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Sciatic Nerve Entrapment from Cerclage Wiring in Intramedullary Nail Fixation

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Abstract

Cerclage wiring may be used to optimize the stability of intramedullary nail or plate fixations in comminuted proximal femoral fractures, periprosthetic fractures, and other selected cases. In this article, we presented a novel case of iatrogenic sciatic nerve entrapment from cerclage wiring used to supplement intramedullary nail fixation. We also illustrate and highlight the role of ultrasound in assessing the sciatic nerve to make a timely diagnosis.

Keywords
- sciatic nerve
- entrapment
- cerclage wiring
- femoral neck fracture
- intramedullary nail

Introduction

Cerclage wiring is often utilized to optimize the stability of intramedullary nail or plate fixations in comminuted proximal femoral fractures, periprosthetic fractures, and other selected cases. Its use requires special attention to neighboring soft tissues, in particular neurovascular structures, which may be inadvertently damaged during insertion. Although several authors have documented iatrogenic vascular injuries, specifically the deep and superficial femoral arteries, following cerclage wiring of the femur,[1–5] the occurrence of sciatic nerve entrapment is considered rare with only two reported cases.[6,7] Rapid identification and emergent explorative surgery are essential to reduce the long-term sequela of nerve injury. We present a novel case of cerclage wire entrapment of the sciatic nerve in a patient with intramedullary nail fixation and, for the first time, illustrate and highlight the role of ultrasound (US) in making a timely diagnosis.

Case Report

A 72-year-old male presented to our institution with an inability to bear weight following a fall. Initial radiographs demonstrated a displaced and comminuted intertrochanteric fracture of the left hip with no associated neurovascular compromise. The patient was treated surgically by intramedullary nail fixation with supplementary cerclage wiring due to the complex fracture pattern. After the resolution of the regional anesthesia the same day, the patient was found to have a new left-sided (ipsilateral) foot drop. On examination, the patient had a deficiency of dorsiflexion and eversion at the ankle with a Muscle Power Scale score of 0/5 in the anterior (extensor) compartment and a score of 1/5 in the lateral compartment of the lower leg. The power was normal within muscle groups pertaining to ankle plantarflexion, and knee and hip movement. The patient also demonstrated hypoesthesia over the anterolateral aspect of the lower leg

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and dorsum of the foot. Although ecchymoses were present, there was no palpable hematoma or visible deformity of the joint. A postoperative radiograph was initially performed which revealed a congruent hip joint and satisfactory placement of the intramedullary nail with no evidence of periprosthetic fracture (►**Fig. 1**). Given the mixed motor and sensory deficit, and recent localized surgery, an iatrogenic injury of the proximal sciatic nerve was suspected and further evaluated with a US the following day.

US demonstrated a congruent sciatic nerve but revealed a focal caliber change adjacent to the caudal loop of the cerclage wire, at the level of the proximal femoral shaft. The cerclage wire encompassed the sciatic nerve resulting in an “hourglass” deformity with a focal hypoechoic appearance of the entrapped part consistent with intraneural edema (►**Figs. 2A, B** and **3B**). Proximally and distally, the remaining sciatic, tibial, and common peroneal nerves were intact and of normal echogenicity (►**Figs. 2C** and **3A**). US did not demonstrate any hematoma or musculotendinous injuries surrounding the operative site. A diagnosis of sciatic nerve entrapment was made and urgently communicated to the orthopaedic team. The patient underwent emergency explorative surgery which

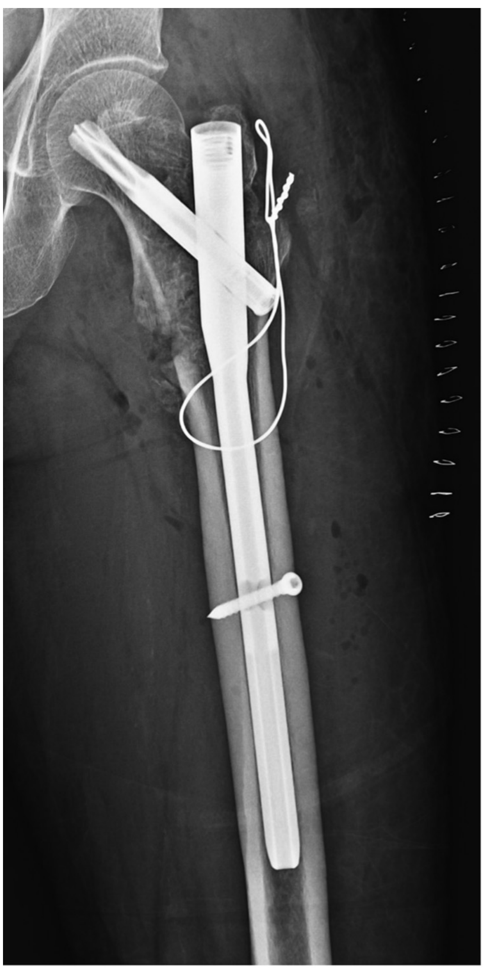

Fig. 1 Postoperative anteroposterior (AP) radiograph of the left hip and femur showing intramedullary nail fixation with cerclage wire. No intraoperative fracture or adverse features of the metalwork. Subcutaneous locules of gas and overlying cutaneous staples are from the recent intervention.

confirmed the suspected diagnosis of sciatic nerve entrapment but the nerve remained intact. The cerclage wires were subsequently removed to release the nerve. In addition, neurolysis was performed to facilitate the healing of nerve edema and symptomology. The patient was managed with physiotherapy and is being clinically followed up.

Discussion

Image quality following metalwork insertion may be hindered by susceptibility artifact in magnetic resonance imaging and streak artifact in computed tomography. US is a superior modality to assess the surrounding soft tissues, including posttraumatic neuropathies, as it is not limited by these effects.[8–11] US is also a widely available, cheap, and rapid modality to acquire diagnostic information. However, the diagnostic utility of US is limited by the operator who requires a detailed knowledge of anatomic structures which may not conform to the appearance of orthogonal planes acquired during cross-sectional imaging.[12,13] In addition, normal fascial interfaces and tissue echogenicity may be altered by the effects of edema, hemorrhage, or surgical metalwork. An awareness of expected postoperative appearances as well as sufficient clinical history are essential to clinch the diagnosis.[11]

US of the sciatic nerve is performed with the patient in a prone position. A linear superficial (6–15 MHz) probe is normally used but a lower frequency curvilinear (1–6 MHz) probe may be employed in patients with a large body habitus.[14] The US probe is initially placed in the short axis plane over the gluteal crease which serves as a landmark for the ischial tuberosity (►**Fig. 3A**). In this view, the sciatic nerve is identified as a hyperechoic fibrillated oval structure located centrally between the origin of the hamstrings' tendons at the ischial tuberosity medially, gluteus maximus muscle superficially, and quadratus femoris muscle deeply.[15] Scrolling inferiorly, the sciatic nerve can be tracked into the thigh lying deep to the biceps femoris–semitendinosus conjoint tendon. The sciatic nerve is invested by a compact perineural sheath, unlike other nerves which are composed of epineurium, perineurium, and endoneurium,[16,17] which itself encloses both the tibial and common peroneal nerve bundles. This explains why injuries of the sciatic nerve may preferentially affect one component (i.e., the tibial or peroneal bundle). In the distal thigh, the sciatic nerve divides into the tibial nerve and common peroneal nerve.

Subtrochanteric and intertrochanteric fractures of the proximal femur are typically treated by osteosynthesis using intramedullary nailing or dynamic hip screw fixation, respectively.[18] Although the risk of avascular necrosis from vascular compromise is low, the natural traction from the multiple tendinous attachment sites in this region may lead to nonunion where multiple fracture fragments are present. Cerclage wires are used to optimize fixation of these fragments and reduce the risk of secondary bone necrosis.[19–21] Cerclage wires may also be used in conjunction with a plate to serve a similar role in stabilizing periprosthetic fractures.[22] A comprehensive knowledge of the close anatomic

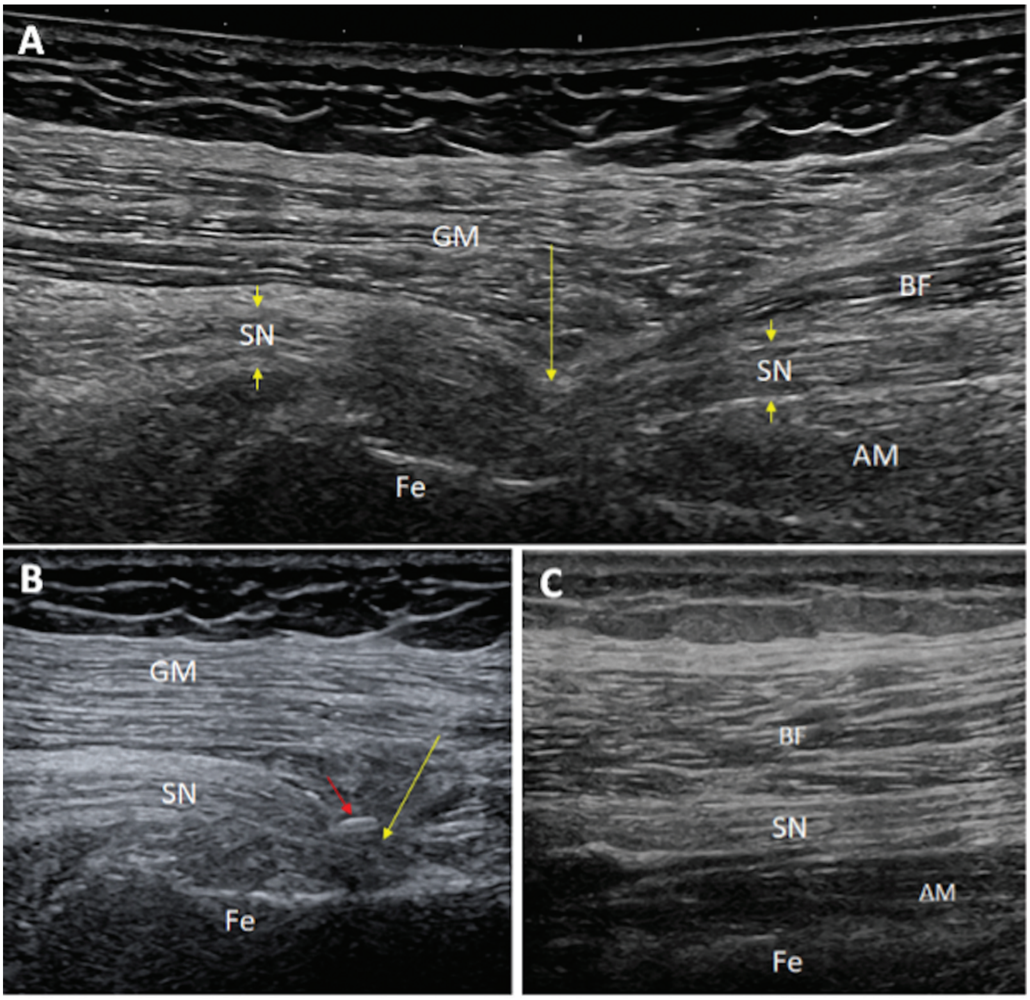

Fig. 2 Longitudinal postoperative ultrasound images of the left sciatic nerve entrapment by cerclage wire. (**A**) Sciatic nerve (SN, small yellow arrows) at the level of the proximal femoral shaft demonstrates a focal depression (long yellow arrow) within the nerve and associated hypoechoic appearance of the compressed component, giving an "hourglass" appearance. (**B**) Further assessment of this area reveals a hyperechoic linear structure (red arrow), consistent with cerclage wire, causing entrapment of the nerve (yellow arrow). (**C**) Sciatic nerve in the midthigh appears normal in echotexture and caliber. AM, adductor magnus muscle; BF, biceps femoris muscle; Fe, femur; GM, gluteus maximus muscle.

relationship of neurovascular and other soft tissue structures is required to ensure these structures are free prior to twisting or tightening of the wire. The distal aspect of the wound requires special attention given this is where the neurovascular structures are closest to the femur, as was demonstrated in our case.[1]

There are several reports of entrapment of the deep and superficial femoral arteries following cerclage wire usage,[1–5] but entrapment of the sciatic nerve is rare.[6,7] Neuropraxia of the sciatic nerve may occur following iatrogenic injury following hip and acetabular surgeries and typically recovers spontaneously.[23] The ideal management of sciatic nerve injury following entrapment by cerclage wiring is not established, given the paucity of case reports. Treatment options and outcomes following nerve injuries vary considerably depending on multiple factors including severity of nerve damage, time to repair, graft size, and other patient factors. Management of sciatic nerve injuries includes neurolysis, nerve grafting, repair by suturing, and conservative management. Several authors have reported varying efficacy of each method; generally, (a) an intact nerve is treated by neurolysis, (b) a transacted nerve requires suture fixation, and (c) graft repair is reserved for transacted nerves with large gaps. Recovery of function is reported to be higher in tibial compared to peroneal bundle involvement[24] and in patients with a shorter time interval from diagnosis to intervention.[25–27] This may be explained by more neuronal degeneration which ensues in delayed repair.[27,28] In our case, given that the nerve was completely intact intraoperatively, neurolysis was performed following cerclage wire removal. As with the previously documented case by Nakamura and colleagues,[6] where the patient demonstrated similar symptoms and an intact nerve was observed intraoperatively, our patient did not show any resolution of power following the release of mechanical compression, suggesting a high-grade nerve injury had occurred. Further studies are required to determine if alternative surgical methods are superior to neurolysis in the recovery of nerve function following entrapment.

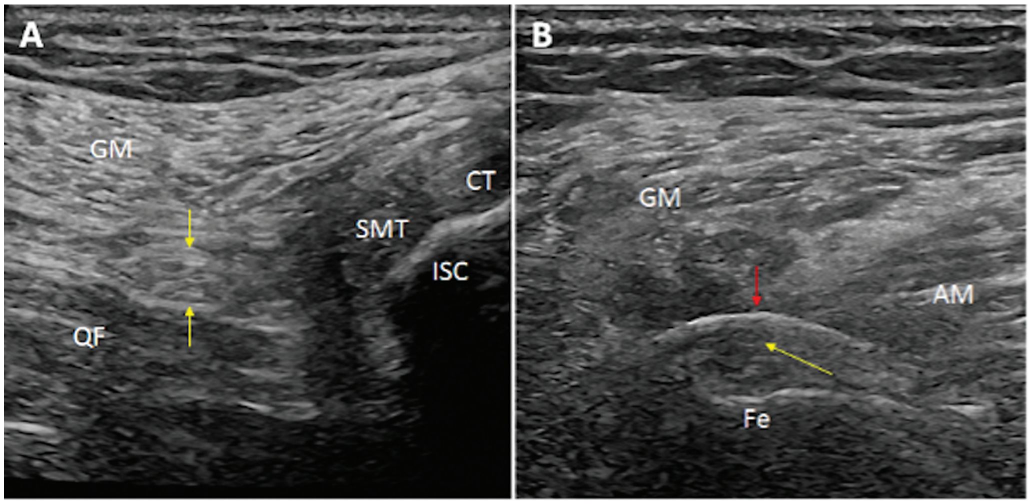

Fig. 3 Transverse postoperative images of the left sciatic nerve entrapment by cerclage wire. (**A**) Proximal image at the level of the ischial tuberosity (ISC) shows normal caliber and fibrillar echotexture of the sciatic nerve (yellow arrows). (**B**) Inferior images at the level of the proximal femoral shaft, correlating to long yellow arrows in Fig. 2A, B, demonstrate a linear hyperechoic structure (red arrow) consistent with a cerclage wire. Deep to this, the sciatic nerve appears reduced in anteroposterior caliber and hypoechoic (yellow arrow). AM, adductor magnus muscle; CT, conjoint tendon of the semitendinosus and biceps femoris; Fe, femur; GM, gluteus maximus muscle; ISC, ischium; SMT, semimembranosus tendon.

Conclusion

Sciatic nerve entrapment caused by cerclage wiring in surgical fixation of proximal femoral fractures is rare but has significant implications on the patient's motor function which may not recover to preoperative levels. The wide availability, increased use, and lack of metal imaging artifacts in US make it well-suited to assess postoperative complications following pelvic surgery but a comprehensive knowledge of anatomy and postoperative soft tissue appearances is essential. US allows a prompt diagnosis of nerve injury and facilitates emergent surgical exploration.

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Conflict of Interest
None declared.

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