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SURGICAL TECHNIQUE

"Screw First" Technique to Get Past Nail–Jig Mismatch in Proximal Femoral Nailing

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Abstract
Proximal femoral nailing is the gold standard of surgical treatment for unstable intertrochanteric hip fractures. One of the intraoperative complications encountered in this procedure is the nail–jig mismatch due to causes such as manufacturing errors and fatigue deformation of sleeves or jig. Nail–jig mismatch leads to eccentric placement of guidewire within the screw slots of PFN and subsequent difficulty in reaming and screw insertion. The potential complications of this include guide wire deformation, breakage, nail damage and screw malposition. We propose a simple and effective technique to tackle this complication, called as "Screw first" technique. The principle of this technique is to utilize screws as guide wire sleeves to effectively centralize the guidewire position within nail slots. On identifying a mismatch by the eccentric position of guidewire, a long screw is first inserted partially till its shaft engages into the screw slot allowing subsequent insertion of a guidewire which assumes a centralized position, thus bypassing the mismatch of jig. Following this, the usual steps of reaming and final screw insertion are undertaken. This method is effective, simple, quick and requires no special instrumentation.

Keywords Proximal femoral nail · Nail–jig mismatch · Screw first technique

Introduction

Intertrochanteric hip fractures are one of the most common fractures encountered in the geriatric population [1]. Proximal femoral nailing is the gold standard of surgical treatment for unstable intertrochanteric hip fractures [2, 3]. Good reduction of neck–shaft angle and stable fixation is essential for satisfactory outcomes [4, 5]. Technique for proximal femoral nail (PFN) insertion is relatively straightforward and reproducible. However, occasional intra-operative complications related to implant and instrumentation can make its execution difficult.

PFN is a fixed angle (130*/135*) cephalo-medullary nail with two cephalic screws. The proximal one is called the derotation screw, and the distal one is called the lag screw/compression screw [6]. Nail is inserted through the entry point on the tip of the greater trochanter, and the cephalad screws are inserted through the jig over guide wires after reaming with the help of an image intensifier.

In developing countries where patients cannot afford expensive implants, surgeons depend on locally manufactured instruments and implants for carrying out surgeries. Because of inferior quality and repeated usage, we occasionally come across instrumentation-related problems intraoperatively. The nail–jig mismatch is one such problem, where inserting the cephalic screws through the jig becomes cumbersome [3, 7–10]. Unlike distal locking bolts, freehand locking cannot be carried out for proximal screws because of the obliquity of screw slots.

Nail–jig mismatch for passing cephalad screws in PFN can happen because of multiple reasons like fatigue failure/deformation of locking sleeves, deformation of the jig with overuse, loose/weak nail–jig junction, bent guidewires and nail deformation during insertion. Many measures to avoid nail–jig mismatch are routinely followed like: preoperative check of nail–jig assembly and rechecking accuracy of jig before insertion into the body. Other measures include using fresh guide wires for every case, avoiding deformed sleeves or jigs, ensuring the sleeves sit flush with lateral cortex of femur prior to guidewire insertion and using a trocar to mark the entry point of guide wires on the lateral femoral cortex.

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However, despite these measures, it is not uncommon to encounter nail–jig mismatch after the nail–jig assembly is introduced in femur. This intraoperative hurdle can lead to complications like guide wire bending/breakage, nail damage/breakage and unacceptable screw positions [7–10].

Our technique serves to address such an eventuality where the surgeon notices an eccentric guidewire inside nail slot despite the instrumentation clearing the preoperative checks.

Methodology

The nail–jig mismatch can be anticipated when the guidewires do not pass through the center of screw slot in the nail. When the guidewire is in an eccentric position within the screw slot, reamers cannot progress smoothly across the nail into the head of the femur. If continued with reaming, it can potentially damage the nail or even result in guidewire bending and breakage. Screws inserted in such cases can also be malpositioned (convergent or divergent instead of parallel).

A simple method to overcome this hurdle intraoperatively is the "screw first" technique. This technique makes use of a partially inserted long screw to act as a guidewire sleeve. By virtue of this sleeve, a newly inserted guidewire gets centralized within the slot of PFN. This is subsequently reamed, and the final screw is inserted. Thus, the mismatch is tackled, and complications are prevented.

Each step below is depicted by a schematic diagram along with image intensifier shots. Color coding is employed for ease of understanding. Black: jig and sleeves; Green: nail; Red: eccentric guidewire; Orange: centralized guidewire; Dark blue: screws; Light blue: reamer; Yellow: screwdriver.

Step 1: Look for eccentric position of guidewire through the screw slot in PFN using image intensifier to anticipate nail–jig mismatch. (Fig. 1 Note the eccentric position of guidewires within the screw slots).

Step 2: Retaining the guidewire in the proximal slot to act as derotation device, we first tackle the compression screw. This step involves reaming of only the lateral cortex of proximal femur over the eccentric guidewire.

Step 3: The longest available screw is selected (usually 120 mm) and partially introduced over the eccentric guidewire without a sleeve. Using the image intensifier, the screw is slowly inserted. Because of the tapered nature of the screw tip, it will find its way inside the slot even in case of eccentric position, and it should be advanced till the threaded portion of the screw just crosses the nail. Thus, the smooth shaft of the screw snugly fits into the nail slot. Some deformation of the guide wire is expected at this stage, and care should be taken not to break the guidewire. (Fig. 2 Note the partial introduction of the long screw within nail which induces some deformation of the guidewire). As we introduce the long screw into the nail slot, we can expect a subtle nail migration of few millimeters (superiorly or inferiorly) due to the screw being inserted from an eccentric position.

Step 4: Then, the eccentric bent guide is removed carefully. (Fig. 3 Note the position of the screw after removal of a bent guidewire).

Step 5: A fresh, straight guidewire is inserted through the cannulation of the partially inserted long screw without the sleeves. Here, the partially inserted long screw acts as a guidewire sleeve and centralizes the guidewire within the slot. The guidewire is inserted deep enough to achieve a

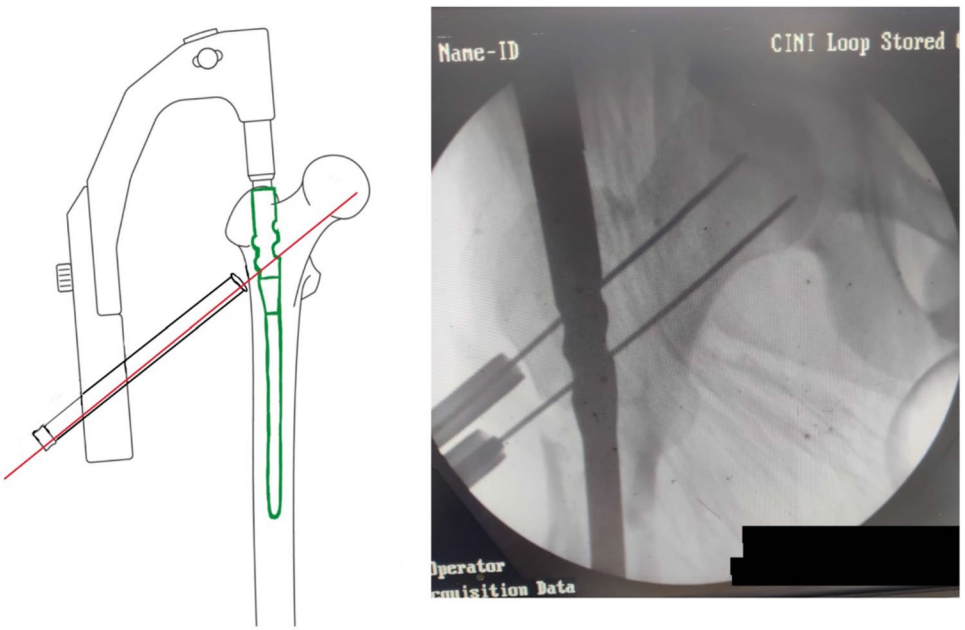

Fig. 1 Eccentric guidewire indicative of jig–nail mismatch

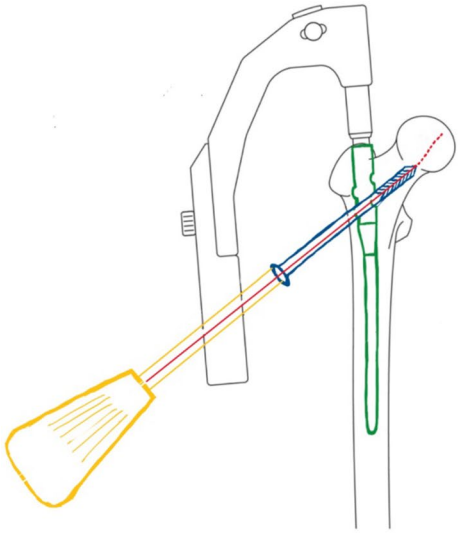

Fig. 2 Insertion of long screw partially into the nail slot, note the bent guidewire

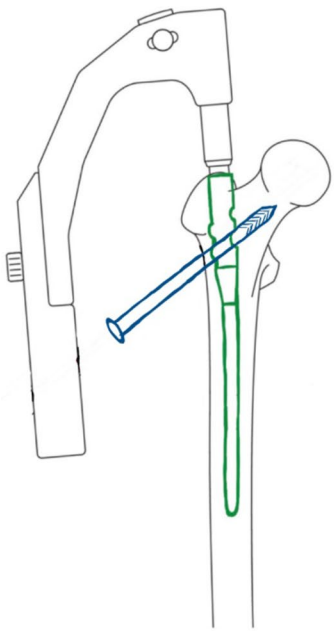

Fig. 3 Removal of bent guidewire

strong subchondral purchase. (Fig. 4 Note the newly inserted straight guidewire).

Step 6: Now, the partially inserted long screw is carefully removed. On doing so, one can confirm that the newly inserted guidewire is positioned in the center of the nail slot and bears no deformation. (Fig. 5 Note the centralized position of new guidewire after removal of the long screw).

Step 7: Sizing and reaming are done over the guidewire. (Fig. 6 Note the step of reaming done over centralized straight guidewire).

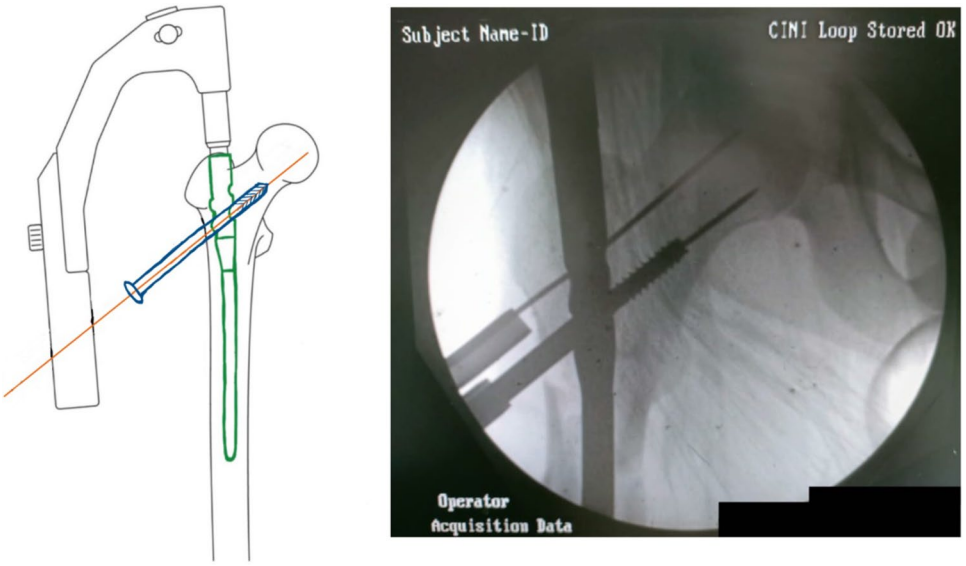

Fig. 4 Insertion of straight guidewire using the long screw as a sleeve

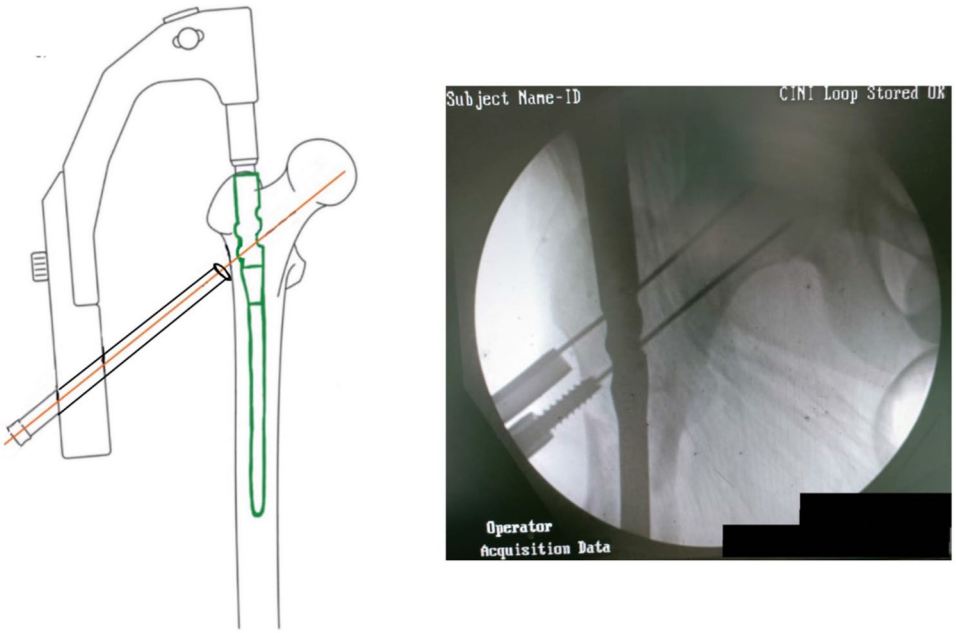

Fig. 5 Removal of long screw, note the guidewire is centralized

Step 8: Appropriate screw is chosen and inserted. Note the guidewire does not undergo any deformation as the screw is inserted. (Fig. 7 Note the final compression screw inserted).

Step 9: Same steps are followed for the derotation screw. (Fig. 7 Note insertion of derotation screw with same technique).

Discussion

Screw first technique exploits the fact that the shaft of cephalic screws snuggly fit into the nail slot. Inserting the longest available screw partially into the nail slot (until all threads have just crossed the nail) ensures that the subsequently inserted guidewire will be centralized. Thus, it bypasses the problem generated by the mismatch of the jig and nail. Reaming over this centralized guidewire will proceed smoothly, preventing damage to the nail, bending breaking of guidewire, and malposition of screws. Here, a long screw is desirable because it would allow sufficient length of screw to protrude outside the surgical site/skin, thus effectively protecting soft tissues from the new guidewire. The use of long screw also provides a long guided trajectory to the new guidewire being inserted to achieve accuracy of desired trajectory.

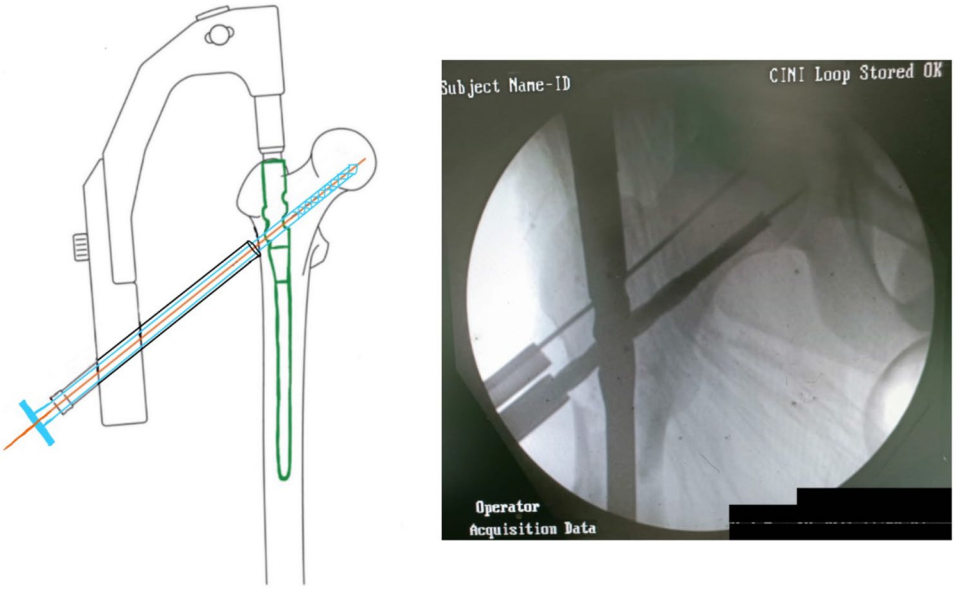

Fig. 6 Reaming over the straight centralized guidewire

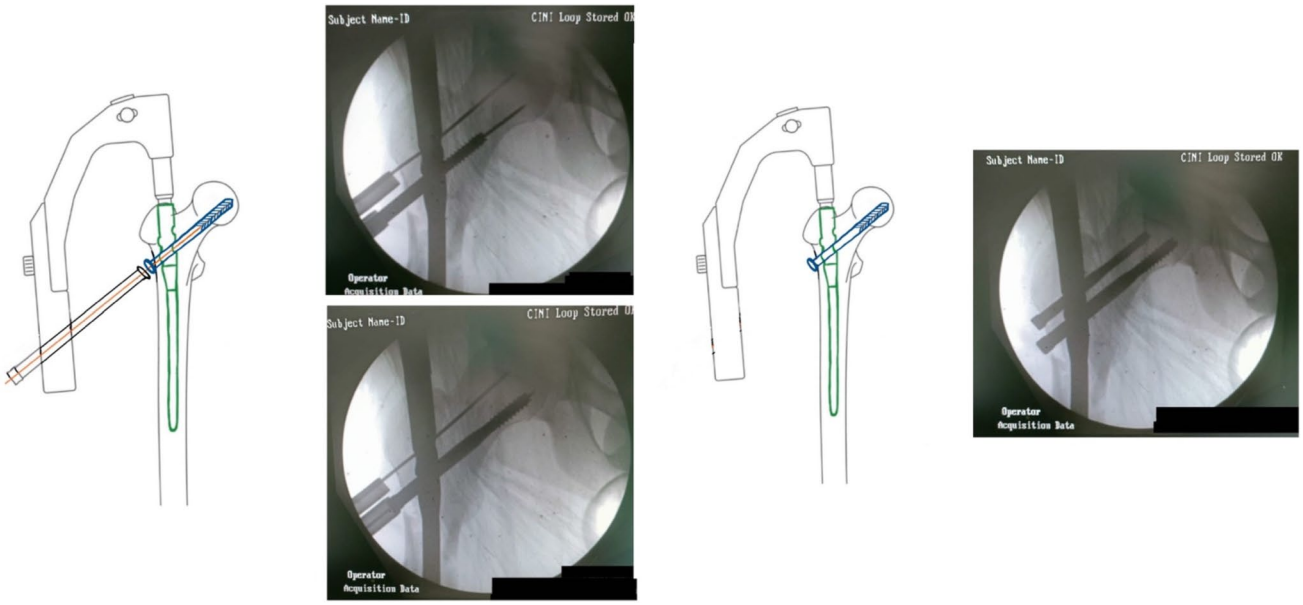

Fig. 7 Insertion of final screw of appropriate length and final image

An alternate technique commonly practiced is to use the reamer itself as a sleeve to achieve centralisation of guidewire. We believe that use of a reamer instead of long screw has certain drawbacks. First, the reamers have a tapered design. So, when the tip of reamer crosses the nail, it does not snugly fit into the nail slot. Thus, the reamer follows the course of guidewire instead of centralizing it. Whereas, the smooth part of shaft of screw snugly fits into the nail slot. Thus, it induces centralization of the guidewire. Second, a reamer inserted (often using a drill gun) over an eccentric guidewire has the tendency to cause damage to the nail slot by its flutes. On the contrary, a screw is inserted with hand and does not tend to damage the margins of nail slot.

This technique is easy to adopt and requires no special instrumentation. A limiting factor for this technique could be the length of the longest available screw. But in our experience, 120 mm length of the compression screw and 110 length of derotation screw generally suffices in most Indian patients. These screw lengths are available in regular sets, hence needing no special arrangements. While this technique serves to solve a nail–jig mismatch causing eccentric guidewire, but this technique offers no relief in event of a

massive mismatch where in the guidewire completely misses the nail slot. Such an occurrence in our opinion is due to a grossly faulty jig and can be identified while checking the jig preoperatively, which is a usual practice at most institutes.

In most Indian setups, where nail–jig mismatch is not an unusual occurrence [3, 6–9], this technique can be a valuable method to bail out the surgeon intraoperatively and prevent complications.

Declarations

Conflict of Interest Samarth Thakkar, Atmananda Hegde, Prajwal Mane and Chethan Shetty declare that they have no conflict of interest. On behalf of all authors, the corresponding author states that there is no conflict of interest.

Human and Animal Rights This article does not contain any studies performed on animal or human subjects.

Informed Consent For this type of study, informed consent is not required.

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