

## A SIMPLE TECHNIQUE FOR ON-TABLE CONFIRMATION OF LOCKING SCREW PLACEMENT FOR CANNULATED INTRAMEDULLARY NAILS

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### ABSTRACT

**Background:** Locked intramedullary nailing is the standard of care for femoral and tibial shaft fractures. Correct placement of locking screws is often an ordeal followed at times by a tormenting wait for check radiographs to confirm whether or not the locking screws were correctly placed.

**Objective:** We present a simple, inexpensive, fool-proof technique that confirms the correct placement of the locking screws on table thus allowing for revision at the time of surgery in case the locking screw missed the locking hole in the nail.

**Methods:** The basis of this technique is that a screw or drill bit in the locking hole prevents advancement of a guide wire beyond the level of the screw or drill bit. The maximal length of wire that goes in is marked prior to locking. The most distal distal lock is placed first. If the lock is in place, then less of the guide wire will go in than what went in in the first instance. The length of wire that goes in up to the most distal lock is then marked and used to confirm the placement of the proximal distal lock. In the same manner, the distal proximal lock is placed followed by the most proximal lock in that order.

**Results:** We have used this technique to confirm placement of locking screws in thirty nailing procedures and on all occasions, check radiographs confirmed that the locking screws were correctly placed as confirmed by this technique.

**Conclusion:** This technique enables the surgeon to confirm correct placement of locking screws on table. It can be used with any cannulated nailing system. It is simple, in-expensive and foul-proof. As an adjunct during closed nailing under image intensification, the technique helps reduce operating time and exposure to radiation.

### INTRODUCTION

The standard of care for femoral shaft and tibial shaft fractures is locked intramedullary nailing (1). Locking of intramedullary nails prevents rotation and shortening in comminuted fractures. It has been reported that the error rate of distal lock implantation is as high as 29% (2). New methods have been developed that make locking of intramedullary nails both faster and accurate. These include computer assisted navigation systems (3), as well as use of devices that use a magnetic field about the nail to localize the locking holes i.e. Smith and Nephew's SURESHOT<sup>®</sup> (4-6). All these are very expensive and are not available locally and thus correct placement of locking screws when performing locked intramedullary nailing remains a challenge. This is then followed by at times tormenting wait for check radiographs to confirm whether or not the locking screws were correctly placed. We present a simple, inexpensive technique that confirms the correct placement of the locking screws on table thus allowing for revision at the time of surgery rather than wait

to discover that the locking screws missed the locking hole postoperatively when check radiographs are done.

**Description of Technique:** The basis of this technique is that a screw or drill bit in the locking hole prevents advancement of a guide wire beyond the level of the screw or drill bit (7). After reduction and placement of the intramedullary nail as per the technique prescribed for the particular nail, a guide wire is passed down the nail as far down as possible and a clamp used to mark the length of wire left outside the target arm as shown in Figures 1 and 2.

**Figure 1:** The guide wire passes down beyond the tip of the nail as there is nothing to prevent this



**Figure 2:** The length of guide wire outside the nail/targeting device is marked with a clamp



An attempt is then made to lock the most distal lock either with the aid of a proximally loaded distal targeting device or image intensification. Once the proximal cortex is drilled, the drill bit is advanced so as to get it into the locking hole of the nail. Before drilling the distant cortex, this technique is used to confirm whether the drill bit is truly in the locking hole. This is done by passing the guide wire down the nail.

If the drill bit is in the locking hole, it will not be possible to advance the guide wire beyond the drill bit and therefore the length of wire left outside the nail will be longer than that left at the first attempt. Thus the clamp used to mark how much wire went in will be short of the targeting device as in Figure 3.

**Figure 3:** The guide wire cannot advance beyond the drill bit in the locking hole confirming correct placement of the drill bit in the locking hole



If this technique confirms that the drill bit is inside the locking hole, then proceed to drill the distant cortex after withdrawing the guide-wire. Then insert an appropriately sized locking screw and confirm whether or not the screw is in the locking hole by reintroducing the guide-wire. If the screw is in the locking hole, it will not be possible to pass the guide wire as far down as the point which was marked with a clamp in the previous step as shown in Figure 4. This confirms correct placement of the locking screw.

**Figure 4:** The guide wire cannot advance past the screw. Thus the clamp does not abut on the targeting device



If the drill bit or screw missed the locking hole, then the guide wire will pass down all the way to the previously clamped point. In that case, attempt to redirect the drill bit or screw with the aid of the targeting device or image intensification whichever the case may be.

**Figure 5:** The drill bit has missed the locking hole in the nail so the guide wire passes all the way down beyond level of the locking hole.



**Figure 6:** The locking screw has missed the locking hole in the nail so the guide wire passes all the way down beyond level of the locking hole



After successfully locking the most distal lock, reintroduce the guide wire and push it down until it abuts on the locking screw and cannot advance any further down as in Figure 7.

**Figure 7:** The guide wire is reinserted until it abuts on the most distal locking screw



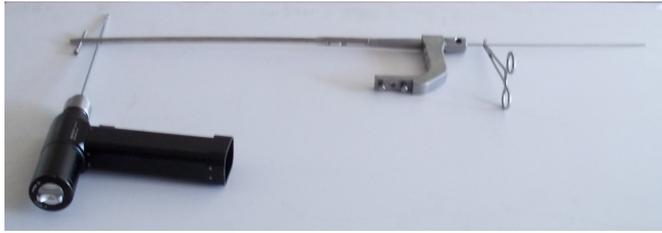
Mark the length of wire that has gone in by placing a clamp at the end of the portion of wire left outside the targeting device as in Figure 8.

**Figure 8:** The length of guide wire that goes in with the most distal lock in place is marked out



Withdraw the guide wire and attempt to lock the remaining distal lock the same way as the first one. After drilling the proximal cortex, advance the drill bit into the nail. Confirm whether the drill bit is truly in the locking hole by reintroducing the guide wire into the nail. If the drill bit is in the locking hole, then you will not be able to advance the guide wire beyond the drill bit and therefore the length of wire left outside the nail will be longer than that left at the previous attempt when you advanced the wire up to the distal lock. Thus the clamp used to mark how much wire went in will be short of the targeting device.

**Figure 9:** The guide wire cannot advance beyond the drill bit in the locking hole confirming correct placement of the drill bit in the locking hole



If this technique confirms that the drill bit is inside the locking hole, then proceed to drill the distant cortex after withdrawing the guide-wire. Then insert the locking screw and once again, confirm that the screw is placed in the locking hole by reintroducing the guide-wire. Once again, if the screw is in the locking hole, it will not be possible to pass the guide wire as far down as the point it was clamped.

**Figure 10:** The guide wire cannot advance past the screw. Thus the clamp does not abut on the targeting device.



If the drill or screw missed the locking hole, then the guide wire will pass down all the way to the distal lock, and the previously clamped point abuts on the targeting device as in Figure 11.

**Figure 11:** The locking screw has missed the locking hole in the nail so the guide wire passes all the way down beyond the level of the locking hole and the clamp abuts on to the targeting arm



In that case, attempt to redirect the drill bit or screw with the aid of the targeting device or image intensification whichever the case may be.

After locking the distal locks, the reduction and rotation is reconfirmed before placing the proximal locks. The proximal locks are usually easier to get as the nail is unlikely to have deviated much from the targeting device. However there are still instances when the locking screws miss the locking holes and are anterior or posterior to the nail. It is therefore important to confirm these locks as well.

The same principle of the drill bit or locking screw preventing advancement of the guide wire is used. An

attempt is made to lock the most distal of the proximal locks. After drilling the proximal cortex, drive the drill bit further and confirm whether the drill bit is in the nail by passing down the guide wire. If the drill bit is in the locking hole, then only a short length of the wire will pass down as in Figure 12.

**Figure 12:** Only a short length of wire gets in as the drill bit prevents advancement beyond the level of the most distal proximal locking hole



Mark this by placing a clamp on the guide wire next to the targeting device as shown in Figure 13.

**Figure 13:** A clamp is used to mark out the length of guide wire that went into the nail



Withdraw the guide wire and proceed to drill the distant cortex. The next step is to place an appropriately sized screw into the locking hole. Confirm that the screw is in the locking hole by reintroducing the guide wire. Only as much as had gone in when the drill bit was in should go in. Mark the wire by clamping next to the targeting device. The final lock is placed in the same way as the other ones. Correct placement is confirmed if the guide wire cannot go down to the level of the clamp used to mark it after placing the most distal proximal lock as in Figure 14.

**Figure 14:** The drill bit in the most proximal locking hole prevents advancement of the guide wire to the previously clamped level confirming correct placement of the drill bit.



Precautions to take include ensuring that the guide wire used runs smoothly within the nail. It should not be too big as to get jammed within the nail.

## RESULTS

This technique has worked consistently whenever we have used it. We have used this technique to confirm placement of locking screws in thirty nailing procedures and on all occasions, check radiographs confirmed that the locking screws were correctly placed as confirmed by our technique. We used this technique while nailing femora/tibiae with the orthomed-e and orthofix nailing systems that utilize a proximally loaded distal targeting device.

## DISCUSSION

This technique enables the surgeon to confirm correct placement of locking screws on table. It can be used with any cannulated nailing system including systems that utilize a proximally loaded distal targeting device for distal locking or as an adjunct with closed nailing systems done under image intensification giving it wide applicability.

As an adjunct during closed nailing under image intensification it provides a fool-proof confirmation of correct locking. Many times locking screws appear to be correctly placed under image intensification only to turn out to be out of place when a proper lateral view radiograph is taken. This technique will pick out such. This technique also helps reduce operating time by cutting on time spent disengaging the drill to allow for a lateral view radiograph to be taken and also the time taken to position and adjust the image intensifier.

By using this technique to confirm placement of locking screws instead of intraoperative radiographs, it will reduce exposure to radiation by reducing the number of radiographs taken. It has been reported that the amount of radiation exposure during distal locking of the femur can be up to 2.6 times the amount of radiation exposure during the actual insertion of the nail (8,9). This technique would help reduce this.

This technique is simple, in-expensive and fool-proof. In all instances when we have used it to confirm correct placement of the locking screws, check X-rays have also shown that the locking screws were correctly placed. Missed locking screws are a potential reason for malpractice suits. In an audit of malpractice suits filed against orthopaedic surgeons by the American Association of Orthopaedic Surgeons, fractures of the

femur ranked first on the list of most frequent and third on the list of most expensive (10). Some of these suits were due to misplaced locking screws.

This technique is not dependent on the patients position during surgery i.e. it can be used whether the patient is in the supine position or lateral position. However, when nailing the femur on a fracture table, the proximal targeting device may limit use of this technique as it limits abduction and locking under image intensification may be difficult. This will not be a limitation when using a proximally loaded distal targeting device.

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