Surgical Technique

Simple Technique for Removing a Locking Recon Plate With Damaged Screw Heads

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Abstract

Background The introduction of locking plates in the treatment of periarticular fractures was a major breakthrough in orthopaedic evolution. Removal of these implants is extremely difficult as a result of cold welding and stripping of screw heads.

Description of Technique A 31-year-old man had a schwannoma of the left C5-C6 nerve roots and upper trunk of the brachial plexus. One year before presentation he had undergone excision of the lesion through an approach using a clavicular osteotomy. The osteotomy had been fixed with a titanium locking recon plate. While surgically removing the implant, only one screw could be removed. The remaining five screws could not be turned owing to cold welding; repeated attempts at removing the screws damaged the screw heads. A large bolt cutter was used to cut

the plate between the holes, and the resulting rectangular sections with the screws then were unscrewed from the bone.

Review of Literature Limited literature is available regarding techniques for locking screw removal. These include using a carbide drill bit or diamond-tipped burr, high-speed disc, or conical extraction screw.

Conclusions Not all centers have specialized instruments such as carbide drill bits to remove screw heads, but a large bolt cutter usually is available when screws cannot be unscrewed owing to cold welding. The technique of cutting is easily reproducible and does not require additional soft tissue stripping.

Introduction

The introduction of locking plates for treatment of periarticular fractures was a major breakthrough in fracture fixation. Although initially described for bridging plate fixation for multifragmentary shaft fractures [13], the indications have expanded from treating articular fractures [9] to osteoporotic bone fixation [9]. As these more rigid fixation systems are being used, we are seeing the complications of more rigid fixation such as nonunion [3, 4].

Removal of these implants for whatever reason may be difficult as a result of cold welding and stripping of screw heads [1, 5, 12]. Only limited literature is available regarding techniques of locking screw removal [6]. These include using a carbide drill bit or diamond-tipped burr [5, 8], high-speed disc [9], or conical extraction screw [5, 8]. Most of these techniques use sophisticated instruments that may not be immediately available to all surgeons. We encountered a case in which all but one screw could not be removed and describe a novel approach

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to removing these screws. We also conducted a search of the current literature for locked plate removal techniques.

Description of Technique

We approached the plate through the previous scar. After exposing the implant, only one of six screws could be readily removed (Fig. 1). Repeated attempts to remove the other screws damaged the screw heads. The tip of one screwdriver broke and was stuck in the screw head. The conical bolt extraction system also failed to remove the screws. It became obvious the screws could not be separated from the plate. Because the plate was of low profile, we cut the plate between the screws. A large bolt cutter, frequently used for cutting rods in spine instrumentation, was used for this purpose (Fig. 2). The plate was cut at narrow portions and between the holes. In doing this, each screw and portion of the plate acted as a unit (Fig. 3). The unit (plate and stuck screw) was unthreaded and removed (Fig. 4). The wound was closed in layers, and the patient's postoperative period was uneventful.

Case Report

The patient was a 31-year-old man who had a schwannoma of the left C5–C6 nerve roots and upper trunk of the brachial plexus. One year before presentation he had undergone excision of the lesion through an approach using a clavicular osteotomy. The osteotomy was fixed with a titanium locking recon plate although the indication for the locking plate was not mentioned. He recovered from surgery, but 8 months postoperatively he had a sudden increase in pain, for which he was treated with pain medicine by a local doctor. Radiographs revealed a broken

Fig. 2 The plate was cut between the screws.

Fig. 3 The cut portion of the plate and locking screw acts as a unit.

Fig. 1 An intraoperative picture shows the broken recon plate.

Fig. 4 The implant after removal is shown.

implant with nonunion of the clavicular osteotomy site (Fig. 5). Because there was skin tenting from prominent hardware, removal of the implant was indicated.

After removing the implant the wound was thoroughly washed and closed. The sutures were removed 2 weeks after surgery. Because the patient was asymptomatic during

followup, further surgery to fix the clavicular osteotomy site was deferred.

Discussion

Locking plates pose challenges when removal is attempted but there are complications. The various indications for removal are implant-related pain, infections, broken implant, and nonunion [2, 6, 8]. According to the literature [6], the rate of removal of less invasive stabilization system plates ranges between 8% and 26% [6, 10]. Implant removal should not be done as a routine procedure. At times, it may be more time-consuming than the index procedure [9] and may not be successful. Raja et al. [12] stated that complications during plate removal occurred in 47% of their patients.

Apart from the typical reasons for difficulty in implant removal such as stripping of the recess of the screw heads and crossthreading between threads in the screw head and the screw hole [1, 4–6, 12], an additional reason for difficulty in removing a less-invasive stabilization system plate is cold welding of the screws. Few techniques for removal of less-invasive

Fig. 5 A preoperative radiograph shows the broken recon plate with nonunion of the clavicle.

Table 1. Techniques for removal of jammed screws

Study	Technique	Remarks
Pattison et al. [10], Bhutta et al. [2]	Small swab or foil wrapped around the tip of the screwdriver that creates interference fit between the screwdriver and the screw head, creating more torque for removal	Not successful each time; not very useful in locking plates
Georgiadis et al. [6]	Cutting of the LISS and plate to remove the screws	Needs sophisticated instruments; risk of thermal necrosis present; metallic debris may be generated
Phisitkul et al. [11]	Screws levered off the bone with the plate	May be of help in osteoporotic bones; not useful when multiple screws are stuck; not possible when screws are inserted in compression mode; may result in iatrogenic fracture
Hak and McElvany [7], Georgiadis et al. [6]	Drilling out the screw head using carbide drill bits or diamond-tipped burr	Disadvantages of thermal necrosis and metallic debris present; shanks of screws needs to be removed with a hollow mill afterward
Hamilton et al. [8]	Screw shaft sometimes can be cut with a large bolt cutter if there is adequate space between the plate and bone	Not possible when screws are inserted in compression mode
Hak and McElvany [7], Georgiadis et al. [6], Hamilton et al. [8]	Using conical extraction bolt	Not successful in cases of cold welding and crossthreading; breakage of conical bolts reported frequently
Kumar and Dunlop [9]	Radial cuts made in plate to release screw heads using high-speed disc that creates interference fit between the screwdriver and the screw head, creating more torque for removal	Needs sophisticated instruments; thermal necrosis; metallic debris generation may be harmful

LISS = less-invasive stabilization system.

Table 2. Causes for difficulty with screw removal

Technical difficulties	Reason
Stripping of recess on screw head	Incorrectly aligned screwdriver; resistance to extraction
Resistance to extraction	Cold welding; crossthreading of screw head in the screw hole; failure to use torque-limiting screwdriver, resulting in overtightening; cortical bone growth at the flute present in the tip of locking screw
Crossthreading	Failure to use external targeting guides; off-axis screw insertion in minimally invasive osteosynthesis

stabilization systems have been described [6, 8, 9, 12] (Table 1), but the described techniques may cause thermal necrosis [8, 9]. The key advantage of these is minimal destruction [8, 9], but they have the disadvantages of cost and availability of the instrumentation and thermal necrosis (Table 1). The difficulty in removal of less-invasive stabilization system plates was discussed by Hamilton et al. [8] and Cole et al. [3]. Cold welding, a complication described with titanium implants [5], is unique for a less-invasive stabilization system. It occurs at the time of screw insertion and may result from overtightening or crossthreading. The screw head adheres firmly to the plate, thereby making extraction impossible. The use of external targeting devices, like sleeves, during bone drilling is important in preventing crossthreading. Being a relatively soft metal in comparison to stainless steel, titanium deforms easily. The screwdriver tip should be aligned properly in the recess of the screw head before removal is attempted; otherwise, the recess in the screw head is more likely to be deformed, leading to stripping. Another common mistake is failure to use the manufacturer-prescribed, torque-limiting screwdriver. These devices reduce the risk of overtightening and stripping of threads [5, 6, 12]. Another questionable reason is that cortical bone ingrowth at the screw end flutes, thereby making removal difficult [4]. We tabulated the described reasons that cause difficulty with screw removal (Table 2).

The conical extraction device can be used initially to remove the deformed screws [6–8]. However, when cold welding occurs, a conical extraction bolt may not be of help. The other techniques described use carbide drill bits or diamond-tipped burrs to remove screw heads. The remaining screw shanks must be removed with a hollow mill [6, 7]. These techniques also involve generating heat and metal debris. Other techniques use a high-speed disc to cut the plate [6, 9]. This also involves the previously mentioned disadvantages. In addition, high-speed discs are not always available. Cutting the bolts beneath the plate is difficult if conventional screws are applied. Levering out the plate may be of help in

osteoporotic bones with one or two screws [11], however there always is the risk of iatrogenic fracture.

The technique we described is simple, uses a large bolt cutter, which is readily available, and does not have the disadvantages of high-speed instruments such as thermal necrosis and metallic debris generation. It does not add to the cost of the procedure. Although described for a reconstruction plate, we believe it also can be extended to titanium forearm locking plates. In vitro, we were able to cut a titanium narrow locking plate, but we do not have clinical examples.

The technique described here will be useful for reconstruction locking plates, low-profile forearm locking plates, and one-third tubular plates. The instrument we used was a large bolt cutter, which is inexpensive, unsophisticated, and manually operable. The technique is easy and does not require additional soft tissue stripping.

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