Endomedullary Rods in Long Bones: A Danger Aboard

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Endomedullary nailing of long bone fractures has simplified their synthesis and led to shortened healing times, limited blood loss, rapid weight bearing, and small skin incisions. These amazing results were reported in the publication *Time* in 1945 following a medical evaluation conducted at England General Hospital in Atlantic City on a repatriated American soldier operated on with a Küntscher V-shaped femoral rod (Figure A) in Germany.\(^1\)

The nail works similar to a cane, but is located inside the bone.\(^2\) This splint can bend or break at any time, becoming stuck in the endomedullary channel and therefore difficult to remove. German surgeon Gerhard Bruno Küntscher\(^3\) became aware of these drawbacks, observing that “…rupture of an endomedullary rod is explainable as a fatigue crack in the place of less resistance [in Latin aka ‘locus minoris resistentiae’] located about at the fracture site, where the nail is not supported by the bone cylinder…. A nail can rupture not only due to a fatigue rupture but also through a chemical process, namely corrosion crack oscillation…. Rupture or bending of a nail are rare events.”\(^4\)

These uncommon events lead to an urgent situation involving techniques to straighten and remove deformed nails or to remove broken distal nail ends. Moreover, if the rod is in place too long, new bone formation (ie, heterotopic ossification) into the channel may lead to its incarceration, further complicating its removal.\(^5\) An English proverb states that “a stumble may prevent a fall.” Hence, the knowledge of the only mechanical inconvenience of a correct endomedullary nailing granted its permanent employment with development of multiple salvage methodologies over time. The “stumble” is often the secondary trauma leading to bending (Figure B) or breaking of the rod along with the host bone becoming fractured again. Although removal of the failed nail may be difficult, it is essential.

Many procedures have been reported for removal of the failed nail, a few of which I mention here. Patterson and

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Figure: Postoperative anteroposterior radiograph of a V-shaped first version of the Küntscher nail in an outpatient operated on approximately 50 years ago for a femoral fracture (A). Postoperative anteroposterior radiograph of a second version of the Küntscher cloverleaf nail that became bent 40 days after its introduction for the treatment of a femoral fracture (B). Photograph of the straightening technique of Patterson and Ramser\(^6\) illustrated by sawbones. It is performed by means of 2 forces: F\(_1\) is the straightening force performed by an operator and F\(_2\) is the stabilizing force performed by an assistant (C). Photograph of the cerclage wire technique from Marwan and Ibrahim\(^9\) illustrated by sawbones. The 2 ends of the cerclage wire meet each other through a bony window and are tied together, allowing the surgeon to remove the broken distal end of a nail by a proximal manual traction (arrow) (D).
Ramser\(^6\) developed a closed manipulation technique for straightening bent nails (Figure C) to permit their removal. Apivatthakkul and Chiewchantanakit\(^7\) added to this procedure the drilling of the tip of the bent nail angulation site to lessen the force required for the straightening. Nicolaides et al\(^8\) prefer a metal cutting blade through a limited anterolateral femoral approach. Marwan and Ibrahim\(^9\) use a cerclage wire introduced in the nail hollow channel and in the space between nail and bone, both tied together through a bony window at the location of distal locking holes of the distal broken part of the nail (Figure D), permitting its removal by simple proximal traction. Brewster et al\(^10\) suggest not removing the proximal broken nail end because it works to host the extraction hook that is stabilized with some interference guidewires introduced along it, permitting extraction of the entire nail.

Thus, creative approaches have been proposed to remove a bent and broken endomedullary rod. Nailed limbs and the activities of patients with them should be monitored. The rod should be removed as soon as the bone has healed.

**References**