

Surgical Technique for Femoral Intramedullary Bent Nail Removal: A Case Report and Review of the Literature

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ABSTRACT

A 21-year-old male patient was admitted with a severe right thigh deformity following a car accident. He had experienced a previous history of intramedullary interlocking femoral nail 3 years ago.

The neurovascular examination was normal. The radiologic evaluation revealed a bent nail with 105° angular deformity in the sagittal plane.

With a lateral approach to the apex of the fracture site, the bent nail was cut by an 8mm cobalt drill, two parts of the nail were extracted; then fixation was performed by a new intramedullary interlocking nail and autogenous cancellous graft.

The fracture healed properly without any complications 6 months after corrective surgery.

INTRODUCTION

Intramedullary (IM) interlocking nailing for the treatment of femoral shaft fractures is traditionally considered as the gold standard procedure [1, 2]. A secondary high-energy trauma to a previously stabilized long bone fracture with an intramedullary nail is exceedingly rare [3-7].

A broken nail can be removed easily through the fracture site. However, no standard protocol exists precisely in the literateurs regarding the removal of bent nails, as very few cases have been documented [8]. Straightening of bent nails intraoperatively is difficult and considered by many authors practically impossible, especially when bending involves a high-strength nail or titanium nail [9-11].

We present a surgical technique for the treatment of a patient with a bent nail after femoral shaft re-fracture following a car accident.

CASE PRESENTATION

A 21-year-old male patient was admitted to hospital following a car accident. He had a history of right femoral shaft fracture treated by interlocking IMN three years before.

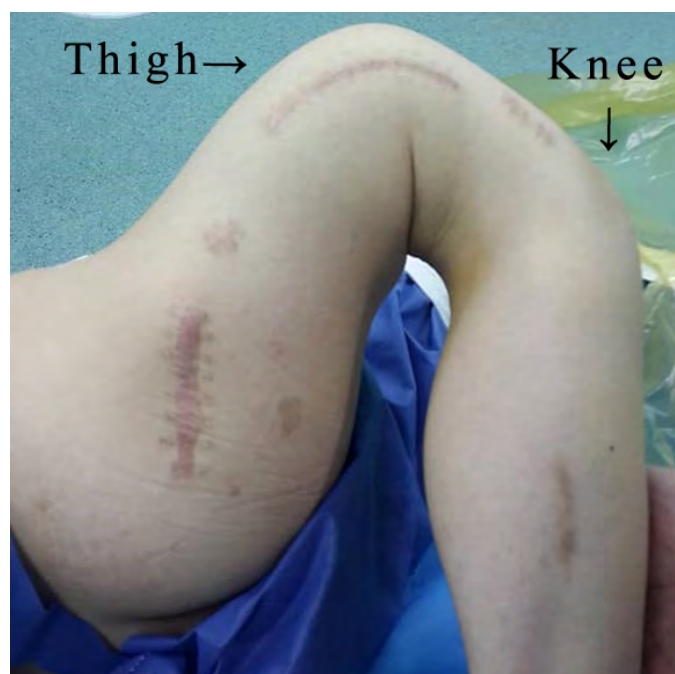


Figure 1. Obvious anterior angulation deformity in right leg



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Figure 2. 20° varus angulation and 105° anterior angulation

The patient suffered from severe pain and deformity of the right thigh without any other associated injuries. The neurovascular status was intact (Figure 1).

Plain radiography of right thigh revealed significant bending of the nail and femoral shaft fracture. The IM nail had a 105° anterior angulation in anterior-posterior (AP) view with a 20° varus angulation in lateral view while continuity of the nail was intact (Figure 2). After obtaining the informed consent of the emergency operation, in the preoperative analysis, straightening out the nail was considered to be impossible.

With a 7.5cm lateral approach to the apex of deformity, the fracture area was exposed; the bent nail was cut by an 8-mm cobalt drill.

Another incision in the previous surgical site was performed; the proximal part of the nail from the proximal site and the distal part from the fracture site extracted.

The femoral canal was then reamed to 2.5 mm greater than the diameter of the original nail. A new nail, with a similar length but 2 mm larger in circumference than the original nail was inserted. After the passage of the new nail, four interlocking bolts were inserted through the new nail as a static model. The reduction was checked under fluoroscopy and was considered to be satisfactory. Iliac crest bone grafting was done. Postoperatively, there were no complications and radiographs showed both good reduction and the alignment of fracture fragments in

the AP and lateral views. The patient's deformity was corrected clinically and radiologically (Figure 3).

The patient started toe-touch mobilization and knee hip mobilization exercises 3 days after surgery. After 6 months the fracture healed without any complications (Figure 4). In the one-year follow-up, the patient had no problems related to this surgery.

DISCUSSION

Bent nail is a rare yet distressing complication and there are some challenges in management of this complication. The use of intramedullary nails for the treatment of femoral fractures is the gold standard [3].

Results in the literature have shown up to 98% union rates, with few complications. Known complications of antegrade femoral nailing include neuropraxia associated with traction, angular or rotational malalignment, heterotopic ossification, hip pain, re-fracture, malunion, non-unions, and implant complications[5-7].

Due to the relative rarity of bent intramedullary nails secondary to trauma, only case reports are found in the literature addressing the treatment options. The first step in approaching fractures recurrences is the well-planned attempt to remove the deformed intramedullary nail. Few methods have been described in literature, such as manipulation of the bent nail via external force on the femur, percutaneous technique with locking compression plate and collinear reduction clamp, weakening the bent nail using high-speed burr, the sectioning of the nail using diamond edge blades and removal of each piece separately, and the re-bending of the nail with the help of a specialized device and locking plate [4].

Canton et al declared that in management of this complication some factors should be considered, including deformity degree, direction and location, and also patient's condition and the surgeon's experience. Proper amount of preoperative imaging is crucial for revealing the magnitude and direction of the deformity. It is also mandatory for planning both nail removal and definitive fracture treatment.



Figure 3. Post-operative X-ray. Anteroposterior and lateral view



Figure 4. Six months-post operative evaluation

Furthermore, this condition happens more in new high-energy trauma cases, however, sometimes it occurs in nonunion and often without trauma which has a different management plan. More soft tissue damage and co-morbid injuries with acuter general conditions may be expected in high energy trauma cases that benefit from a damage control approach for stabilizing a more accurate plan for definite surgery [8].

Nicolaides et al. suggested a lateral longitudinal femoral osteotomy for resection of the bent nail and reconstructing femur with a new nail. Fixation of the osteotomy was achieved with plate and cerclage wires. Five months after surgery, callus formation was evident and standard ranges of motion and gait were regained for the patient, walking with a single cane. Formerly he presented two cases of bent femoral nail removal. The treatment option was a metal cutting blade for nail sectioning, partially or completely. In one patient, lateral approach was combined with a small anteromedial incision for a better blade movement across the thigh. One nail was removed in one piece and the other in two pieces separately. Despite the severity of injuries and co-morbidities, the ultimate result for both patients was satisfying and they maintained complete union after applying interlocking nail in revision surgery [4].

Shen et al. introduced a novel technique with one dynamic compression plate and two bone-holding forceps to straighten a bent nail. This method is simple and efficient [5].

In the method of Otsuka et al., under minimal soft tissue dissection, the nail was straightened by sectioning through half of its diameter with a drill for metal, then removed and replaced with another nail. Femur union occurred without any complications [11].

Heffernan et al. described a novel technique combining the utilization of a Midas Rex MR7 high-speed burr (Medtronic, Minneapolis, Minnesota) and the F-Tool (Synthes, West Chester, Pennsylvania) to facilitate nail removal. In the lateral decubitus position, after limited exposure at the fracture site, the intramedullary nail was diminished at the apex of the deformity with a Midas Rex MR7 high-speed burr. Next the F-Tool was used to straighten the nail extraction through the original proximal insertion site. The F-Tool concentrate forces at the apex of the deformity and reduces soft tissue damage. The additional benefit is one-piece nail exertion [10].

Shishir et al. reported a 33-year-old male patient with 5 weeks postoperative bent intramedullary femoral nail due to a minor fall. With a varus deformity, the IM nail was bent to 30° and the former fracture was still healing. After general anesthesia the nail was unbent, and exchange nailing was carried out. He suggested closed manipulation before surgery for preventing soft tissue and bone damage and major surgeries complications [2].

Banerjee and Posner, in a case report study of post-traumatic sagittal plane deformity, described a simple surgical approach to straighten the sagittal plane bend in situ, then performed nailing while maintaining the symmetric femoral length and rotation. In this technique, disturbance of the fracture is minimal, and also with a small incision, soft tissue and blood supply of the femur are more preserved. The nail was extracted in a sole piece by straightening the nail in situ, however there

is a described technique with transection of the nail which is an option but it poses challenges in extracting the distal part. Also, symmetric length and rotation are achievable. Ipsilateral hip arthrofibrosis and ipsilateral knee ligament injury are the contraindications of this method. Before the operation, the surgeon should become ensured of the knee stability with a physical exam, or else it is possible that this injury may get worse, as the nail is straightened against the fulcrum by engaging force to the distal femur. Ipsilateral hip arthrofibrosis restricts femur excursion and therefore it may be impossible to straighten the femur against the fulcrum [9].

CONCLUSION

We exposed the fracture site at the apex of deformity and transected the nail with an 8mm cobalt drill bit and removed each part of the nail and exchange the nail with another nail 2mm larger than the original one, and the iliac crest autograft was done. The fracture had union in 6 months without any complications. This technique is effective, cost effective and can be considered in such cases. Our technique is simple and cost-effective.

CONFLICT of INTEREST

The authors whose names are listed immediately below certify that they have no affiliations with or involvement in any organizations or entity with any financial interests or non-financial interests in the subject matter or materials discussed in this manuscript.

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REFERENCES

1. Kritsaneephaiboon A, Tangtrakulwanich B and Maliwankul K.A novel minimally invasive technique for removal of a bent femoral intramedullary nail. *Inj Extra*.2012;43(12):157-62.
2. Shishir S, Deniese PN, Kanagasabai R, Najimudeen S and Gnanadoss JJ.A worthwhile attempt to remove a bent intramedullary femoral nail before attempting extensive procedures. *Journal of Current Research in Scientific Medicine*.2015;1(1):44.
3. LaSalle WB and Horwitz T.A method to cut and remove in situ bent intramedullary nail. *Clinical Orthopaedics and Related Research (1976-2007)*.1974;103:30-31.
4. Nicolaides V, Polyzois V, Tzoutzopoulos A, Stavlas P, Grivas TB and Korres D.Bent femoral intramedullary nails: a report of two cases with need for urgent removal. *European Journal of Orthopaedic Surgery & Traumatology*.2004;14(3):188-91.
5. Shen P-C, Chen J-C, Huang P-J, Lu C-C, Tien Y-C and Cheng Y-M.A novel technique to remove bent intramedullary nail. *Journal of Trauma and Acute Care Surgery*.2011;70(3):755-58.
6. Sonanis SV, Lampard AL, Kamat N, Shaikh MR and Beard DJ.A simple technique to remove a bent femoral intramedullary nail and broken interlocking screw. *Journal of Trauma and Acute Care Surgery*.2007;63(2):435-38.
7. Yoon RS, Liporace FA. Impact of Intramedullary Nailing in the Treatment of Femur Fractures An Evolutionary Perspective. *Bull Hosp Jt Dis (2013)*. 2018 Mar;76(1):9-13.

8. Gianluca C, Bramir H, Roberto F and Luigi M. Bent femoral intramedullary nail: a case report and review of the literature. *Acta Bio Medica: Atenei Parmensis*.2019;90(Suppl 1):187.
9. Banerjee R and Posner M. Removal of a bent intramedullary nail with a posttraumatic sagittal plane deformity. *Journal of Trauma and Acute Care Surgery*.2009;66(5):1500-03.
10. Heffernan MJ, Leclair W and Li X. Use of the f-tool for the removal of a bent intramedullary femoral nail with a sagittal plane deformity. *Orthopedics*.2012;35(3):e438-e41.
11. Ohtsuka H, Yokoyama K, Tonegawa M, Higashi K and Itoman M. Technique for removing a bent intramedullary femoral nail: a case report. *Journal of orthopaedic trauma*.2001;15(4):299-301.