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A Rare Case of Titanium Elastic Nail Removal 7 Years after Pediatric Femoral Shaft Fracture Using a Screw Retriever Technique

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Learning Point of the Article:

Understand the long-term biocompatibility of TENs implants, the challenges of delayed removal due to tissue integration, and the importance of specialized tools and regular follow-up for safe and effective implant management.

Abstract

Introduction: Elastic stable intramedullary nailing is a commonly used modality for the surgical stabilization of long-bone fractures in children, with routine implant removal recommended within 6–12 months. Delayed removal beyond this timeframe is uncommon and presents unique surgical challenges. We report a rare case of titanium elastic nails (TENs) removal performed 7 years after initial fixation, highlighting the technical considerations and successful outcome.

Case Report: A 14-year-old female presented with discomfort in the left thigh. The patient had a history of TENs nails inserted at age 7 for a mid-shaft femoral fracture. The patient was lost to follow-up due to family circumstances. The patient had remained completely asymptomatic throughout the retention period with full functional recovery. Radiograph of the left thigh showed two TENs nails. Due to anticipated extraction difficulty from prolonged retention, a screw retriever technique was successfully employed for safe nail removal without complications.

Conclusion: This case demonstrates the excellent biocompatibility of titanium implants and confirms that delayed TENs removal can be safely accomplished using specialized extraction techniques. The use of a screw retriever provides an effective solution for challenging implant removal scenarios while minimizing surgical morbidity.

Keywords: Titanium elastic nailing, delayed implant removal, pediatric femoral fracture, screw retriever technique.

Introduction

Elastic stable intramedullary nailing (ESIN) is a commonly used modality for the surgical stabilization of long-bone fractures in children. It is widely used for treating unstable fractures of the radius, ulna, femur, and, occasionally, the tibia and the humerus [1].

This technique preserves the periosteum, allowing bone healing within a closed and intact biological environment [2].

Stable elastic intramedullary nailing uses two flexible nails, which are introduced percutaneously either through the lower metaphysis or the subtrochanteric area. The intramedullary nail method has advantages, such as closed application, less soft tissue injury, avoidance of nerve injury, and cosmetic benefits [3]. Titanium elastic nails (TENs) nail do not disturb the healing of the fracture. It is stable and adaptable as an internal splint, allowing for compression and micromotion at the fracture site, the ideal location for callus formation [4]. The indications for surgical stabilization of pediatric diaphyseal femur fractures are expanding, now including cases such as children with multiple

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Author's Photo Gallery

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Figure 1: Pre-operative radiograph of patient reveals two intramedullary Titanium elastic nails.

Figure 2: Intraoperative trolley image demonstrating the instrument used for titanium elastic nails removal (screw retriever marked with a yellow arrow).

system injuries or associated head injuries. Additional indications include pathological fractures or situations where spica cast application is not feasible. A routine implant removal is recommended within 6–12 months. However, clinical scenarios occasionally arise where removal is significantly delayed due to patient factors, lost follow-up, or family circumstances.

Extended retention periods may present technical challenges during extraction due to bone overgrowth, tissue integration, or implant fixation. TENs is a safe and effective method for the treatment of pediatric femoral shaft fractures, because it is minimally invasive, relatively easy to use, and shows very good functional and cosmetic results [5].

Removal of TENs after ESIN is a safe procedure with a low complication rate. It also reduces the hospital stay and helps in the early mobilization of children [6]. We present a unique case of successful TENs removal performed 7 years after initial implantation, utilizing a specialized screw retriever technique to overcome extraction difficulties.

Case Report

A 14-year-old female presented with discomfort in the left thigh. The patient had a history of TENs nails inserted at age 7 for a mid-shaft femoral fracture. The patient was lost to follow-up due to family circumstances. Primary treatment consisted of closed reduction and internal fixation using two 3.5 mm TENs inserted through a retrograde approach through the distal femoral metaphysis.

The initial post-operative course was uneventful with complete fracture healing. Plans for routine implant removal at 1 year were delayed due to family circumstances and subsequent loss to follow-up. Throughout the 7-year retention period, the patient remained completely asymptomatic with full return to activities, including competitive sports. (Fig. 1).

Physical examination

Clinical assessment revealed equal limb lengths with a full range of motion at the hip and knee joints. There was no evidence of skin irritation, implant prominence, or functional limitation. The patient demonstrated normal gait pattern and muscle strength.

Radiological assessment

Pre-operative radiographs demonstrated complete fracture healing with appropriate bone remodeling. Both TENs remained in optimal position without evidence of migration into the medullary canal, loosening, or structural failure. Bone quality appeared normal with no signs of stress shielding or cortical changes around the implants.

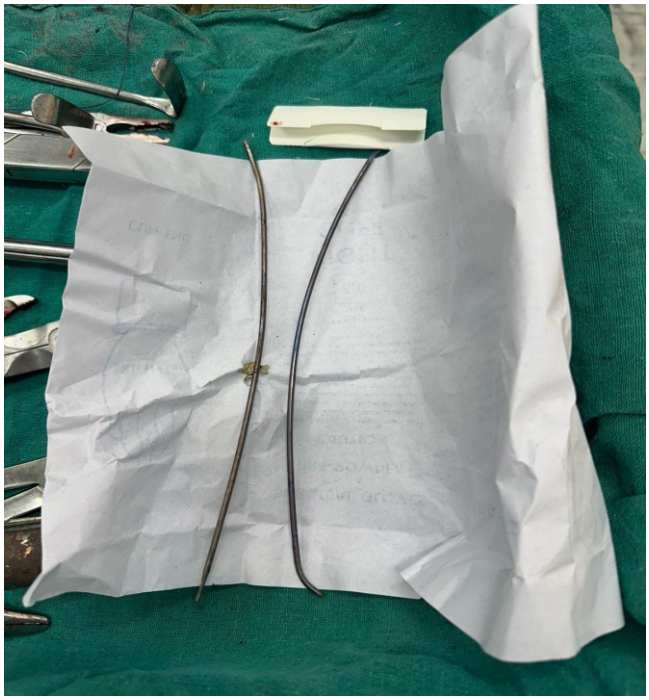

Figure 3: Titanium elastic nails which got removed by the screw retriever technique.

Figure 4: Post-operative radiograph of the after successful removal of the titanium elastic nails.

Surgical technique

Surgery was performed under spinal anesthesia using the original lateral and medial approach. Standard surgical exposure of the nail entry points revealed significant bone overgrowth around the nail ends. Initial attempts at extraction using conventional nail extraction techniques proved challenging due to tight implant integration. A specialized screw retriever (Fig. 2), a threaded instrument typically used for the removal of broken or damaged screws – was employed over the distal ends of the TENs nails. After achieving adequate compression with the ratchet lock, controlled axial traction with gentle rotation successfully removed both nails without cortical damage or the need for extensive bone removal (Fig. 3). Intraoperatively, notable bone overgrowth and tight nail integration were observed, which can contribute to local irritation of the surrounding soft tissues and periosteum – factors known to cause thigh pain following implant removal. However, microdamage or stress reactions in cortical bone near the implant, which might not be apparent during surgery, but contribute to pain. While using this technique, we did not encounter any complications. Post-operative radiograph of the left thigh shows successful removal of TENs nails (Fig. 4).

Post-operative course

The patient experienced an uncomplicated recovery with immediate post-operative mobilization. Pain was minimal and well-controlled with standard analgesics. Wound healing was satisfactory, and the patient returned to full activities within 2 weeks. Follow-up at 2 months demonstrated no complications with maintained limb function.

Discussion

This case represents one of the longest documented TENs retention periods in the pediatric literature, providing valuable insights into delayed implant removal challenges and solutions. The 7-year retention period without adverse effects supports the excellent biocompatibility profile of titanium implants in pediatric applications. Limited data exist about complications of TENs for femur fracture management in pediatric patients [7].

Extraction of the TENs nail can present certain difficulties and may result in a complex surgical procedure. Multiple factors may contribute to challenges during the removal of an elastic stable intramedullary nail. These include a short nail tip, the nail tip positioned very close to the bone surface. There are reports describing complications of ESIN removal in a healed fracture in the form of unsuccessful nail removal [8].

Various techniques for removing the elastic intramedullary nail have been outlined in the literature. These methods involve using a bone chisel around the tip of the nail [9]. Lascombes has described the use of the chisel followed by pliers [9] and the use

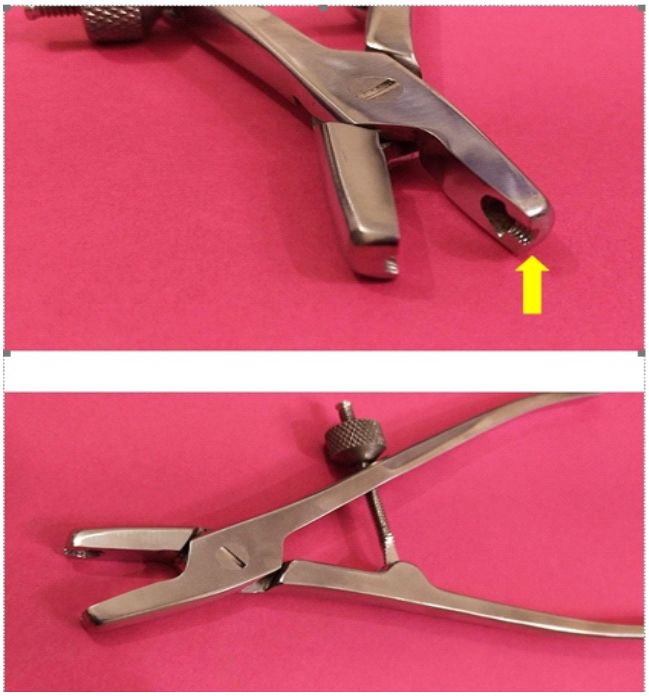

Figure 5: Photos below showing the serrated Jaws (yellow arrow).

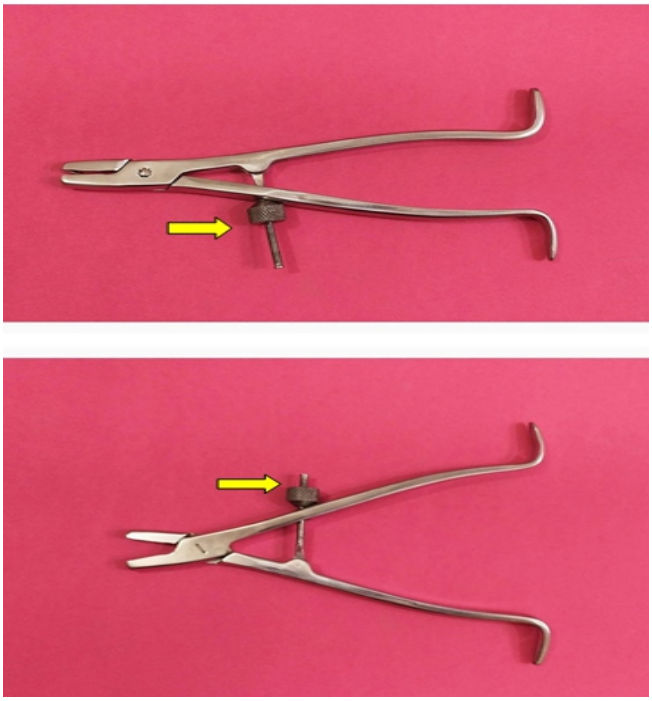

Figure 6: Photo below showing the screw retriever and yellow arrow pointing the ratchet lock/self centered mechanism.

of a hollow reamer [10].

Biocompatibility and long-term tolerance

The absence of complications throughout the extended retention period confirms the superior tissue tolerance of TENs. No evidence of local inflammatory reaction, implant degradation, or systemic effects was observed, supporting existing literature on titanium biocompatibility. TENs are a safe and effective choice for operative fixation of length-unstable femoral shaft fractures in children [11].

Technical challenges of delayed removal

Prolonged implant retention often results in bone overgrowth and tissue integration around implant surfaces, significantly increasing extraction difficulty. Standard nail extraction techniques may prove inadequate in such scenarios, necessitating alternative approaches. The use of a screw retriever provided an effective solution by establishing a secure mechanical purchase, enabling controlled extraction without excessive force or bone destruction.

Screw retriever technique

This specialized instrument (Fig. 2), traditionally employed for broken screw extraction, proved highly effective for challenging TENs nail removal. The threaded design of the jaws allows for reliable engagement with the TENs nail implant (Fig. 5), while the ratchet lock/self-centered mechanism structure facilitates controlled traction (Fig. 6). This technique minimizes surgical trauma and reduces operative time compared to alternative methods requiring extensive bone removal. Removal of TENs after ESIN is a safe procedure with a low complication rate [12].

Clinical implications

While routine early removal remains the standard of care, this case provides reassurance that delayed removal can be safely accomplished when proper surgical planning and specialized instrumentation are employed. The successful outcome should not discourage timely implant removal but rather inform surgical decision-making in cases where delayed removal becomes necessary. TENs is an effective, easy, fast treatment method and has minimal complications for the treatment of femoral shaft fractures in childhood. Most complications can be reduced by performing basic principles and technical directions [13].

Literature comparison

Most published series report TENs removal within 24 months, with limited data on procedures performed beyond this timeframe. This case contributes to the sparse literature on extended retention periods and demonstrates that delayed removal does not preclude successful outcomes when appropriate techniques are utilized.

Limitations of the study

This report describes a single case, which limits the generalizability of the findings to other patients or clinical scenarios. The absence of a control group restricts the ability to evaluate the relative efficacy of the screw retriever method. The unique nature of a 7-year delayed removal also limits extrapolation to standard cases where TENs nails are removed within the recommended 6–12 months. Larger case series or comparative studies would be valuable to further validate the technique and its applicability.

Conclusion

Delayed TENs removal after 7 years is technically feasible and can be safely accomplished using specialized extraction techniques, such as screw retrievers. This case demonstrates the excellent long-term biocompatibility of TENs while highlighting the importance of surgical preparedness for challenging implant removal scenarios. This method is simple to perform, cost-effective due to the reusability of the screw retriever, and does not require any additional equipment. The procedure is not time-consuming and has been shown to be easily adopted by surgeons across different levels of experience.

Clinical Message

In cases of delayed removal of titanium elastic nails (TENS) in pediatric femoral fractures, surgeons should expect difficulties due to bone overgrowth and tissue integration around the implant. Using specialized tools like screw retrievers allows for safe and minimally invasive extraction of well-integrated nails without extensive bone removal, minimizing surgical trauma and complications. This method is easy to use, is inexpensive as the screw retriever is reusable after proper sterilisation , and does not require new or additional equipment. The described technique is simple, cost-effective, and can be performed by any surgeon in any setting.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given the consent for his/ her images and other clinical information to be reported in the journal. The patient understands that his/ her names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

Conflict of interest: Nil **Source of support:** None

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