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Removal of intra-operatively broken flexible reamer: An innovative use of jumbo cutter☆

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ABSTRACT

Reaming is an important step in long bone nailing and has a low complication rate. We report a case of a flexible reamer that got broken and incarcerated in the femoral canal during reaming in a segmental femur fracture. Routine extraction using guide wire was not possible. The incarcerated reamer was successfully extracted with the help of a jumbo cutter.

1. Introduction

Interlocked intramedullary nailing is the standard treatment for closed diaphyseal femoral fractures. Reaming of the medullary canal is an essential component in nailing of a long bone. Several good quality studies have shown improved union rates with a reamed nailing compared to an unreamed nailing.[1] Complications associated with reamer usage are rare. Broken rigid reamers during knee replacement surgery[2] and tibial nailing[3] and incarcerated reamer[4] have been described in the literature. Reaming has several biological advantages,[5] and is now considered an indispensable part of femoral nailing. A flexible reamer can get jammed in the medullary canal during reaming due to the accumulation of reaming debris around the reamer head or it can get stuck in the isthmus, which is the narrowest part of the femoral medullary canal.[6–10] We are reporting a case of a flexible reamer broken at the proximal junction and incarcerated in the femoral canal and a new technique used for its removal. To the best of our knowledge, no such case or surgical technique has been reported.

2. Case report

A 50 year old male patient having an alleged history of road traffic accident, was admitted in our hospital with complaint of pain, swelling, deformity in right thigh and both legs and open wound over both legs. Primary treatment was given, radiographs were done and he was diagnosed as a case of closed segmental fracture of shaft of right femur with open grade 3B (Gustilo and Anderson) fracture in both bones of both legs. After pre anaesthetic check-up, patient was posted in operating theatre. Wound debridement and external fixation was done for both legs in the first setting. Patient was again posted for surgery for segmental femur fracture and was planned for intramedullary nailing with additional distal femoral locking plate fixation for the distal femoral fracture.

After proper positioning, entry hole at the greater trochanter was made with a rigid entry reamer. An 8-mm flexible reamer was

☆ Senior first author Dr Tankeshwar Boruah was the operating surgeon, and played a crucial role in the innovative technique, and in the drafting and submission of the manuscript. Dr Sapan Kumar was involved in writing the manuscript. Dr Mohit Kumar Patralekh (corresponding author) suggested innovative use of jumbo cutter, revised the manuscript, and contributed important intellectual content. Dr Shambhu Prashad, Dr Vibash Chandra, and Dr Ijack Debbarma were in the operating team, and were involved in writing of the manuscript and gave intellectual inputs and critical suggestions during the case. Senior author Dr Ramesh Kumar gave important intellectual inputs for the case and critically reviewed the manuscript.

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then inserted into the medullary cavity of the shaft of the femur through the entry site and sequential reaming was carried out with the use of a guide wire. The reaming continued with sequential 0.5-mm increments in reamer diameter. At last step, 1-mm increment was done. When the 11-mm reamer was used, the reaming end (reamer head with flexible shaft) got jammed in the medullary canal at the distal end of the isthmus and flexible reamer was broken at the junction of drill machine flexible shaft adaptor and shaft of flexible reamer. No further reaming was possible. Attempts to pull out the flexible reamer failed as the reaming end was tightly incarcerated in the medullary canal. Multiple attempts were made with different techniques, including an attempt at grasping the reamer with large pliers and back hammering but a firm grip could not be achieved in any case. At last retrieval was possible with jumbo cutter only. Jumbo cutter made dent over the two opposite surfaces and grasped the flexible reamer with a tight grip, following which back hammering was done over jumbo cutter, which resulted in unjamming of the reamer.

The incarcerated flexible reamer was then successfully pulled out. Reaming was continued with another flexible reamer over a ball tipped guide wire. The cephalomedullary nailing was completed successfully (Figs. 1–3).

3. Discussion

Intraoperative technical complications are possible while reaming. Breakage of flexible reamer during surgery is an unexpected complication experienced by surgeons as a quite stressful and catastrophic situation. While using a flexible reamer with a helical shaft, one should follow two main rules. First, it is imperative to turn clockwise for both reaming and extracting in order to prevent uncoiling of the helical shaft. Second, it is recommended to

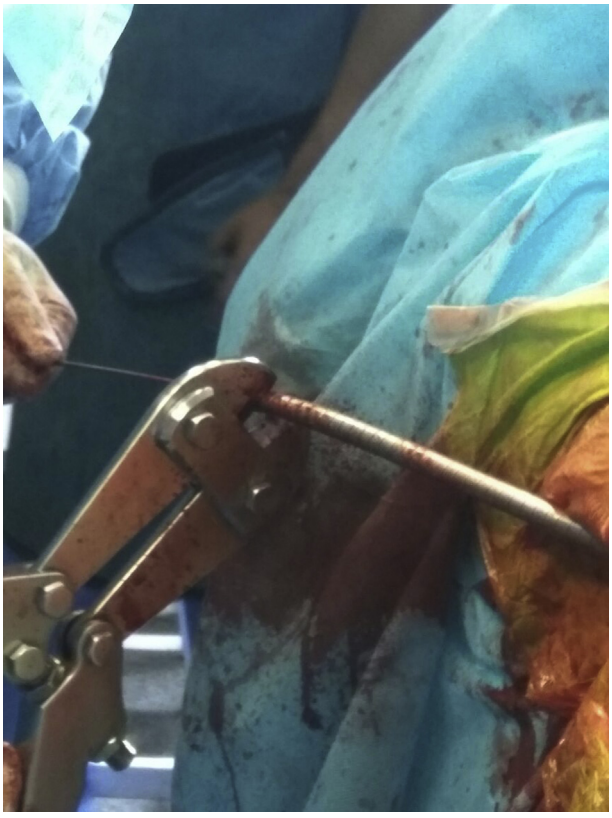

Fig. 2. Indentation being made by the jumbo cutter, enabling a firm grasp on the reamer.

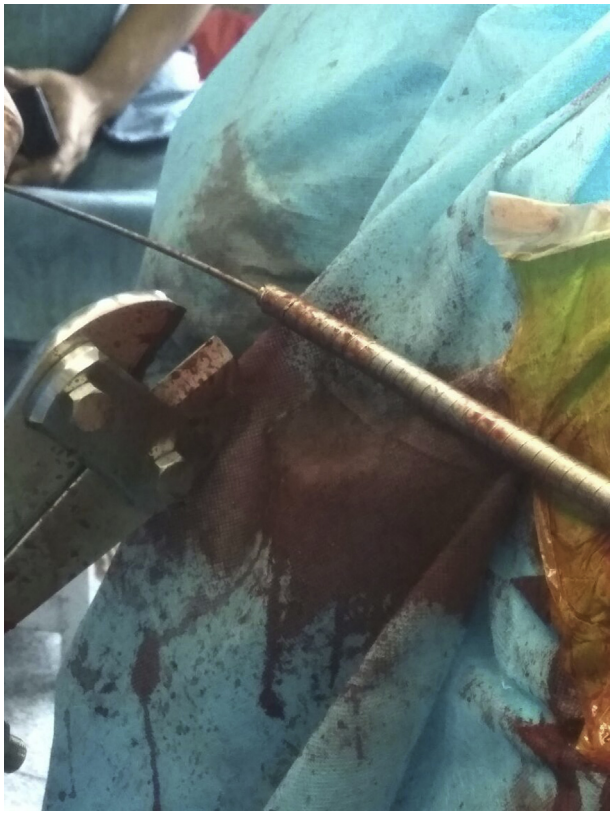

Fig. 1. Jumbo cutter being used to grasp the proximal part of the broken reamer.

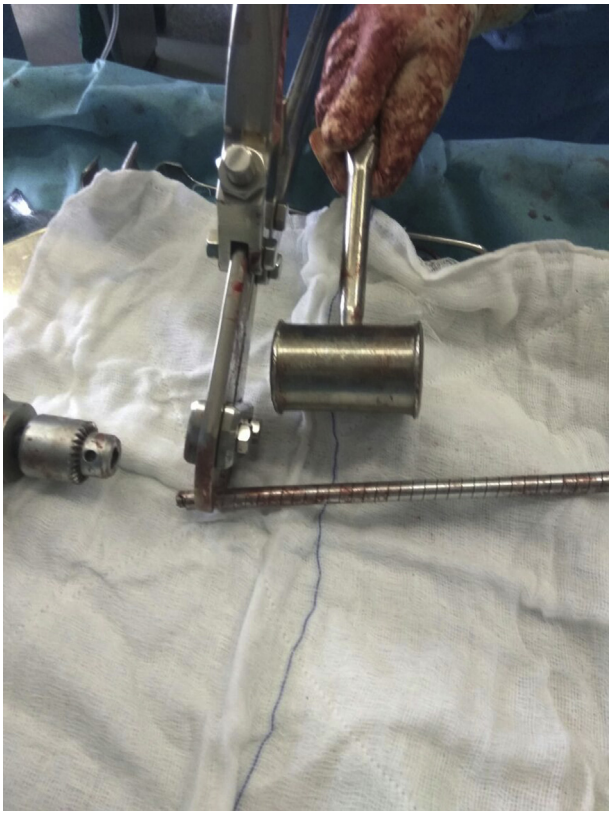

Fig. 3. Mallet used to strike on the jumbo cutter, which disimpacted the reamer and ultimately led to its extraction.

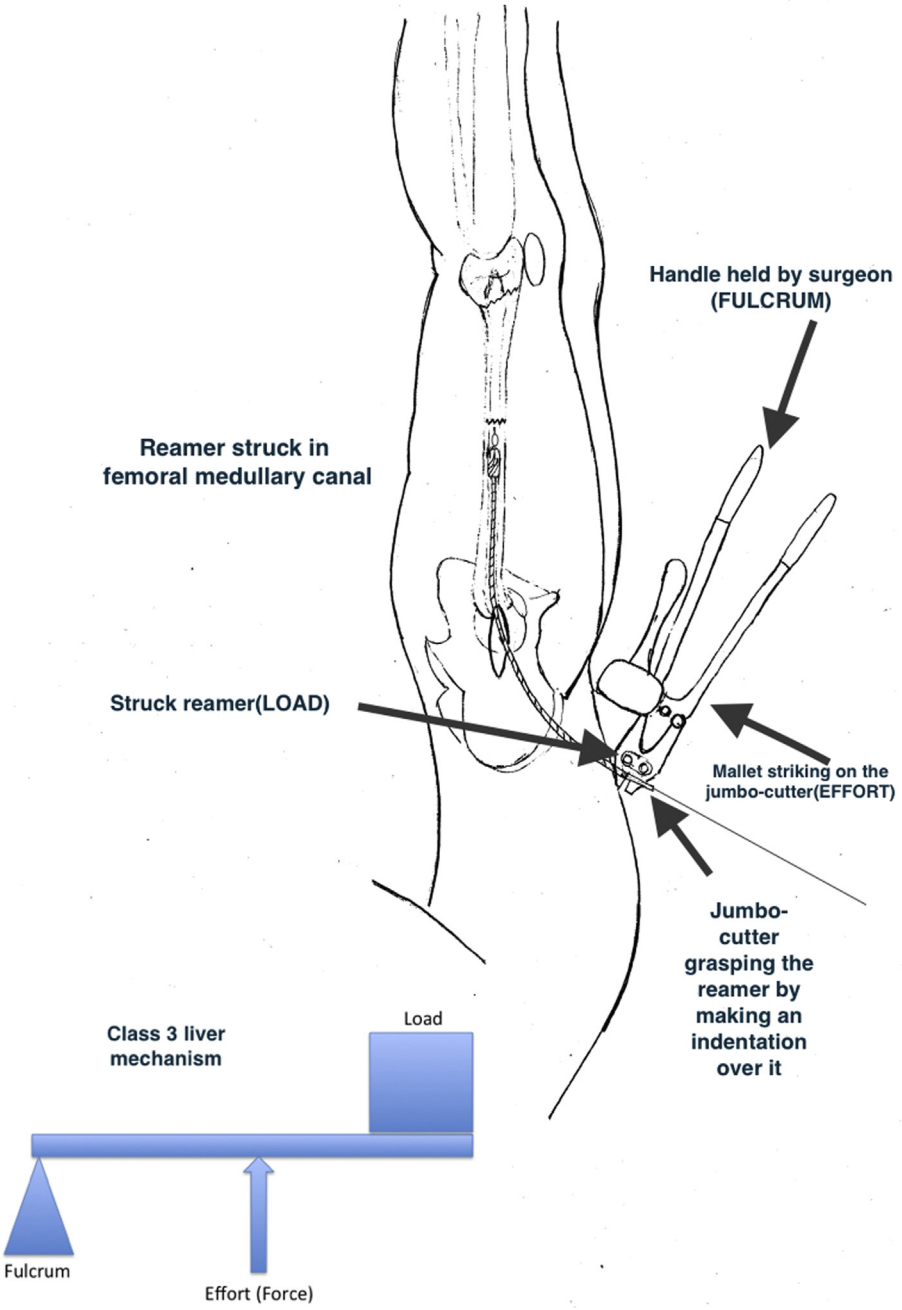

Fig. 4. Schematic diagram illustrating how jumbo cutter-reamer-hammer assembly constituted a type 3 liver mechanism, with load (jammed flexible reamer) at one end, effort (hammer strikes) in the middle and fulcrum (surgeon's hand firmly grasping the handle of jumbo-cutter) in the other end, which enabled extraction of the reamer.

start with the smallest diameter reamer and to progress in 0.5mm diameter increments. This will avoid incarceration of sharp cutting edges of the reamer head. Use of 1mm increment once in our case might have contributed to reamer jamming. One should advance the reamer gently, with a steady and moderate pressure. Reamer should never be forced into the canal. One should also partially retract the reamer often, in order to clear reaming debris from the medullary canal. This will prevent the reamer head from jamming inside the medullary canal. Due care should be taken when reaming across the fracture site, as some additional cortical injury can happen, unless the fracture has been reduced properly. Reaming should ensure that the ultimate track in the medullary canal will be at least 1-mm wider than the diameter of the intramedullary nail that the surgeon plans to use; otherwise there is a risk of nail not progressing or getting jammed. Uncoiling of flexible reamer has also been reported as a complication of reaming, and its successful removal has also been described. Authors recommended extracting the uncoiled reamer by the olivary tip of the guidewire. Attempting to advance the reamer further can worsen the uncoiling with a risk of complete rupture in such cases.[6]

One of the important reasons behind such complications is the use of indigenous instrumentation made of stainless steel of poor quality. It is recommended that the instrumentation should be of good quality and should not be very old. Repeated use of the same reamer over a long period of time in several surgeries may cause rusting, wear and tear of the coils and that can cause such

Table 1
Options for management in a case with incarcerated reamer.

S No	Options for management in a case with incarcerated reamer
1.	Using olivary tip guidewire, gentle thrust with wire holder
2.	Medullary decompression with small drilling corticotomies made adjacent to the reamer head
3.	Unicortical osteotomy of the femur at the site of incarceration
4.	Opening the fracture to push the reamer retrograde
5.	Long laparoscopic prehensile forceps can be used for extraction of the incarcerated part of broken reamer
6.	Getting a firm grip on the exposed part of the reamer through jumbo cutter and removal by gentle back hammering.
7.	Leaving incarcerated part is an option when the reamer breaks very distally in the femur without interfering with the nail insertion

complications. This could have contributed to reamer breakage in our case. The jumbo cutter-reamer-hammer assembly constituted a type 3 liver mechanism, with load (jammed flexible reamer) at one end, effort (hammer strikes) in the middle and fulcrum (surgeon's hand firmly grasping the handle of jumbo-cutter) in the other end. This mechanism, along with long jumbo cutter handle and firm grip made by jaw of jumbo cutter over the indentation made on the flexible reamer (jumbo cutter itself has a type 1 liver mechanisms, and the long liver arm helped in making a dent over the reamer and achieving a firm grip), provided mechanical advantage to the system, and finally made extraction of the jammed reamer possible (Fig. 4).

In one case, the incarcerated reamer was successfully extracted after medullary decompression with small drilling corticotomies made adjacent to the reamer head. Authors used a 4mm drill bit to create three holes in the external face of the femur opposite to the blades of the reamer, which allowed free and easy extraction of the incarcerated reamer. The rationale was to decompress the medullary canal around the reamer head. These authors also speculated that the drill bit helped to clean the bone debris between the reamer blades. Furthermore, the drill bit also helped to move the incarcerated part of the reamer. These cases indicate that the use of an olivary tip guide is not a guarantee of easy extraction.[4]

In another difficult case the reamer uncoiled and broke into several pieces and completely filled the canal. The extraction was impossible even with an olivary tip guide wire. The surgeon, in this desperate situation, had to cut the guidewire and reamer assembly at the point of entry. An external fixation was employed. The patient was referred to another center where a wide corticotomies were performed to extract the whole reamer.[7] In a case of reamer uncoiling in the tibia, the olivary guide did not allow extraction because the sharp cutting edges were deeply incarcerated. Therefore, authors had to open the fracture to push the reamer retrograde.[8] Removal of a broken rigid reamer using guide wire without an olivary tip in the tibia has also been reported. The authors had used long laparoscopic prehensile forceps for extraction of the incarcerated part.[9]

Other authors have reported two cases of reamer breakage during femoral nailing. In the first case, a flexible reamer was broken at the distal end while reaming the femur. The olivary tip of the guide was helpful to extract it. In the second case, rigid reamer was being used. The reamer got broken at the distal end above the fracture. In order to extract the incarcerating part, they opened the fracture and pushed the broken part to extract it.[10]

Removal of broken reamer while performing total knee replacement has been described. Authors had to push the incarcerated part retrograde up to the greater trochanter to extract the reamer. The authors noted that this instrument had been used for several total knee arthroplasty surgeries before, so they were concerned about metal fatigue and the optimal life of reamers.[2]

An alternative option to remove incarcerated reamer that we used was by making a dent on exposed part of flexible reamer with jumbo cutter. So we got a firm grip through jumbo cutter and removal was done by back hammering. This avoided weakening of the femur by osteotomy. Various options described in the literature for removal of incarcerated/broken reamer have been summarized in Table 1.

Finally, leaving the incarcerated part is an option when the reamer breaks very distally without interfering with the nail insertion, but this is quite unusual, as the medullary canal is quite wide distally.

Our technique is unique in the sense that no such technique for extraction of a broken jammed flexible reamer has been reported in the literature to the best of our knowledge, and it also avoids drilling or unicortical osteotomy of the femur at the site of incarceration, which may otherwise be necessary. One potential drawback of our technique is that if the surgeon uses too much of force, the jumbo cutter may cut the guide wire as well as the reamer. Excessive force should therefore be avoided.

The technique mentioned here worked in our case, but it is possible that this may not work in a particular case, and then other strategies to decompress the medullary canal at the jammed reamer head site may ultimately be needed.

Conflict of interest

The manuscript has been approved by all authors, and they do not have any conflict of interest to be disclosed.

References

1. Tornetta III P, Tiburzi D. Reamed versus nonreamed anterograde femoral nailing. *J Orthop Trauma*. 2000;14:15–19.
2. Bisbinas I, Ho YM, Learmonth DJ. Reamer breakage in the femoral medulla during total knee arthroplasty: should reamers have a finite life? *J Arthroplasty*. 2004;19(4):501–503.
3. Rijal L, Manandhar H, Nepal P, Ansari MT, Yadhav CS. Instrument fails, but surgeon should not. Surgical techniques for retrieval of broken intramedullary reamer from tibia. *Eur J Orthop Surg Traumatol*. 2010;20(6):505–507.
4. Low TH, Loke YH, Chiu CK. Minimally invasive retrieval of incarcerated flexible intramedullary reamer. *Eur J Orthop Surg Traumatol*. 2012;22(1):113–115.
5. Brumback RJ, Virkus WW. Intramedullary nailing of the femur: reamed versus nonreamed. *J Am Acad Orthop Surg*. 2000;8:83–90.
6. Meena S, Trikha V, Singh V, Mittal S, Kishanpuria TS. Uncoiling of reamer during intramedullary nailing for fracture shaft of femur. *J Nat Sci Biol Med*. 2013;4(2):481–484.
7. Darowish M, Gorczyca JT. Catastrophic intramedullary fragmentation of a tinel reamer. *Journal of Trauma and Acute Care Surgery*. 2009 Aug 1;67(2):E36–E40.
8. Kwak HY, Kim JS, Young KW, Joh JW, Hwang SM. Breakage of reamer during tibia intramedullary nailing-A case report. *Journal of the Korean Fracture Society*. 2013 Oct 1;26(4):333–337.
9. Rijal L, Manandhar H, Nepal P, et al. Instrument fails, but surgeon should not easy approaches for retrieval of broken intramedullary reamer from the tibia. *Internet J Orthop Surg*. 2008;15(1).
10. Abbassi N, Agoumi O, Kharaji A, Daoudi A, Najib A, Yacoubi H. How to manage a breaking reamer? Two case reports and literature review. *Journal of Orthopaedics Trauma Surgery and Related Research*. 2017 Dec 15;12(3).