



A Clinical Case Report: Closed Extraction of a Broken Distal Piece of the Tibial Intramedullary Nail Remaining for 8 Years

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Authors' contributions

This work was carried out in collaboration among all authors. Authors GM and CW conceived the study. Authors CW and GM. drafted the manuscript. Author GM performed the literature search. Authors GM and CW contributed to the clinical management of the patient and performed the surgery of this patient. Author QY revised the manuscript critically and approved the modified text. All authors read and approved the final manuscript.

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Case Study

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ABSTRACT

Aim: Closed extraction of a broken distal piece of the intramedullary nail is very challenging. We herein report a case of the broken distal piece of the tibial intramedullary nail remaining for 8 years, which was successfully extracted by closed method using a self-made broken nail extractor.

Case Presentation: A 51-year-old male patient was admitted to our hospital for extraction of the broken distal piece of the tibial intramedullary nail for 8 years. The preoperative X-ray films showed the broken intramedullary nail was cannulated and the outer diameter is 10 mm, larger than the isthmus of the medullary cavity.

Results: After reaming with Φ 11 mm drill, the self-made broken nail extractor was inserted into the medullary cavity from the nail entry point and passed through the canal of the broken nail, and successfully pulled out the broken nail.

Conclusion: Our technique is a simple reproducible alternative that has high extraction success rate for broken distal piece of cannulated intramedullary nails.

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1. INTRADUCTION

Intramedullary nailing of long bone fractures is a standard internal fixation method with the advantages of not disturbing the fracture hematoma and the biomechanical superiority over plating [1-3]. However, the incidence of difficult healing including nonunion or delayed union of long bone fractures after intramedullary nailing is 15%~20% [3-5]. In cases of difficult healing of a fracture stabilized with intramedullary nails, fatigue failure of the nail can occur due to cyclic loading. Extraction of the broken nail will be needed in the revision surgery. Closed exchange nailing is becoming now one of the preferred methods to treat nonunion of fracture tibia and femur. Multiple techniques had been described to extract a broken distal piece of the nail, yet the procedure still can be very challenging and the commonly used methods and tools can fail to extract the broken part [6-12]; thus, there is no guarantee which particular extraction technique will be most effective for any given case, so it is incumbent on the surgeon to be familiar with a variety of intramedullary nail extraction techniques and to have all potentially required equipment available. We herein report a case of the broken distal piece of the intramedullary nail remaining for 8 years, which was successfully extracted using a self-made broken nail extractor.

2. CASE PRESENTATION

A fifty-one-year-old male patient was admitted to our hospital for removal of a broken distal piece of the tibial intramedullary nail remaining for 8 years. 10 years ago, he had closed tibial shaft fracture caused by a collision and was treated with close reduction and intramedullary nailing fixation. Delayed healing occurred after operation and caused broken of the nail at a distal locking screw hole. The fracture healed after plaster fixation for 3 months. Removal of the internal implant was performed 2 years after the fracture, the broken distal piece remained in the medullary cavity due to the failure of the hook extraction method (Fig. 1). His function of lower limbs recovered well. It can be seen from the preoperative X-ray film that the broken distal piece of intramedullary nail was hollow, and its outer diameter was larger than that of the isthmus of the medullary cavity; the outer diameter of the broken nail was 10 mm by measurement, and was larger than the isthmus of the medullary cavity.

A self-made broken nail extractor was manufactured, comprising a guide needle and a spear. The diameter of the guide needle was 2.5 mm. The spear contained two 1.0-mm-diameter pins with a 2.5-mm-long barb on one side (Fig. 2).



Fig. 1. X-ray films showed union of the right tibial fracture with the broken distal piece of intramedullary nail remaining in the tibial medullary cavity

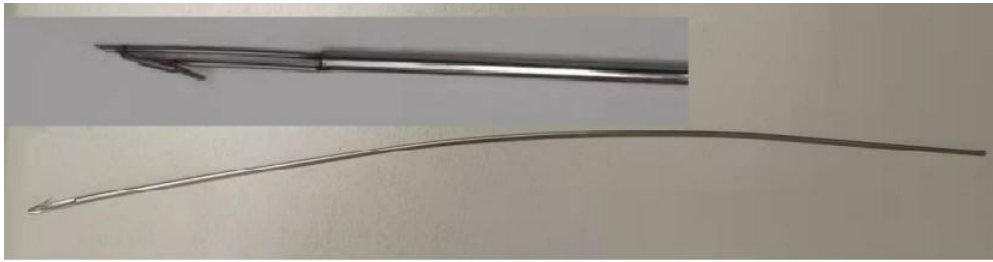


Fig. 2. Appearance of self-made broken nail extractor

3. RESULTS

During the removal procedure, we made a hole at the entry point of tibia for intramedullary nail, inserted the guide needle and reamed the tibial medullary cavity with a Φ 11 mm drill bit along the guide needle (Fig. 3), and flushed and sucked out the residue after reaming. We adjusted the diameter of the spear at the barb of the self-made broken nail extractor to 3 mm, then inserted it into the medullary cavity and passed the broken nail extractor (Fig. 4), finally pulled back, the barb hooked the canal wall (Fig. 5) and successfully extracted the broken nail (Fig. 6). The operation was performed under fluoroscopy.



Fig. 3. Intraoperative X-ray showed reaming of the medullary cavity with a drill along the guide wire

4. DISCUSSION

According to whether the bone at the broken nail site is fenestrated, these techniques can be divided into two categories: closed extraction and fenestration extraction methods [6-14].

Interference fit guide wire method and hook extraction method are the main closed extraction methods [6,7,12]. The interference fit guide wire

method entails passing a ball-tipped guide wire and a nontipped guide wire or Kirschner wire through the nail canal, filling the canal as much as possible, and extracting the broken nail using the resistance generated by the friction between the enlarged ball at the front of the wire and the canal wall [6,7]. The disadvantage of this method is that it is very difficult for the nontipped guide wire and the Kirschner wire to pass through the canal of the broken nail along with the ball-tipped wire. The hook extraction method involves hooking a guide needle through the broken nail canal and extracting the broken nail. The disadvantage of the hook method is that it is very difficult for the hooked guide needle to pass through the broken nail canal. Therefore, both methods have a low success rate. Another defect is the minimally invasive extraction methods require multiple X-ray fluoroscopy, which subjects operators and patients to large doses of X-ray radiation.



Fig. 4. Intraoperative X-ray showed the broken nail extractor was inserted into the medullary cavity and passed through the canal of the broken nail



Fig. 5. Intraoperative X-ray showed the broken nail extractor was pulled back and the barb hooked the canal wall.



Fig. 6. The broken nail extractor extracted the broken distal piece of the intramedullary nail

The fenestration extraction method entails the creation of a window on the bone at the location of the broken nail and then inserting a 2-mm-diameter and approximately 2-inch-long elastic nail or screw through the locking hole on the side of the broken nail. The ball-tipped guide needle is then pulled outwards. Because of the incarceration between the ball-tipped guide wire and the elastic nail or screw in the canal of the broken nail, the ball-tipped guide needle is closely connected to the broken site of the

intramedullary nail. As a result, the broken nail is pulled to the nail entry point. After fenestration, the guide needle or a thick steel wire can be inserted through the hole of the broken nail in a retrograde manner, and the distal end of the guide needle can be bent, or the thick steel wire tied, so that the broken nail is extracted by pulling the guide needle or the thick steel wire at the nail entry point [5,7]. The fenestration extraction method has a high success rate and basically avoids radiation exposure, but the disadvantage is that it creates relatively large surgical trauma.

Our technique is a new closed extraction method, which is not only simple to manufacture but also reasonable in design. The tip of the extractor is relatively small and is located in the center of the extractor so that it can easily enter the canal of the broken nail and guide the wide barb into the canal. The diameter of the barb can be reduced and expanded. After compression, the barb diameter was ≤ 3 mm, allowing the body to pass smoothly through the canal of the broken nail. After passing through the canal, the barb diameter was expanded to more than 3 mm, and the barb could easily hook the canal wall of the broken nail. The width of the barb was increased by approximately 2 mm after full expansion and had exactly the same thickness as the canal wall of the broken nail; thus, it could not hook the medullary cavity wall and become stuck. The diameter of the barb was 1.0 mm and had a certain resistance to bending, allowing the broken nail to be extracted even if there was some resistance.

The surgical essentials are as follows: First, when it is expected that the broken nail extractor to pass through the medullary cavity, especially the isthmus, will encounter great resistance, a drill must be used to ream and expand the medullary cavity. Second, the diameter of the barb should be adjusted according to the inner diameter of the broken nail to be consistent with or slightly larger than the inner diameter of the broken nail; otherwise, if it is too small, the barb will not easily hook the canal wall, and if it is too large, the bar will be difficult to pass through the canal of the broken nail.

5. CONCLUSION

Our technique is a simple reproducible alternative that has high extraction success rate for broken distal piece of cannulated intramedullary nails.

ETHICAL APPROVAL

As per international standard or university standard ethical approval has been collected and preserved by the authors.

CONSENT

Written & Oral informed consent was obtained from the patient before writing this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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