

Practical steps for Freehand Technique insertion of locking screws in intramedullary nails

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SUMMARY

Freehand Technique for drilling and insertion of locking screws in intramedullary nails can be technically demanding and prone to handling issues. It requires the precise placement of a screw through the holes in the nail under fluoroscopic guidance and can result in a time consuming procedure associated with exposure to radiation. Dedicated training as a result of experience can help overcome these problems. The Freehand Technique of interlocking screw placement is the current standard teaching in most orthopedic residency programs in United States.

Key words: intramedullary nail locking screws, Freehand Technique

Introduction

Interlocking intramedullary nailing is a well-established and universally utilized method of surgical stabilization of long bone fractures. It provides fracture fixation with a minimally invasive procedure, allowing early mobilization with weight bearing and return of function ¹. The advantages of intramedullary nailing are attributable to indirect reduction and stabilization of the fracture, without exposing the fracture site in case of closed fracture. A device is inserted along the mechanical axis of the long bone. Stable fractures are treated with an intramedullary nail that can be locked in a dynamic configuration, which allows axial compression while preventing rotational instability. Proximal locking in the tibia is performed through a guide device attached to the implant insertion hand piece, while at least two locking screws are recommended distally to prevent instability and alignment defects ². Interlocking screw insertion in intramedullary nailing of long-bone fractures is a challenging task for orthopedic surgeons to master, especially for novice surgeons. In the USA, the freehand method has traditionally been the mainstay for placement of locking screws in the femur and tibia nails. However, the freehand method possesses the disadvantages of additional radiation exposure as well as potentially increased operative time, particularly for the inexperienced surgeon. Numerous technology adjuncts have been developed to improve the locking technique during the intramedullary nailing of long bones. The traditional Freehand Technique utilizes an radiographic image intensifier that is aligned with the distal holes to achieve coaxial alignment of the nail holes, so that the passage for the screws appears as a perfect circle on the image. A sharp trocar, with radiolucent handle is positioned on

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the lateral cortex of the bone, aligned with the center of circular image. The hole is then drilled by drill bit and the transfixing screw is implanted³. In the last decade, several techniques and devices have been proposed to aid distal targeting in the attempts to overcome some of the problems associated with Freehand Technique, with varying success, including hand-held guides, image intensifier targeting devices, nail-mounted guides, and computer-assisted methods⁴⁻⁹.

Freehand Technique for distal interlocking under fluoroscopic guidance remains the most popular method, despite potential exposure to radiation and the drawback of missing the holes in the nail and possibly creating a large cortical defect if the drilling holes have not been positioned correctly. Modifications to the Freehand Technique have dealt with the problem of initial cortical perforation to achieve an accurate position using Steinmann pin, Kirschner wire, guide pin for primary insertion into the cortex, cannulated drill instead of the reamer, and modified cannulated reamer^{10,11}.



Figure 1. Lateral radiograph of the distal femur showing the distal holes of the intramedullary nail.

Technique

We have been utilizing a very simple technique to aid locate the screw holes positions for femoral, tibial and humeral interlocking nails, employing a commonly available instrument in the operating room, which we feel is both easy and reliable while attempting to limit the amount of radiation exposure. Crucial preparation for successful placement includes the utilization of the image intensifier. Once the intramedullary nail has been successfully inserted, a lateral fluoroscopic view of the end of the nail is obtained. The limb has to be placed over a bump to be elevated compared to the contralateral and to obtain an unobstructed view. The position of the image intensifier C arm needs to be adjusted until the screw holes are visualized as “perfect circles” (Fig. 1). At times, even the limb must be rotated or ab-adducted to obtain the best view in the lateral projection. We stress the opportunity of having the monitor in front of the surgeon, with the limb in the same direction as it is in the video. We then utilize a simple open tonsil forceps, with the ratchet serving as a reference point, on the surface of the skin. (Fig. 2A-B). The oval of the forceps hand is centered on the distal hole of the nail and the ratchet will show the accuracy of the position, complementary of the C arm (Fig. 2C). A minimum of X-rays is necessary at this point, since the oval of the instrument provide a good reference position for the holes in the nail. At this point a stab incision is performed, from skin to periosteum, in line with the screw hole in the nail (Fig. 3A-B). Once the perfect circles have been rechecked and confirmed, a drill is positioned on the circle’s image, with the drill tip lined up on the superior aspect of the hole, aiming from superior to inferior (Fig. 4). Initially, slow drilling is paramount to successfully start the opening of the cortex. Subsequently, the same maneuver must be repeated from below up. (Fig. 5A-B). In this way the hand of the operator will not prevent the visualization of radiographic images. The drill is passed through the near side cortical bone, near the screw hole, far screw hole and then far side cortical bone (Fig. 6A-B). The same steps are repeated for the second hole, always maintaining a drill bit in one hole while drilling the second one, as to not lose the position with the locking screws holes. The image intensifier C arm is then rotated through 90° to obtain an anteroposterior projection,

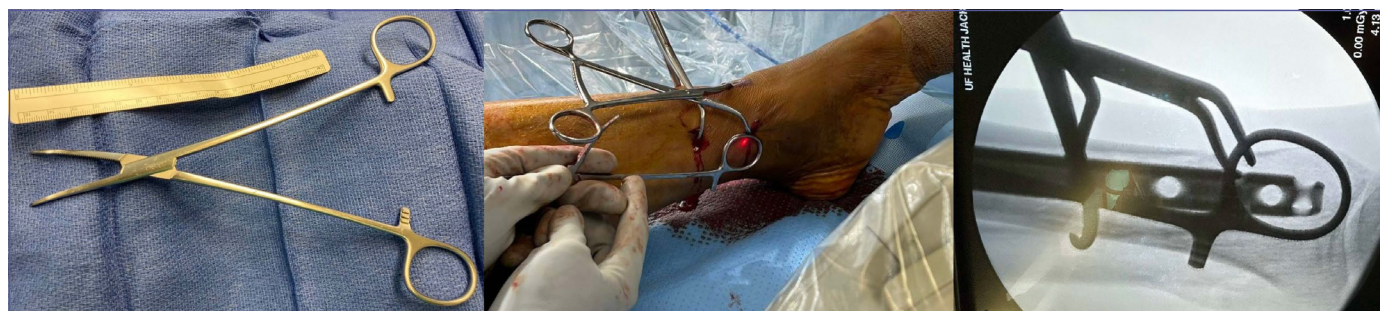


Figure 2. A) Open tonsil forceps; B) Ratchet of the open tonsil used as a reference to facilitate the correct location of the holes in the distal nail. Note the red laser beam; C) Ratchet of the open tonsil forceps used as reference.

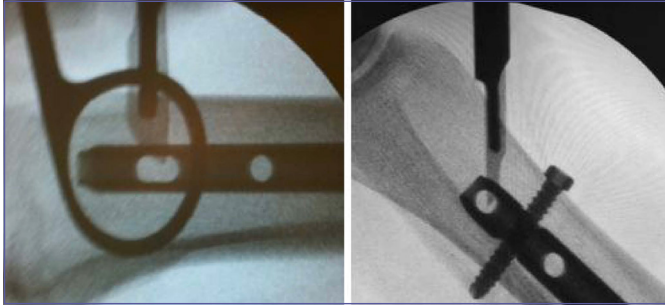


Figure 3. A-B) Lateral radiograph of the distal femur (left) and tibia (right) with the scalpel blade overlying the center of the most distal hole.



Figure 4. Lateral radiograph of the distal femur with the drill tip lined up on the superior aspect of the hole.

so that one can measure the length of the screws and insert them (Fig. 7A-D).

Discussion

The placement of screws into an intramedullary nail can be challenging to perform and teach. Indirect visualization with



Figure 5. A-B) Lateral radiograph of the distal tibia with the drill tip lined up on the superior aspect of the hole. Once started to drill the outer cortex, you slowly move the hand inferior, in line with axis of the hole.

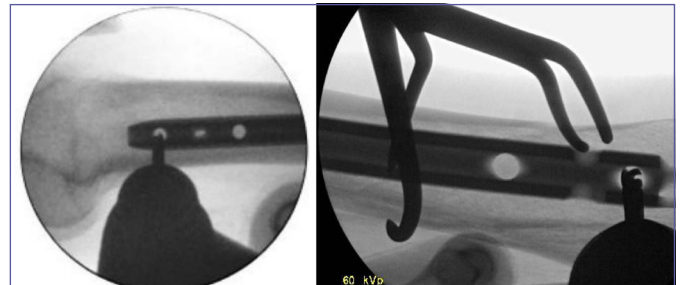


Figure 6. A-B) Drill bit drilling outer and inner cortex for insertion of distal locking screws.

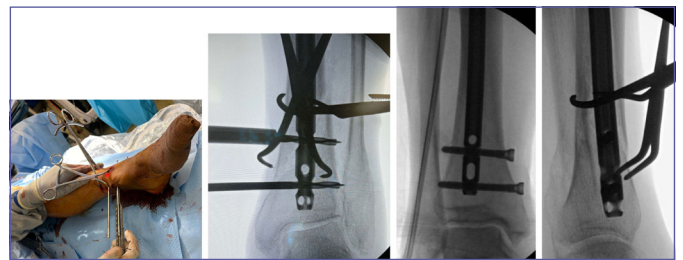


Figure 7. A-D) Measurement of the length of the drill inside the bone for the corresponding screw.

the aid of radiographic to image intensifier adds to the difficulty. Once a false screw hole has been placed, drilling eccentrically through the nail can cause significant damage, potentially weakening the nail and causing implant failure. Additionally, salvage maneuvers to redirect both the drill and subsequent screw will be required. While the experienced orthopaedic trauma surgeon will often pass the drill in a single motion, a surgeon in training may lack the spatial awareness to success-

fully perform the task. The technique described can be used with good results with significant improvement in successful first-time screw placements by junior surgeons or those who infrequently perform intramedullary nail procedures ¹².

Conclusions

This very simple technique to detect the virtual location of holes in the intramedullary nails on the skin of the limb has proven remarkably easy, allowing the surgeons to “find” the holes in just a few attempts. The positioning of the drill first superior to the holes helps with the direction of the drilling, since the weight of the hand naturally moves the drill down.

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Conflict of interest statement

The authors declare no conflict of interest.

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Author contributions

MMM: conceptualization, supervisions, writing, review and editing; PP, CS: conceptualization, investigation, methodology; FR: conceptualization, methodology, investigation.

Ethical consideration

This study was approved by the Institutional Ethics Committee (approval number: LSUHSC 000001894).

The research was conducted ethically, with all study procedures being performed in accordance with the requirements of the World Medical Association's Declaration of Helsinki.

Written informed consent was obtained from each participant/patient for study participation and data publication.

References

- 1 Bone LB, Johnson KD. Treatment of tibial fractures by reaming and intramedullary nailing. *J Bone Joint Surg Am* 1986;68:877-887.
- 2 Buckley RE, Moran CG, Apivatthakakul T. Principi AO per il trattamento delle fratture. Milano: Edra 2019.
- 3 Whatling GM, Nokes LDM. Literature review of current techniques for the insertion of distal screws into intramedullary locking nails. *Injury Int J Care Injured* 2006;37:109-119. <https://doi.org/10.1016/j.injury.2005.09.009>
- 4 Noordeen HH, Sala MJ, Belham GJ. Insertion of distal screws in interlocking intramedullary nails. *Injury* 1993;24:357-358. [https://doi.org/10.1016/0020-1383\(93\)90068-h](https://doi.org/10.1016/0020-1383(93)90068-h)
- 5 Owen TD, Coorsh J. Insertion of the distal locking screws in femoral nailing: a simplified technique. *Injury* 1993;24:101-103. [https://doi.org/10.1016/0020-1383\(93\)90198-f](https://doi.org/10.1016/0020-1383(93)90198-f)
- 6 Stevens JM, Faortha S, Shiels T, et al. Technique for guiding distal locking screws into intramedullary nails. *Techniques in Orthopaedics* 2019;36:188-189. <https://doi.org/10.1097/BTO.0000000000000402>
- 7 Caiaffa V, Leone A, Manca M. The role of computer-assisted navigation in intramedullary nailing of pertrochanteric fractures: a prospective multicenter comparative study between EBA 2 standard and EBA NAV nails. *Lo Scalpello Journal* 2020;34:154-159. <https://doi.org/10.36149/0390-5276-186>
- 8 Mondì M, Zocca C, Giaretta S, et al. Computer-assisted navigation in intramedullary nailing of intertrochanteric femoral fractures treated with EBA2 nailing system: a single center retrospective study. *Lo Scalpello Journal* 2023;37:64-70. <https://doi.org/10.36149/0390-5276-296>
- 9 Chabihi Z, Nouidi N, Demnati B, et al. Fast and accurate distal locking of interlocked intramedullary nails using computer-vision and a 3D printed device. *3D Print Med* 2024;10:28. <https://doi.org/10.1186/s41205-024-00221-2>
- 10 Pennig D, Brug E, Kronholz HL. A new distal aiming device for locking nail fixation. *Orthopedics* 1988;11:1725-1727.
- 11 Singer G. Occupational radiation exposure to the surgeon. *J Am Acad Orthop Surg* 2005;13:69-76. <https://doi.org/10.5435/00124635-200501000-00009>
- 12 Gabriele L, Castellini I, Perani P, et al. How to facilitate the insertion of distal locking screws in intramedullary nails. Update in intramedullary nailing, chapter 6. Torino: Minerva Medica 2025.