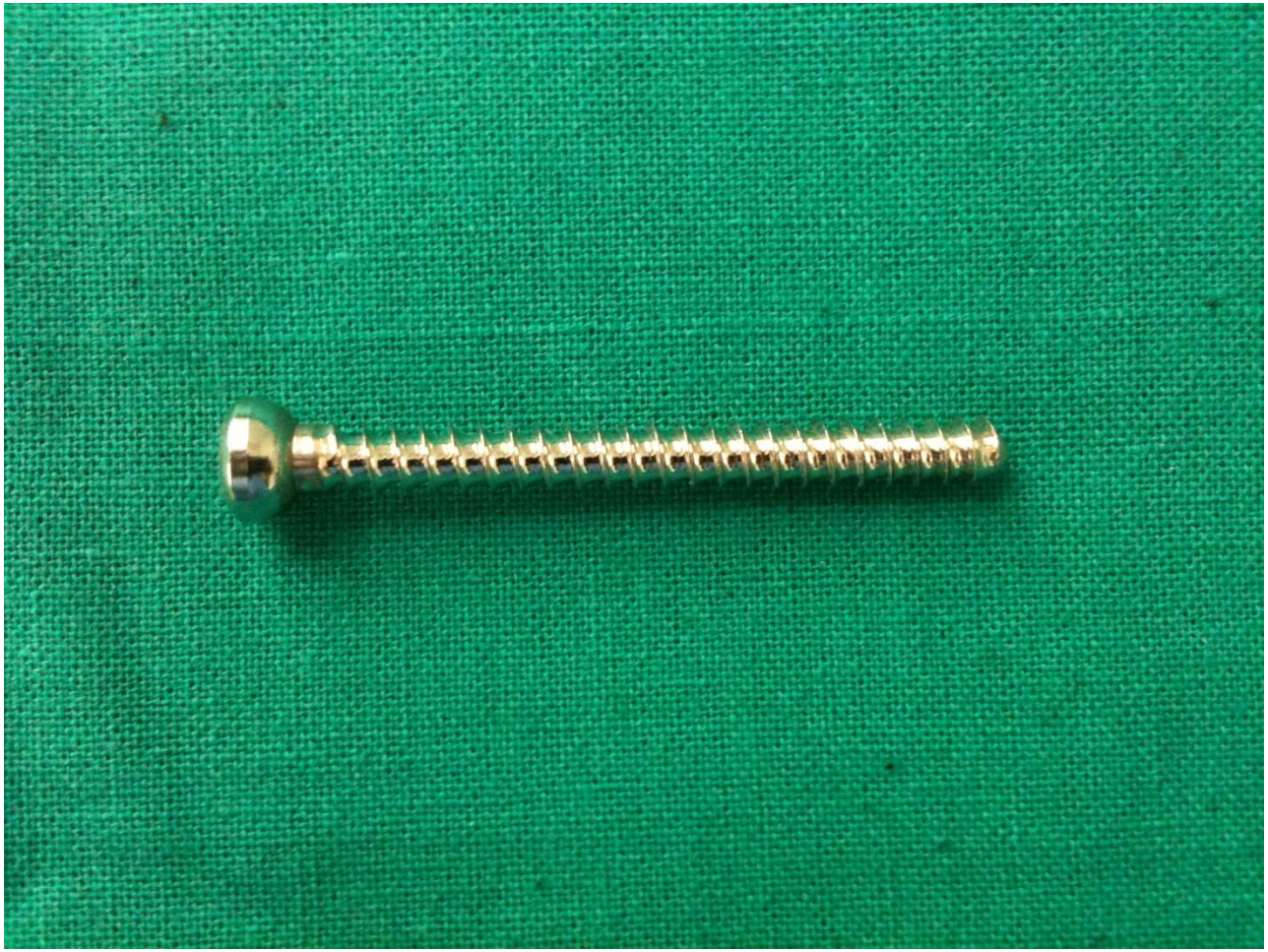
  - in cortical bone: shallow thread and fine pitch

- in cancellous bone: deep thread
  coarse pitch

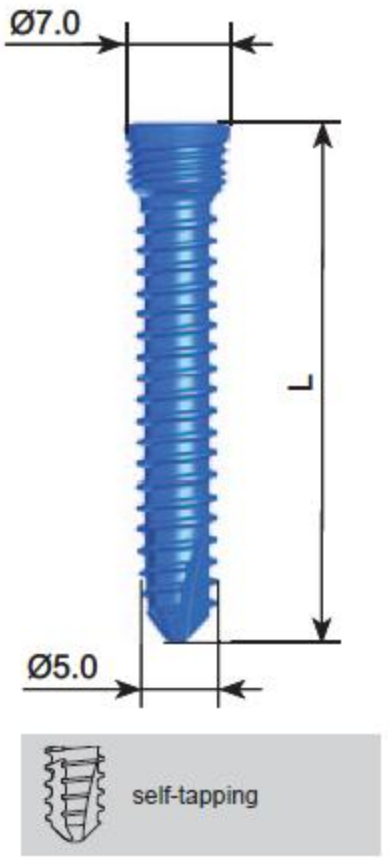
- **Pitch** : distance between adjacent threads
  - in cortical screw: 1.75 mm
    or 40.5 TPI (threads per inch)
  - in cancellous screw: 2.75mm or 9.2 TPI
- <u>Prerequisite for optimal holding power:</u>
  - thread hole = core dia of screw
  - threads cut should correspond to the screw thread

- **Core diameter** : core is the solid stem from which threads project
  - also called inside or root diameter
  - 4.5mm cortical screw
    6.5mm cancellous screw } 3 mm dia
    malleolar screw
  - *determines the size of drill bit for pilot hole*
- TWO MAIN PURPOSES OF SCREW:
  - interfragmentary compression
  - fixation of plate to bone

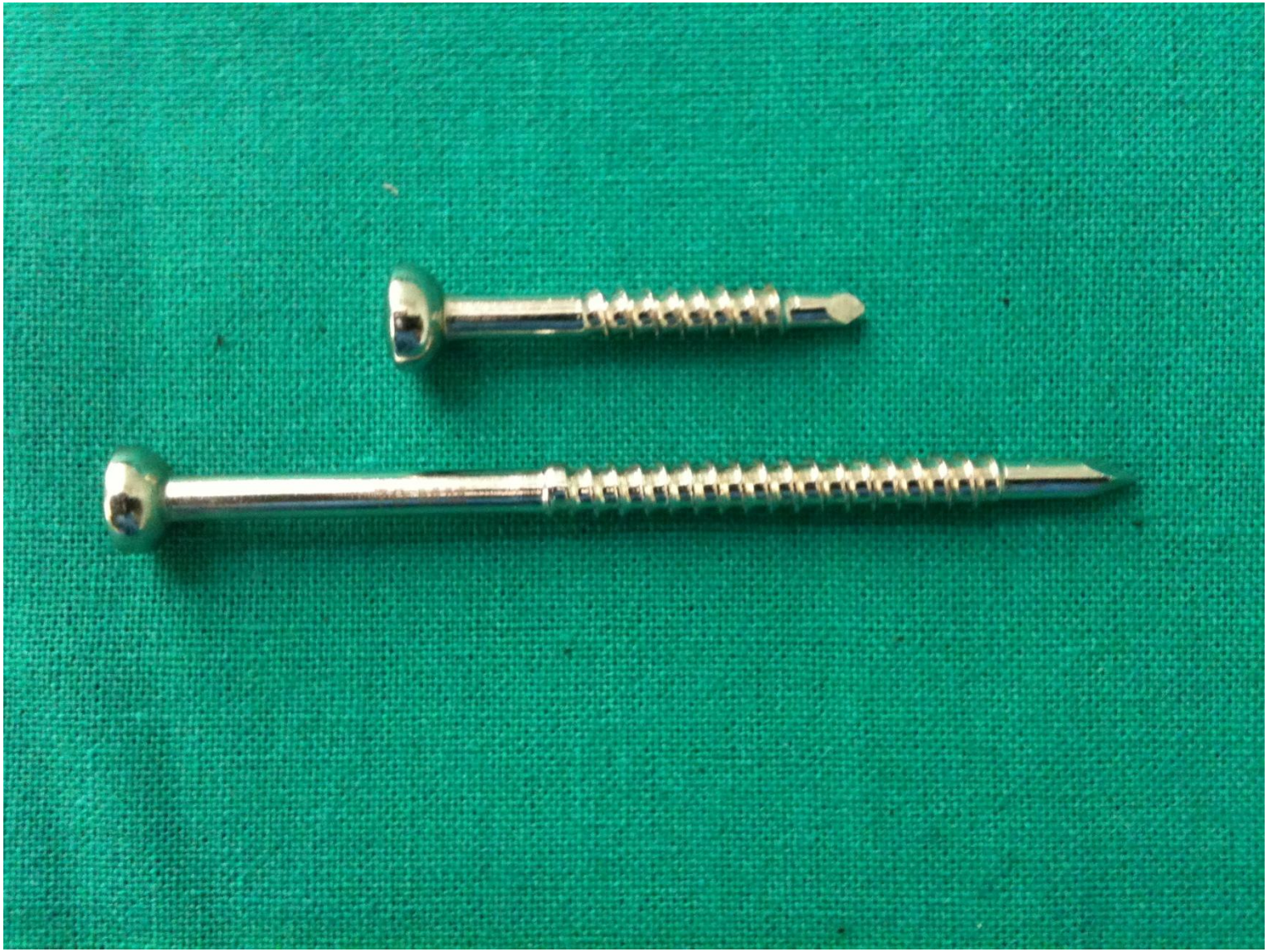
- TYPES: - CORTICAL
  - CANCELLOUS
- **CORTICAL: -** non self cutting (threads have to be cut)
  - fully threaded
  - partially threaded (also called **shaft screws**)
  - threads should engage entire far cortex
  - sizes : 14 mm – 110 mm
  - holding power : 250 kg **(** in hard cortical bone)



- **CANCELLOUS SCREWS:**
  - fully threaded : used as plate fixation screws
  - partially threaded : (16 mm or 32 mm thread length) used as lag screws
  - holding power is increased when screw itself creates threads
  - engaging far cortex increases the holding power (only needed in porotic bone) , as tip is pointed care must be taken


Ø7.0
L
Ø5.0
self-tapping

- MALLEOLAR SCREW:
  - smooth shaft
  - partially threaded
  - trephine tip : no tapping needed
  - was designed as lag screw for malleoli fixation NOW small cancellous screws preffered
  - also used in distal humerus , lesser trochanter
  - size : 25mm – 75 mm



	Cortical screw	Cancellous screw	Malleolar screw
head diameter	8mm	8mm	8 mm
Socket width	3.5mm	3.5mm	3.5mm
Core diameter	3 mm	3mm	3mm
Thread diameter	4.5 mm	6.5mm	4.5mm
pitch	1.75 mm	2.75 mm	1.75 mm
Tap diameter	4.5mm	6.5mm	4.5 mm (rare)
Shaft diameter		4.5mm	3mm

- **WASHER :**

  - flat side: rests on bone

  - countersunk side: accepts screw head

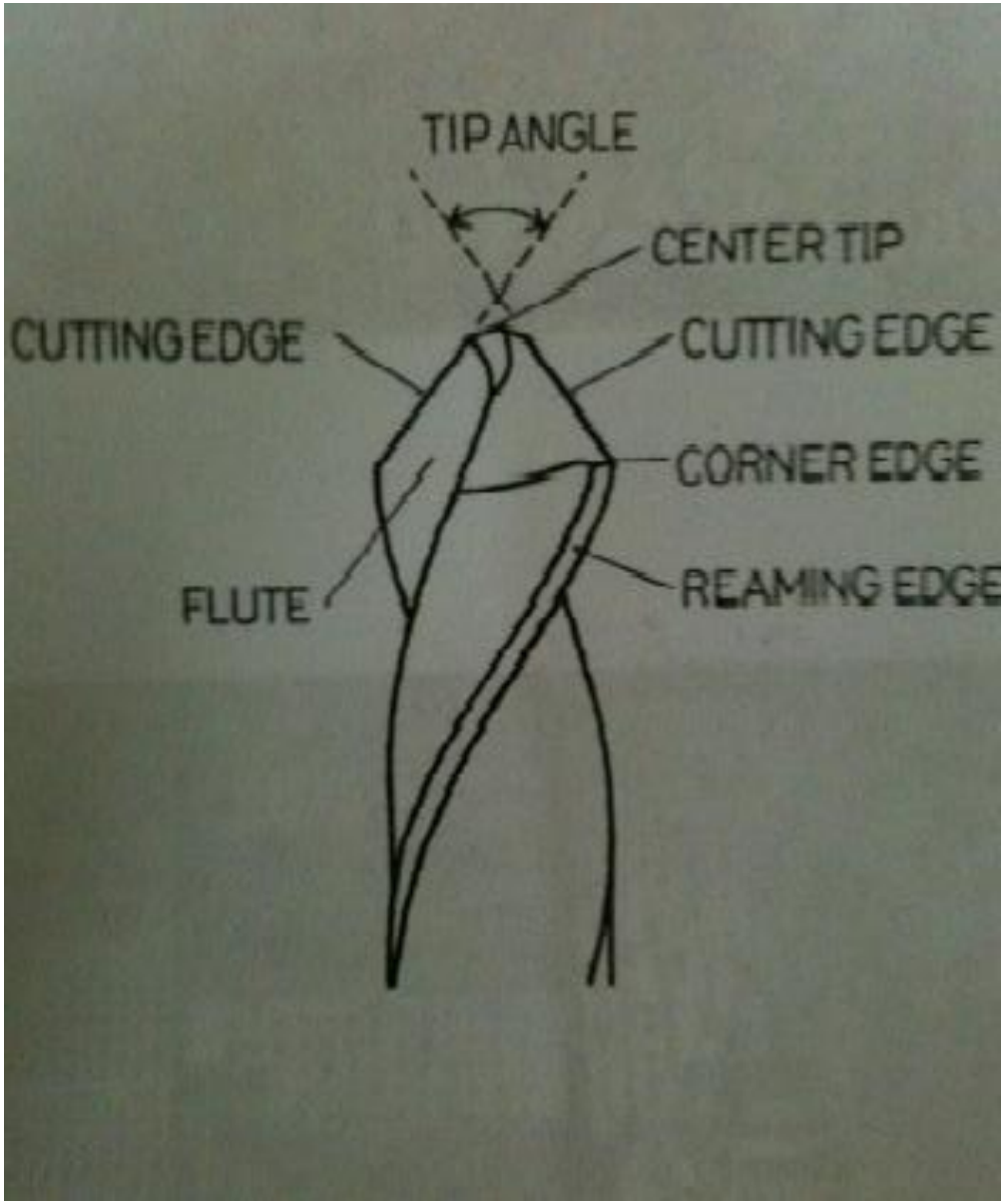
  - prevents screw from breaking through

    thin cortex in metaphysis

DRILL BIT

- To provide optimal cutting with as little thermal damage to bone

- **Effectiveness**:- wear
  - Material
  -Design of cutting edge
- **Parts**:
  -centre tip: ensures safe first bite
  -cutting edge: actual cutting
  -flutes: debris transported away


TIP ANGLE
CENTER TIP
CUTTING EDGE
CUTTING EDGE
CORNER EDGE
FLUTE
REAMING EDGE

- Standard drill bit : two flutes
- Three fluted : drilling at oblique angles
  - reduced skidding on bone
- cannulated drill bits are available
- Calibrated drill bits are available
  - in pelvic surgeries
- Heat production decreased by continuous irrigation : RL preferred
  - regular check and replacement

- Always used in sleeves of corresponding size

  - drill bit must be stationary (not rotating)

- **3.2 mm bit**: for - 4.5 mm cortical screws
  - 6.5 mm cancellous screws
  - malleolar screws
- **4.5 mm bit**: for- gliding hole with 4.5mm cortical screw
  - if 6.5mm cancellous screw is to be inserted through cortical bone at entry

- **2 mm bit** : to pre-drill for K-wires and guide wires

TAP

- To cut threads in bone of same size as the screw to facilitate insertion
- Flutes : to clear the bone debris
- Two turns forward and half turn backward recommended to clear debris
- Used with sleeve
- Done manually
- Power tapping NOT recommended
- For cancellous bone : short and wide thread , slightly smaller dia than screw

- For cortical screws :
  - as fixation screw : both cortices
  - as lag screw : only far cortex
- For cancellous screw:
  - only near cortex
  - sometimes in young pt.s tapping entire screw length needed

- **<u>LAG SCREW TECHNIQUE</u>** :
  - to achieve interfragmentary compression
  - this tech. is used if a screw is to be inserted across a **#** , even through a plate.
- PRINCIPLE :
  screw has no purchase in near fragment,
  thread grips the far fragment only
- Achieved either with screw with shaft or fully threaded screw

- Positioning of screws:

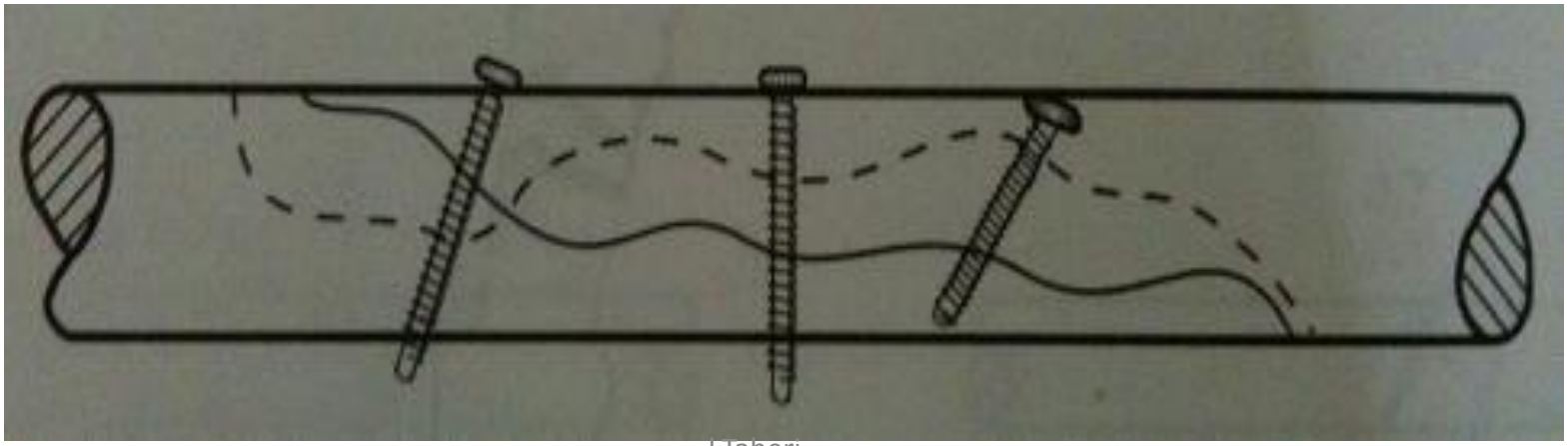
  -max. interfragmentary compression :

  placed in middle of fragment,

  right angle to fracture plane

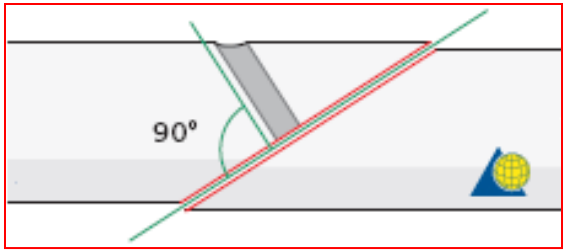
  - max. axial stability: right angle to long

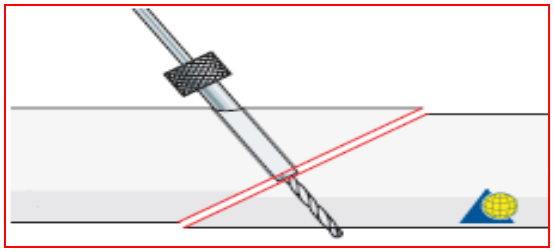
  axis of bone

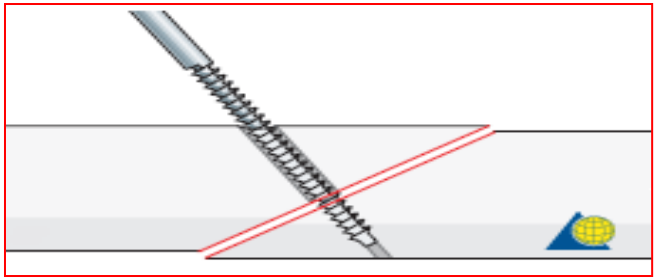


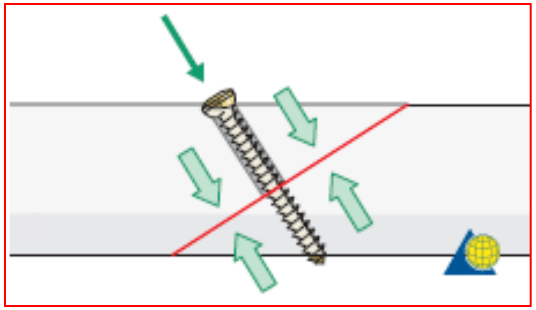
- In the near fragment :
  - gliding or clearance hole
  - equal in size to thread diameter
- In far fragment :
  - thread hole
  - slightly larger than core diameter , then tapped.

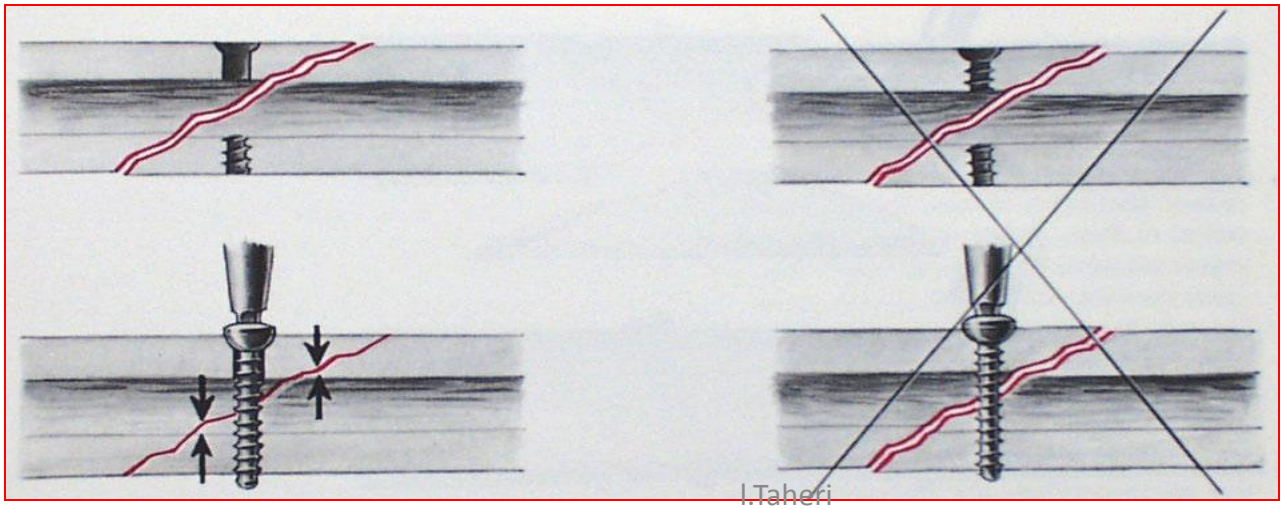
Screw size	Thread hole	Gliding hole
4.5 mm	3.2 mm	4.5 mm
3.5 mm	2.5 mm	3.5 mm
2.7 mm	2.0 mm	2.7 mm


90°



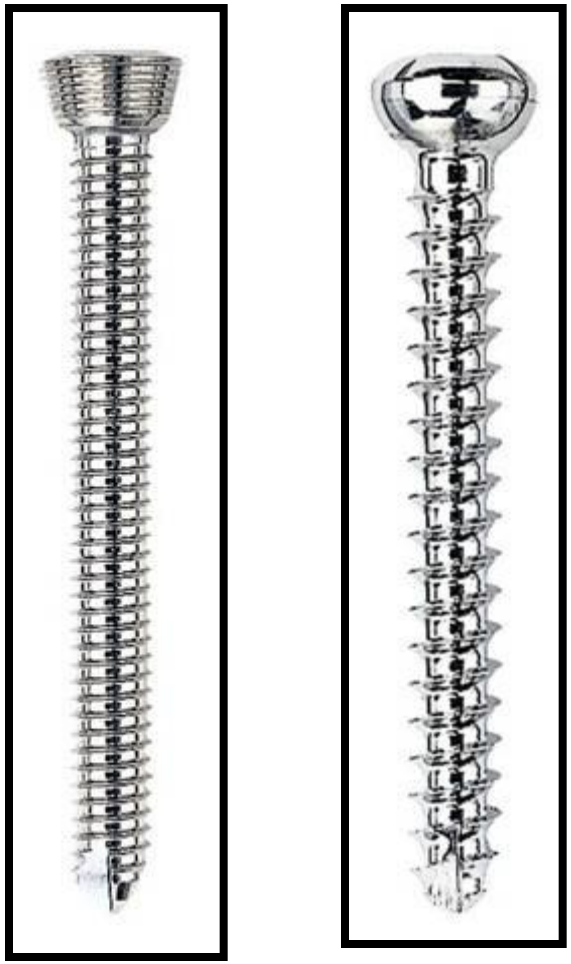






Locking Screw Design

- Threaded underside of head
  - To thread (lock) into plate hole
- Larger core diameter:
  - Increases strength
  - Dissipates load over larger area of bone
- Smaller thread pitch:

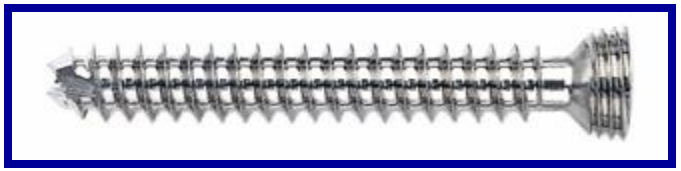


Locking Screw Design

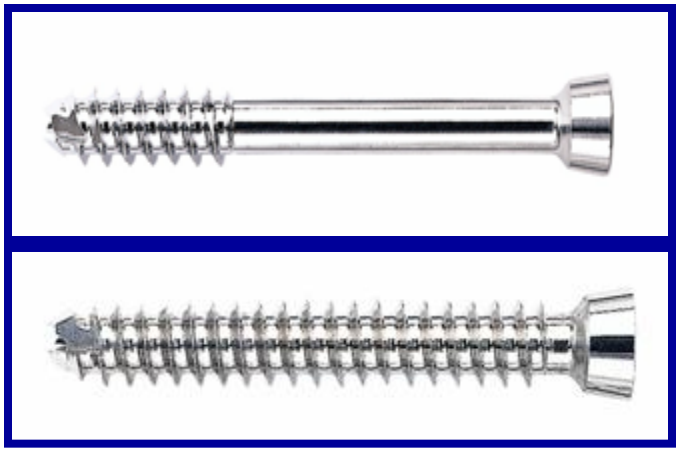
- Core design:
  - Solid and cannulated
  - Cannulated screws are inserted over guide wires for precise placement

Screw Head Designs

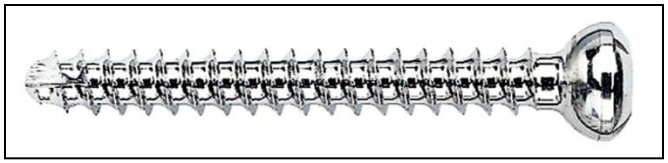
- Threaded head:
  - Locks screw to plate



- Conical head:
  - Can be used instead of locking screws
  - Smooth underside fits in round holes
  - Partially threaded -- lags two fragments together
  - Fully threaded -- pulls bone to plate



- Spherical head cortex screw:
  - Conventional use



Plates

- CLASSIFICATION: depending on

- Shape: semitubular , 1/3 tubular
- Width: broad , narrow
- Surface contact: limited contact
- Site: condylar
- Function: neutralization plate,
  compression plate
  buttress plate

- Three main groups:

  - straight plates : diaphysis

  - special plates : metaphyseal and epiphyseal areas

  - angled blade plates: proximal and distal femur

- **STRAIGHT PLATES:**

DYNAMIC COMPRESSION PLATE (DCP)

- special geometry of plate hole allows
  self compression and
  congruent fit b/w head and plate at various angles of inclination
- thus can function as –
  neutralization plate
  tension band plate
  compression plate

- SPHERICAL GLIDING PRINCIPLE:

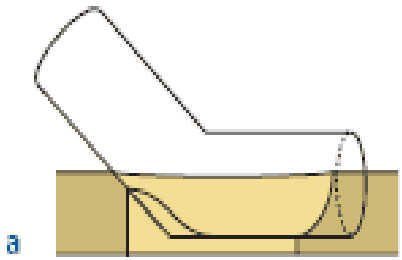
  - plate hole described as a part of inclined

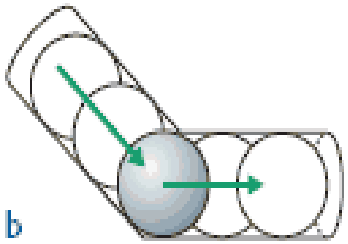
    and horizontal cylinder , in which a sphere

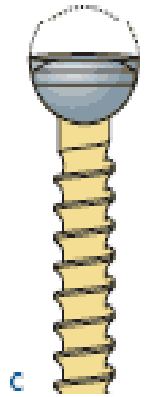
    can be moved downward, horizontaly.

  - cylinder : plate hole

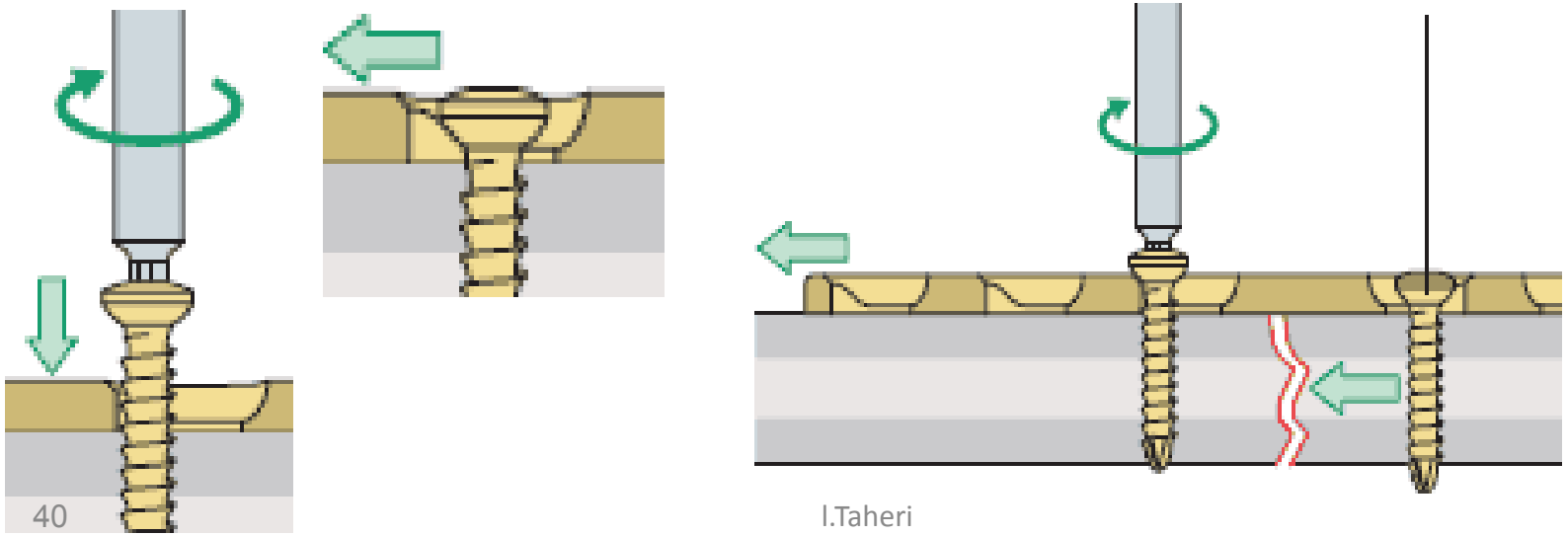
  - sphere : screw head







- Screw placed eccentrically (load position) will move the underlying bone horizontaly until the head reaches the intersection
- cortical screw can be placed at
  - eccentric / load position
  - neutral position

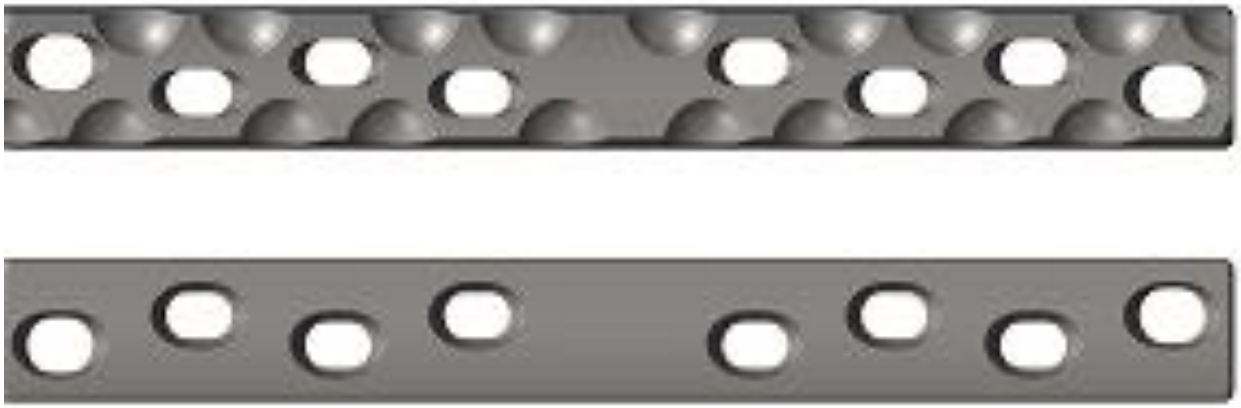


- NARROW DCP :
  - on tibia
  - sometimes on radius and ulna
  - both ends have notch on underside (for hook of tension device)
  - middle part with wider space b/w holes , stronger , placed over #
  - 2 to 16 holes

- BROAD DCP:
  - for diaphyseal # s of humerus , femur
  - thicker and wider than narrow dcp
  - notch at each end
  - 6 to 18 holes

	narrow dcp	broad dcp
thickness	3.6mm	4.5 mm
width	12mm	16mm
Hole spacing	16 and 25mm	16 and 25 mm
Hole length	8.5mm	8.5mm

- LIMITED CONTACT DCP (LC DCP):
  - development of DCP
  - same indications as DCP



- <u>additional advantages</u> :
    - undercuts decrease the contact area b/w bone and plate, thus decrease the impairment in blood supply and consequent demineralization
    - undercuts allow small callus formation
    - constant stiffness all along the plate so no stress concentration occurs at holes when bent or contoured
    - trapezoid cross section – smaller contact area
    - holes uniformly placed contd…..

- undercut plate holes: allow

. 40 tilting in long. Axis

. 7 tilting in transverse axis

. thus lag screw fixation possible for short oblique fractures

	Narrow lc dcp	Broad lc dcp
Thickness	4.6mm	6 mm
width	13.5 mm	17.5mm
Hole spacing	18 mm	18mm
Hole length	8.5mm	8.5mm

- SEMITUBULAR PLATES:
  - shape of half tube
  - 1 mm thick
  - good rotational stability as edges dig into
    bone
  - oval holes allows eccentric screws
  - were used for forearm fractures
  - now occasionally in pelvic # s

- RECONSTRUCTION PLATES:
  - can be bent and twisted in two directions
  - in places where extensive contouring needed eg: pelvis
  - bending angle > 15 avoided at any one site
  - oval plate holes – allow compression

Plate Evolution

- **DCP**
  - Dynamic Compression Plate

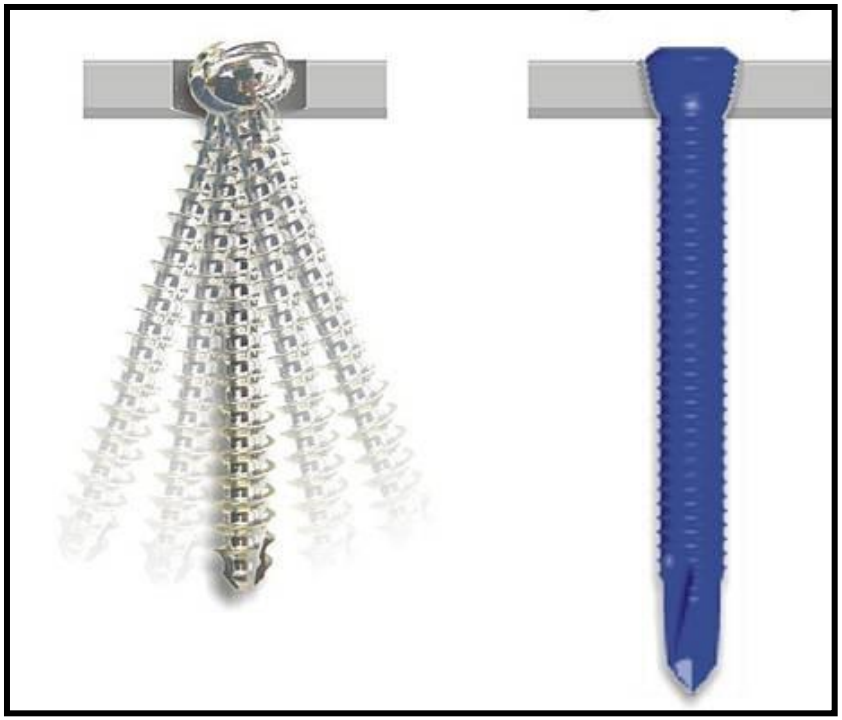
- **LC-DCP**
  - Limited Contact Dynamic Compression Plate

- **LCP**
  - Locking Compression Plate

How is a Locking Plate Different?

- Conventional plates depend on *friction* between the screw & bone for stability

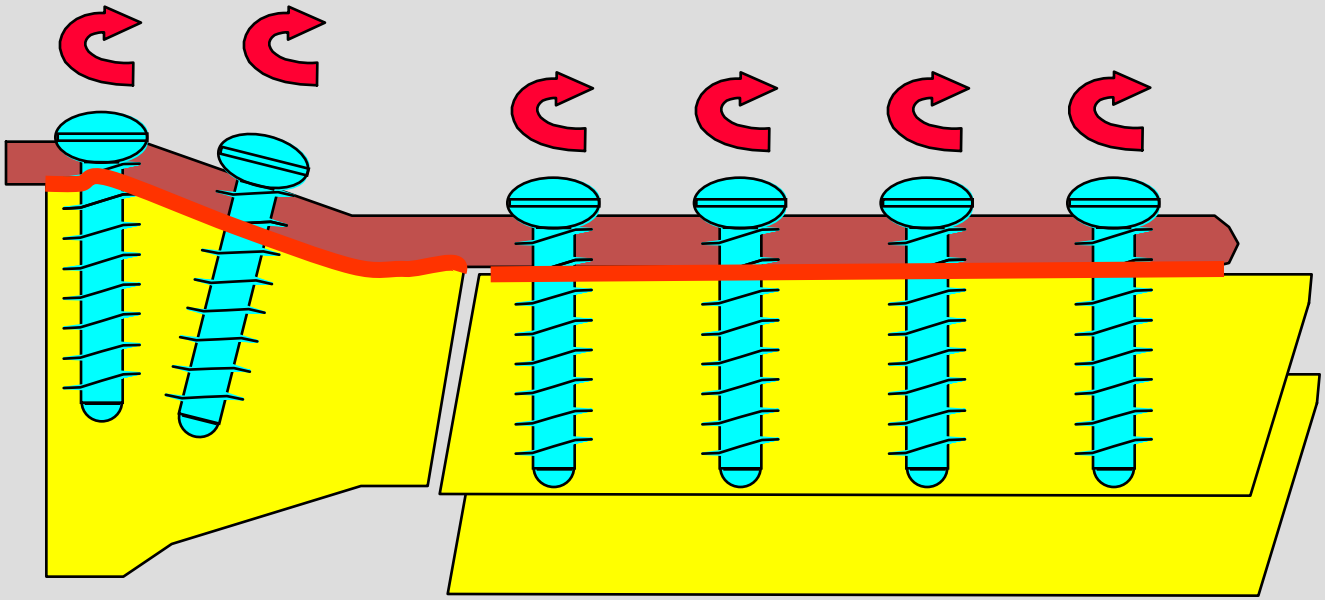
- Locking plates & screws create *fixed angles* that do not rely on screw purchase in bone



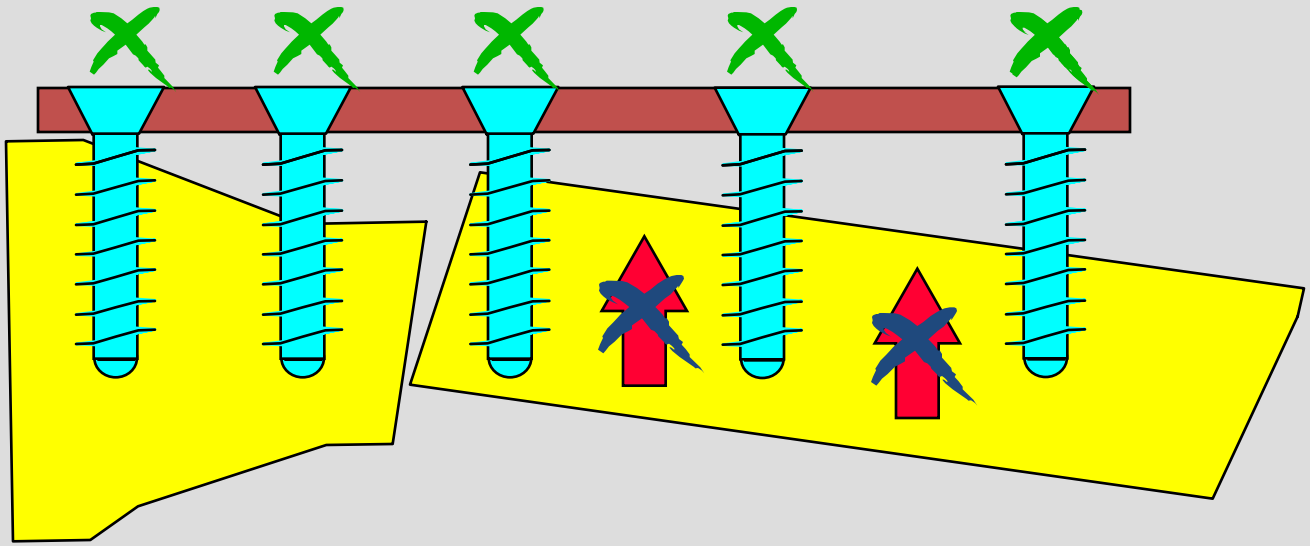
Conventional Screw & Plate

Locked Screw & Plate

Conventional Plate Fixation



Locking Plates & Screws



No Bone Alignment to the Plate

Conventional vs Locking Plates

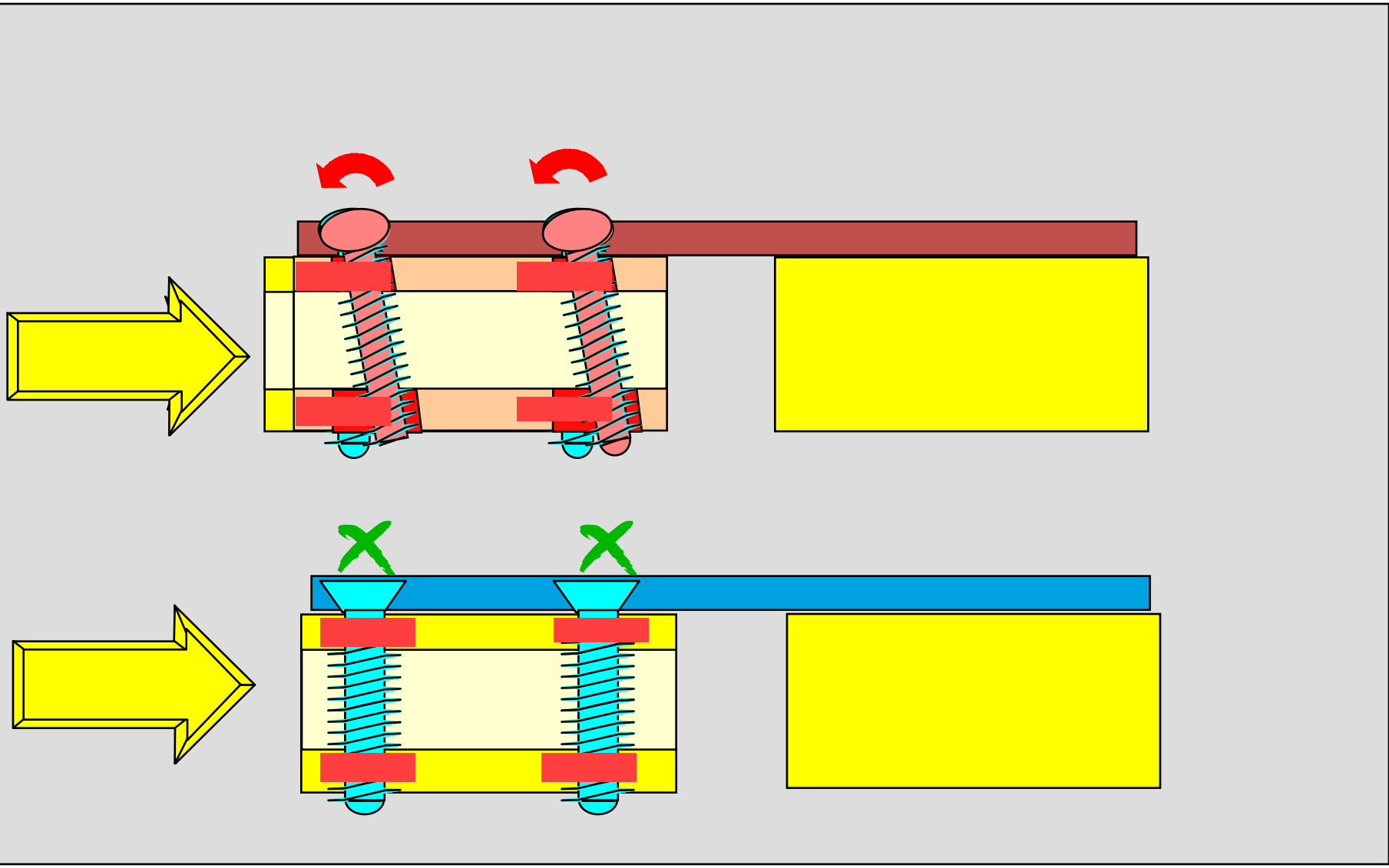
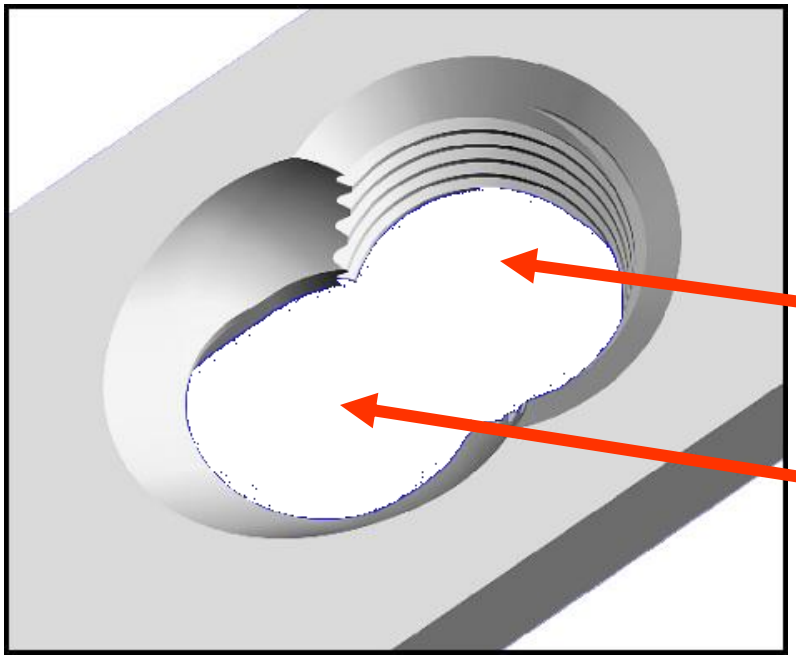


Plate Design

Looks familiar:

- Same basic construct of plates and screws
- Anatomically shaped
- Same stainless steel and titanium materials

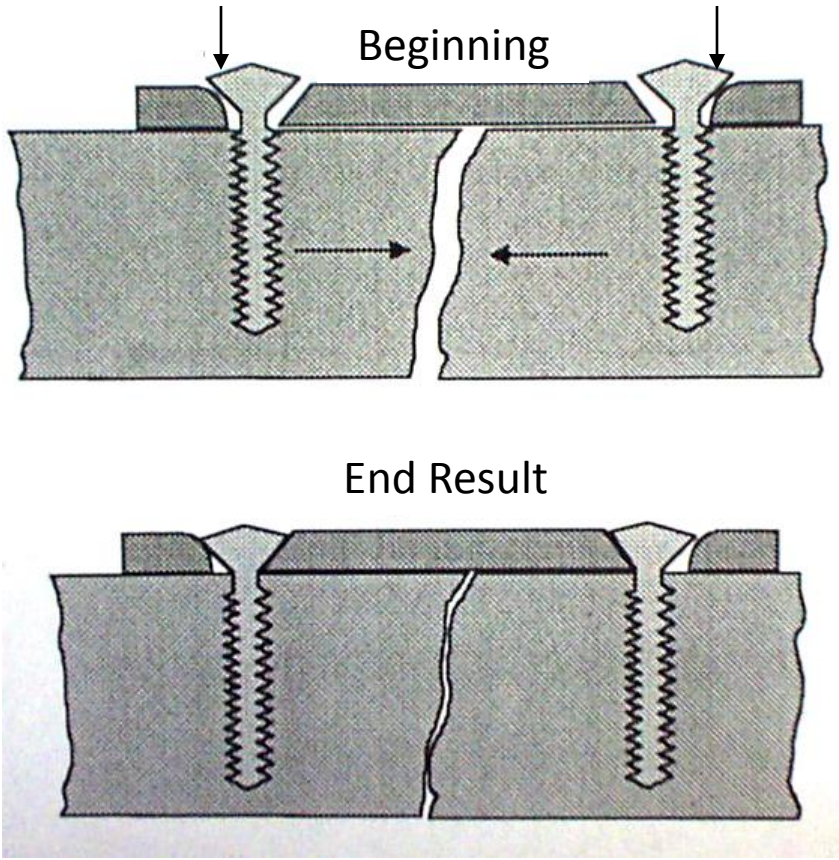
Plate Design: Combination Hole



- “Figure of eight” hole design
- Locking screws
- Conventional cortex & cancellous screws

Biomechanics of Dynamic Compression Plate (DCP)

- Designed to compress the fracture
  - Offset screws exert force on specially designed holes in plate
  - Force between screw and plate moves bone until screw sits properly
  - Compressive forces are transmitted across the fracture



ttb.eng.wayne.edu/ ~grimm/ME518/L19F3.html

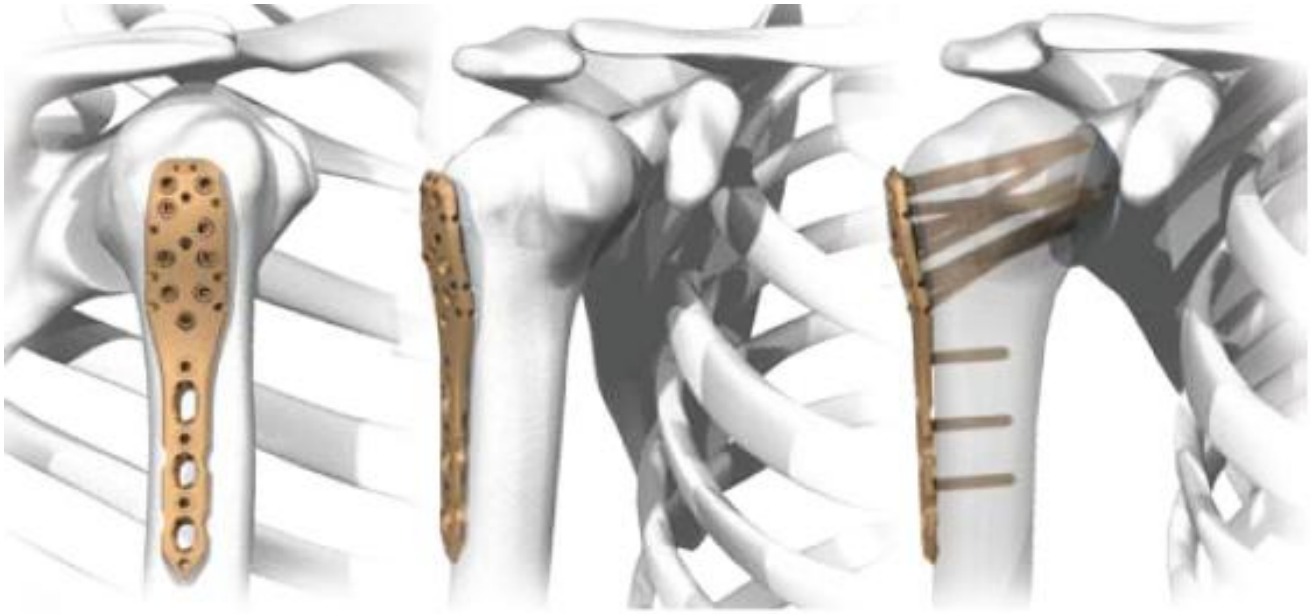
- **<u>SPECIAL PLATES:</u>**
- T PLATES:
  - medial aspect of tibial plateau
  - proximal humerus

- T AND L BUTTRESS PLATE:
  - lateral aspect of tibial plateau
  - have double bend

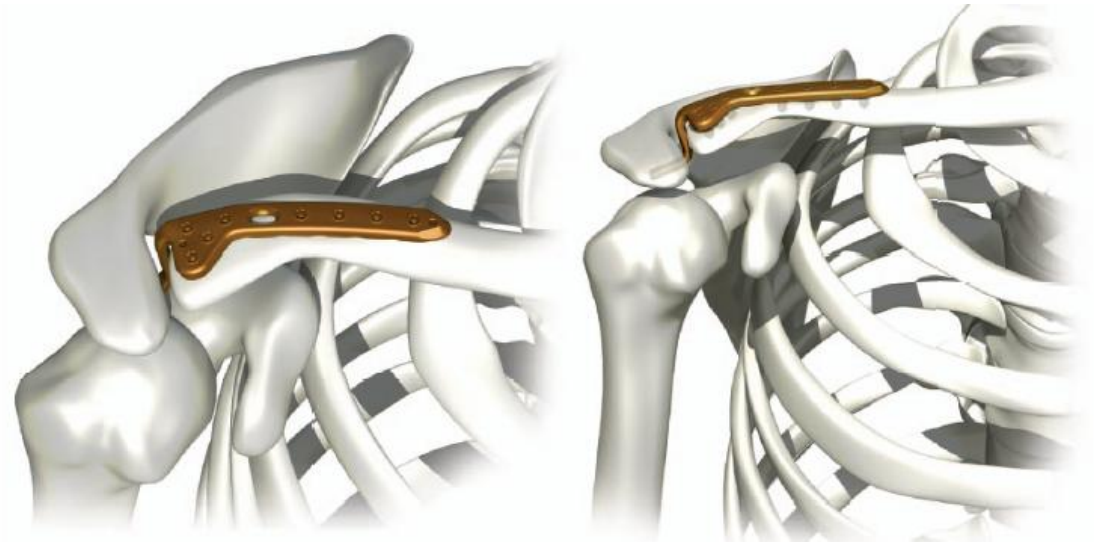
- Lateral tibial buttress plate:

- Condylar buttress plate:

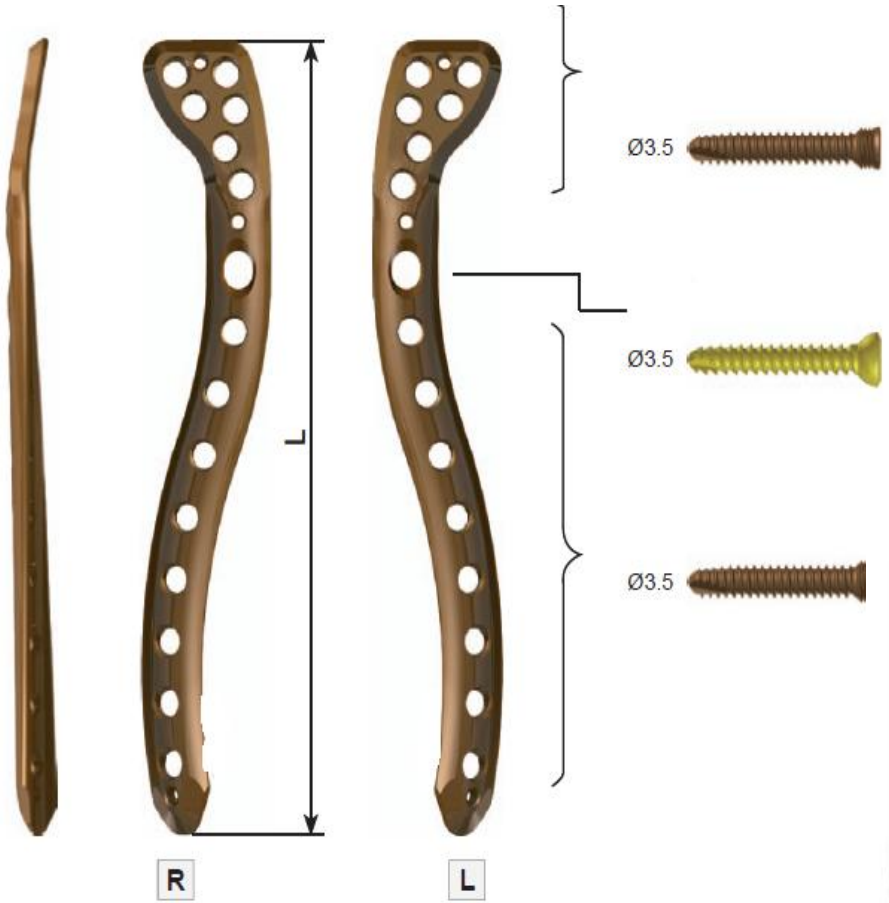
Humeral Plate

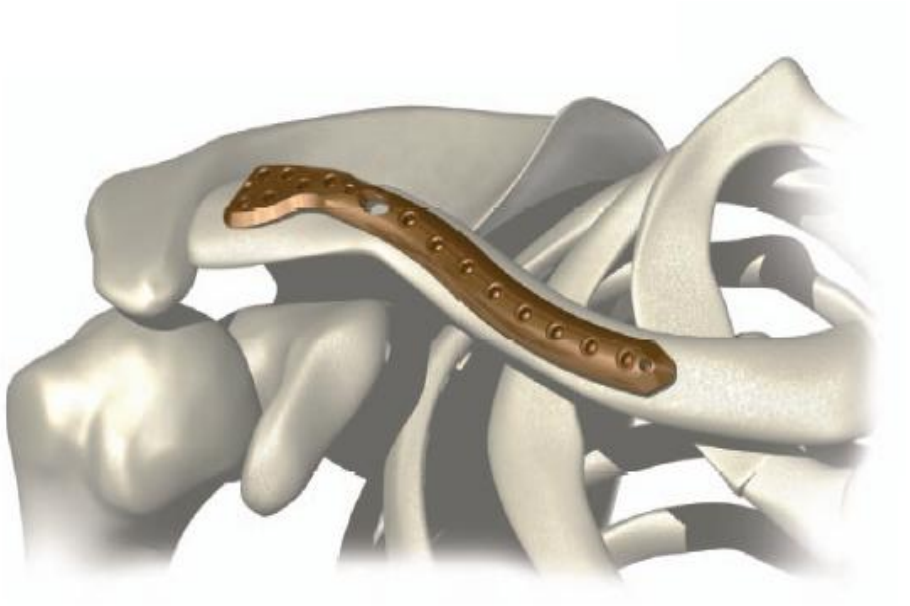


Clavicular hook plate

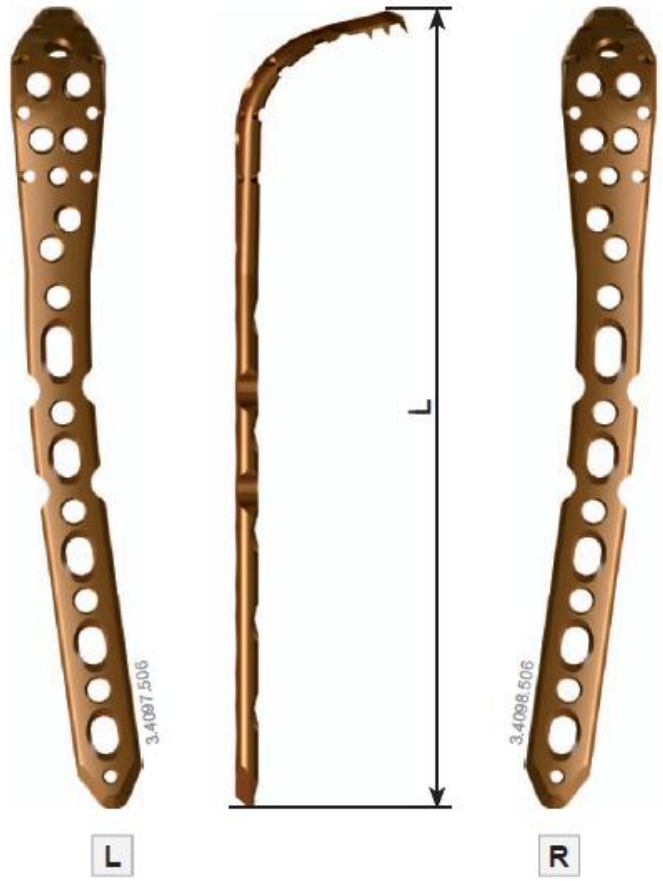


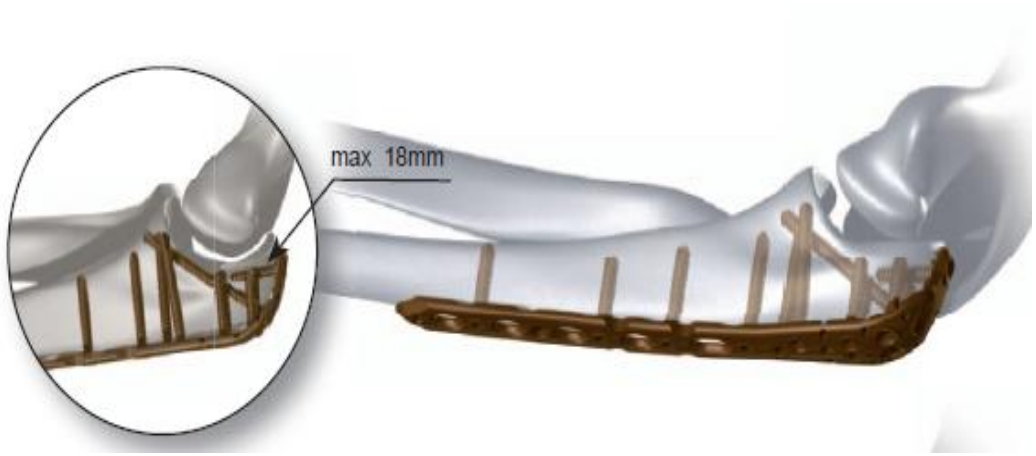
Clavicle S Plate



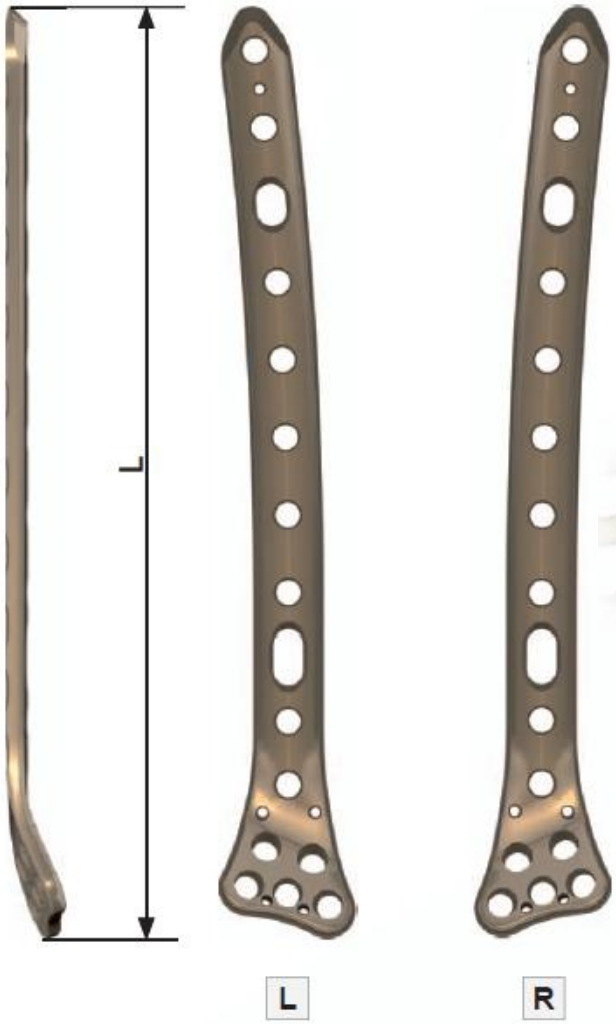


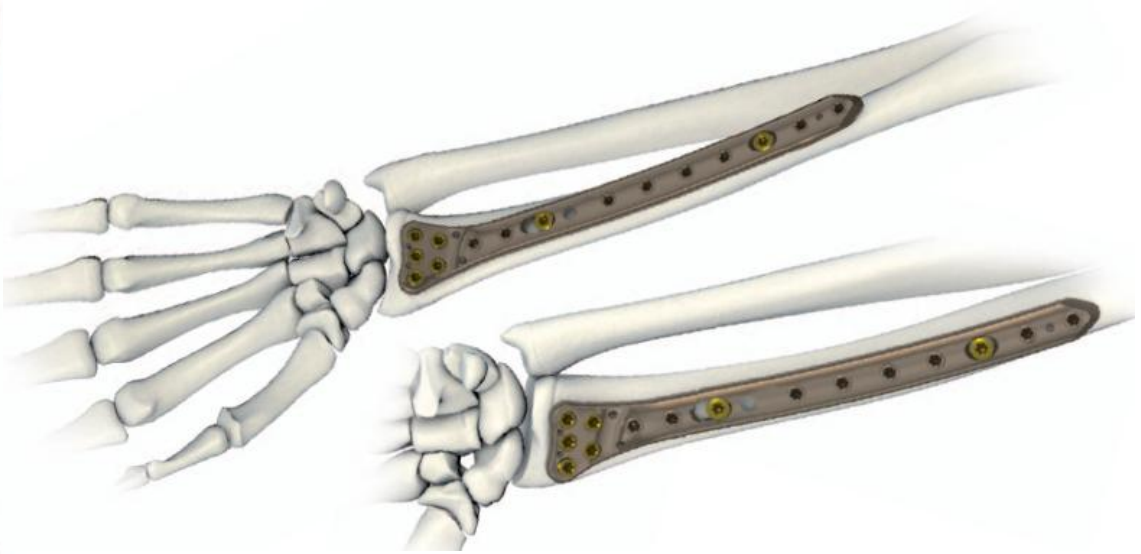
Olecranon Plate



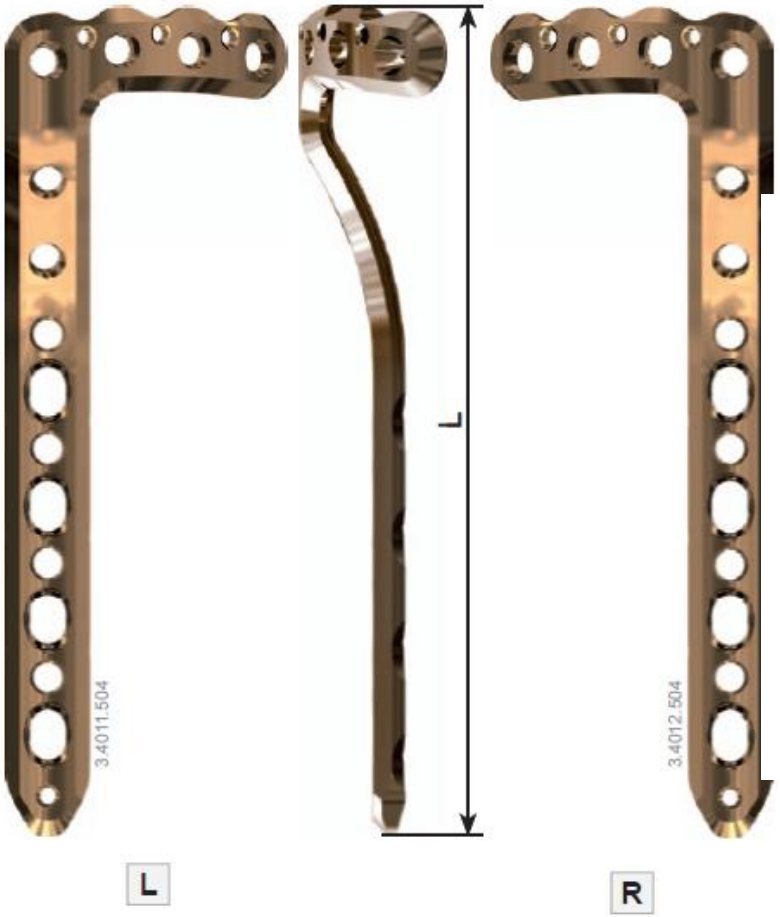


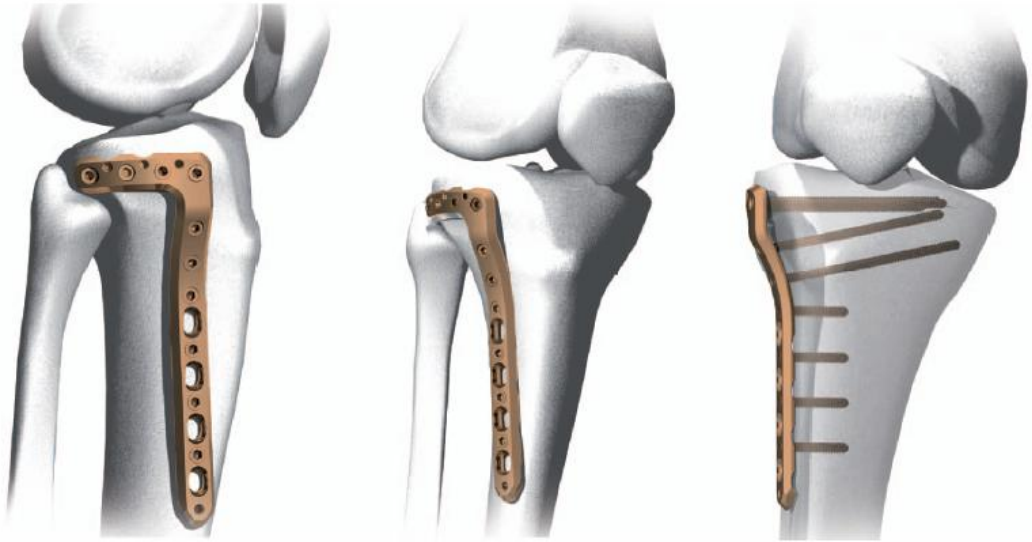
Radius volar plate



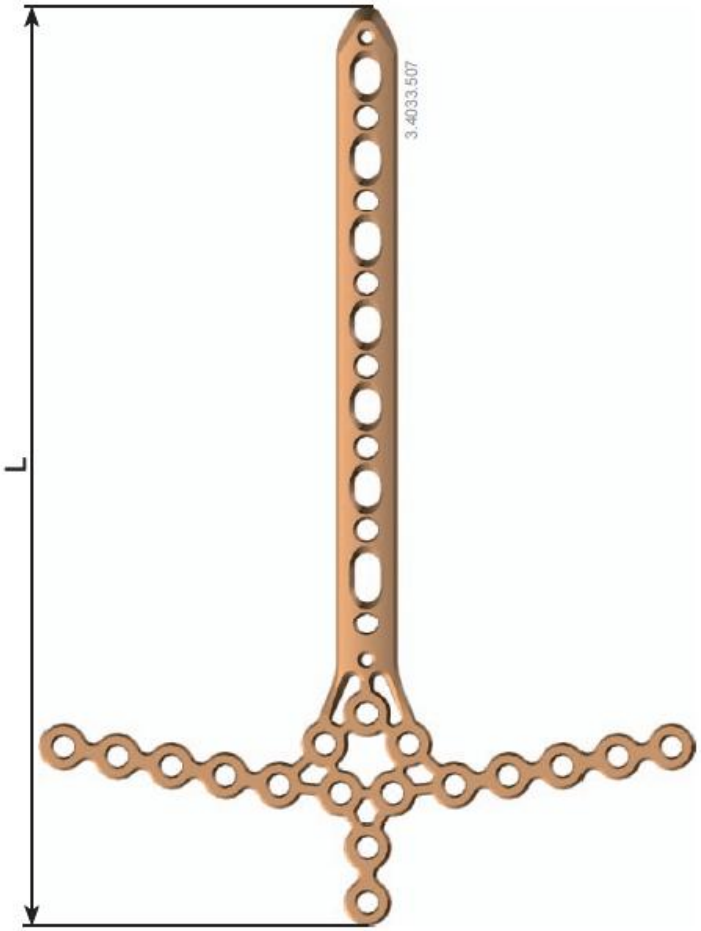


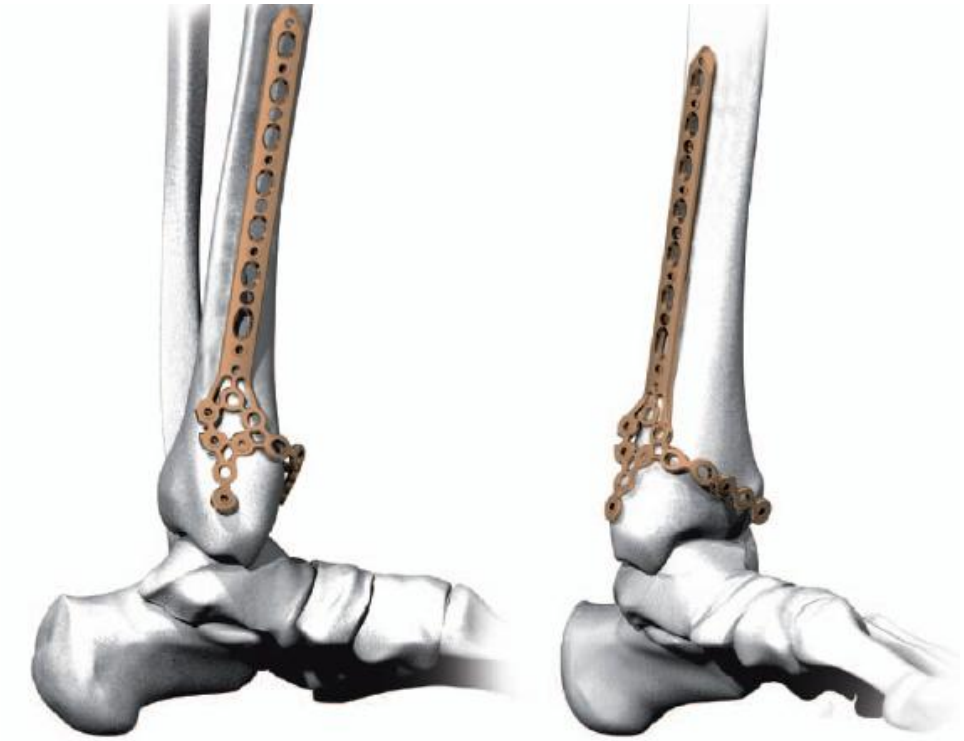
L plate(Tibia)





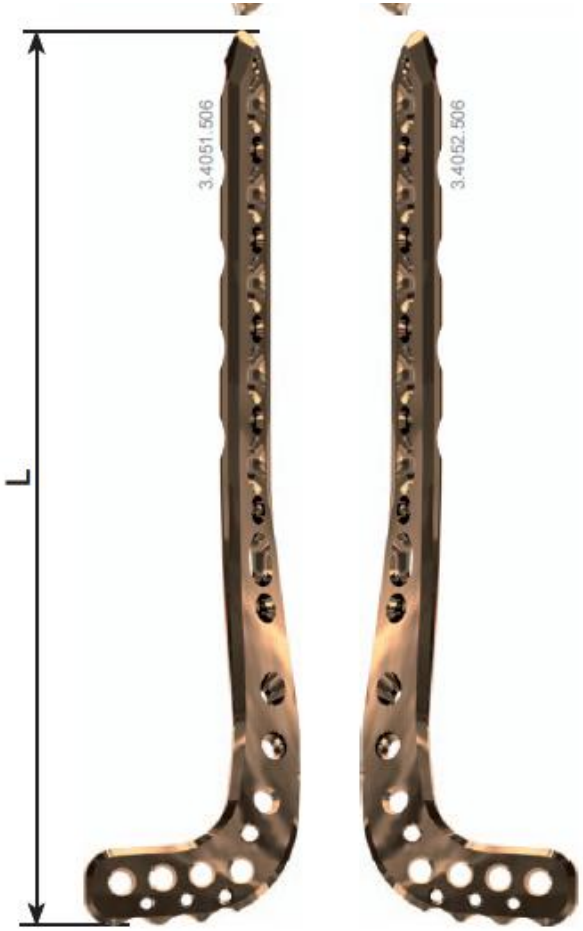
Distal medial Tibial Plate



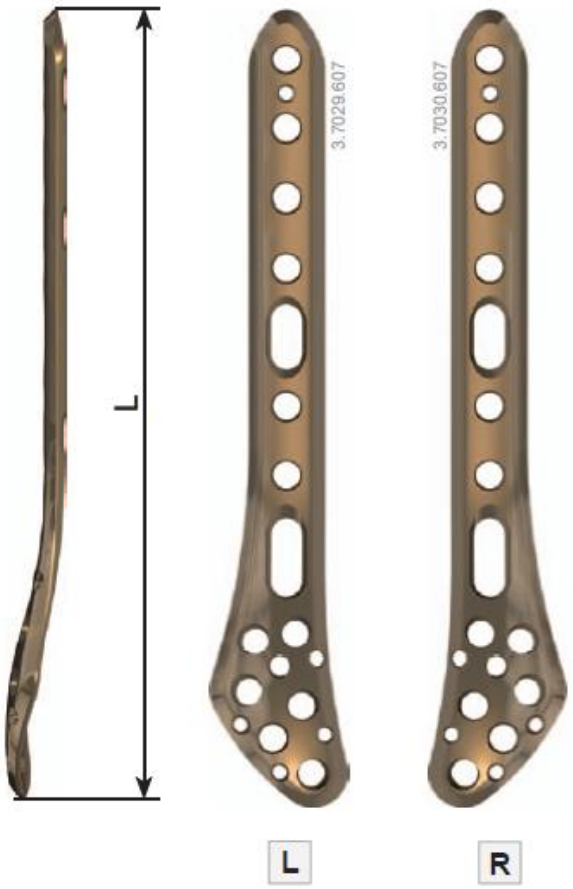


Distal medial Tibial Plate

Distal Tibia L Plate

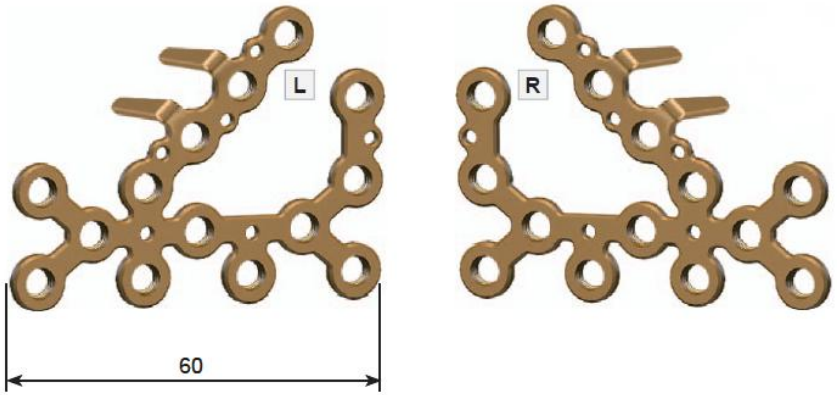


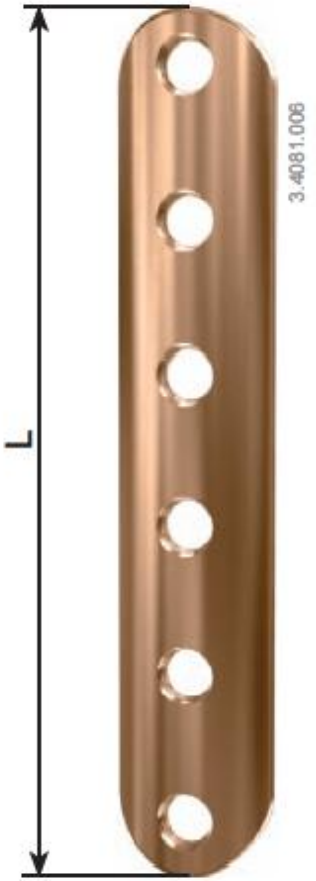
Distal lateral Fibula Plate



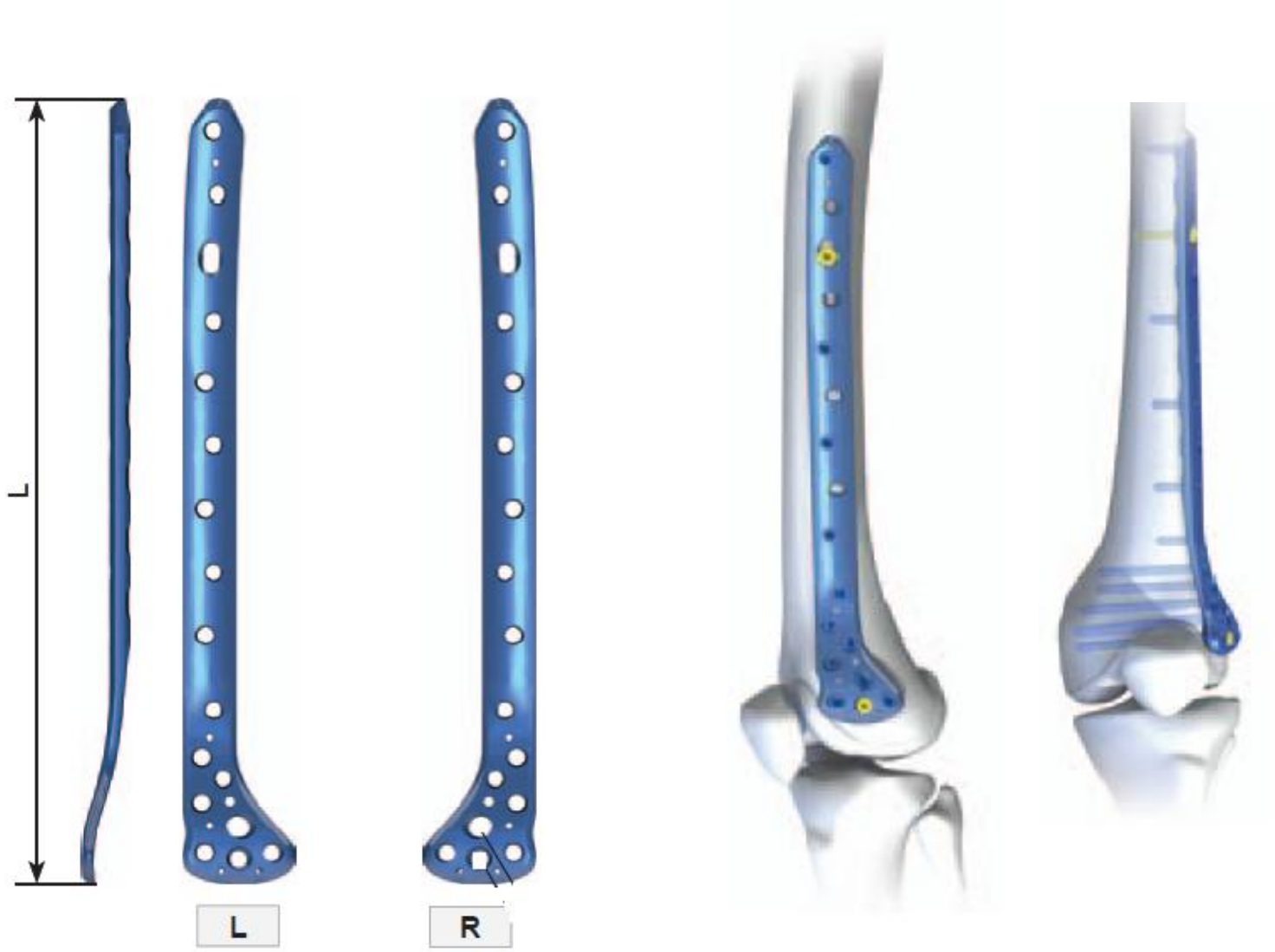
1/3 Tubular Plate

Calcaneal Plate





Condylar femoral Plate

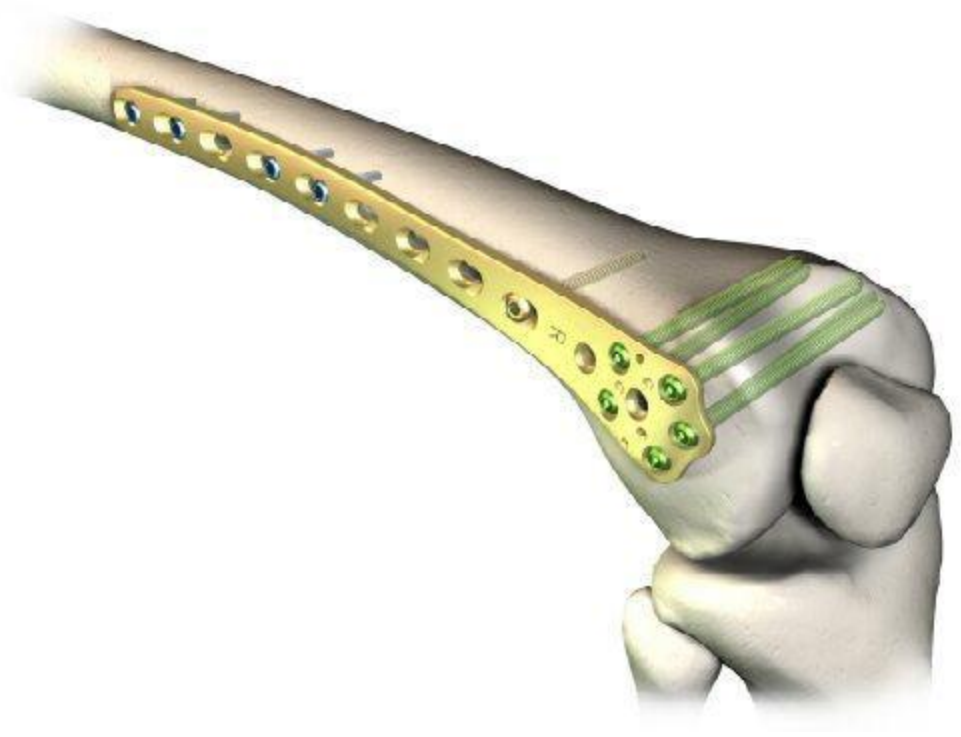


Femoral Proximal Plate

- cobra head plate

- Spoon plate

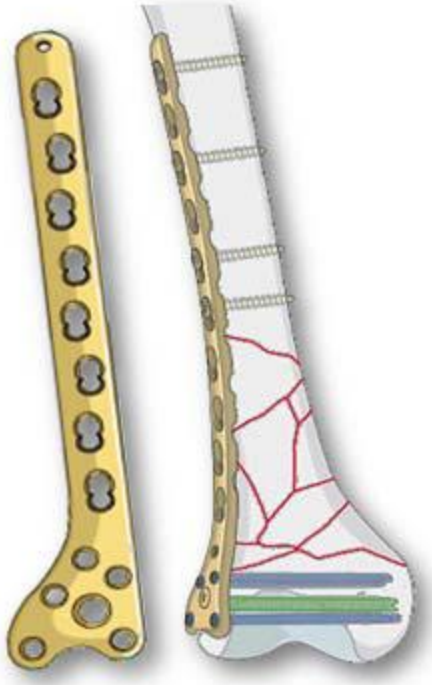
LCP distal femur



T-plate for phalanges

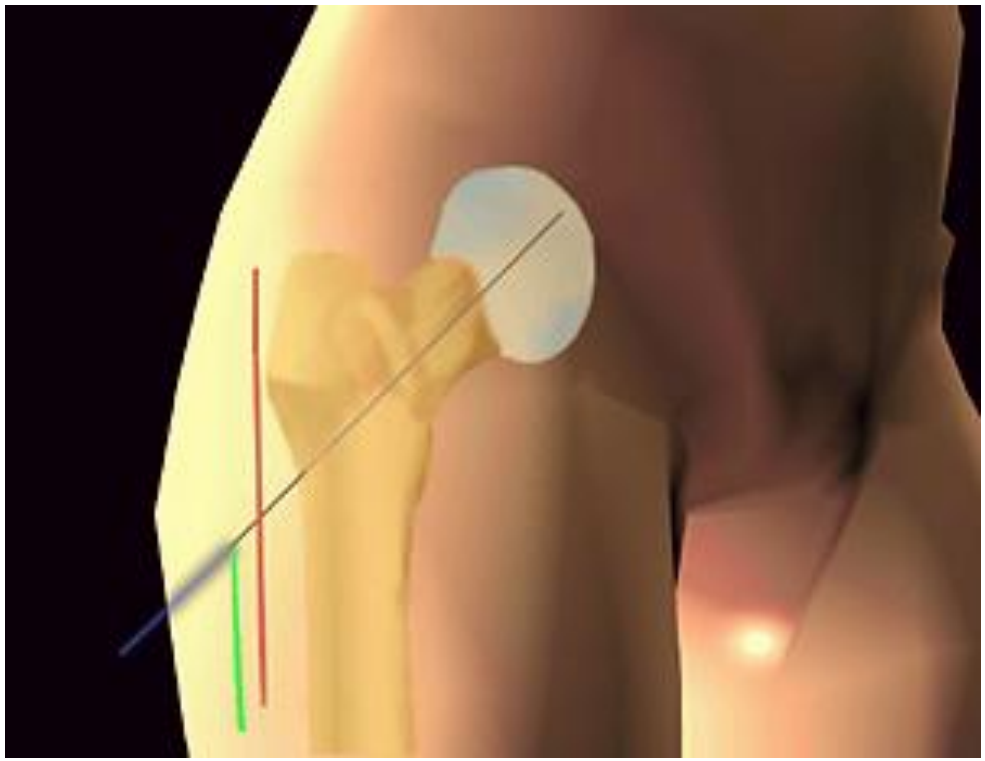
L and LCP contoured plates for distal radius

Ulna plates and distal humerus plates



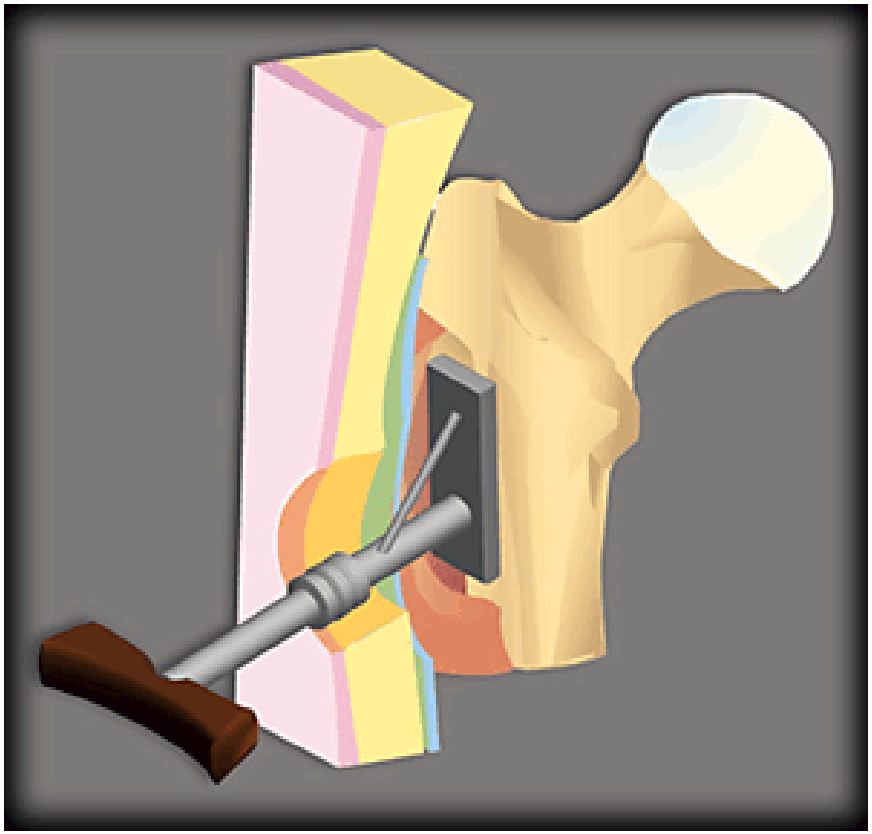
DHS Technique

- Incisional line
  - Red = conventional
  - Green = minimal access
- Procedure is monitored by x-ray image intensifier



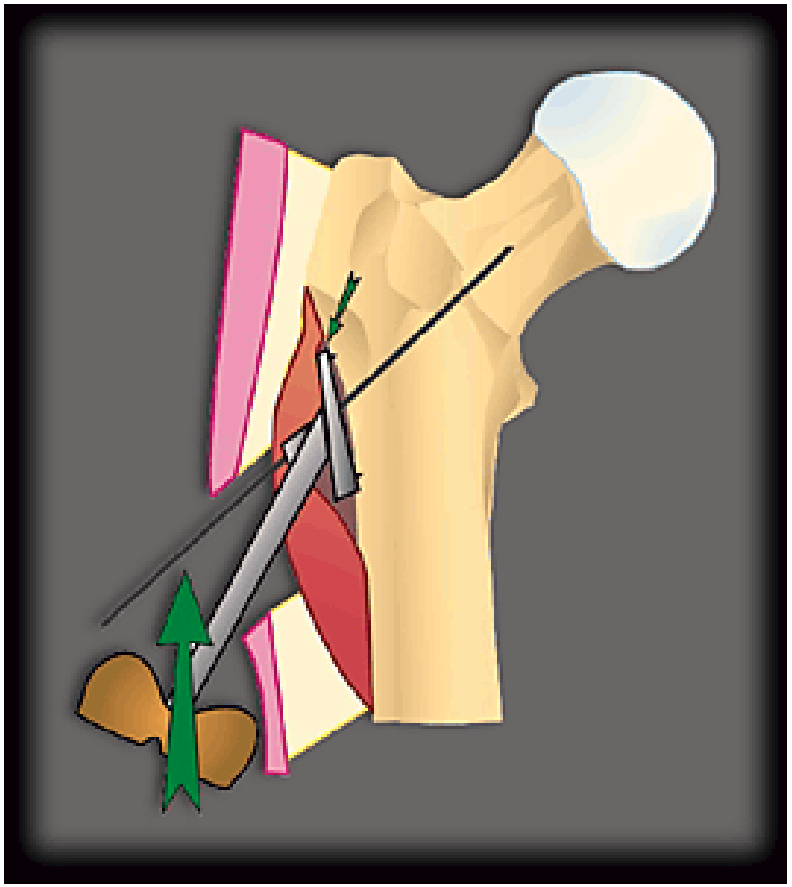
DHS Targeting Device

- Aligns guide pin
- Under the vastus lateralis
- Wedged in upper part
  - Between vastus and femoral shaft



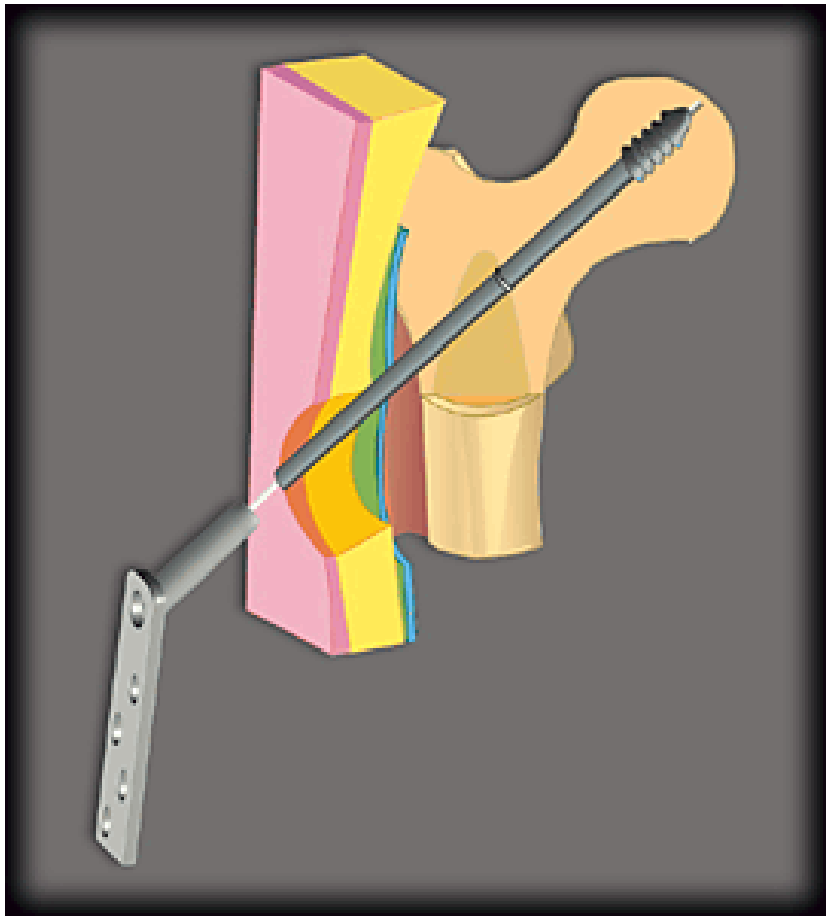
DHS Guide Pin

- Guide pin is inserted
  - Centered in the femoral neck



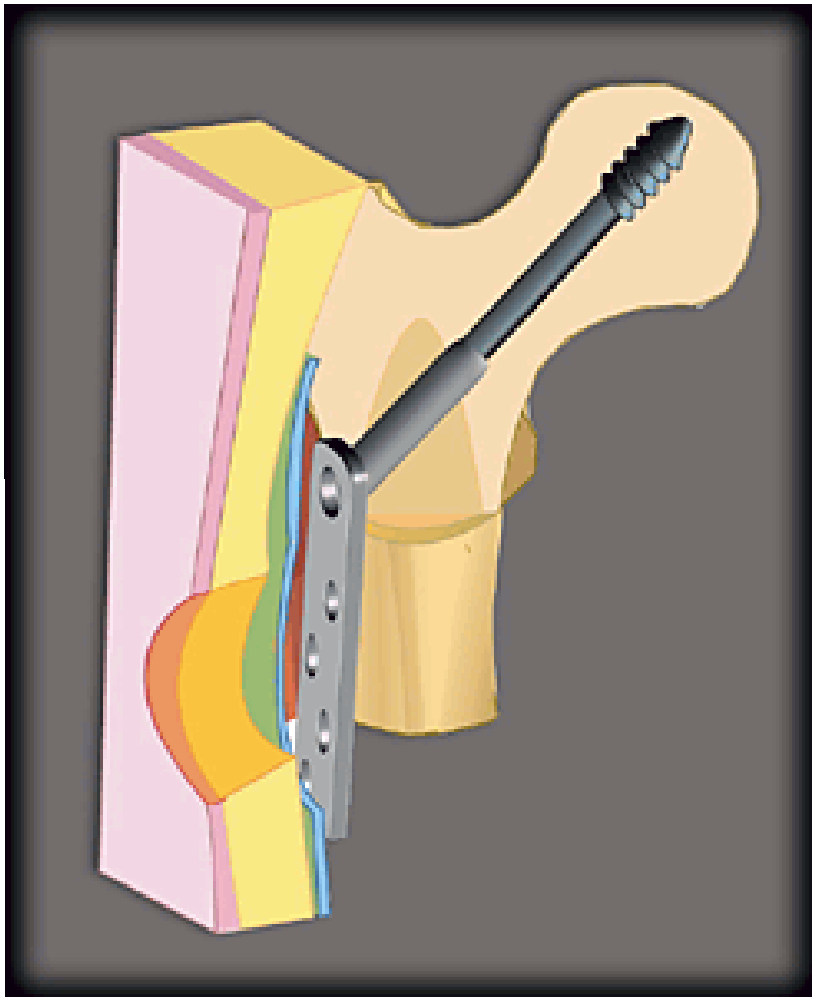
DHS Axial Screw

- Axial screw is inserted with an extension
  - Extension to guide the barrel of plate
    - Slot along screw fits a longitudinal ridge inside barrel prevents rotation, allows axial compression only

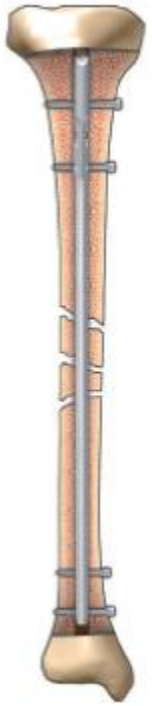


DHS Plate

- Plate against femoral shaft
  - Shaft screws are inserted



Intramedullary nail



- . Length
- Diameter
- Tibial,FeMural,Humeral

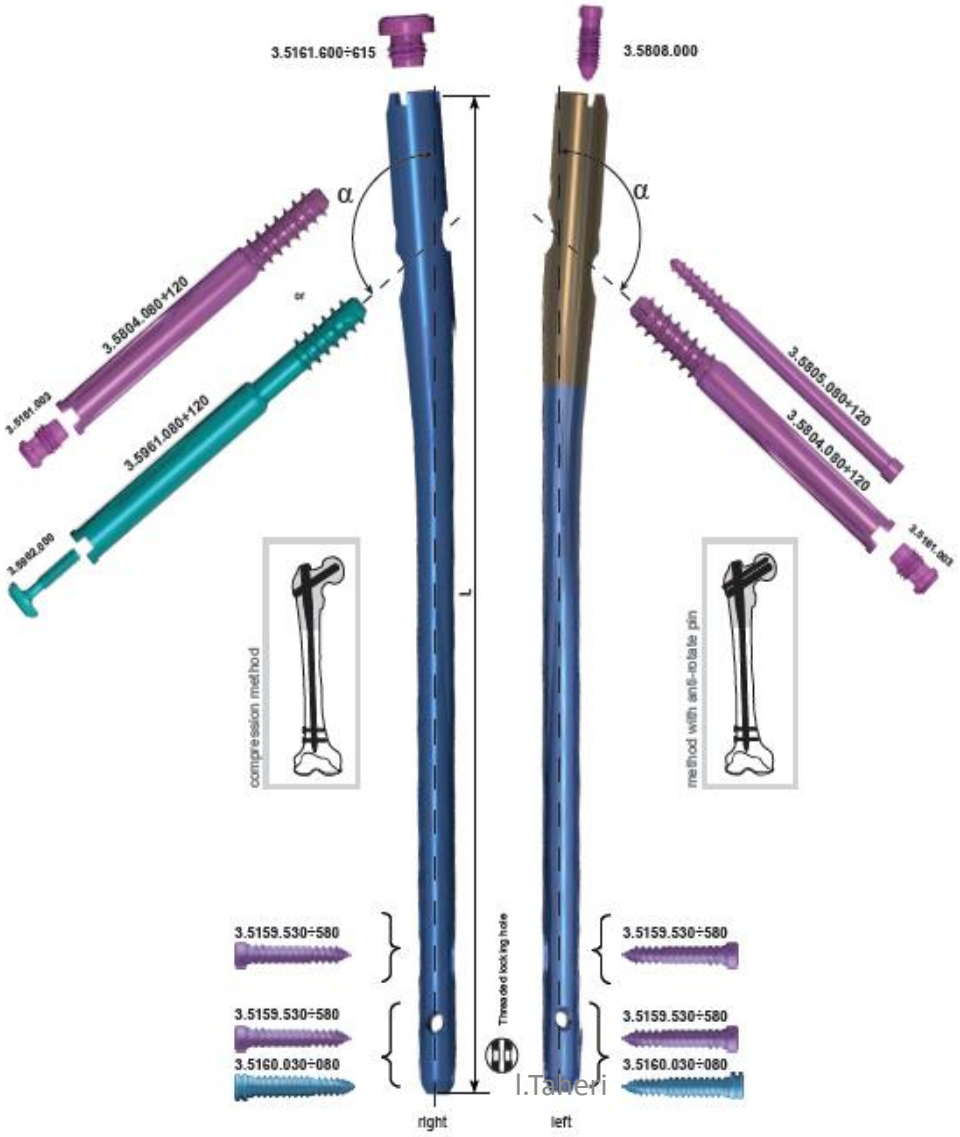
Advantage of IM Nail

- Less malunion
- Early weight-bearing
- Early motion
- Early WB (load sharing)
- Patient satisfaction

Distal femoral nail

Retrograde - antegrade femoral nail

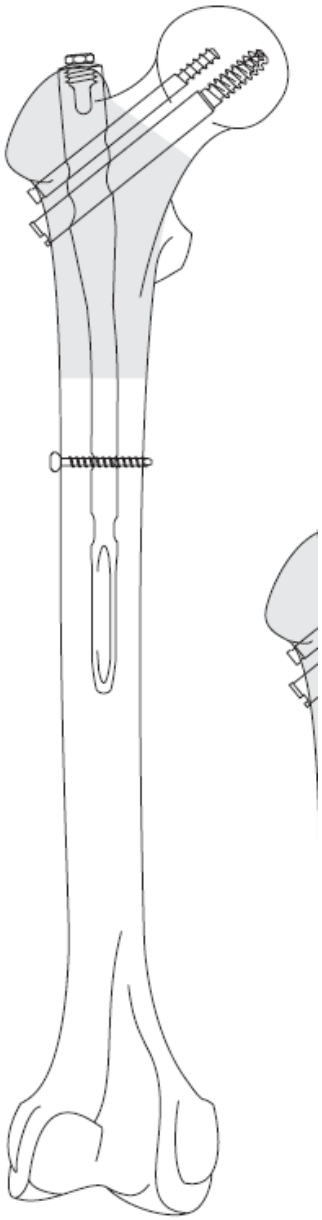
Gama Nail

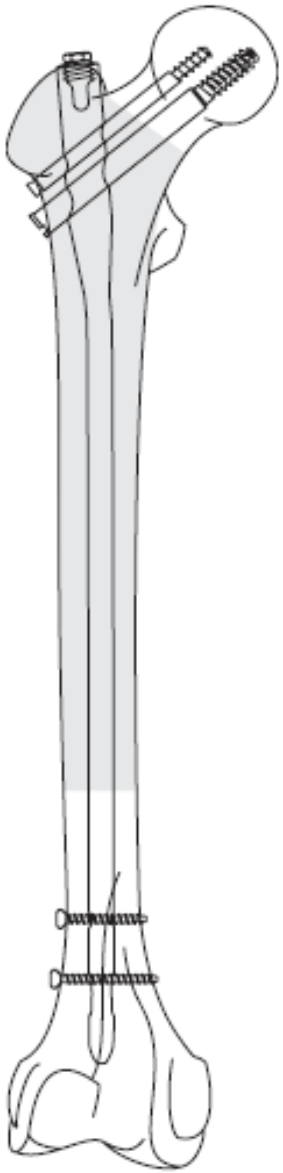

3.5161.600÷615
3.5808.000
α
α
3.5804.080÷120
3.5961.080÷120
3.5805.080÷120
3.5804.080÷120
compression method
method with anti-rotate pin
L
3.5159.530÷580
3.5159.530÷580
3.5160.030÷080
Threaded locking hole
3.5159.530÷580
3.5159.530÷580
3.5160.030÷080
right
left

PFN

- End Cap
- Proximal diameter 17.0mm
- Self-tapping 6.5mm Hip Pin
- Lengths 55–100mm (<5mm>)
- For true rotational stability
- Featuring insertion safety stop
- CCD angle 125°/130°/135°
- Self-tapping 11.0mm Femoral Neck Screw
- Lengths 80–120mm (<5mm>)
- Featuring insertion safety stop
- Anatomical 6° ML angle
- Distal diameters of 10, 11, and 12mm enable unreamed insertion
- 4.9mm Locking Bolt
- Lengths 26–52mm (<2mm>)
- A choice of static or dynamic interlocking (dynamization: 5mm)
- Flexible distal nail end (length: 58mm) minimizes stress concentration
- The PFN is available in titanium alloy (Ti-6Al-7Nb) and stainless steel
- Total length: 240mm

PFN



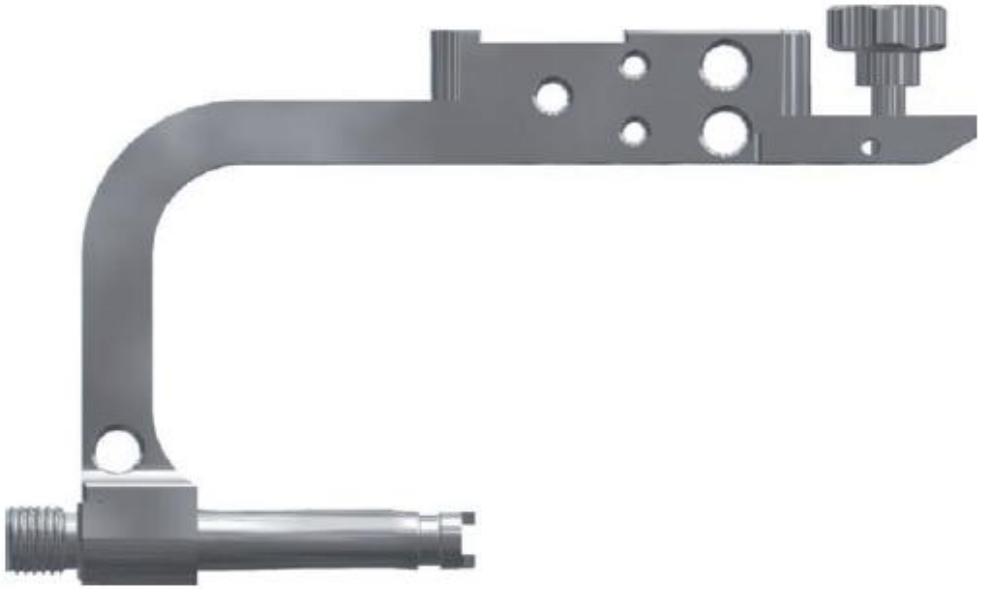


Instrument set

To carry out the surgery some other basic devices are needed:

- electric drive,
- set of flexible intramedullary reamers (Ø 8.0-13.0 mm) with drill guide and handle,
- set of awls (solid and cannulated),
- set of surgical drills,
- Kirschner wires,
- hammers,

and others.



1. Proximal tibia target B

2. Distal tibia target D

3. Connecting screw M8x1.25 spec.

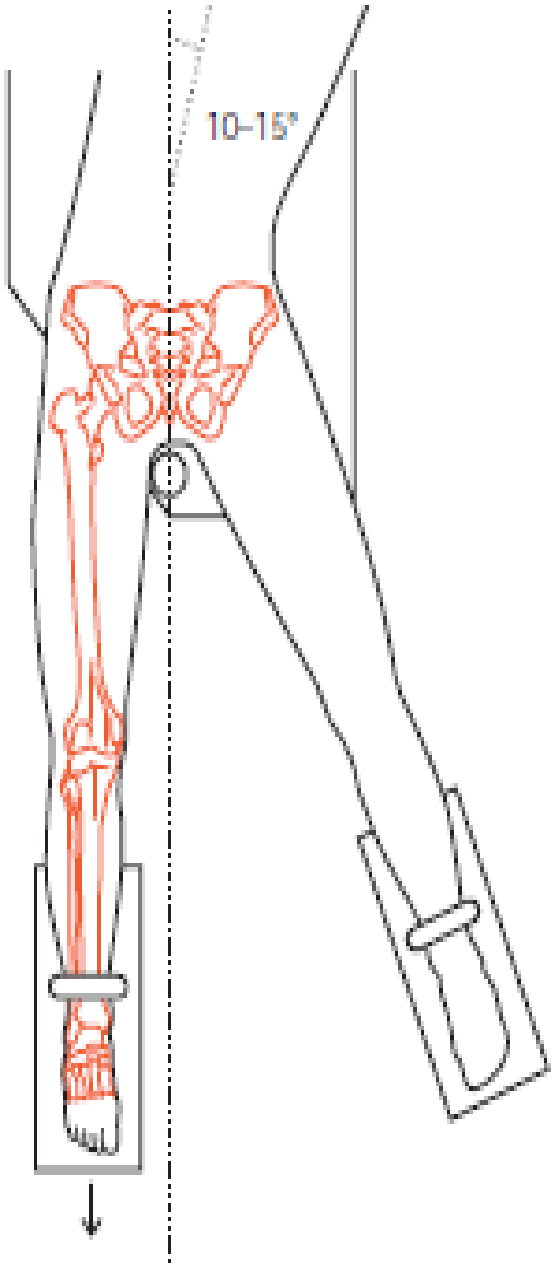
4. Guide rod Ø2.5/500

5. Tibial reconstruction target

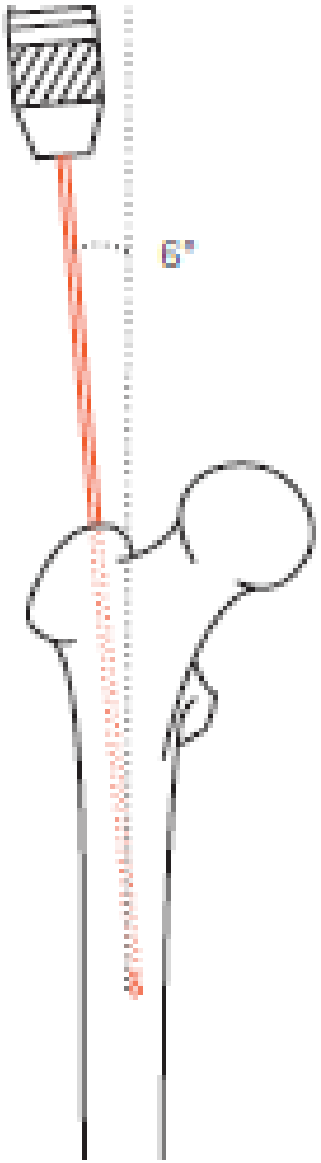
6. Insertion target Ø9.0

7. Target D

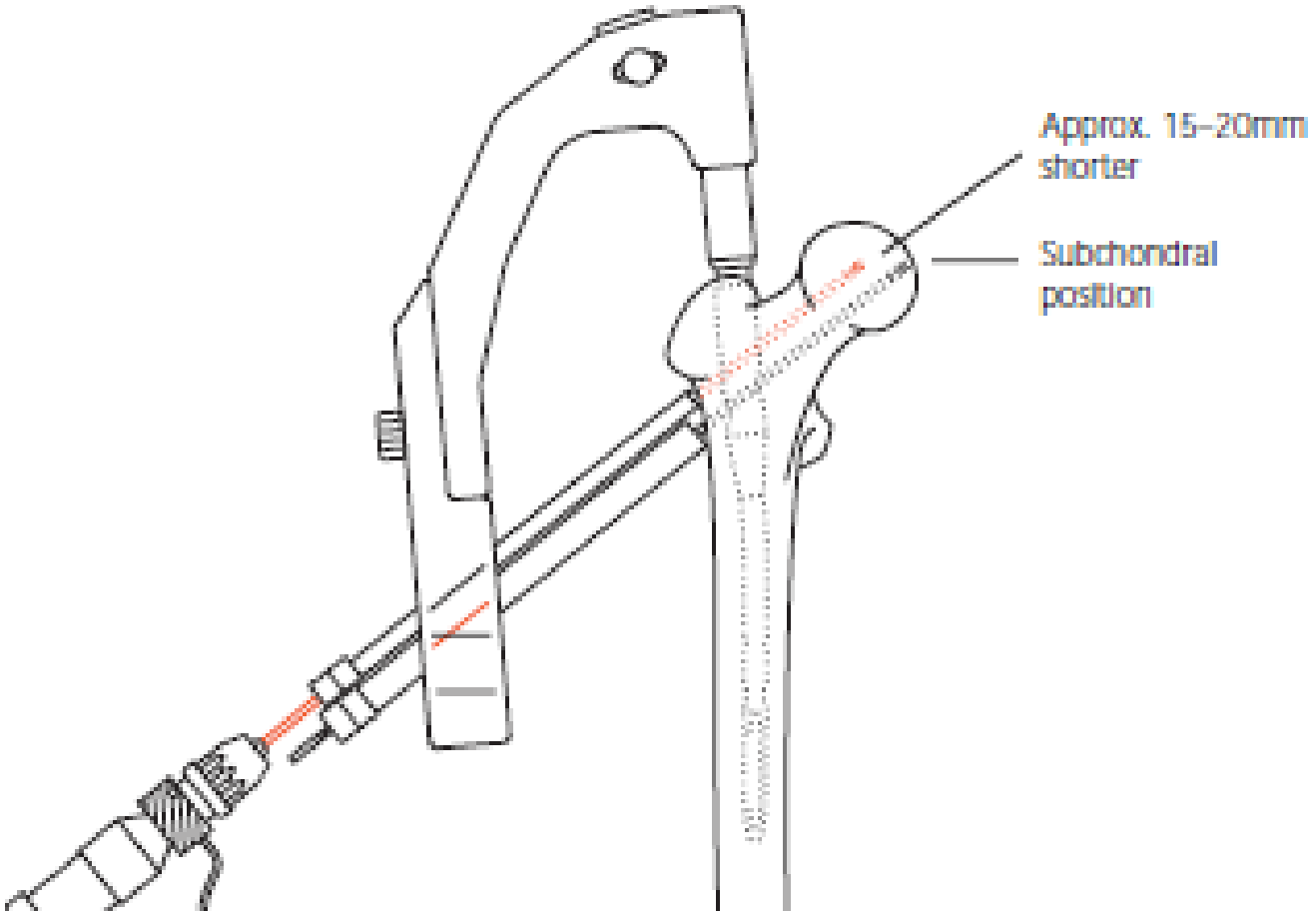
Patient positioning



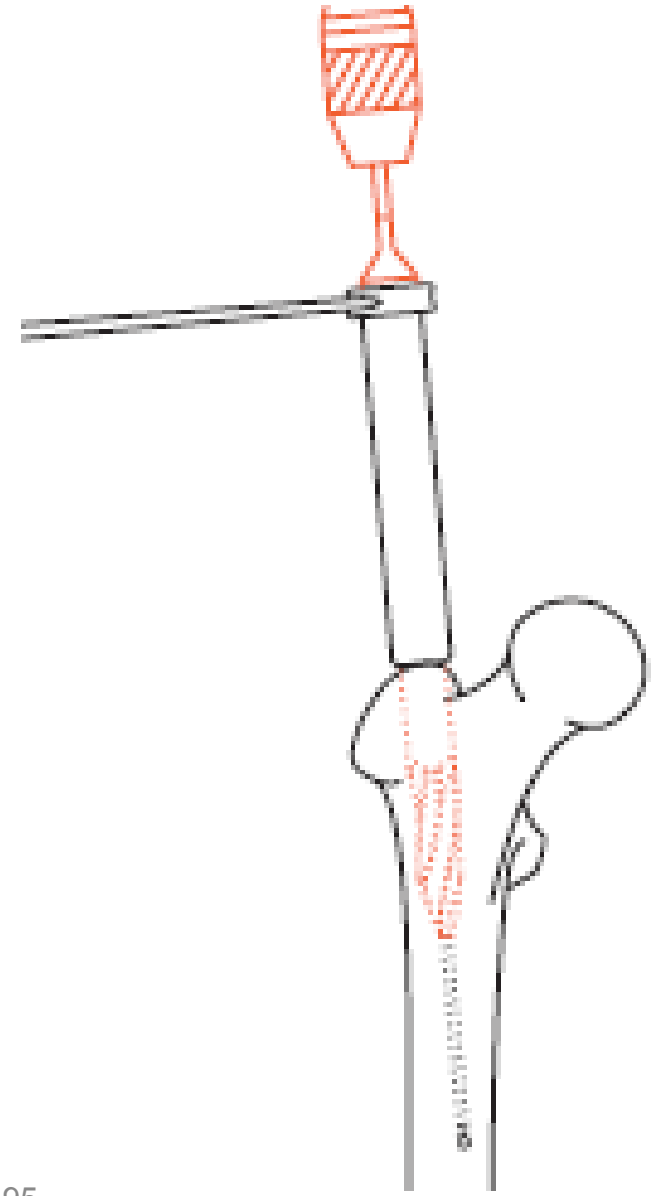
Insertion of guide wire for femur opening



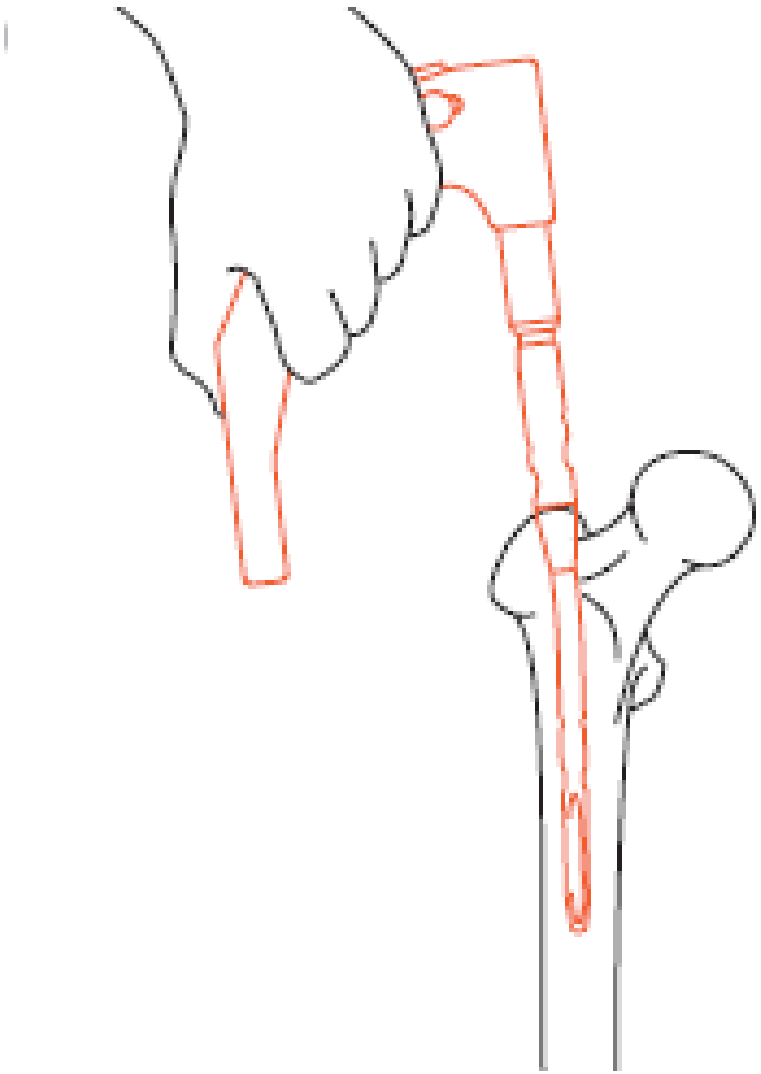
Insertion of guide wires for femoral neck screw and hip pin



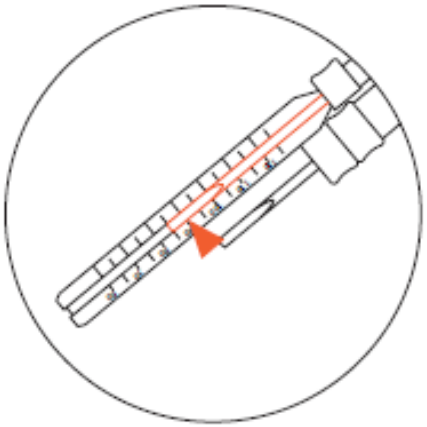
Open femur

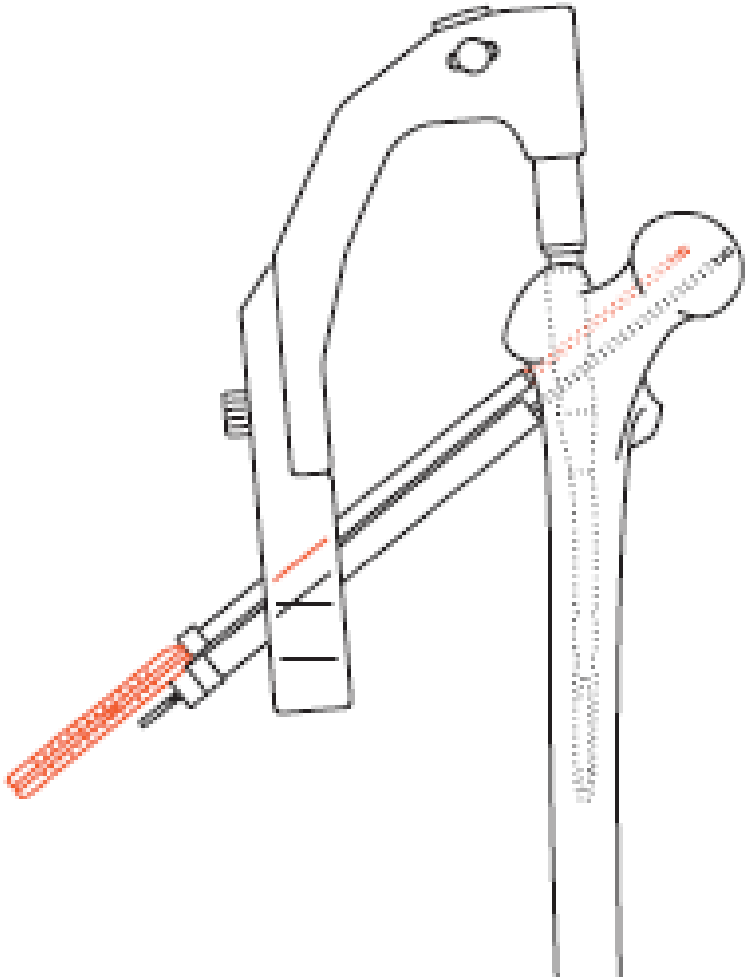


Insertion of Proximal Femoral Nail

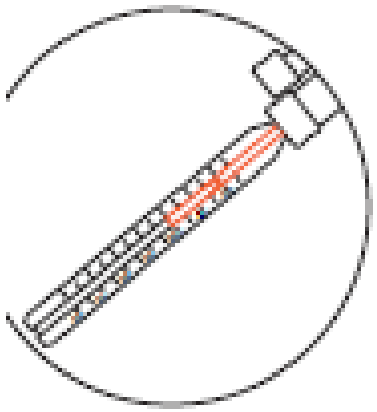


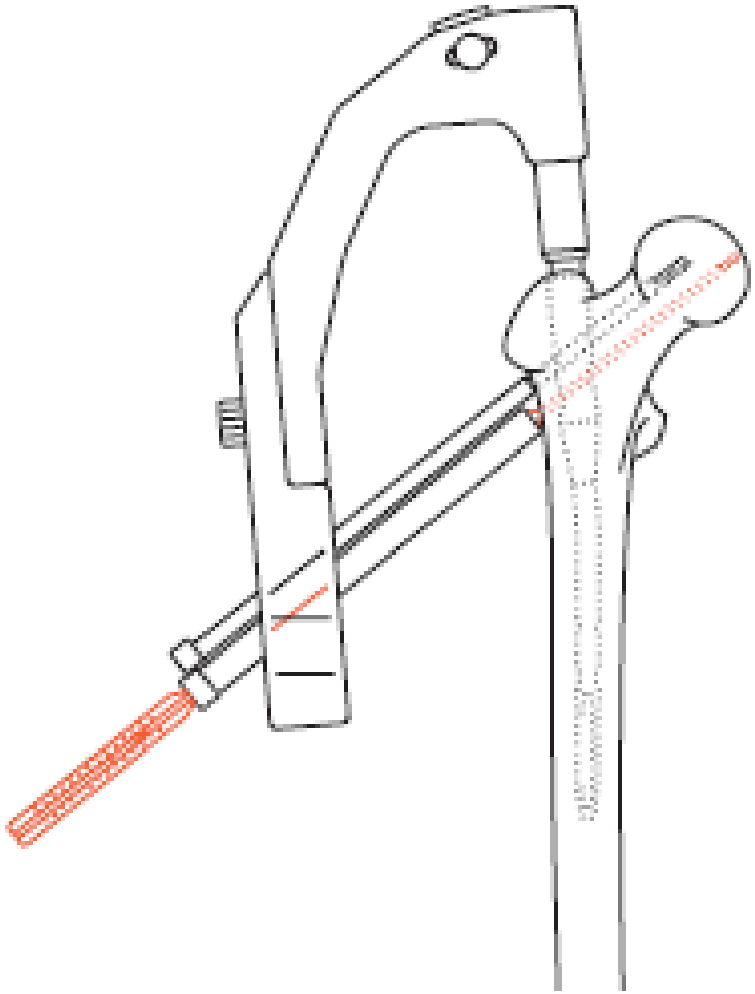
- Measure length of hip pin



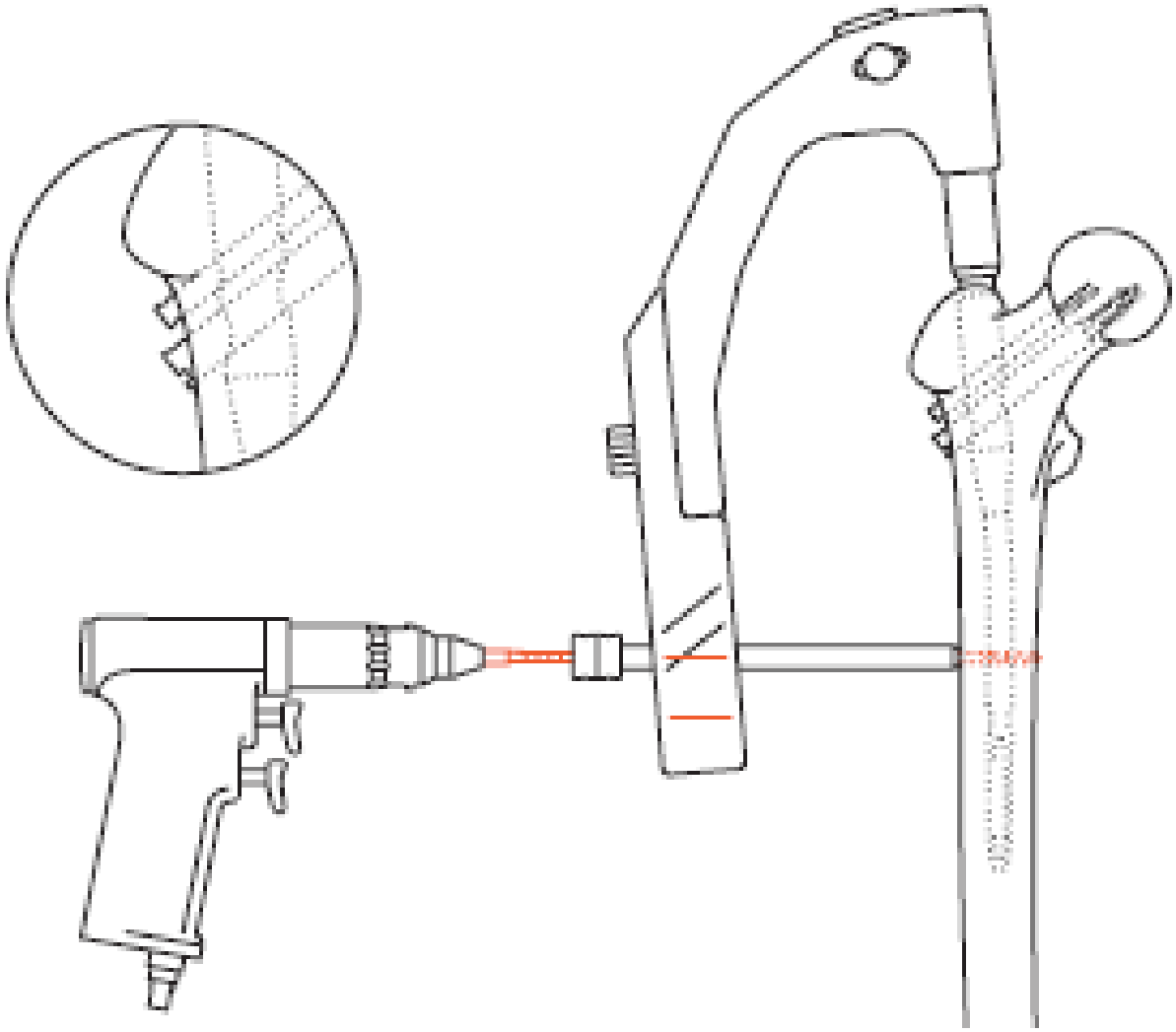


Measure length of femoral neck screw

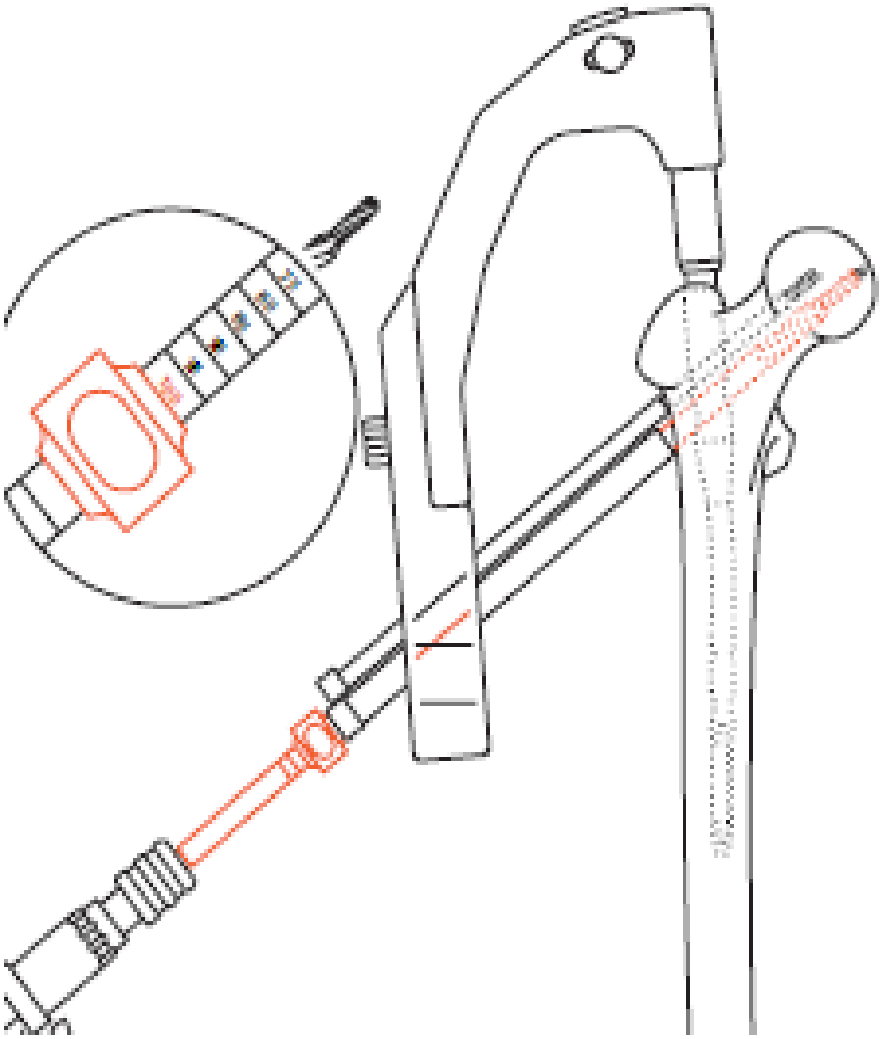




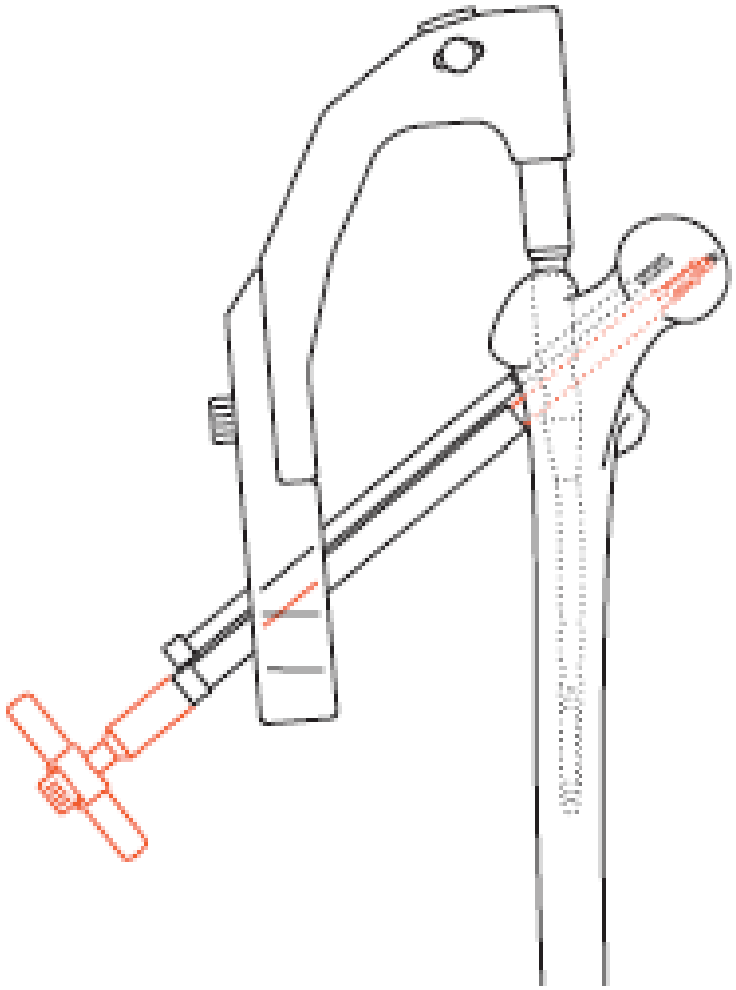
Drill hole for distal locking



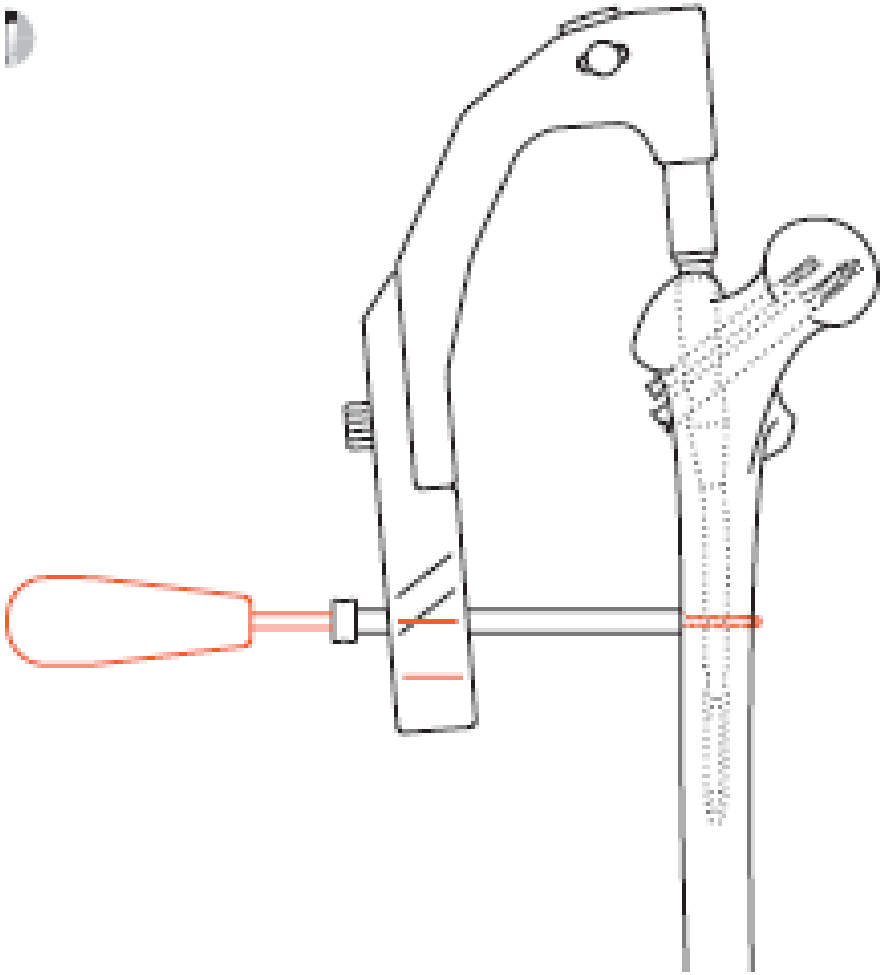
3 Drill hole for femoral neck screw



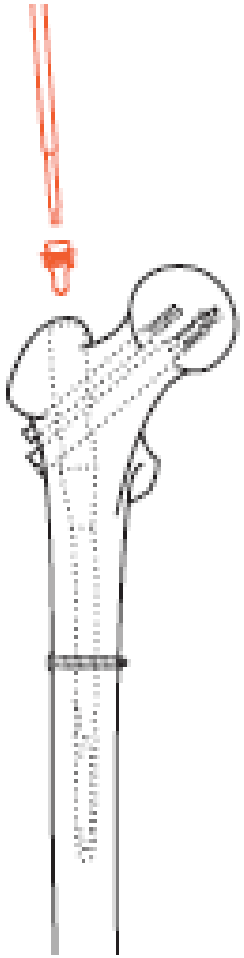
Insertion of femoral neck screw



Insertion of Locking Bolt



Insertion of End Cap



Nails, Wires & Pins

K. Nails Implants & Instruments

Square Nails

Rush Nails

Suture Wire

Kirschner Wire

Steinmann Pins

External Fixator Indications

- Open fractures
- Periarticular fractures
- Polytrauma/Damage control
- Pelvic fractures
- Children's fractures

Indications

<u>Deformity Correction</u>

Congenital

Post-traumatic

Acquired

Components of the Ex-fix

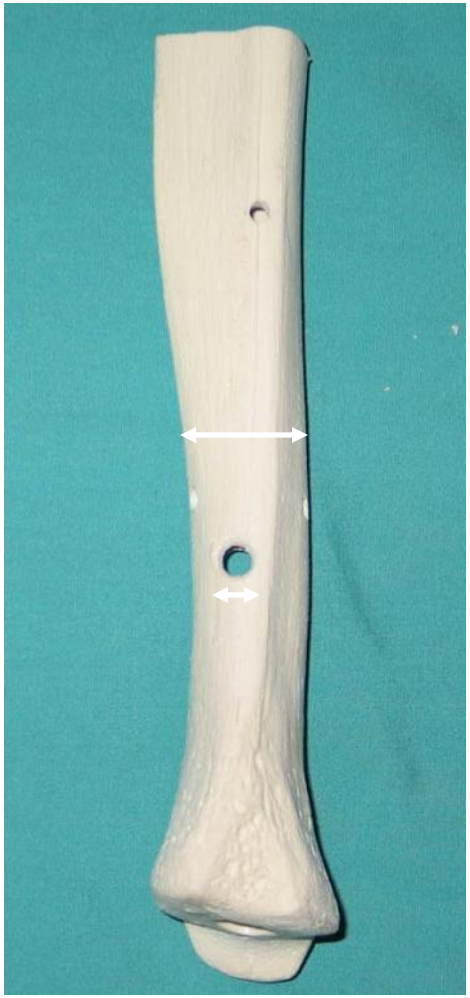
- Pins
- Clamps
- Connecting rods

Pins

- Various diameters, lengths, and designs
  - 2.5 mm pin
  - 4 mm short thread pin
  - 5 mm predrilled pin
  - 6 mm tapered or conical pin
  - 5 mm self-drilling and self tapping pin
  - 5 mm centrally threaded pin
- Materials
  - Stainless steel
  - Titanium
    - More biocompatible
    - Less stiff

Pin Diameter Guidelines

- Femur – 5 or 6 mm
- Tibia – 5 or 6 mm
- Humerus – 5 mm
- Forearm – 4 mm
- Hand, Foot – 3 mm



Clamps

- Two general varieties:
  - Single pin to bar clamps
  - Multiple pin to bar clamps
- Features:
  - Multi-planar adjustability
  - Open vs closed end
- Principles
  - Must securely hold the frame to the pin
  - Clamps placed closer to bone increases the stiffness of the entire fixator construct

Connecting Rods and/or Frames

- Options:
  - materials:
    - Steel
    - Aluminum
    - Carbon fiber
  - Design
    - Simple rod
    - Articulated
    - Telescoping

- Principle
  - increased diameter = increased stiffness and strength
  - Stacked (2 parallel bars) = increased stiffness

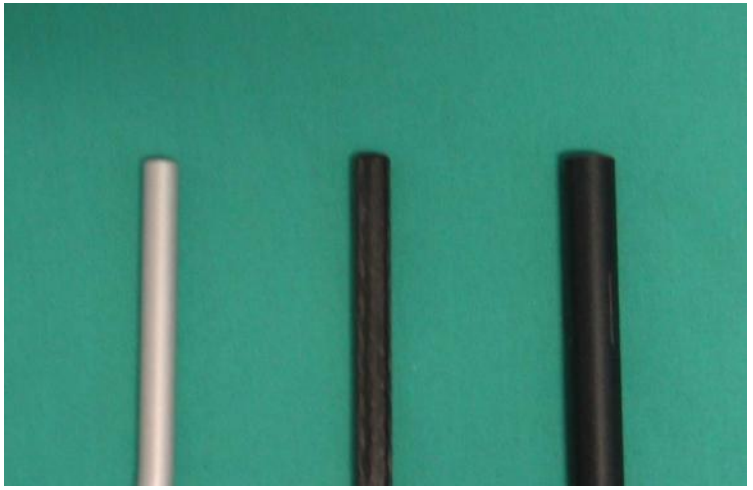
Bars

- Stainless vs Carbon Fiber
  - –Radiolucency
  - –↑ diameter = ↑ stiffness
  - –Carbon 15% stiffer vs stainless steel in loading to failure
  - –frames with carbon fiber are only 85% as stiff ? ? ? ?Weak link is clamp to carbon bar?

Added bar stiffness

≠

increased frame stiffness

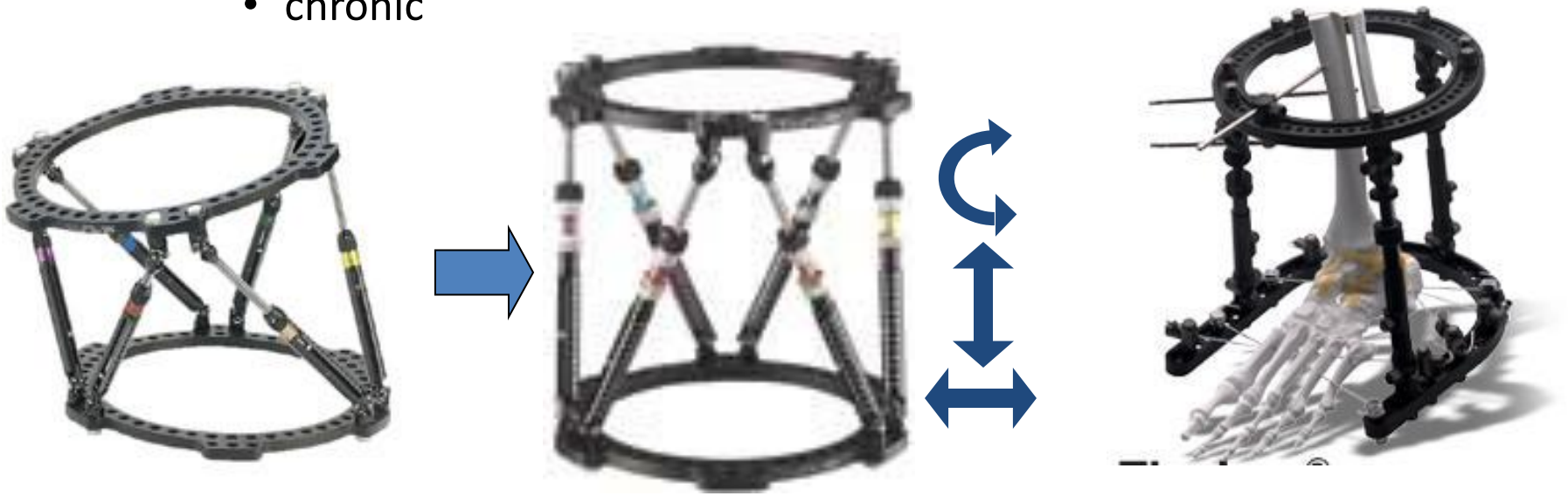


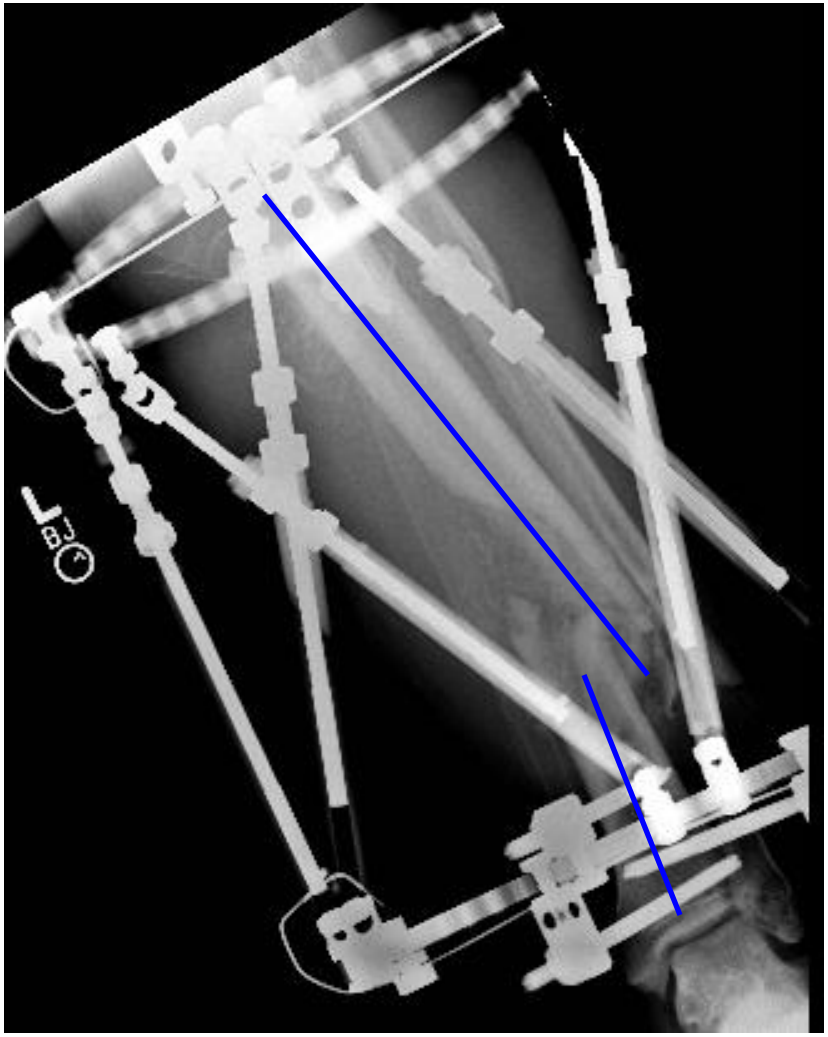
Ring Fixators

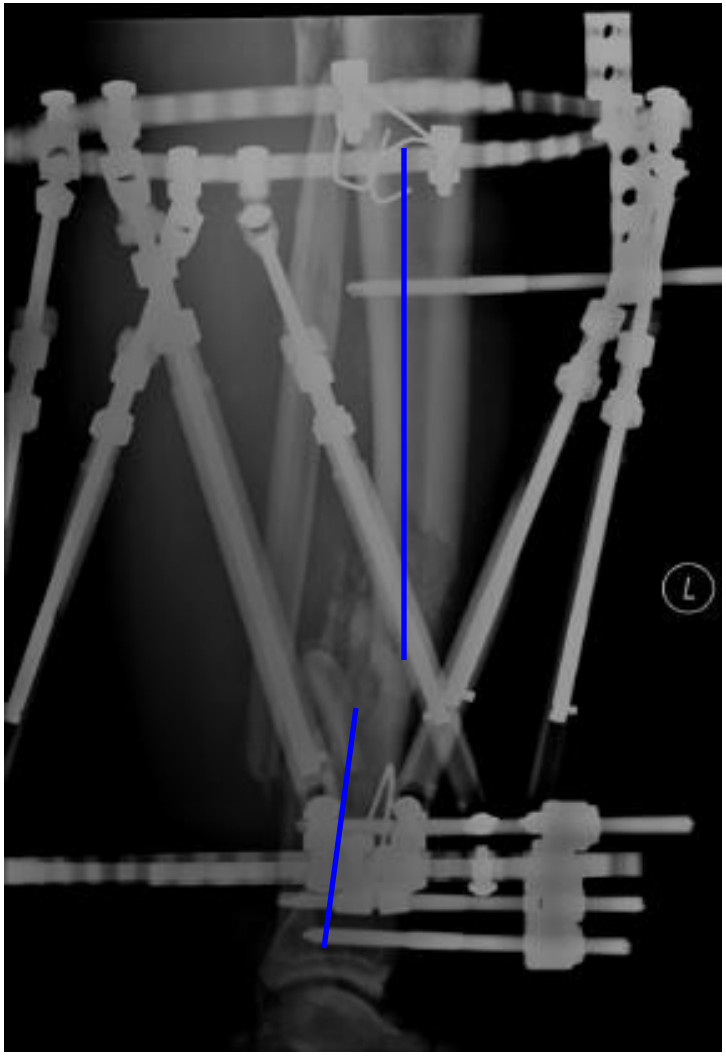
- Components:
  - Tensioned thin wires
    - olive or straight
  - Wire and half pin clamps
  - Rings
  - Rods
  - Motors and hinges

Multiplanar Adjustable Ring Fixators

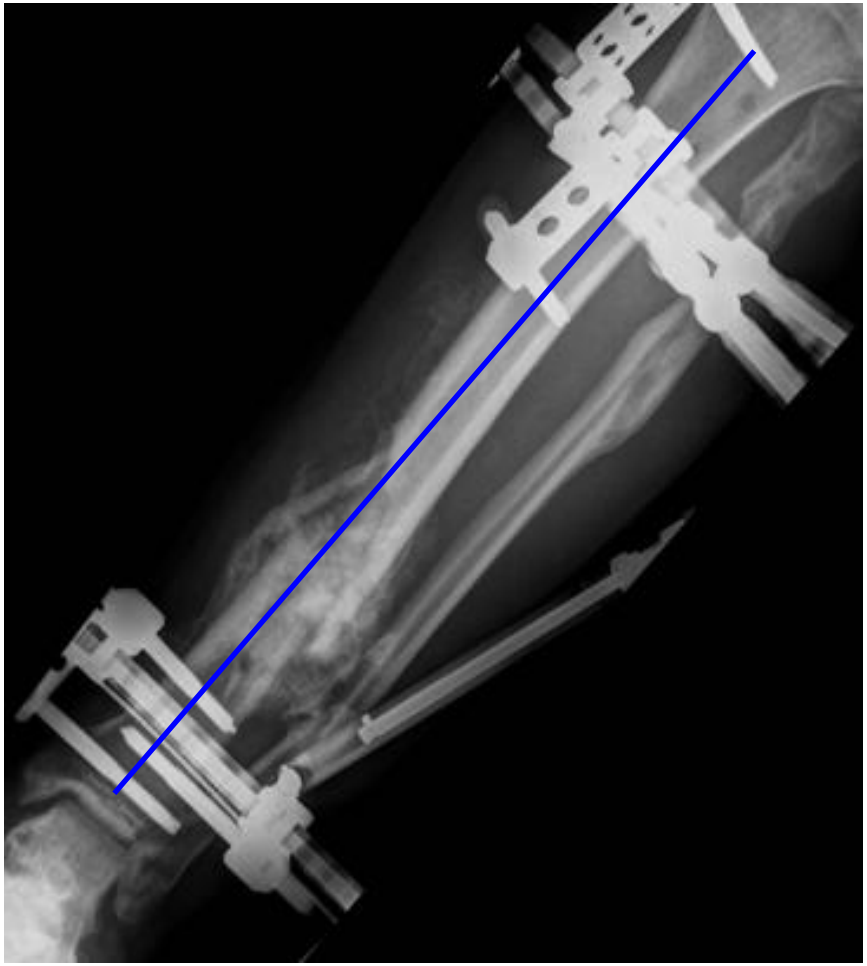
- Application with wire or half pins
- Adjustable with 6 degrees of freedom
  - Deformity correction
    - acute
    - chronic

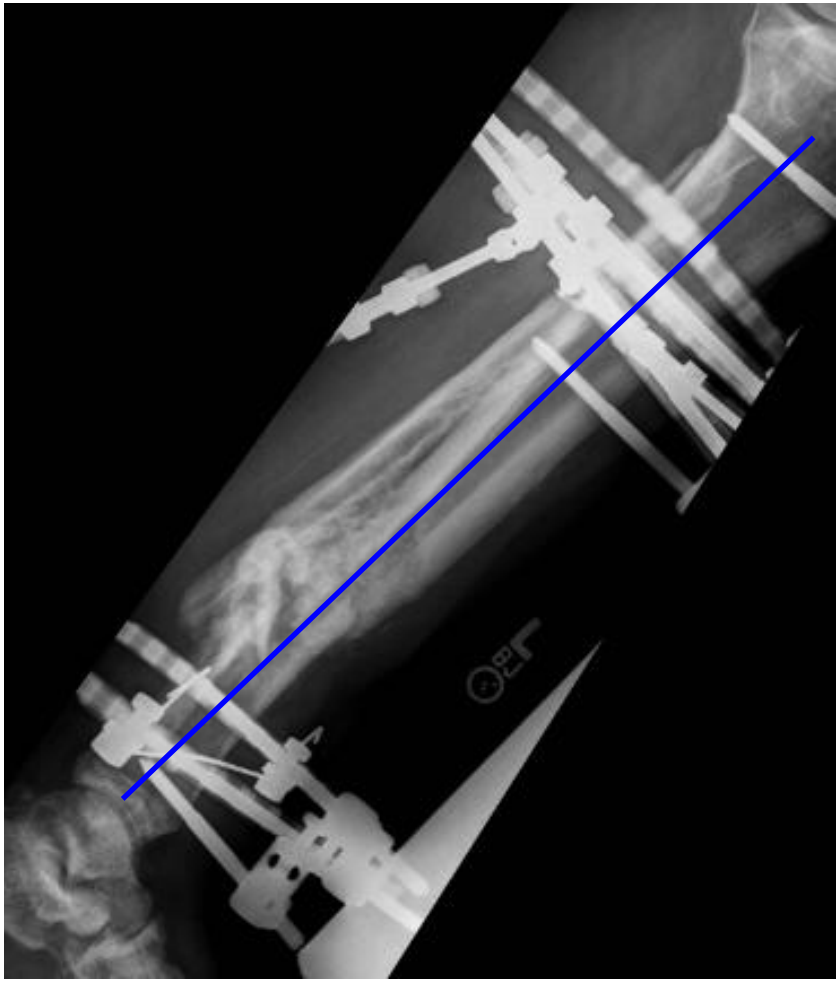






- Type 3A open tibia fracture with bone loss

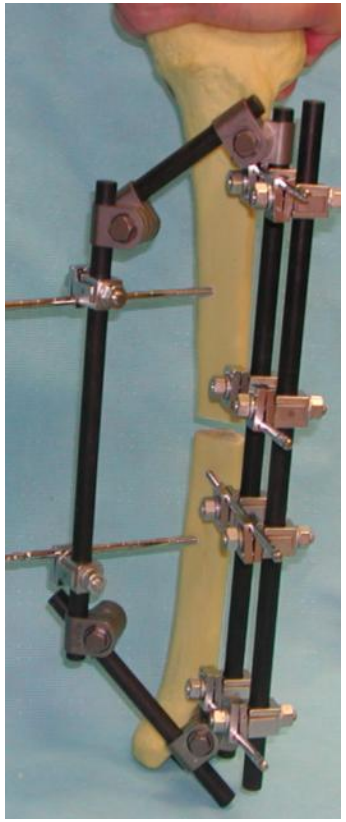




- Following frame adjustment and bone grafting

Frame Types

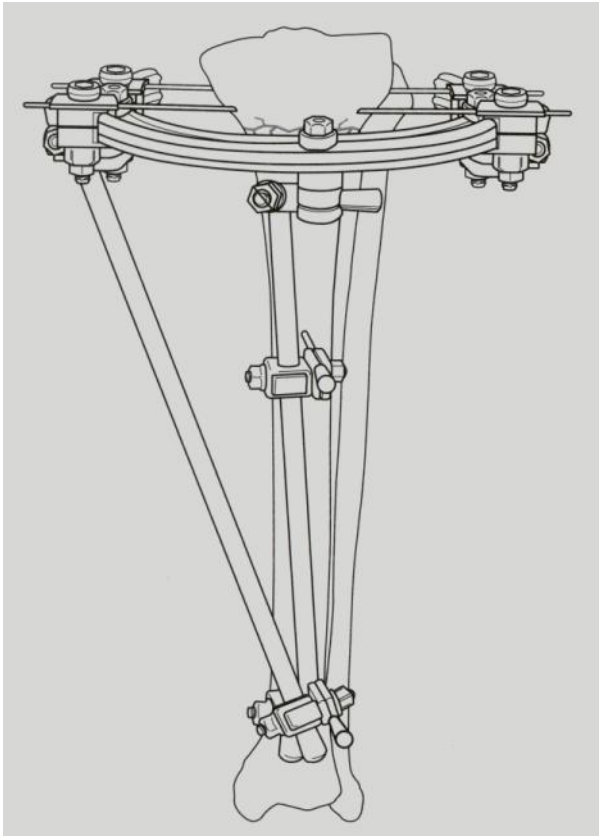
- Uniplanar
  - Unilateral
  - Bilateral
    - Pin transfixes extremity
- Biplanar
  - Unilateral
  - Bilateral
- Circular (Ring Fixator)
  - May use Half-pins and/or transfixion wires
- Hybrid
  - Combines rings with planar frames



Unilateral uniplanar Unilateral biplanar

Hybrid Fixators

- Combines the advantages of ring fixators in periarticular areas with simplicity of planar half pin fixators in diaphyseal bone



External Fixators

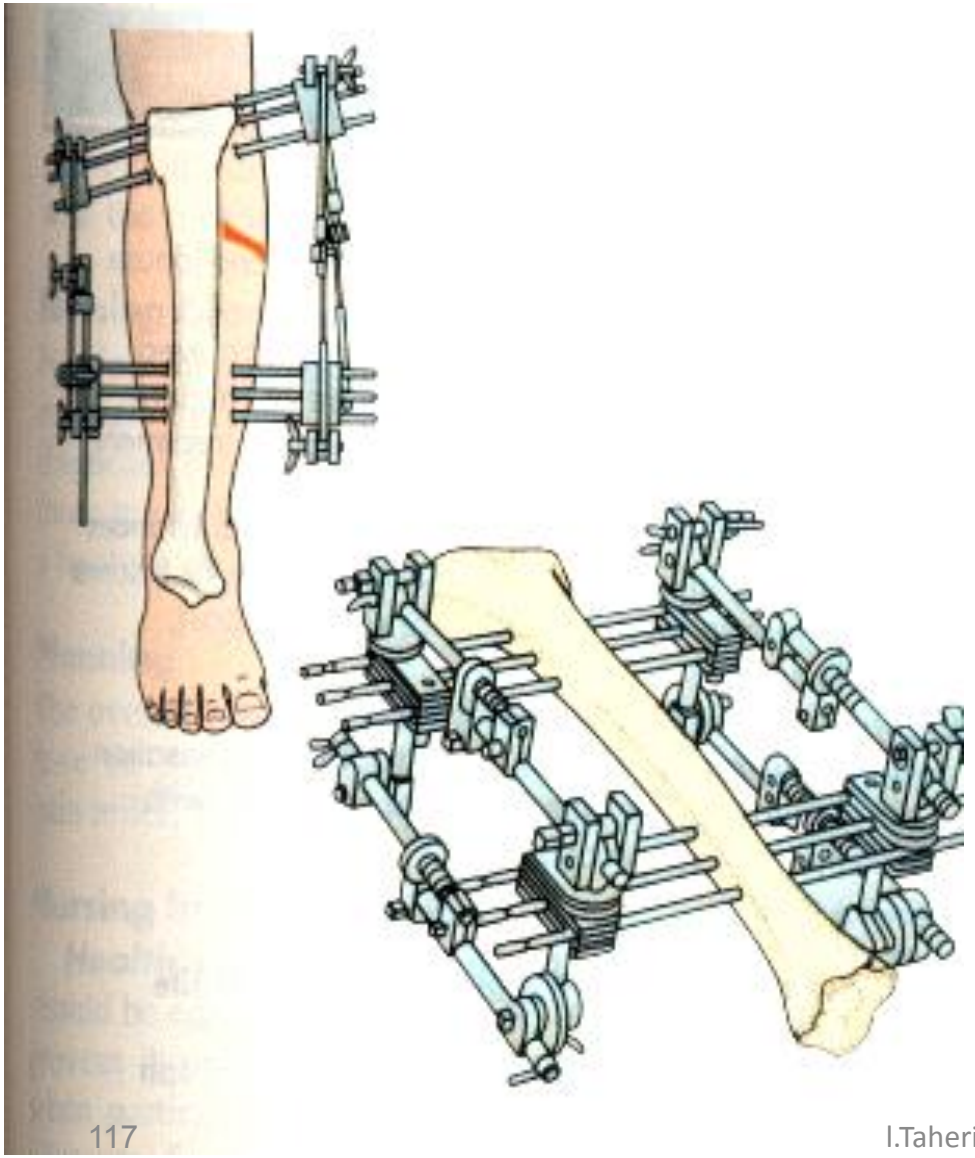
External Fixator for Forearm & Metacarpals

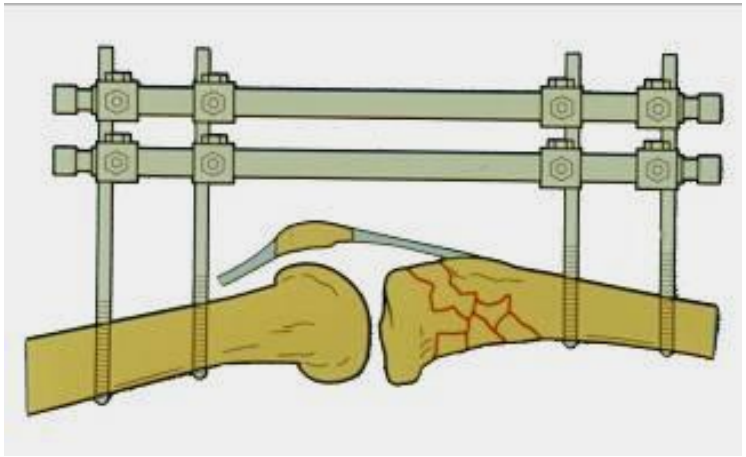
Tubular External Fixators

Illizarov External Fixators

Illizarov Wire, Nuts, Bolts & Washers

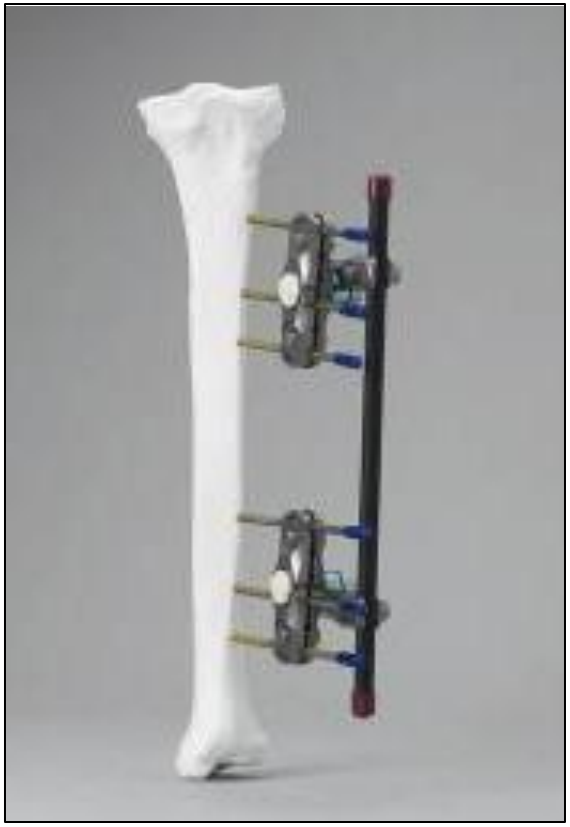
External Fixator





Increase Stability

- Pins
  - Larger diameter
  - More pins
  - Closer to fracture site



Increase Stability

- Bars:
  - Closer to limb
  - More bars
  - Second plane at right angle to decrease torsion (twisting)

Increase Stability

- Rings:
  - Smaller is stiffer
    - Use smallest diamaeter ring possible but allow for swelling
  - More rings = more stable

Advantages

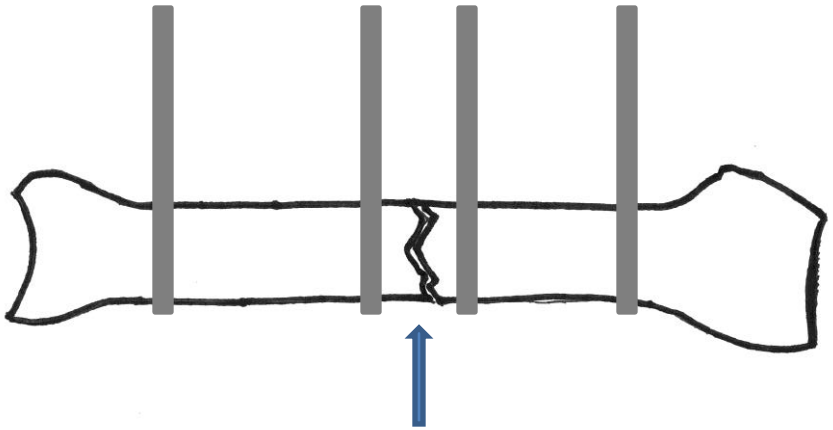
- Simplicity and ease of application
- Minimal blood loss
- Adjustability after surgery
- Access for wound management

Disadvantages

- Anatomic structures at risk (Safe Zones)
- Pin/Wire site infections
- Joint contractures
- Prolonged time to bony healing

Safety Factors

Pin/Wire should not be in the fracture

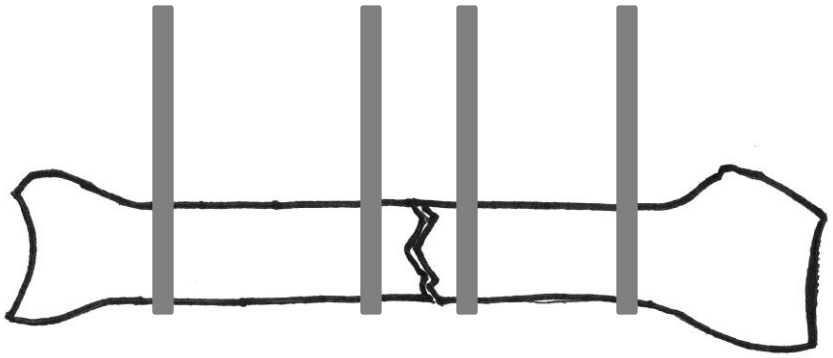


When drilling go slow as not to burn the bone

Stability Factors

Pin/Wire Location

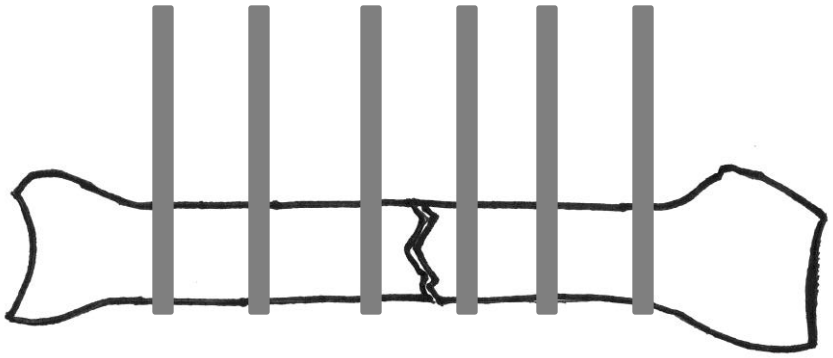
Maximal pin span



Stability Factors

Pin/Wire Number

More pins distribute forces and increase construct stiffness



Stability Factors

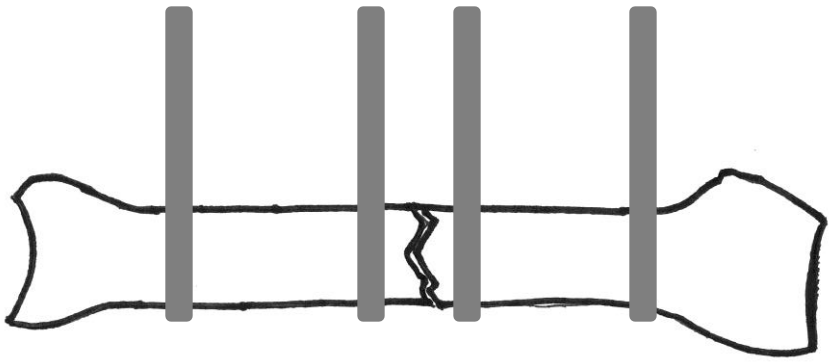
<u>Pin/Wire Size</u>

Torsional strength proportional to its radius^4

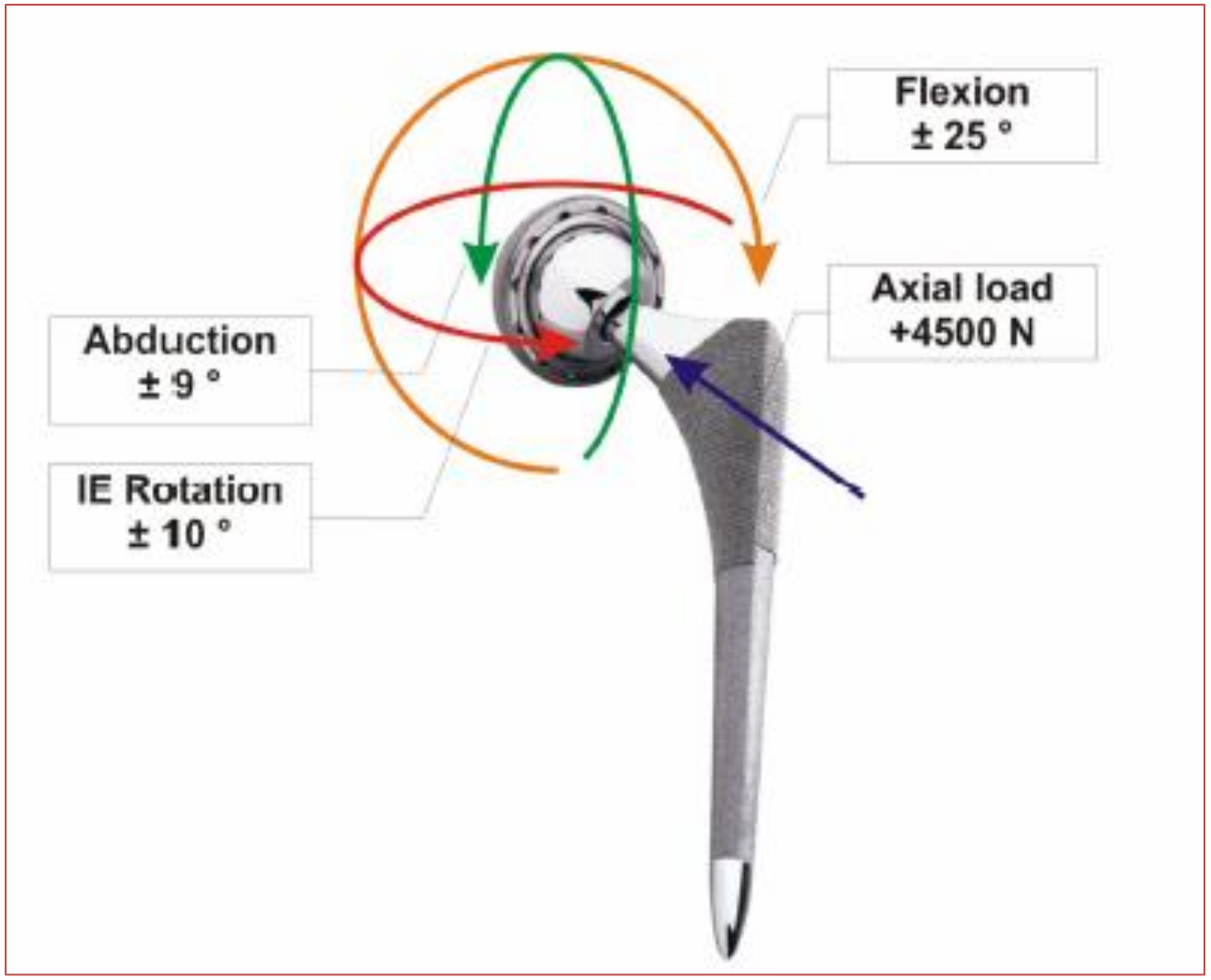
Pin core diameter

≤

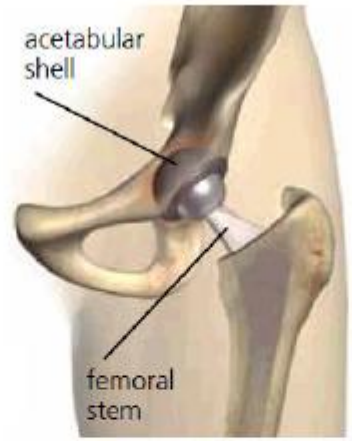
1/3 bone diameter

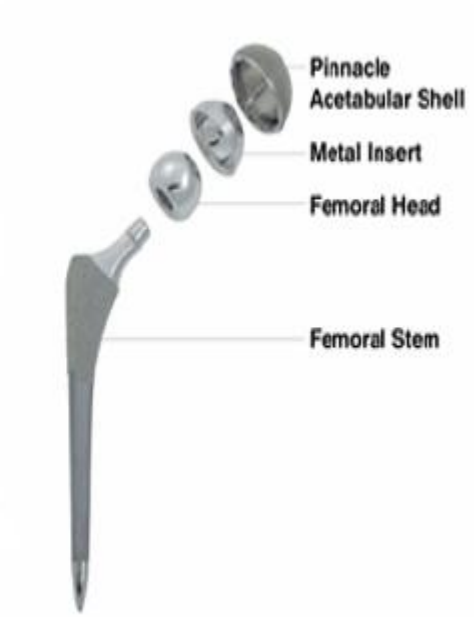


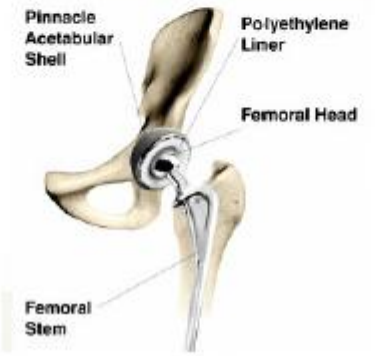
Arthroplasty



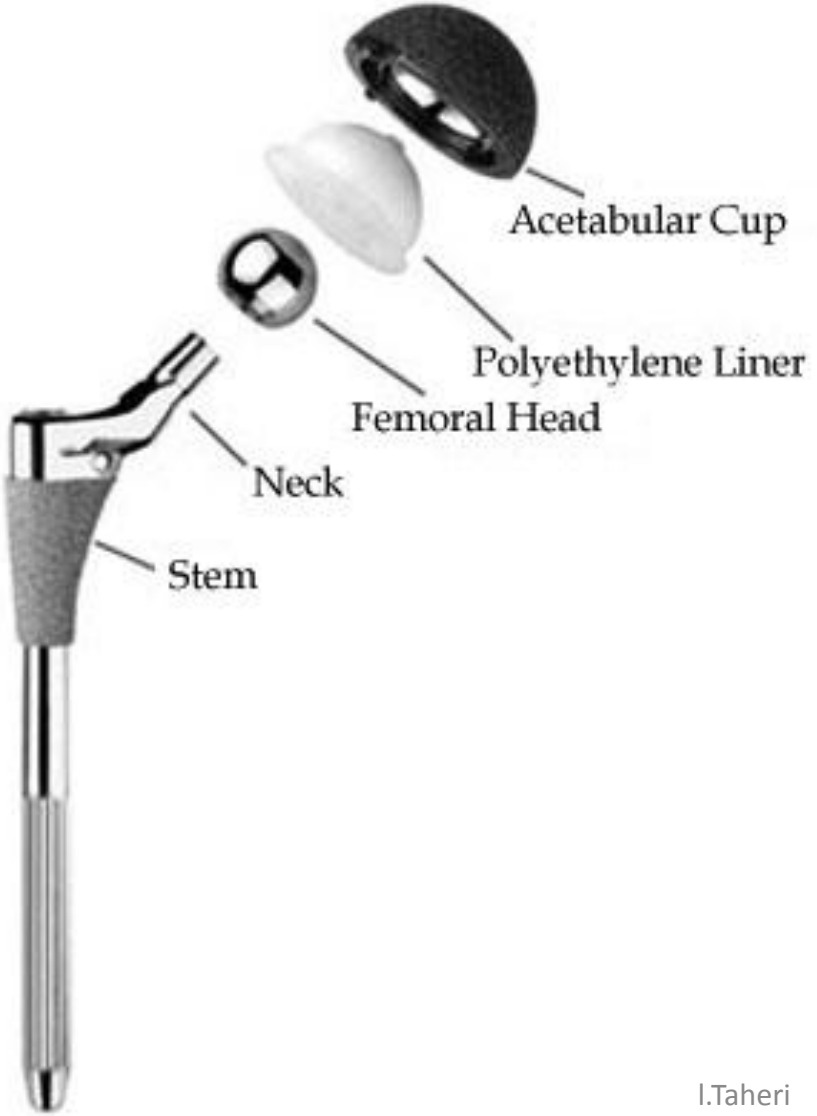
Total Hip Replacement

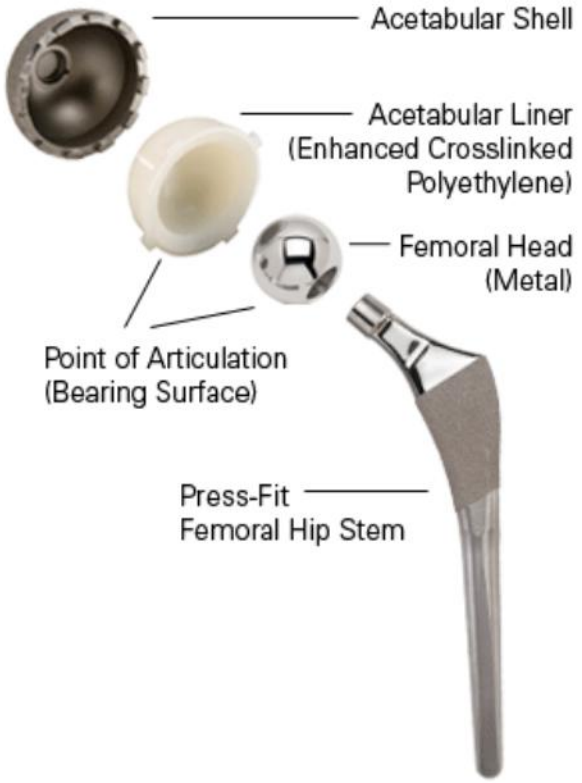






Arthroplasty

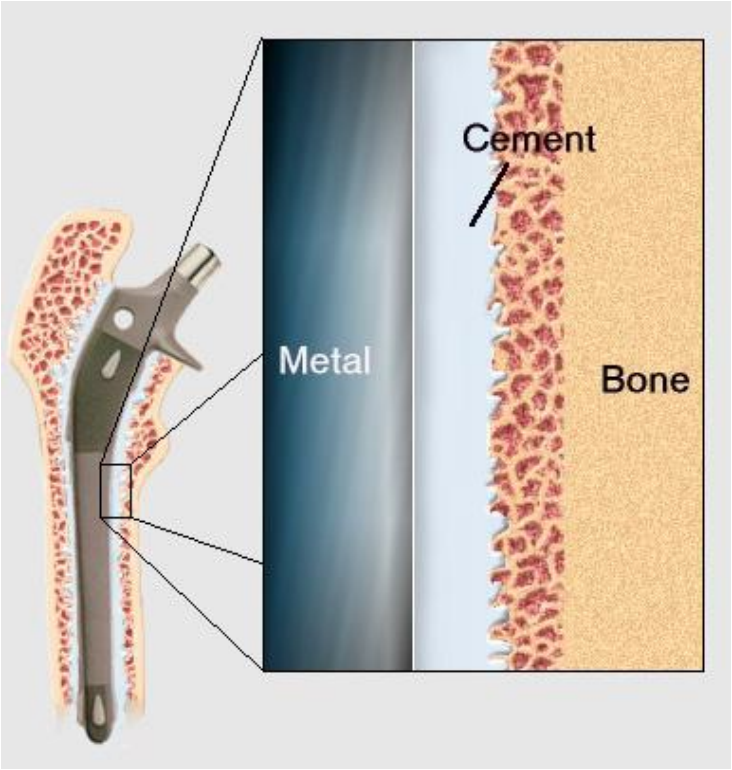




Arthroplasty

Cemented:

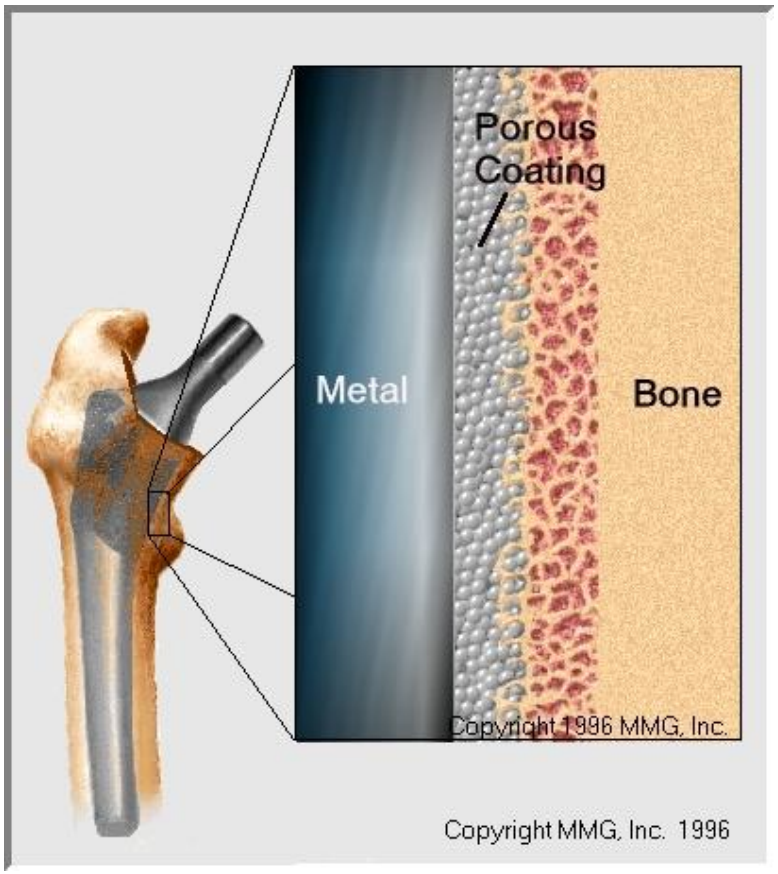
- Elderly (>65)
- Low demand
- Better early fixation
- late loosening



Arthroplasty

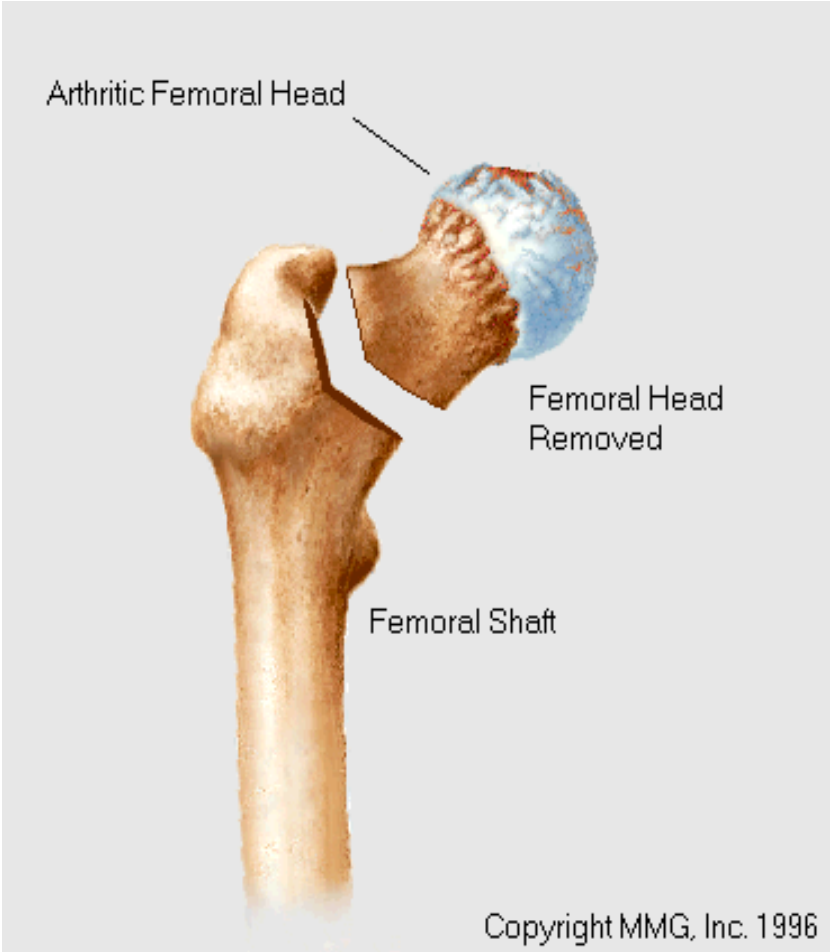
Cementless:

- Younger
- More active
- Protected weight-bearing first 6 weeks
- ? Better long-term fixation



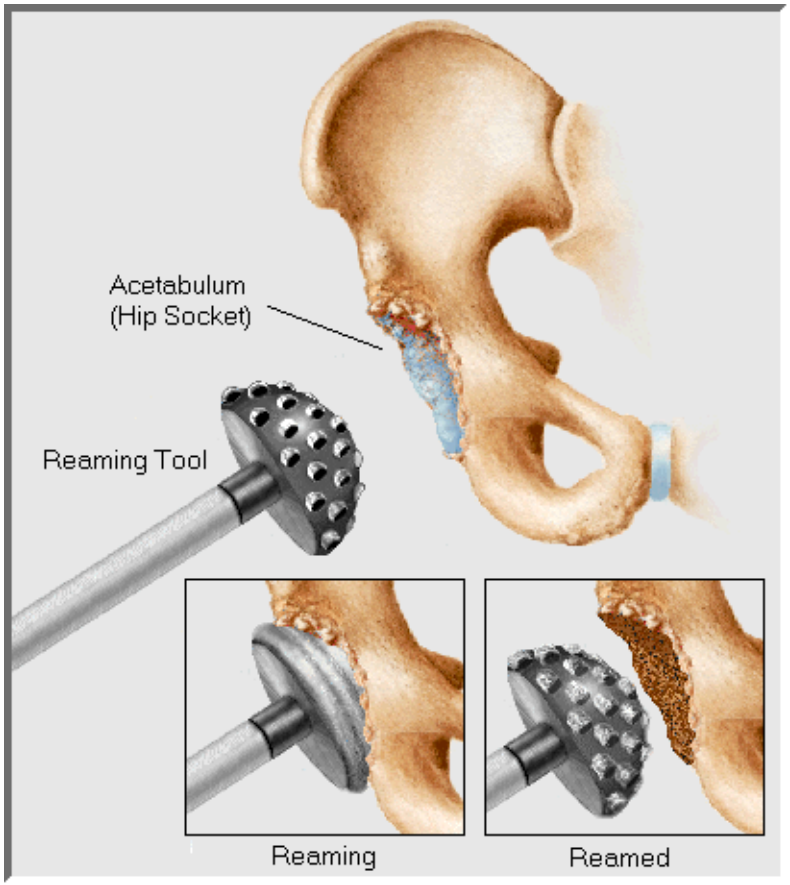
Technique: Total Hip Replacement

- Femoral neck resection

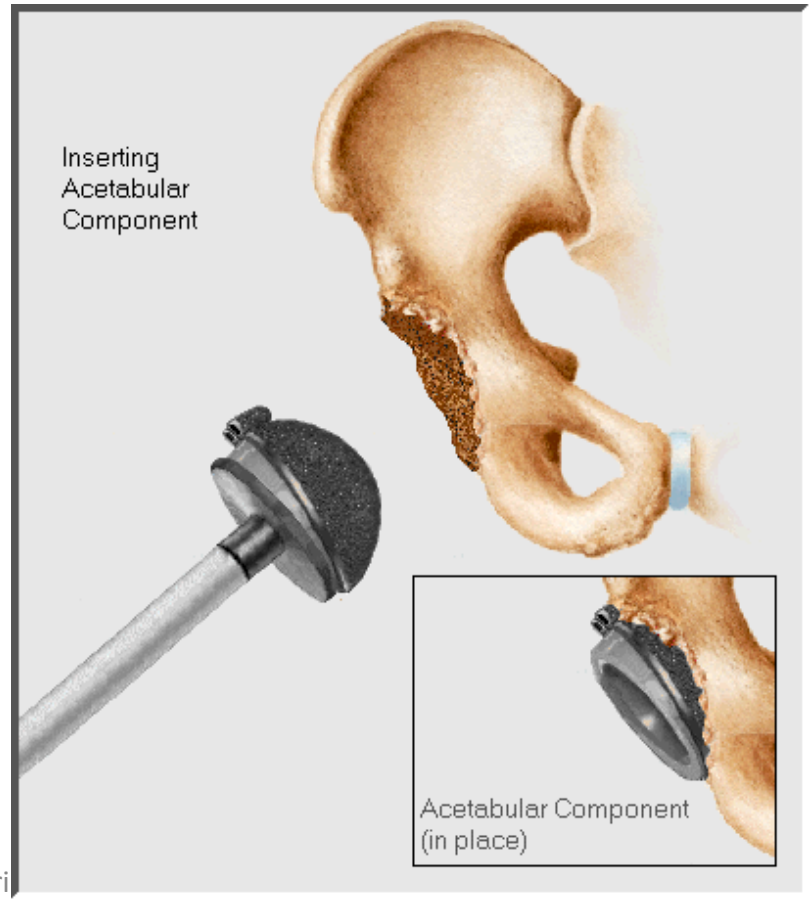


Technique: Total Hip Replacement

- Acetabular reaming

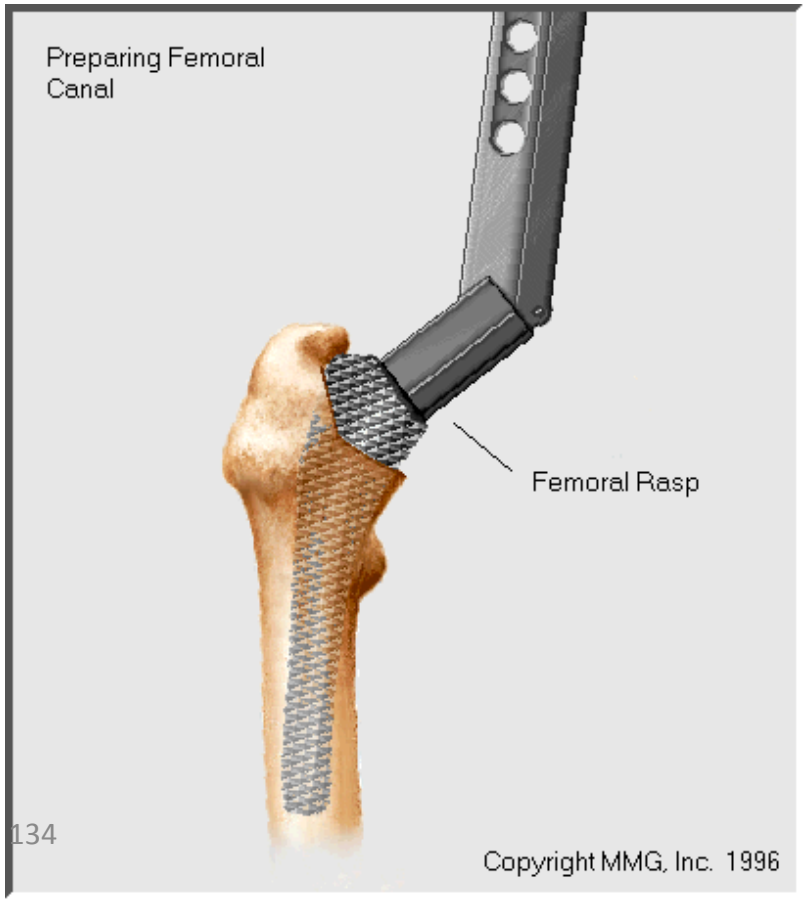


- **Insertion of acetabular component**

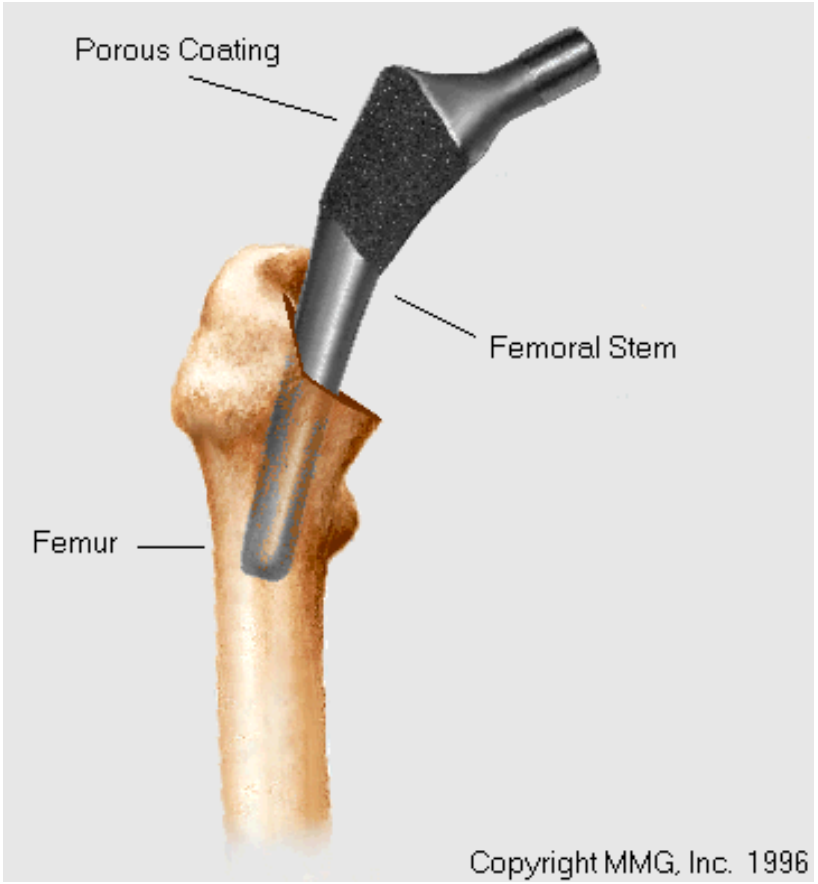


Technique: Total Hip Replacement

- Reaming/broaching of femoral component

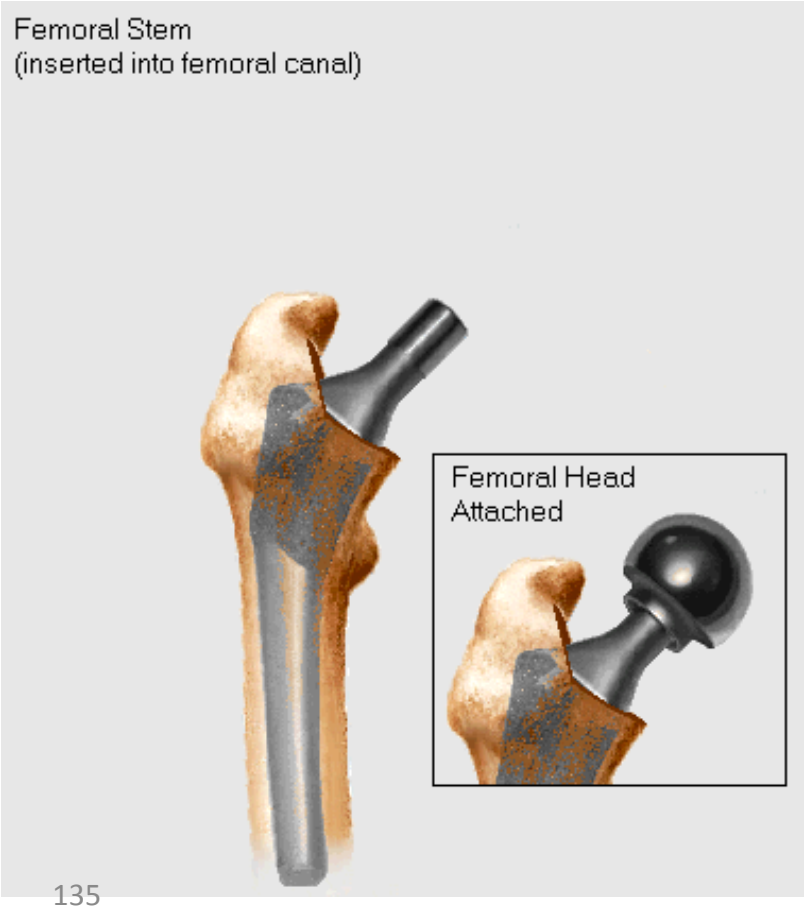


- **Insertion of femoral component**

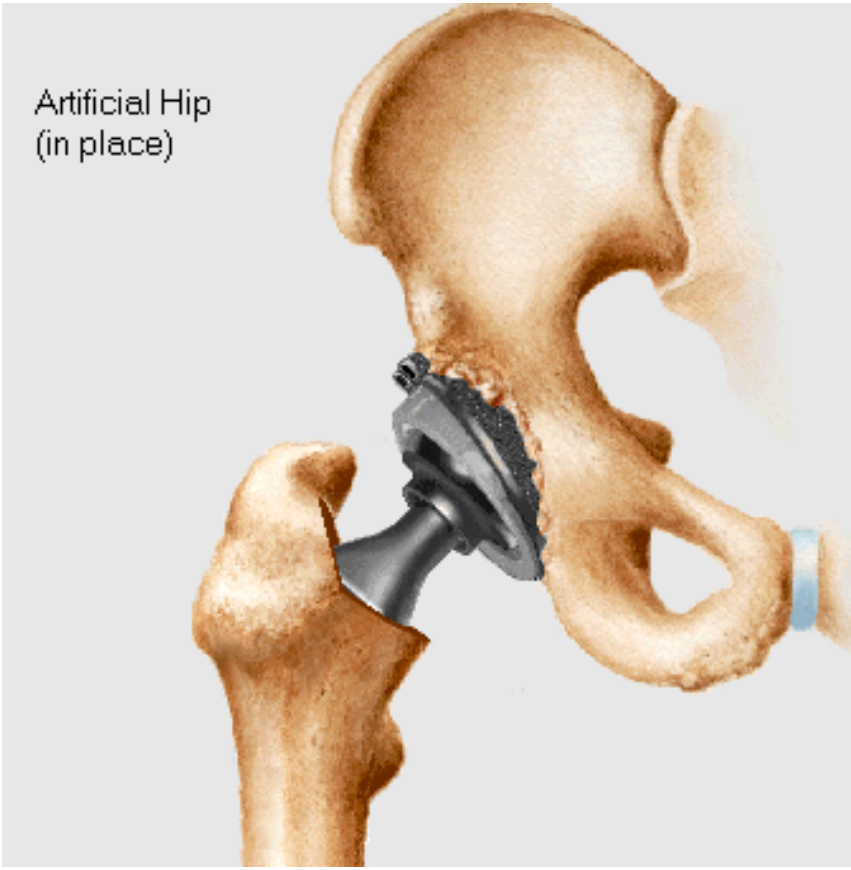


Technique: Total Hip Replacement

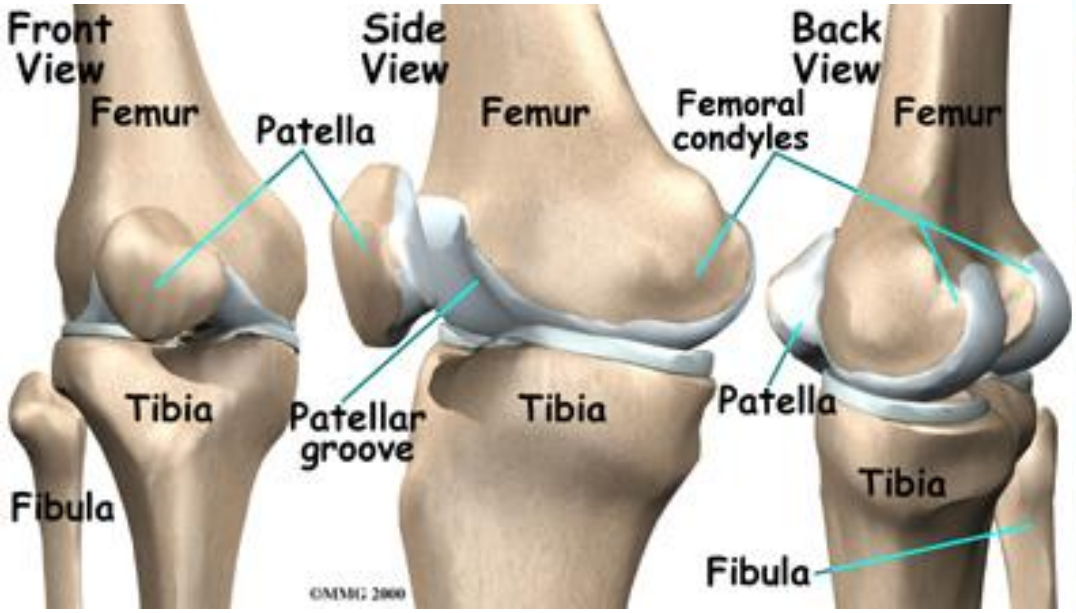
- Femoral head impaction

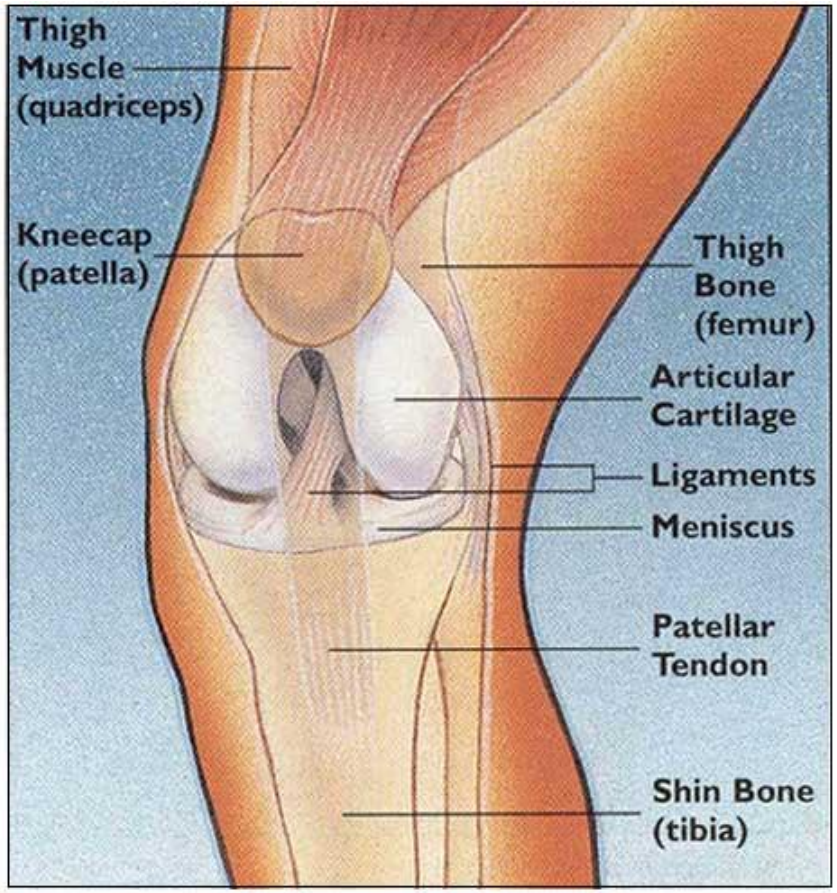


- **Final implant**



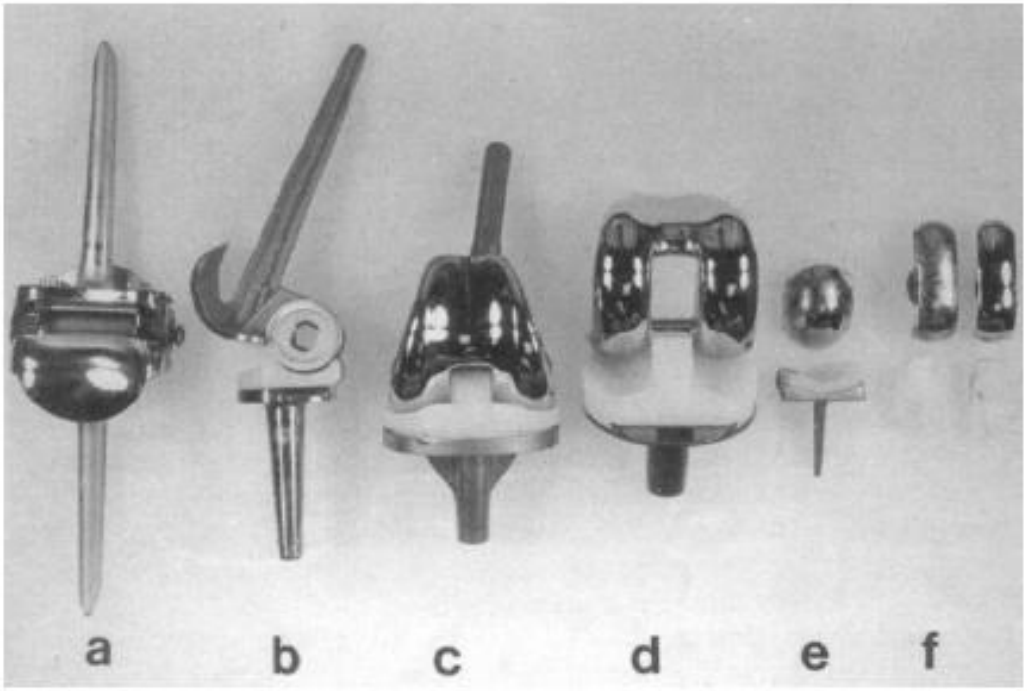
Anatomy—Knee



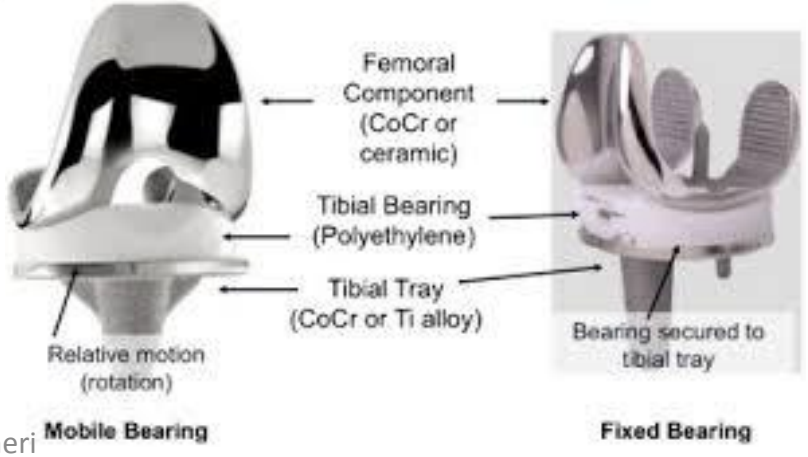


Normal Knee Anatomy

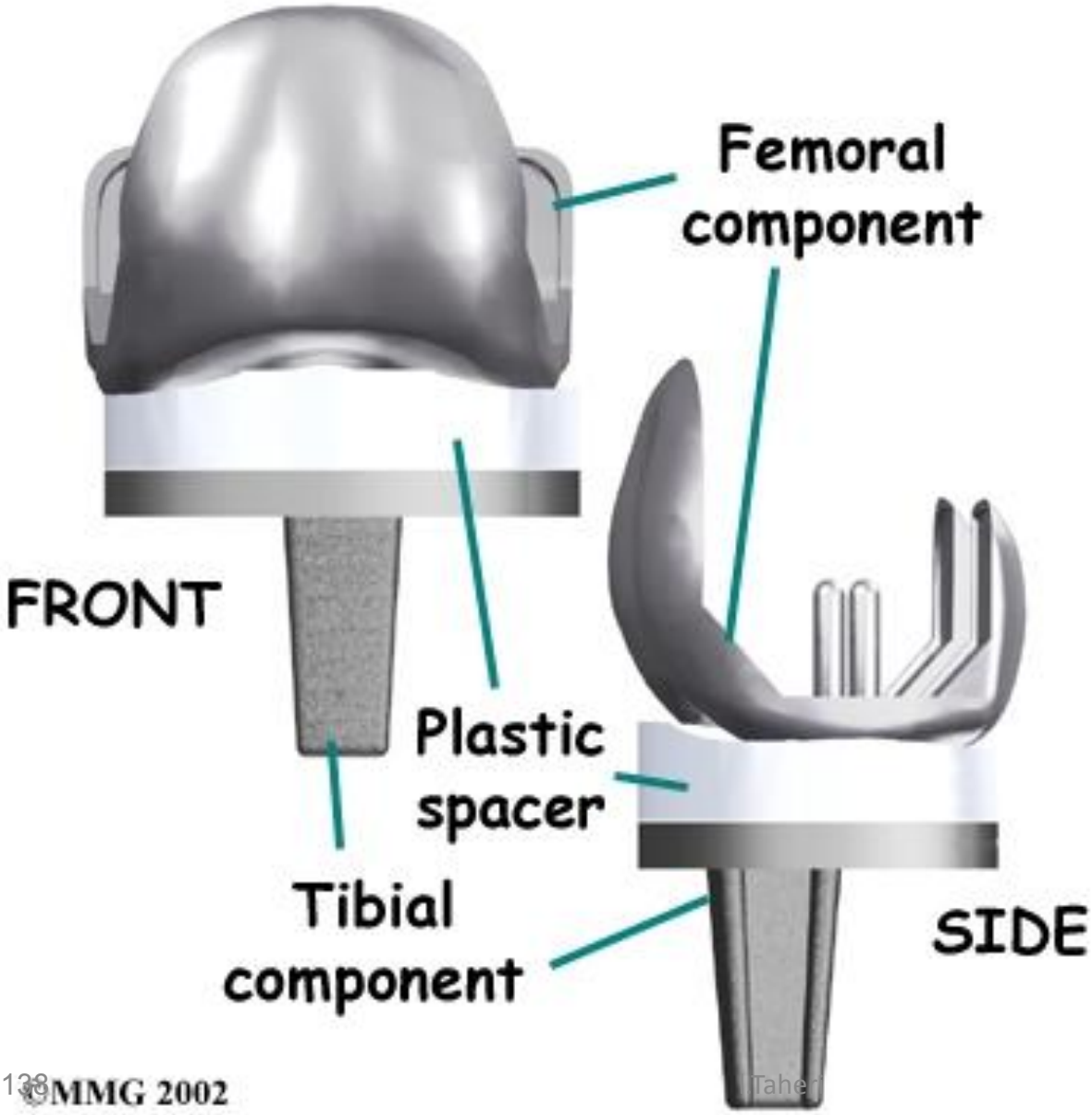
تعویض مفصل زانو



(a): مفصل لولایی فلزی
(b): لولا شده با پوشش
(c): تثبیت داخل کانالی
(d): تعویض سطح،
(e): تعویض تک بخشی
(f): تعویض دو بخشی

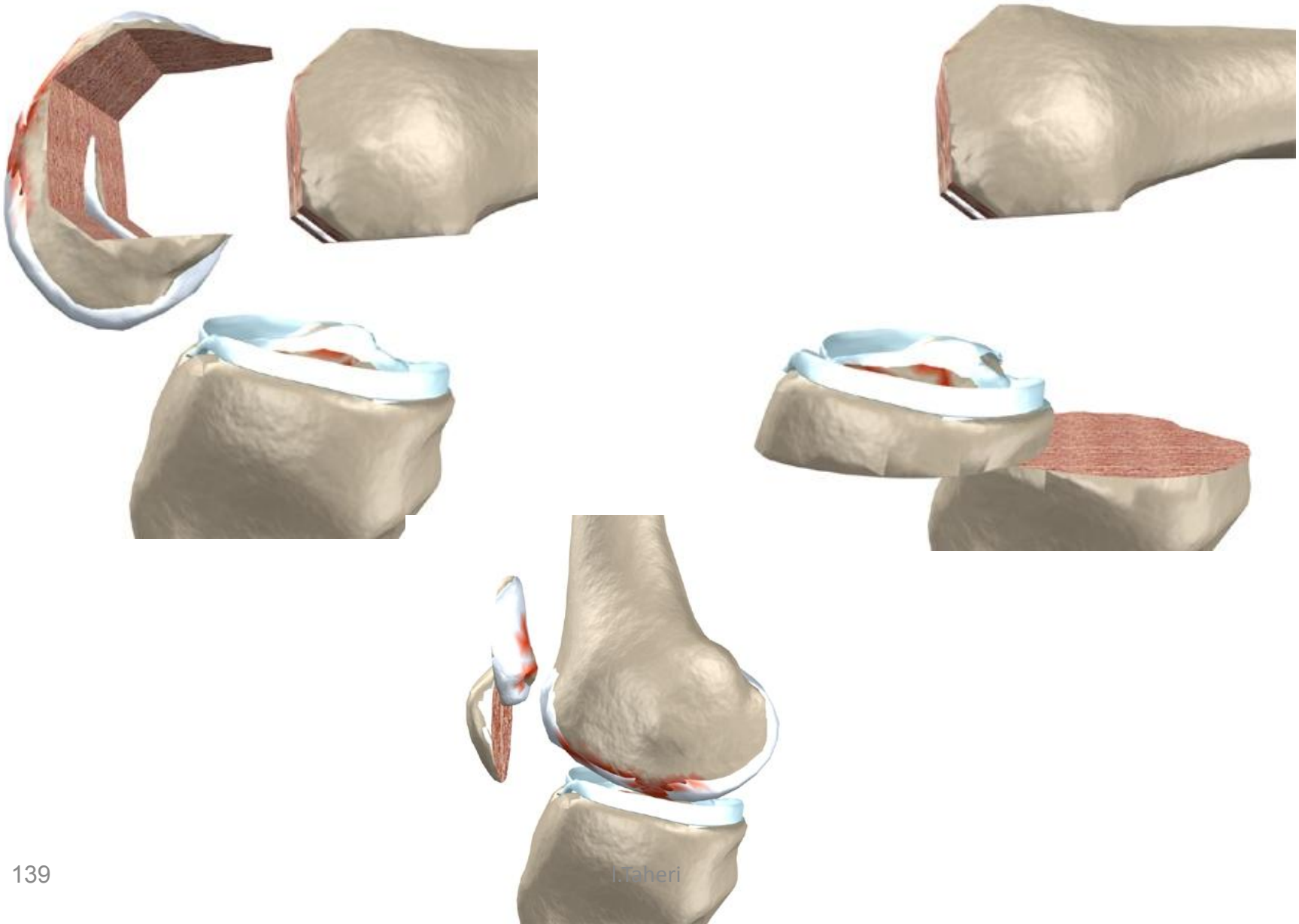


Knee Replacement—Implants

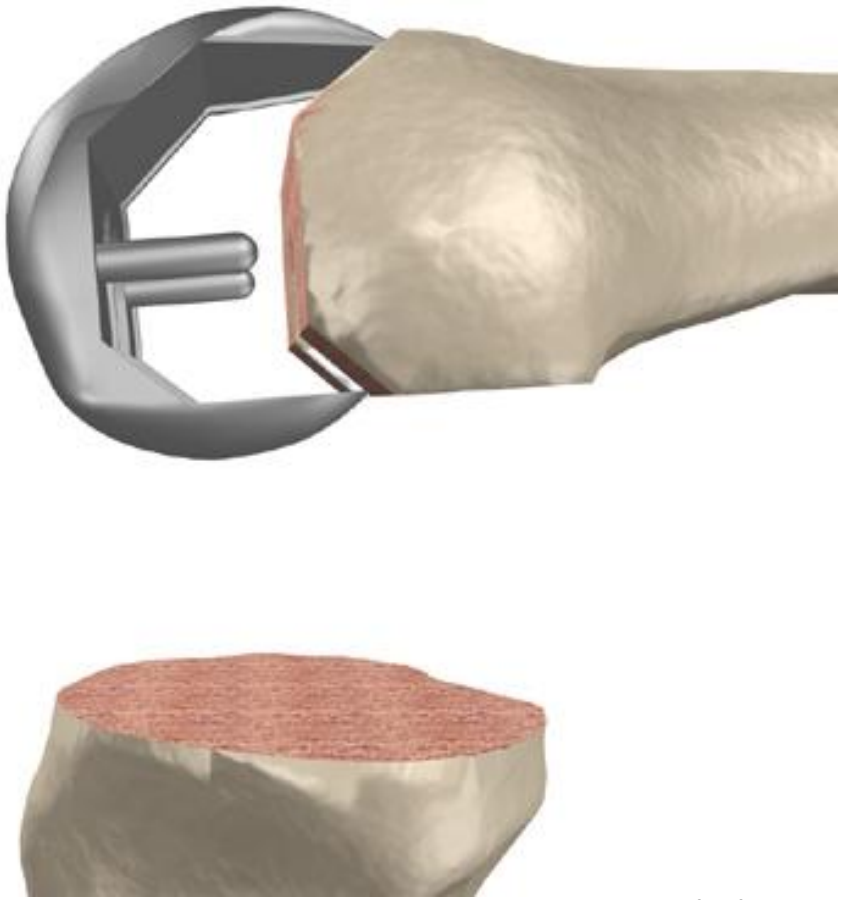


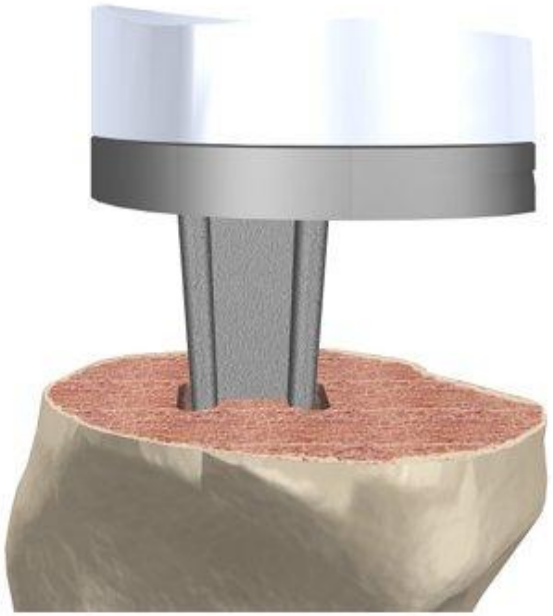
Patellar component

Knee Replacement—Bone Cuts

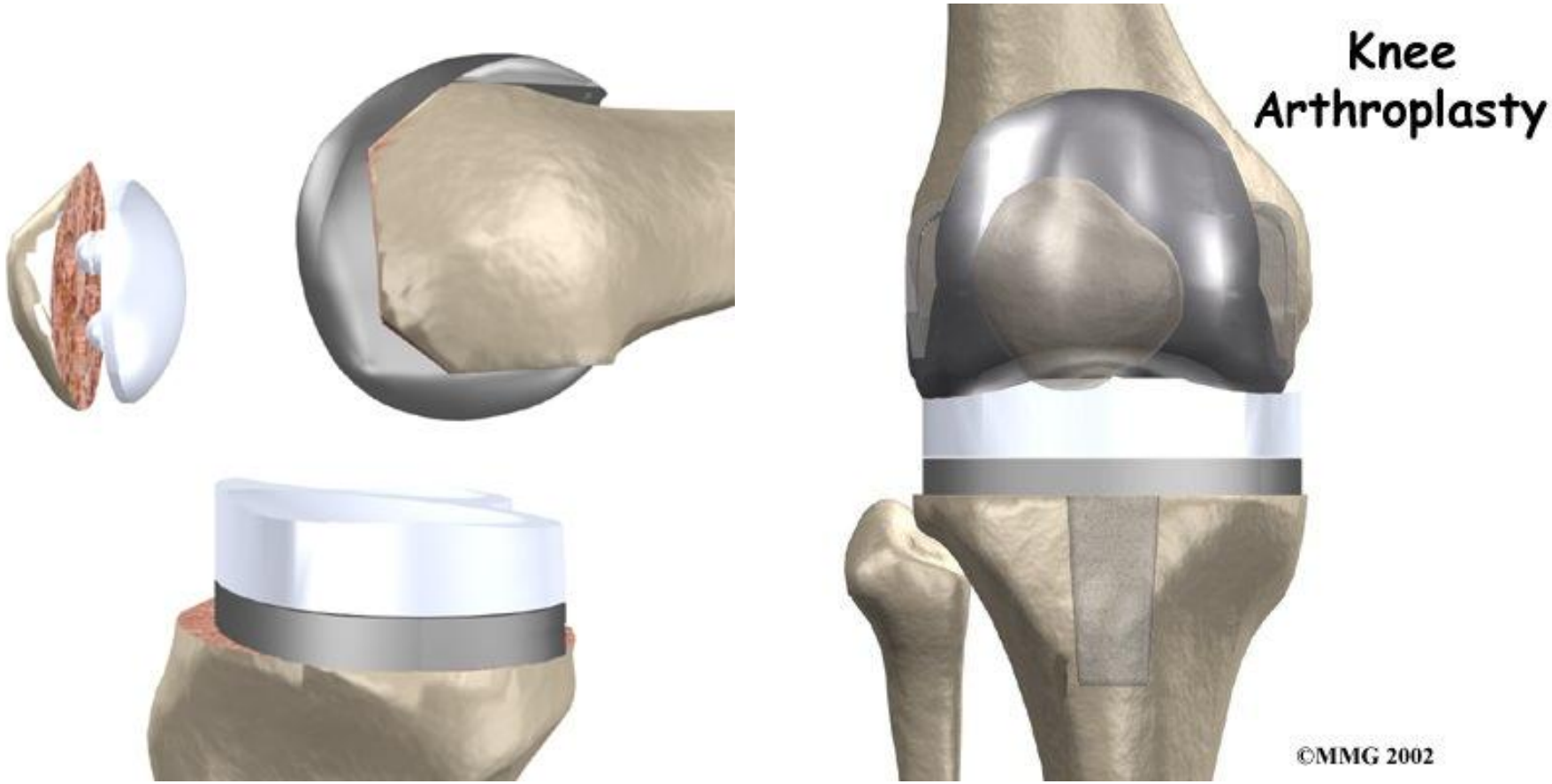


Knee Replacement—Implants





Knee Replacement—Implants



Bone Grafts
Bone Transplantation

- Both bone autograft and allografts are used for bone defect reconstruction
- Bone xenografts are not used nowadays because of sequester of all viable osteocyte
- Cortical or cancellous bone graft
- Revascularization of cortical grafts may take a few months
- Revascularization of cancellous bone grafts are more rapid
- Healing of vascularized bone grafts are better. Particularly suitable in a field after trauma, cronic scarring, or prior radiation. Biomecanically are superior to nonvascularized grafts

Bone Graft Donor Areas

- Cranium (cortical)
- Thorax (split rib grafts)
- İliac (good quality cortical and cancellous bone source)
- Tibia (cancellous)
- Others
  - Distal radİUs, proXimal ulna (hand surgery)
  - Fibula (esp. vascularized flap)
  - Metatars

Bone Allografts

- Available in various forms
  - Processing methods may vary between companies / agencies
- Fresh
- Fresh Frozen
- Freeze Dried

Bone Allografts

- Fresh
  - Highly antigenic
  - Limited time to test for immunogenicity or diseases
  - Use limited to joint replacement using shape matched osteochondral allografts

Bone Allografts

- Fresh frozen
  - Less antigenic
  - Time to test for diseases
  - Strictly regulated by FDA
  - Preserves biomechanical properties
    - Good for structural grafts

Bone Allografts

- Freeze-dried
  - Even less antigenic
  - Time to test for diseases
  - Strictly regulated by FDA
  - Can be stored at room temperature up to 5 years
  - Mechanical properties degrade

BONE CEMENT

- Acrylic cement is used for the fixation of total joint prosthesis
- The cements used in orthopedic surgery are combination of prepolymerized PMMA solid particle and the liquid monomer
- The powder particles are sphere (30 to 150 µm in diameter), molecular weight of 20,000 to 2 million
- For the reaction to occur,prepolymerized PMMA needs to contain an initiator, dibenzoyl perioxide (BP)

BONE CEMENT

- The liquid monomer contains the activator N,N-dimethyl-p-toluidine (DMPT)
- The monomer will polymerized on its own when exposed to light or heat.
- To prevent to monomer from polymerizing, the liquid generally contain an inhibitor or retardant, hydroquinone- function to absorb free radical that may occur and initiating the polymerization