Proximal femur nail in IT fractures

Indications and Tips/Tricks

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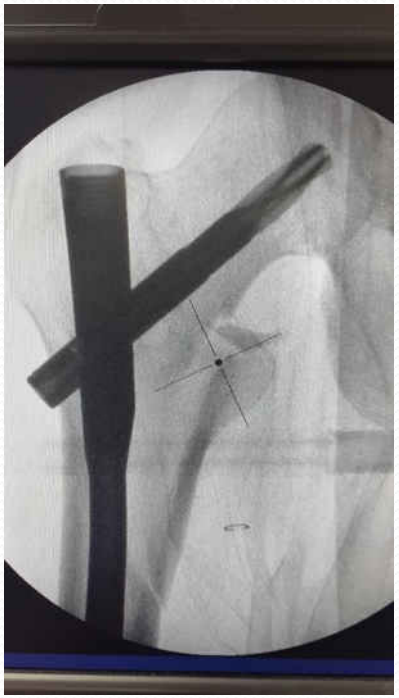


PFN in IT fractures

Indications

Unstable IT fractures

- Comminuted
- Reverse oblique
- Subtrochanteric extension

Associated shaft fracture

Comparison between Proximal femur nail (PFN) and Trochanteric femoral nail /Trochanteric fixation nail (TFN)

PFN	TFN
Length 240 mm.	Length 170 mm. ? Less anterior cortex impingement.
Proximal diameter around 17 mm.	Smaller proximal diameter around 15 mm. In narrow canals less possibility of impingement/ fracture extension during nail insertion.

Advanced versions of both nails offer spiral blade instead of head screws, lesser mediolateral angle of 5 degrees, flat lateral surface at proximal end, long nail options and distal targeting device with long nail option.
Surgical technique remains the same
Features change from manufacture to manufacturer, hence we need to study the design of chosen nail carefully.

PFN Biomechanically stronger than DHS

- Intramedullary. Nearer axis of deforming force.
- Resists excessive collapse by buttress effect.
- Replaces comminuted lateral wall.
- Often has 2 Screws in head. Lag screw and hip pin. Controls rotation well

Excessive collapse with DHS within first week. ?Due to lateral wall comminution

Factors that ensure success in PFN.

- Maintaining the proper neck shaft angle
- Placing the hip screw in the centre of hip.

  Both are interlinked as screw placement angle is prefixed and hence unless good neck shaft angle is achieved, it is impossible to put the hip screw correctly.
- Compression screw first. (inferior lag screw)

- Hip pin should be shorter by at least 15 mm

  Otherwise it could take weight and can back out or migrate into joint leading to cut out. In our study, we placed hip pin of at least 20 mm shorter compared to hip screw.

Ref. Janardhana Aithala et al. Proximal Femoral Nailing: Technical Difficulties and Results in Trochanteric Fractures* Open Journal of Orthopedics, 2013, 3, 234-242.

Successful result depends on good fracture reduction and implant position

- The risk of cut-out is directly dependent on the quality of fracture reduction and on implant position. Proximal femoral nail antirotation (PFN-ATM) fixation of extra-capsular proximal femoral fractures in the elderly: Retrospective study in 102 patients.

  Ref. E Soucanye de Landevoisin , Orthopaedics & Traumatology: Surgery & Research Volume 98, Issue 3, May 2012, Pages 288–295

? Tip apex distance not important in PFN

- The standard tip apex distance (TAD) measurement above 25 mm did not predict failure (p = 0.62).

- The TAD scale focuses on length measurement and lacks the vector properties of multidirectional measurements. Vector analysis revealed that the caudal-cranial correct lag screw position is the most important factor in preventing mechanical failure.

Ref: Herman A[1], Landau Y, Gutman G, Ougortsin V, Chechick A, Shazar N. Radiological evaluation of intertrochanteric fracture fixation by the proximal femoral nail. Injury 2012 Jun;43(6):856-63.

Difficulties in PFN

- Only 2 angles are available in PFN 130 and 135 degrees.
- In PFN we are first passing IM nail then head screw.
- Technology dependant. Good quality instruments a must as cannulated instruments and implants have to pass through nail over guide wire.
- Learning curve.

Preoperative Plan

- Study Head size/Neck size to see whether it will accommodate 2 screws.
- Study Neck Shaft angle on opposite hip. Too much varus may make it unsuitable.
- In case of failure to get closed reduction or in case of failure to obtain good valgus angle of head and neck proceed to open reduction or switch to DHS. Only 2 angles are available in PFN 130 and 135 degrees.

- Back up option of DHS/ DCS/Extra long plate/TSP to be ready.

Key steps and instruments to ensure good fracture reduction and implant position, and facilitate surgery

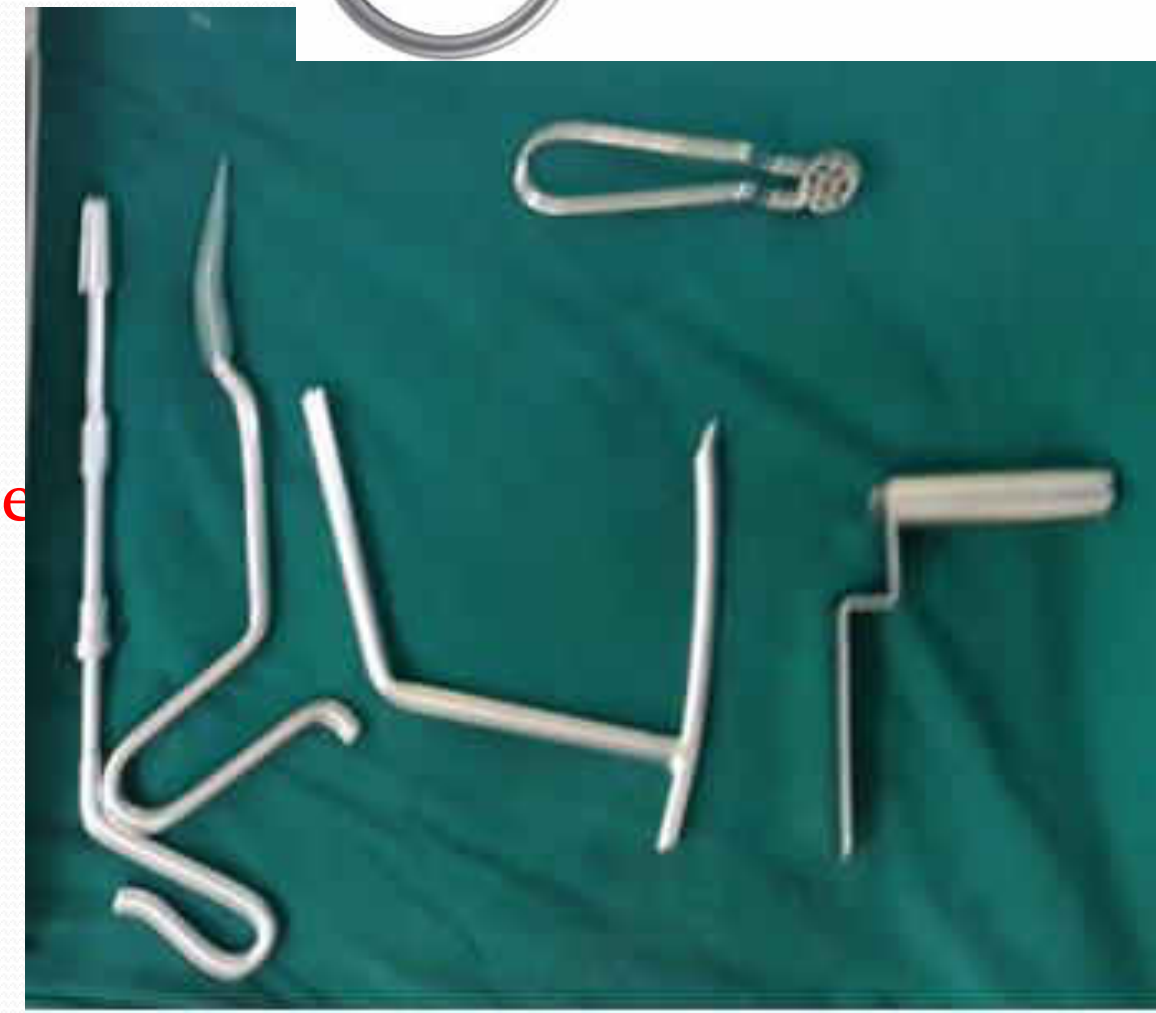
- Good infrastructure/instruments must.
- Good C positioning and closed reduction.
- If CR fails open/limited open reduction.
- Accurate Entry point.
- Correct proximal reaming path.
- Distal Incision for spikes, reduction clamps or circlage for assisting reduction.
- Use of curved internal reduction device to pass the guide wire in correct direction.
- Tight Nail assembly and easy Nail passage.
- If nail not progressing, ream ream ream. Do not hammer.
- Good positioning of head screws in AP and lateral view.
- Efficient distal locking.

Beware of Varus. So common in Indians PFN angle?

Instruments Trolley. Routine

and special

- Wire passers
- Proximal reamer
- Internal reduction device to redirect Guide wire,
- Sleeve with Multiple parallel holes
- Solapur sleeve



Position on traction table

- C position on fracture table with eccentric perineal post.
- Closed reduction is a must. If not proceed to open reduction
- in 5-10 degrees adduction
- Heavy traction ensures closed reduction. But heavy traction may result in disappearance of dorsalis pedis pulse.
- Heavy traction may lead to loss of adduction.
- Keep limb in 5-10 degrees of external rotation. Double check position of patella under drapes in order to prevent fixation in internally rotated position.

- Tilt table to Elevate the fracture side by 5-10 degrees as this helps in exposure.

Good table for C positioning

Check for good lateral view beforehand

Failure of closed reduction

- If there is failure of closed reduction better to open the fracture and achieve reduction by bone spikes/reduction clamp/ circlage wire etc
- Nail will not ensure reduction
- If reduction is not there the head screws will go into malposition.

Incision.

Proximal and in line with Greater trochanter

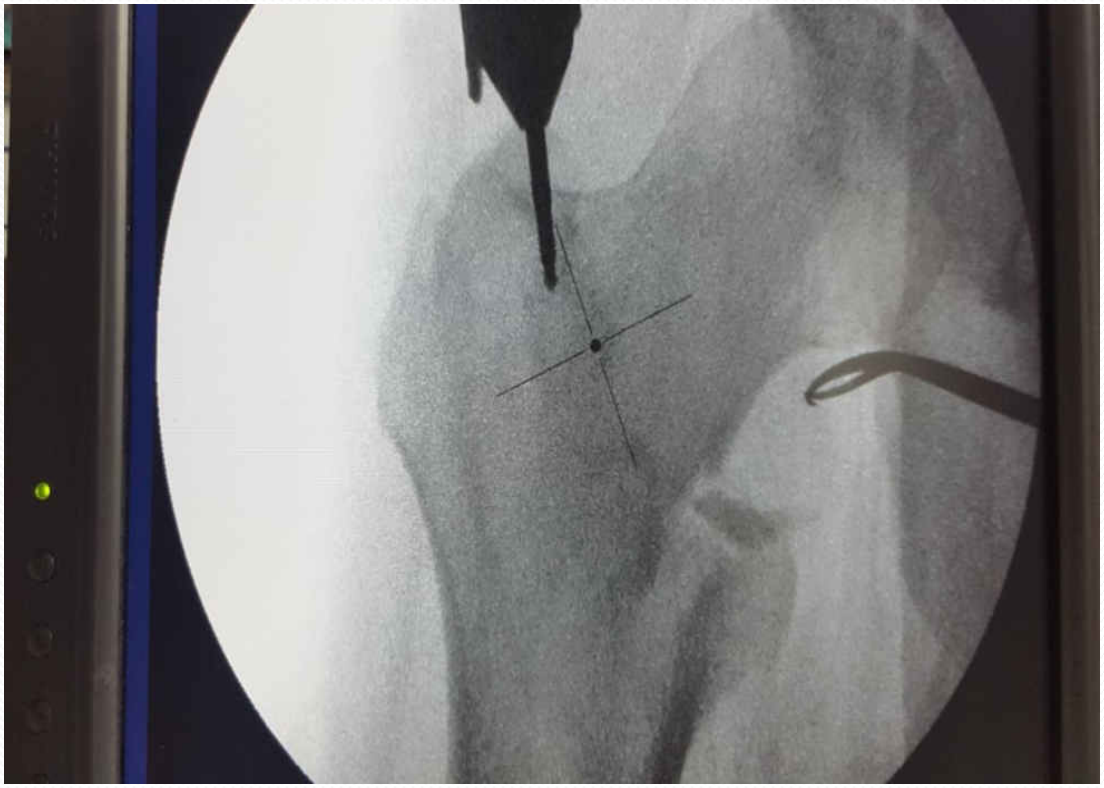
Exposure of entry point

- Adequate incision just proximal to greater trochanter.
- Deepen through tensor fascia lata
- Cut Gluteus medius insertion in line with middle of trochanter and palpate the tip of trochanter.
- Entry point while seeing in AP view.

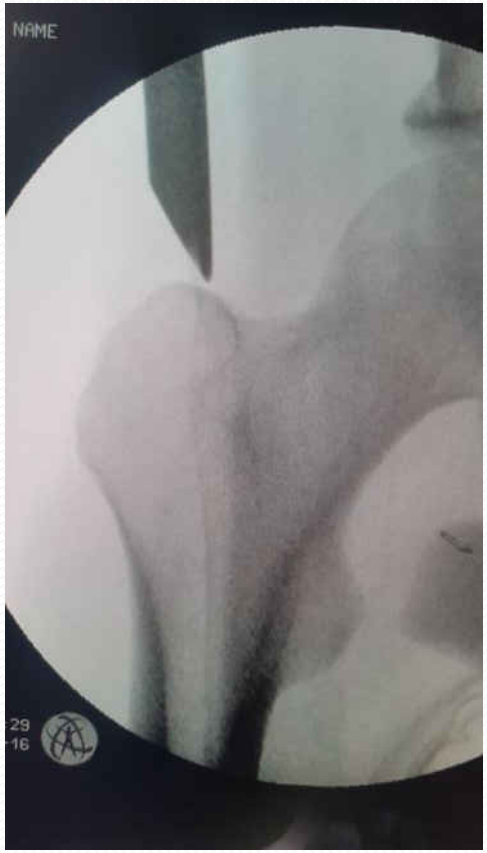
Entry point

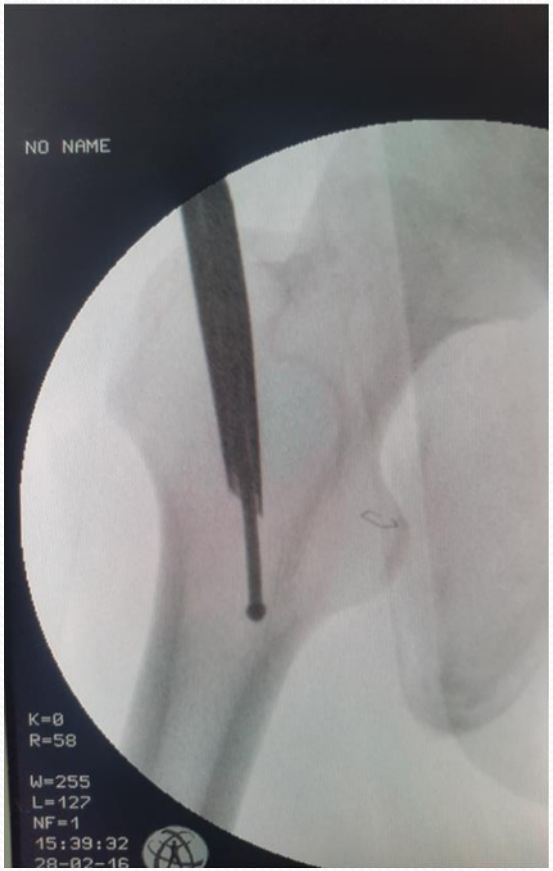
Dead AP is 10 degree tilt of C arm

Entry by guide wire and special sleeve with multiple options at the trochanteric tip.



Alternatively Entry point by femur finder, Cannulated awl





Curved awl can ensure entry medial to GT and reaming parallel to lateral cortex

For change of entry point

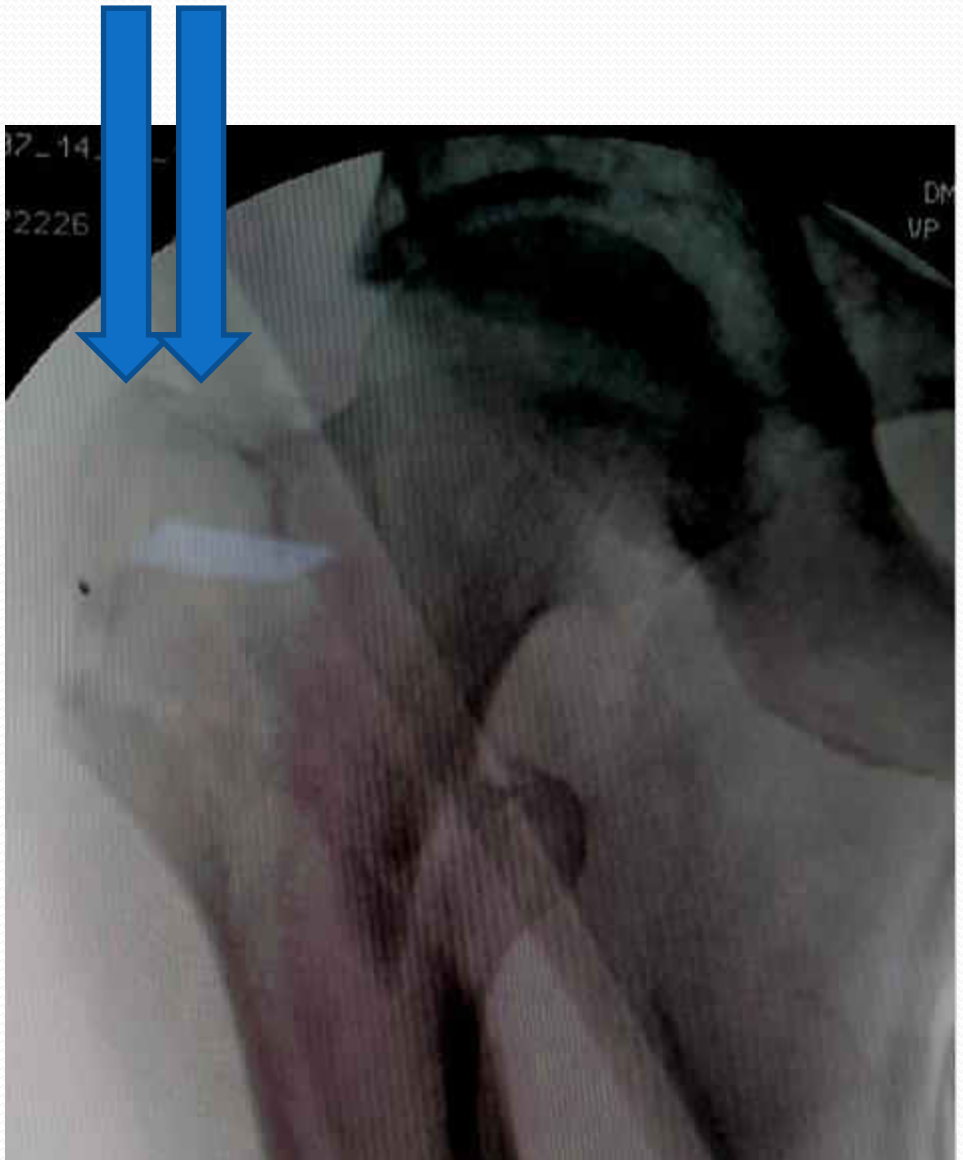
- Use Special sleeve with multiple options.
- Eccentric reaming by awl while keeping the first Guidewire is possible.

Distal Incision for spikes or circlage

- Distal incision onto the lateral aspect of upper thigh corresponding to the future entry point of guidewires onto head and neck. Deepened to the bone and use this window for reduction of fracture or medial pushing of fracture/fragments to facilitate guidewire entry.
- Spike from proximal incision anterior aspect can go onto neck to correct version and to push down on anterior displacement of fracture spike.

Entry point to be at tip with medial bias

- In AP view entry point to be more medial. This allows 2 screws in head in good position.



If too lateral entry point

- Varus malreduction can be particularly problematic in cases where a trochanteric start nail has been used with a starting point that has been placed lateral to the tip of the trochanter.

Ref. Ostrum RF, Marcantonio A, Marburger R. A critical analysis of the eccentric starting point for trochanteric intramedullary femoral nailing. J Orthop Trauma. 2005 Nov-Dec;19(10):681-6.

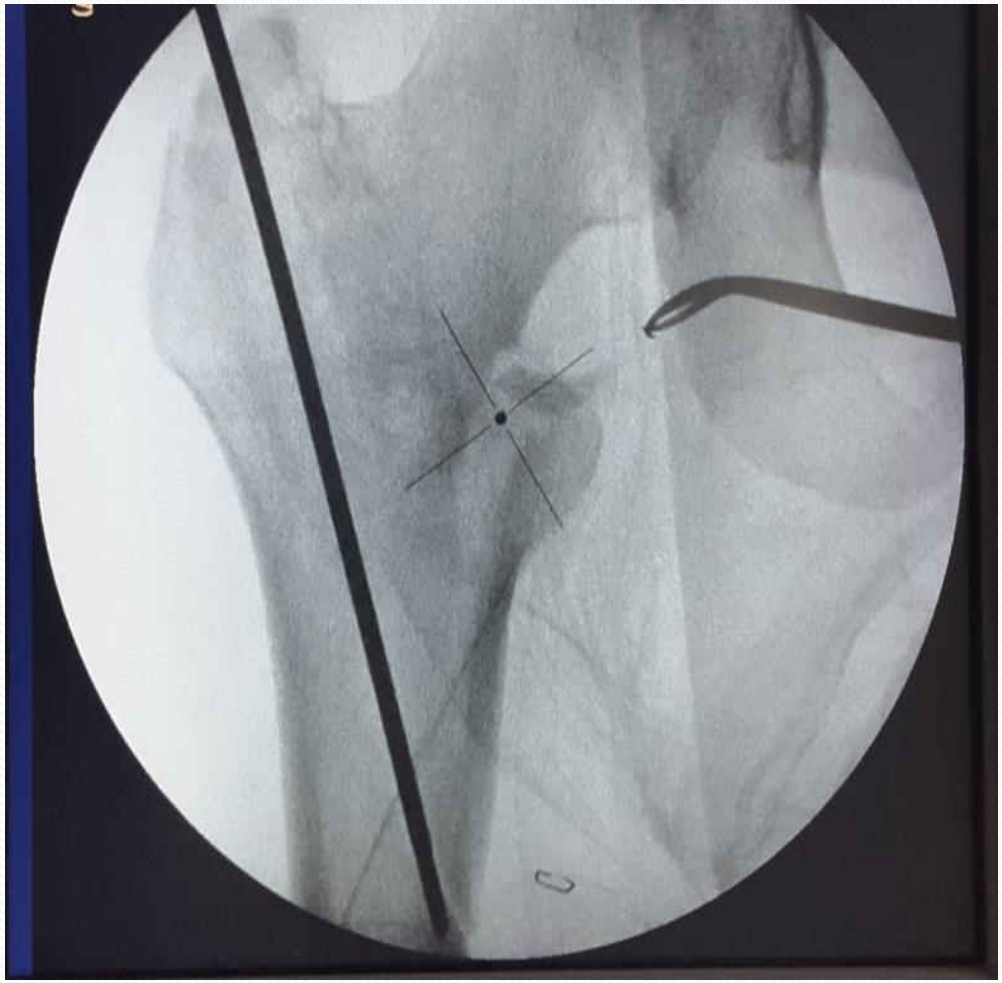
If too lateral entry point

- When the entry point is incorrect or lateral, there is a tendency for overlateralisation of the nail, which leads to a loss of the lateral wall buttress and subsequent failure. In addition, using an incorrect entry point may result in malreduction and further displacement of the fracture during nail insertion and implant failure. To overcome this, proper reduction, medialisation of the entry point, and careful reaming of the lateral wall are recommended. The shaft should be used as a reference point for the entry point rather than the tip of the greater trochanter, especially when there is a displaced coronal split fragment. Ref. Bryan Yijia, Morphology and fixation pitfalls of a highly unstable intertrochanteric fracture variant. Journal of Orthopaedic Surgery 2015;23(2):142-5

- Lateral entry point, pushed proximal fragment into varus and screws into malposition

Varus reduction
Malposition of screws,

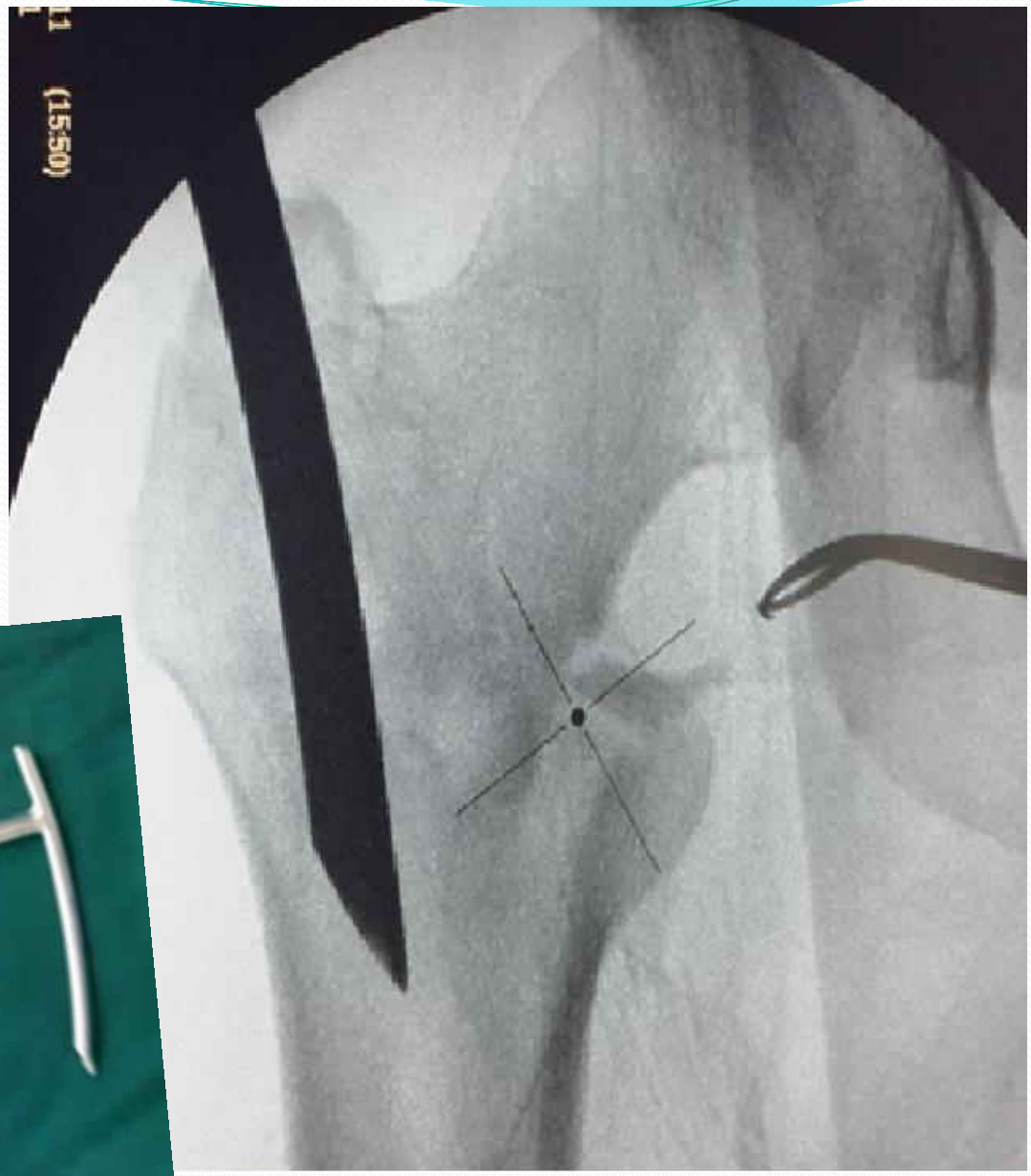
Guide wire in canal deviating medially



Redirection by Retractor push, Femur finder, Cannulated awl.

Ref:Oh Jong-Keon*, Hwang Jin-Ho, Sahu Dipit. Nailing of Intertrochanteric Fractures: Review on Pitfalls and Technical Tips. Journal of Orthopaedics, Trauma and Rehabilitation. (2010)

- Guide wire going medially sometimes can exits out through fracture and damage neurovascular structures.

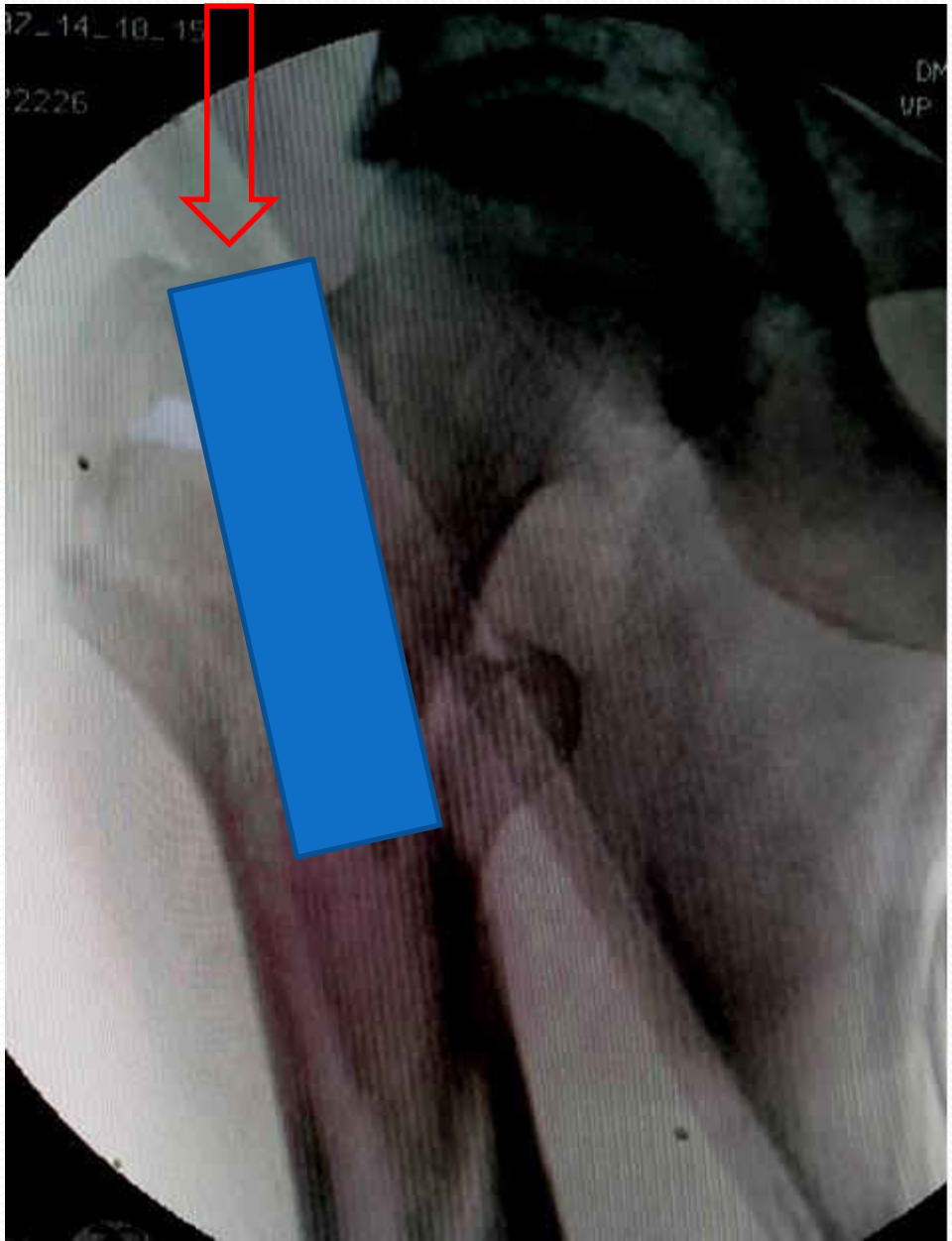


- Use of curved femur finder device to pass the guide wire in correct direction

Redirected Guide wire in canal

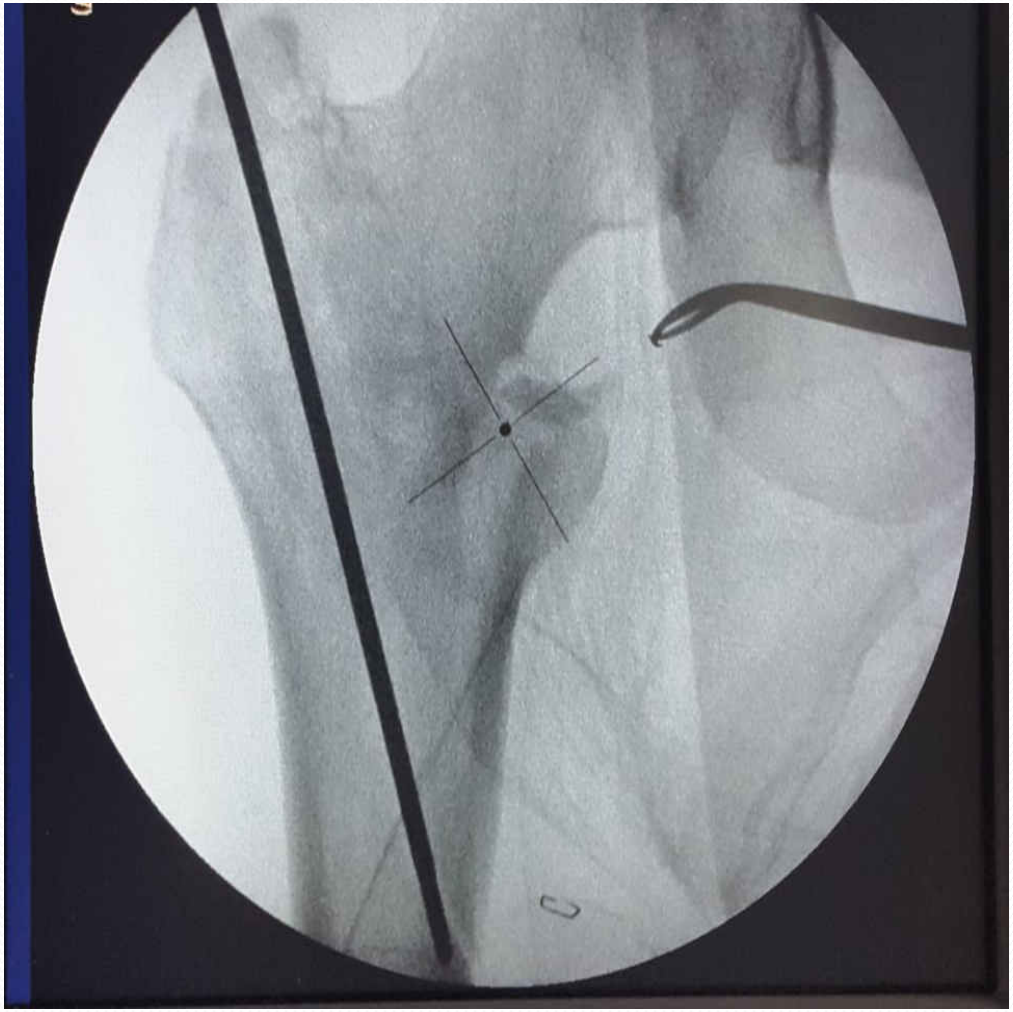
Cut a correct path

- Reamer to hit lateral edge of proximal fragment for correct path. Ref. Hak DJ· Bilat C. Avoiding varus malreduction during cephalomedullary nailing of intertrochanteric hip fractures. Arch Orthop Trauma Surg. 2011 May;131(5)



Guide wire may sink in canal while pushing nail down. Remove G wire early on.

- Be careful with short guidewires as they will migrate distally along with nail and be lost into the medullary canal. so this guidewire needs to be thick and long..



Proximal reaming must to accommodate broad proximal part of nail

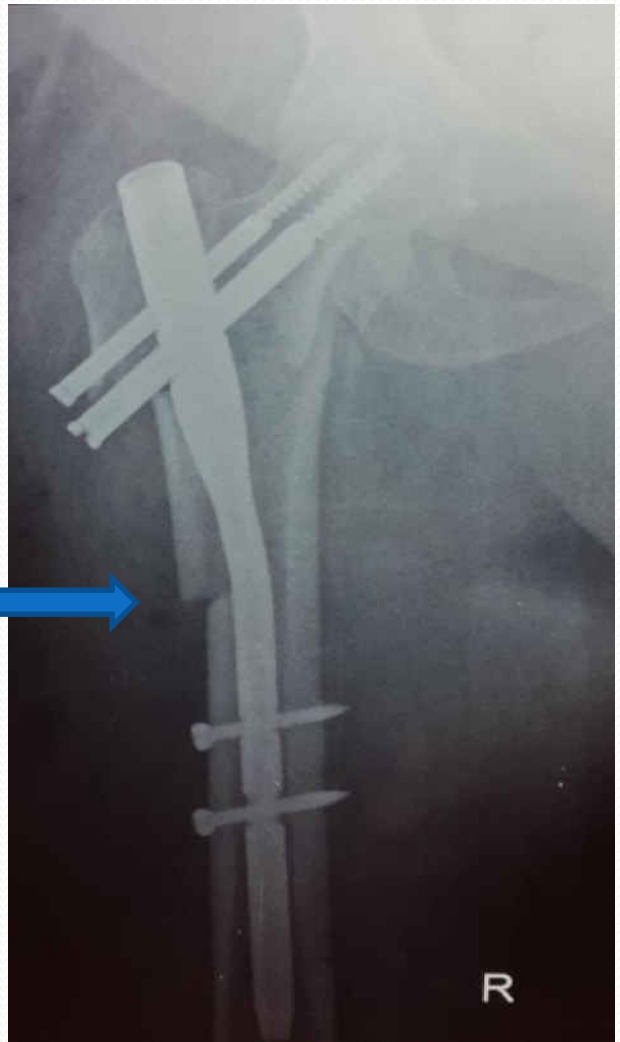
- Reamer to be pushed medially at entry point to break cortex so that reamer and nail is not displacing the fracture, as it leads to malposition of screws in head.
- Reaming on guide wire upto the length and breadth of proximal part of nail up to lesser trochanter. Otherwise nail may not progress distally
- Reaming parallel to outer cortex/intact anterior or posterior cortex

Nail assembly and passage

- Check nail side and size, assembly side and curve, yourself.
- Check after assembly sleeves and if Drills reamers are passing through nail holes.
- Look for play.
- Tighten assembly bolt well otherwise if loose sleeves/screws/distal bolts do not pass accurately.

Ref . Minos tyllianakis, andreas panagopoulos, andreas papadopoulos, socratis papasimos, konstantinos mousafiris. Treatment of extracapsular hip fractures with the proximal femoral nail (PFN) : long term results in 45 patients acta orthop. Belg., 2004, 70, 444-454

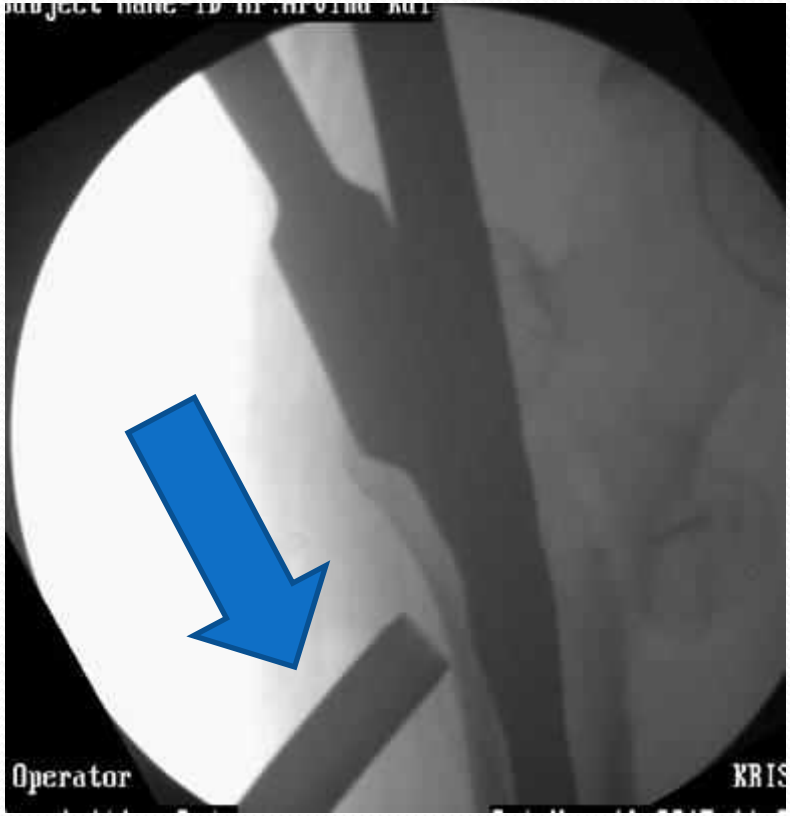
- If nail not progressing do not Hammer
  Short lady. Narrow canal. Angled nail.
  Ream REAM REAM. Do not Hammer or only last 1 cm.
  Risk of intraop fracture extension



- Apply Betadine to sleeves so they slide easily
- Hammer sleeve in to touch cortex. Remove intervening soft tissues like fascia lata.

- Increase traction to get good valgus

- Sleeve has tendency to Skid upwards, (proximally), entry hole is then proximal creating difficulty for passage of reamer. Push down on cortex/sleeve at drill entry.

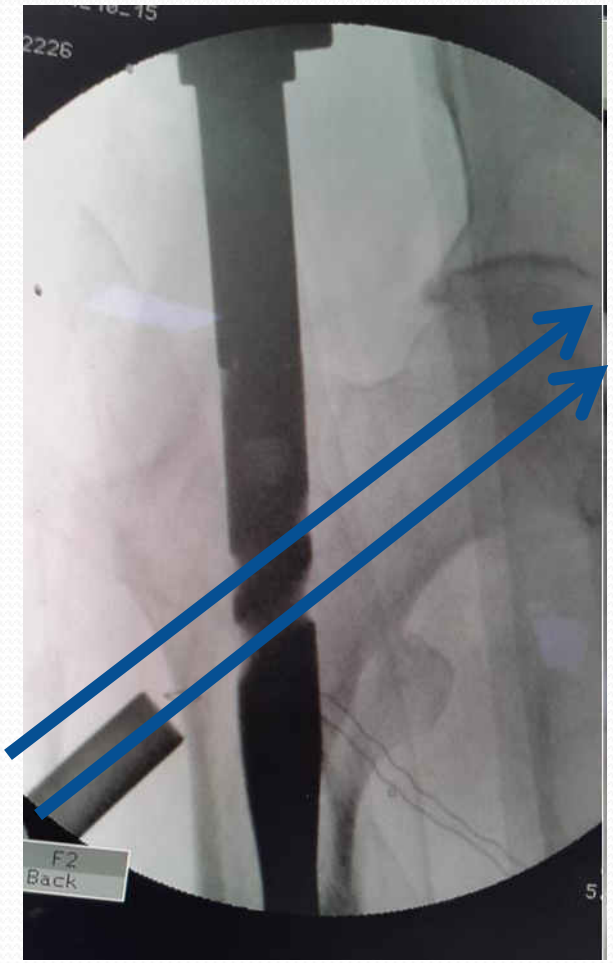


Drill and wire

- The guide wire can bend at outer cortex also but this can be prevented with predrilling the entry point at lateral cortex with a drill

Ref. Janardhana Aithala et al. Proximal Femoral Nailing: Technical Difficulties and Results in Trochanteric Fractures* Open Journal of Orthopedics, 2013, 3, 234-242.

- Of the two guide wires first pass the one that you think is at edge of neck not centre of neck, so revision by adjusting position of nail is easy



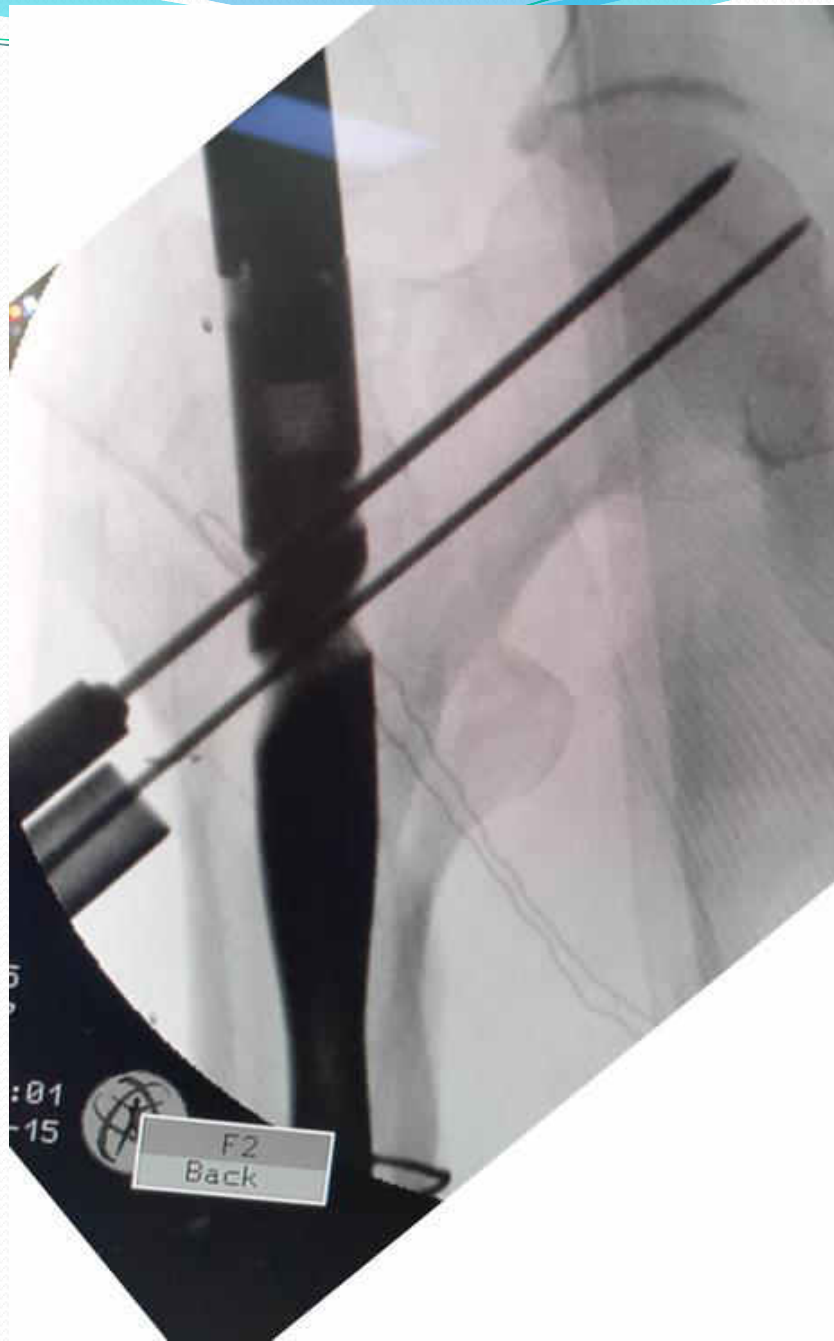
For good positioning in AP view

- Medial entry point
- Heavy traction
- ?Abduction,
- Push in with jig, push out distal frag/thigh
- Push on fracture
- Push down by spike superior to neck

For good positioning in lateral view

- Lift up fracture by sheet under hip
- Lift up fracture by hand to remove sag to allow good positioning in lat view
- Lift up fracture by bone spike posteriorly or Jig.
- Rotate jig for change of version

- Drive deep or wire comes out at reaming but not into joint. If it Breaks one has a major problem…
- Reinsert wire if comes out or else screw may change direction.



Reaming

- Rotate reamer in forward direction only to remove so threaded wire doesn't disengage and come out.
- Hand reamer over Guide wire may be better.

- Checking length by use of another same length wire on bone edge

If guide wire is going in same track

- Thicker wire
- On full power then gentle forward tug, feel to engage, then forward.

- While changing wire or screw , keep existing, introduce the second, then revise first one so fracture remains fixed.

- Non progression of screw may be because of bending of guide wire. Even breakage
- Withdraw wire and pass screw.

Rotate jig to either side to avoid shadow of jig handle

Reaming difficulty

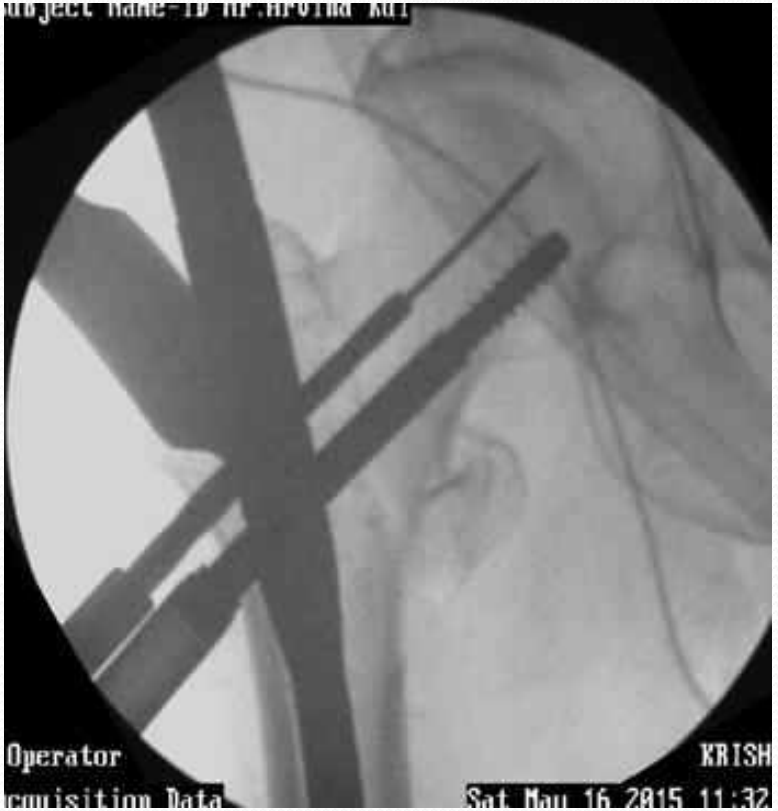
- If reamer is not progressing on guide wire 1. may be hitting edge of nail gentle forward backward motion may help. 2. guide wire may be stuck in reamer

- Start with smaller reamer
- Hand ream
- Ream reverse.
- Ream with smaller reamer
- Ream after removing Guide wire.
- Ream after removing outer sleeve.
- Change direction of reamer by seeing in Carm where it is hitting nail
- Full length reaming may not be necessary. Try passing screw directly, carefully

Reaming If Guide wire bends

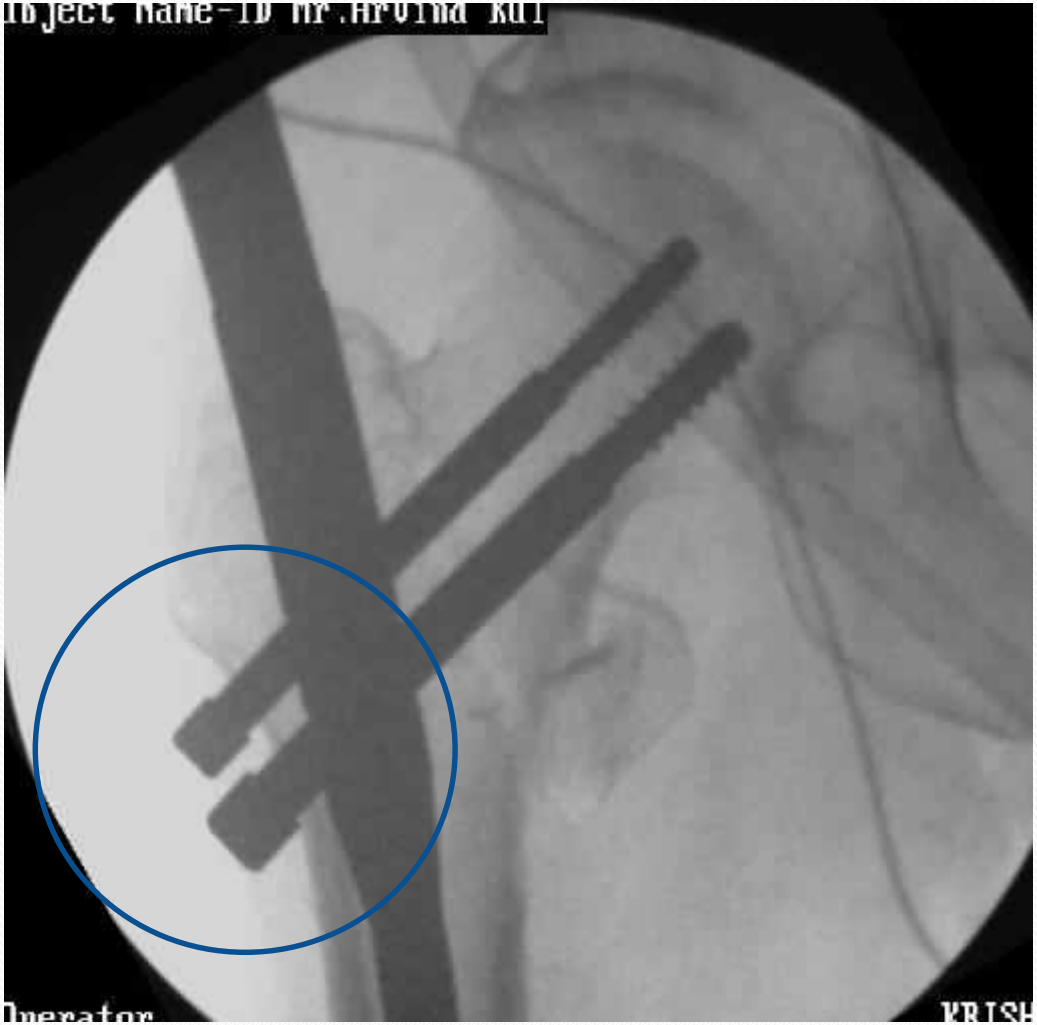
- Hand reamer
- Reverse reaming forward
- Gentle to and fro
- Gentle forward and backward

- Mostly bend straightens out. But careful. May break



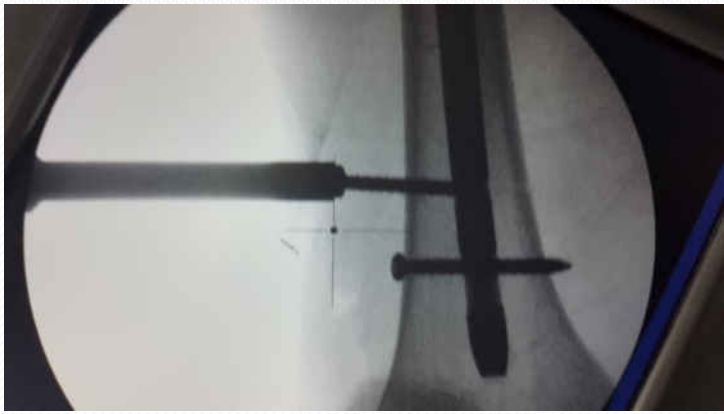
Hip pin to be shorter than compression screw.

- Deep positioning Maintain tip apex distance(?)
- Head screws to be tightened alternately for compression. But may sink inside bone.



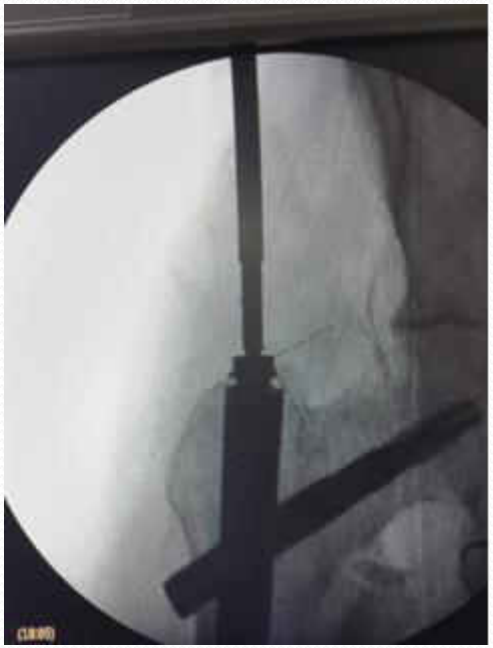
Before distal locking

- Chance to correct rotational deformity.
- Palpate patella hidden under drapes.
- Release traction. Impact if fracture transverse.
- Do not impact if comminuted.
- Drill far cortex well as otherwise bolt may not progress. Specially in midshaft with thick cortex.
- If drill hits on nail switch to smaller drill bit or thick K wire. May use smaller bolt or cortex screw.
- Check length of bolt in Carm before final tightening of bolt, as changing of bolt is tedious. Tying Vicryl to bolt is an option.



Jig removal

- Jig removal is difficult at times, jammed and has to be hammered out.
- Application of end cap is at times difficult



Special situations

- Add TBW in case of split of GT

Complications. Some can be prevented, others may be not.

Summary

- Pre op planning
- Back up option of DHS/ DCS/Extra long plate to be ready.
- Failure of CR proceed with immediate open reduction
- Correct entry point
- Correct proximal reaming path to adequate depth.
- Maintaining the proper neck shaft angle.
- Placing the Compression screw (inferior lag screw) in the centre of hip.
- Compression screw first. (inferior lag screw)
- Hip pin should be shorter by at least 15 mm.
- Learning curve?? Take effort to avoid and solve technical difficulties.

Further reading

- Open Journal of Orthopedics, 2013, 3, 234-242 http://dx.doi.org/10.4236/ojo.2013.35044 Published Online September 2013 Proximal Femoral Nailing: Technical Difficulties and Results in Trochanteric Fractures* Janardhana Aithala P et al.
- “Avoiding varus Malreduction during Cephalomedullary Nailing of Intertrochanteric Hip Fractures, D. J. Hak and C. Bilat, ” Archives of Orthopaedic and Trauma Surgery,” Vol. 131, No. 5, 2011, pp. 709-710.
- Morphology and fixation pitfalls of a highly unstable intertrochanteric fracture variant. Bryan Yijia et al. Journal of Orthopaedic Surgery 2015;23(2):142-5