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Clinical vignette

How to remove a bent intramedullary nail inexpensively: a technical trick

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Background: A bent femoral intramedullary nail is a rare complication following secondary trauma to an unhealed femoral fracture site. Existing strategies for removal require the use of specialized instrumentation such as a diamond tipped drill or a high speed burr. Specialized orthopedic instrumentation is often expensive and frequently unobtainable in the developing world.
Objectives: To provide a solution in resource poor settings and describe a unique approach to managing such complex cases.
Methods: Novel, low cost, and successful use of industrial instruments for removing a femoral nail bent in situ in a 43 year old man who would have likely required a much more extensive operation without it.
Results: Instrumentation was obtained from a local market and at a fraction of the cost of specific orthopedic instruments. This case presents a technical tip for managing this complication in the developing world.
Conclusions: In a resource poor setting, we can recommend the judicious use of inexpensive industrial materials and instruments to manage complex cases.

Keywords: Bent, developing, femoral nail, fracture, resource-poor setting

Femoral diaphyseal fractures are a significant global surgical burden [1], and are frequently seen in counties in the developing world, such as Cambodia, where there are high rates of road traffic accidents [2, 4]. Indeed, injuries in the developing world account for a significant proportion of the burden of global disease [5]. Intramedullary nails are widely used as management in both the developed and developing world, and while they have low levels of complications, subsequent problems are not unknown [3]. One rare complication is a bent nail following a secondary trauma before a fracture has healed, resulting in a "fixed deformity", which is a challenge to correct because of the technical difficulty of nail extraction. There are several case reports which outline strategies for removal, including femoral osteotomies and extraction; use of a diamond tipped drill or a high speed burr to section the nail at the fracture site; and straightening of the nail [6-10].

The use of specialized instruments presents a burden to resource-poor settings, such as those seen in Cambodia. As a consequence, the usual strategy has been the previously reported opening of the femoral shaft through longitudinal windows and removal of the nail [6]. The invasive nature of this procedure results in poorer outcomes with significant morbidity because of soft tissue damage [11]. In the present article, we report a case of a bent femoral nail removed using low cost industrial instruments.

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Case description

A 43-year-old Cambodian man was involved in a motor vehicle accident in which he sustained a closed fracture of the right femur. He was treated 1 day later in Vietnam with a steel intramedullary 12 mm × 420 mm Kuntscher nail. Seven weeks after this initial surgery, the patient fell off his motorcycle and presented to our center in Phnom Penh, Cambodia, with severe pain in his deformed right thigh. A radiograph of his right thigh showed a bent intramedullary nail with an angulation of 20°, in an unhealed femur (**Figure 1**).

We elected to try to cut the nail at the fracture site, and extract the 2 segments separately. No specialized instruments were available, so we decided to use tools from our maintenance department. A 30 mm diameter, diamond tipped cutting disk (**Figure 2**), made in China and unbranded, was purchased at a local market for USD 1.50. This disk could be mounted on a regular orthopedic Stryker 2102 drill. A 100 mm

diameter diamond-tipped cutting disk (**Figure 3**), also made in China and unbranded, was purchased at the market for USD2.50. This disk could not be mounted on any of our orthopedic hardware, so was mounted on a Nikatec NC984 angle grinder, commonly used to cut angle-iron. The grinder ordinarily operates at the local voltage of 220V, but to achieve greater control, it was modified to operate at 110 V. Both discs were tested before surgery on an available Kuntscher nail, and shown to be effective in dividing it. Subsequently, the discs, drill and grinder were sterilized in a steam autoclave. The patient was fully informed of the procedure to be conducted and later gave written permission to publish this case report.

The patient was anesthetized and placed in the left lateral position. An incision was made over the patient's right lateral thigh. The soft tissue was separated to expose the fracture site and the nail was evident at the point where it was bent, but was difficult to access. The smaller cutting disc was initially used to cut the exposed part of the nail, but was not wide enough to completely cut through it before being blocked by either the proximal or distal femur at the fracture site. The larger disc was subsequently inserted into the groove cut by the smaller one, and in a few seconds, the nail appeared to be severed. An attempt was then made to remove the proximal fragment in a retrograde fashion through the greater trochanter, but surprisingly, the whole nail was removed in one piece, as it had not been completely severed, but had been weakened enough to be easily bent straight again through the remaining intact bridge (**Figure 4**). The femur was then renailed with a new intramedullary Kuntscher nail, and an autologous iliac crest bone graft was applied at the fracture site. The patient subsequently made an uneventful postoperative recovery.

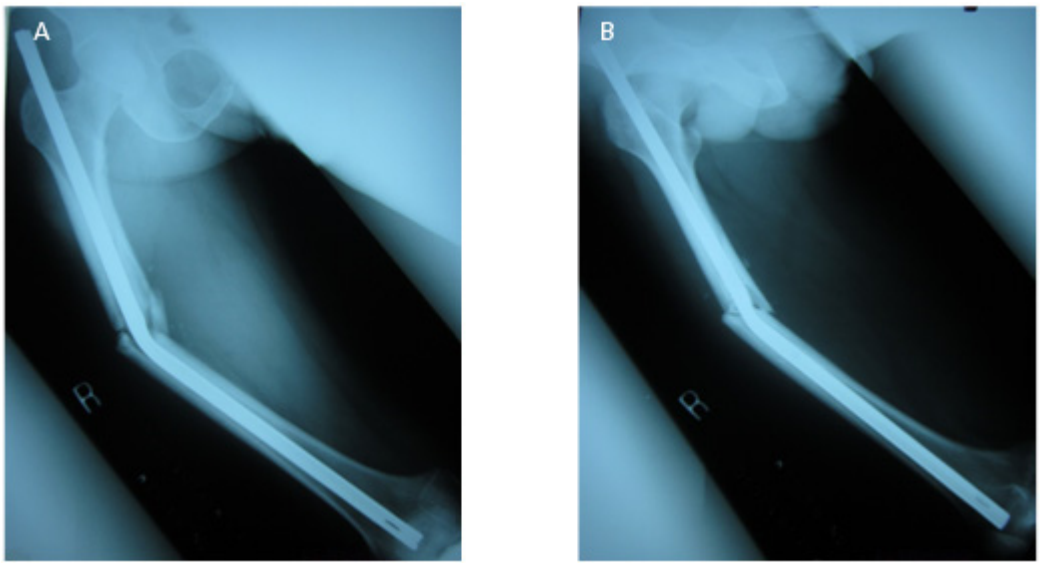

Figure 1. A: Lateral/oblique view of the fracture and bent intramedullary nail in right femur of a 43-year-old Cambodian man. **B:** Anterior–posterior view of the fracture and bent intramedullary nail in his right femur.

Figure 2. A 30 mm diameter diamond tipped cutting disk mounted in a Stryker drill.

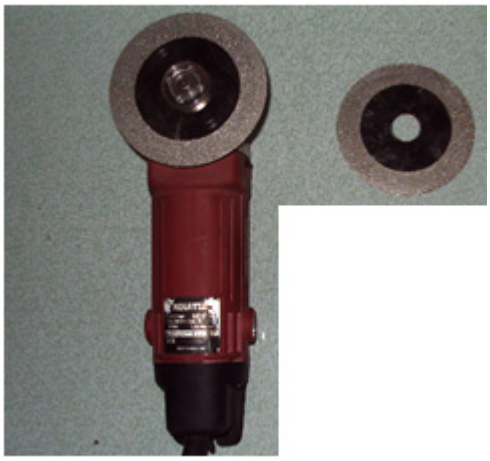

Figure 3. A 100 mm diameter diamond tipped cutting disk mounted on an industrial angle grinder

Figure 4. The bent intramedullary nail cut and removed intact, showing a remaining bridge of metal.

Discussion

Complex and difficult surgical cases present a magnified challenge in resource poor countries. However, they can nevertheless be tackled with a little ingenuity. We outline one such case; the removal of a bent intramedullary femoral nail through the use of low cost industrial equipment, bought in a local market, and used after sterilization.

The use of industrial instrumentation is not without complications and limitations. Potentially excessive soft tissue damage was particularly noted with the 100 mm widened disk, so it was prudent to first cut the nail with the smaller diameter disc and only use the 100 mm disc for the final cut. Cutting through the nail results in some release of metal debris into the surrounding soft tissue, which was minimized in this case by using wet gauze packed around the cutting site, to maximize the capture of debris. This debris also poses a risk to the operator who should use adequate personal protective equipment including eye protection. Finally, irrigation is required to reduce the heating effect of cutting metal.

In summary, in a resource inexpensive setting, we recommend the judicious use of cheap industrial materials and instruments for complex cases, if at all possible.

Conflict of interest statement

The authors declare they have no conflicts of interest and have received no financial support in relation to this paper.

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