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Case report

Intramedullary cortical fragment in tibial nailing: push it, remove it or ignore it?

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Abstract
Intramedullary nailing of long bones is a safe procedure, with excellent long-term results. Even in apparently simple fractures, many complications may arise. Incarceration of a cortical fragment in the medullary canal is a fearsome situation, which may lead to severe complications and, consequently, poor outcomes. The surgeon should be aware of this risk and, after careful analysis of the pre-operative imaging, must remove or, at least, disengage the fragment from the medullary canal. (www.actabiomedica.it)

Key words: intramedullary cortical fragment, nailing, incarcerated free fragment

Introduction

Intramedullary nailing is the gold standard for many femoral and tibial fractures involving the shaft, the metaphysis or, in some cases, even fractures with limited intra-articular involvement. Even when treating cases that look simple, many intraoperative and postoperative complications may occur (1). In any fracture pattern, and especially those that are multi-fragmentary, complications due to free cortical fragments, which are incarcerated in the medullary canal, are reported in the literature (1-8). The cortical fragment can be entrapped in the proximal or distal segment, as a consequence of the injury or after guidewire/reamer insertion. This may lead to a variety of consequences: from impassable guidewire, reamers or nail, to intra-articular penetration of the fragment or of the guidewire, from iatrogenic fractures to malreduction of the fracture (if the fragment acts as a blocking screw). For these reasons, when planning to nail a femur or a tibia, high attention should be paid to these free fragments, so as to anticipate the potential operative difficulty that may be encountered during closed nailing of the fracture. We report two cases of tibial nailing for fractures with intramedullary cortical fragments.

Case reports

Case number 1

Z.M., 34-year-old male, was referred to our hospital following a motor vehicle accident. After the primary and secondary surveys, he was hospitalized in our department, diagnosed with an open fracture (G-A grade II) of the right tibia and fibula (fig. 1a). He was operated on the same day of debridement and irrigation of the wound and external fixation of the tibia. The wound was closed primarily. The following day, a CT scan of the leg was performed to better define the fracture pattern. A cortical fragment was found inside the medullary canal (fig. 1b), in the distal fragment; moreover, a fracture line of the posterior malleolus was noted (fig. 1c). After three days, the patient was scheduled for ex-fix removal and intramedullary nailing of the tibia; the intent was to address the posterior malleolus by percutaneous screws fixation after nailing. The patient was placed supine on a radiolucent table, with the knee flexed on a support for nailing via an infrapatellar approach. After preparation of the proximal tibia with an appropriate entry reamer, the guidewire was progressed to the distal segment, bypassing the free cortical fragment. During reaming, the free corti-

Figure 1. case number 1. a: pre-operative X-rays. b: pre-operative CT scan. The free cortical fragment incarcerated in the medullary canal is evident. c: fracture of the posterior malleolus

cal fragment was pushed down towards the epiphysis. The fragment then acted as a wedge through the distal fracture line, with consequent displacement of the posterior malleolus. Attempts to remove the fragment with a small medial incision were made, though unsuccessfully (fig. 2a). Therefore, the surgeon decided to proceed with tibial nailing, locking the nail both proximally and distally. After skin closure, the patient was placed in a prone position, and a posterolateral approach to the ankle was performed. The free fragment was removed and the fracture of the posterior malleolus was reduced and fixed with a posterior antiglide plate (fig. 2b). No complications were observed postoperatively. The patient was allowed to walk with crutches with partial weight-bearing on the right foot. The patient was encouraged to actively move the ankle and knee. Follow-up, with clinical examination and X-rays, took place after one, two and four months. At the last follow-up, the patient had regained full motion of the knee and ankle and the fracture was considered healed (fig. 2c). A one-year follow-up was prescribed but the patient did not show up for the medical appointment.

Case number 2

L. M., 27-year-old male, sustained a trauma to his left tibia while skiing. He was admitted to the emergency department of the local hospital, where he was diagnosed with a closed fracture of the left tibia and fibula. He was then splinted and discharged, with the recommendation to refer to his local hospital. The patient was admitted to our department the day after, and the operation was scheduled for the following

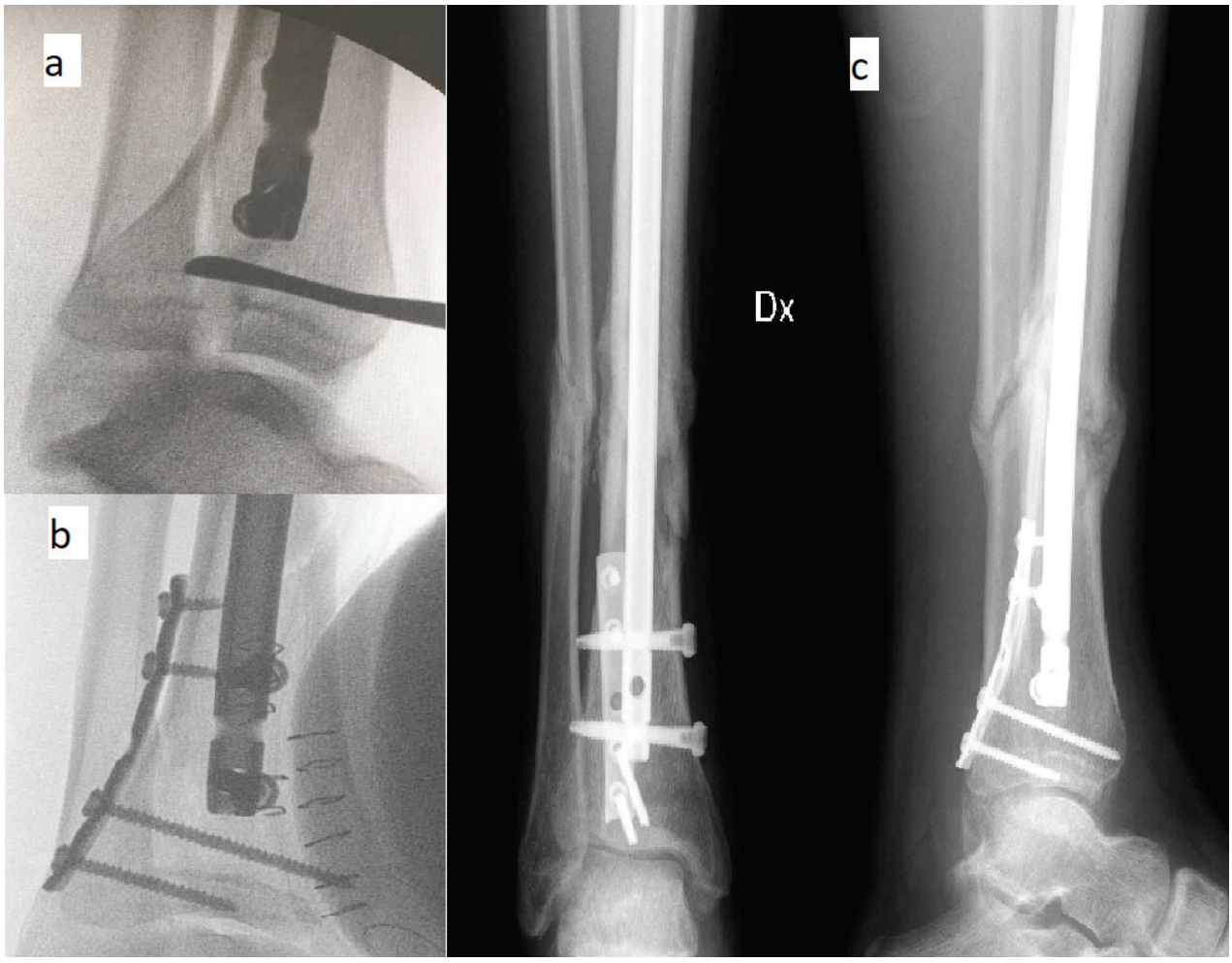

Figure 2. Case number 1. a: percutaneous attempt to remove the free fragment with a freer. b: fixation of the posterior malleolus with plate and screws, after removal of the fragment. c: final X-rays of the healed fracture

day. While planning the operation, an X-ray revealed a free cortical fragment inside the medullary canal (fig. 3a). The patient was positioned on a radiolucent table, with the knee semi-extended, to perform a suprapatellar nailing of the tibia. After reaming of the proximal tibia, the guidewire was easily passed through the fracture (fig. 3b), beside the cortical fragment. A first attempt to remove the free fragment with the hook was made (fig. 3c), though unsuccessfully. It was then decided to proceed with reaming, pushing the fragment distally. During the last reaming, the fragment laid in the centre of the medullary canal, deviating the trajectory of the ream (fig. 3d), and thus the one of the future nail. For this reason, the surgeon decided to remove the fragment. Given the impossibility to grasp the fragment through the medullary canal, the surgeon performed a little incision on the medial side of the leg and removed the fragment with a pituitary rongeur (fig. 3e - 4). The nail was then inserted and locked. The patient was allowed full weight-bearing from the following day. After the routine follow-up examinations, at 6 months the patient had regained full range of movement of the knee and ankle, and the fracture had healed completely (fig. 5).

Discussion and conclusions

Eastman (1) reports, in his institution, the prevalence of an incarcerated fragment to be 2 out of 80

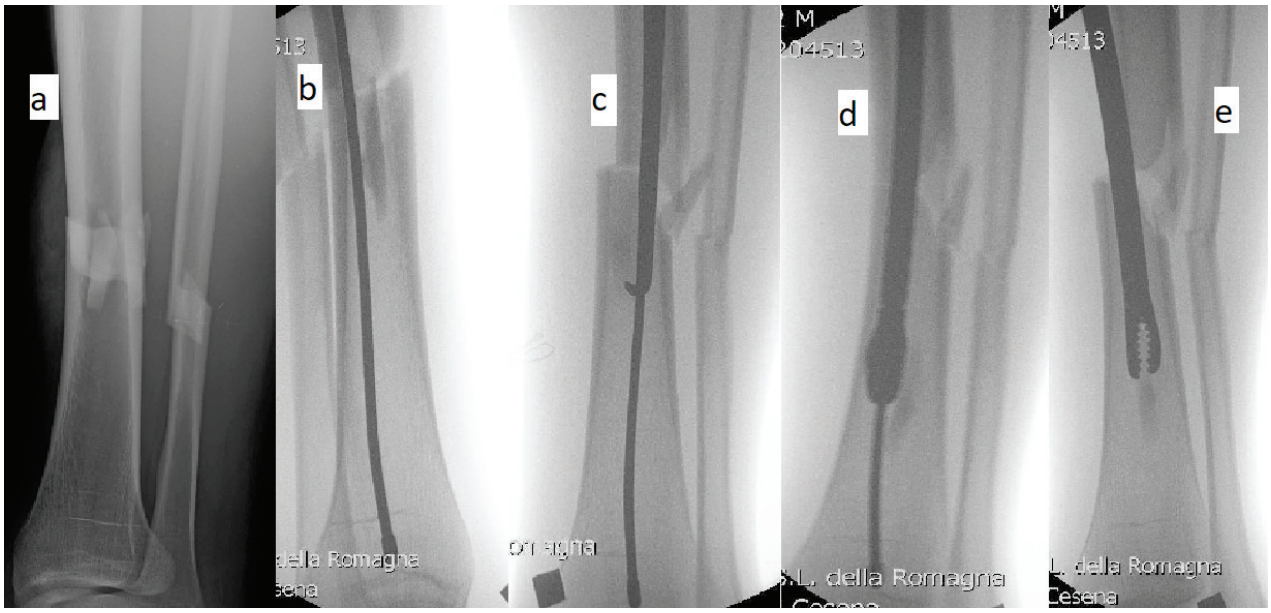

Figure 3. Case number 2. a: pre-operative X-rays, with evidence of a cortical fragment across the fracture. b: progression of the guidewire behind the fragment. c: a hook is used in trying to remove the fragment. d: the reamer pushed the fragment distally, with consequent eccentric reaming. e: the rongeur is grasping the fragment, for extraction

(2.5%) for femur fractures and 1 out of 70 (1.4%) for tibia fractures. These numbers show that the problem of free cortical fragments in the medullary canal is rare but not exceptional. Usually, the first attempts aim to dislodge the fragment with the guidewire or with the reamer to allow a safe and right trajectory of the nail. If this cannot be obtained, many complications, as described in the literature, may arise:

- in tibial nailing, the free fragment may be driven through the plafond into the ankle joint (6);
- the incarceration of a fragment of bone between the guidewire and a tibial nail may prevent smooth sliding of the nail on the guidewire when hammering the nail. This may lead to progression of the guidewire through the ankle and the tarsal bones, until it protrudes under the skin of the foot sole (5);
- similarly, an incarcerated bone fragment at the tip of a femoral nail may lead to jamming of the guidewire, and, consequently, to intraarticular progression of the wire inside the knee (3);

Figure 4. Case number 2. a: clinical picture of the leg, with the small medial incision at the middle third. b: the fragment extracted

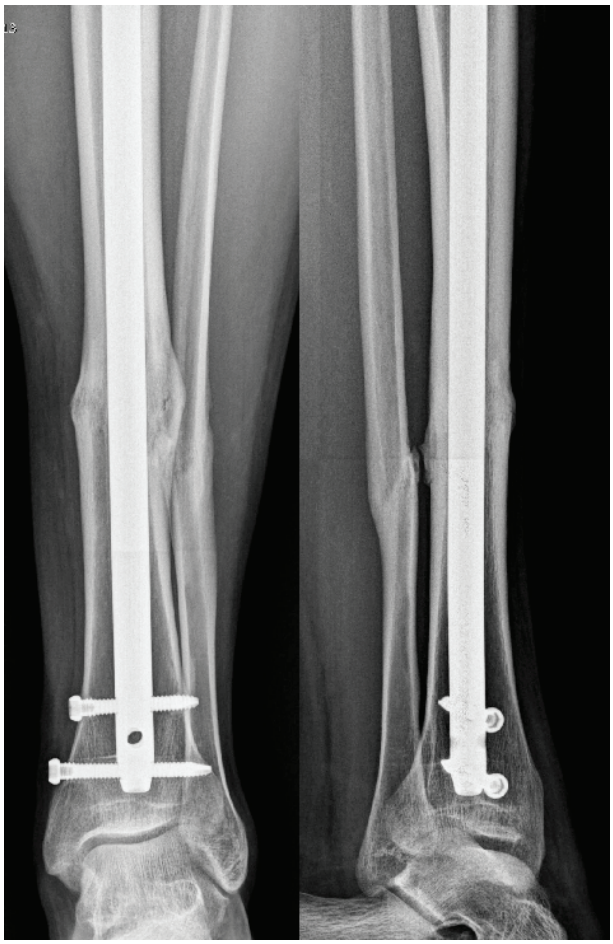

Figure 5. Case number 5. Tibial fracture healed

- in tibia and femur, if the fragment is pushed between the nail and the cortex, eccentric reaming can lead to iatrogenic fracture or, if the nail is inserted in any way, to malreduction of the fracture (2, 7);

Once the surgeon has decided to remove the free fragment, many techniques may be employed to address it:

- a long, narrow, endoscopic grasper can be used through the proximal skin incision, passing inside the medullary canal, to catch the fragment. Only during femoral nailing, if the shape of the fragment does not allow its proximal extraction, it can be released into the soft tissues adjacent to the fracture site (1);
- an extraction hook can be utilized to grasp or mobilize the fragment (4);
- in cases where the aforementioned percutaneous attempts in removing the fragment are in vain or useless, a solution can be, as in our case number 2 and as reported by Salamon (7) in tibia fractures, a formal open removal of the fragment, with a small incision on the medial side of the leg at the level of the fracture.

Even before a "simple" femoral or tibial nailing, a careful visualization of the X-ray (or CT scan, if available) is mandatory during the surgical planning, to detect whether a free fragment is obtruding the medullary canal. The risk of incarcerated fragment is high especially in a comminuted shaft fracture (3).

If the guidewire cannot be passed easily across a reduced fracture, any attempt to force the wire should be avoided. Suspicion of an incarcerated fragment should suggest that the surgeon re-analyse the preoperative X-rays / CT scan or re-check the fracture with several fluoroscopy views (7).

Usually, nailing a shaft fracture is a close procedure, and the key for a successful operation is to keep the soft tissues around the fracture intact. However, in case of need, such as the necessity to remove a free fragment from inside the canal, a small skin incision is mandatory and, with gentle handling of the soft tissues, the infection risk can be minimized.

In conclusion, if a free fragment in the medullary canal is noted during nailing, it must absolutely not be ignored.

Conflicts of interest: Each author declares that he or she has no commercial associations (e.g. consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article.

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