New Technique for Removal of Screws With Damaged Heads

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abstract

Removal of orthopedic implants may sometimes be difficult because of ongrowth of new bone. Titanium screws can become encased or stripped during the process of initial open reduction and internal fixation or at the time of hardware removal. Difficulty in removing screws from a locking plate is particularly well-known. Two patients with tibial and femoral diaphyseal fractures were treated using a locking plate or an intramedullary nail. However, after fracture healing, it was difficult to remove the locking screw or reconstruction screws because of damage to the heads. The stripped reconstruction screw was successfully removed employing the authors’ so-called parallel planes technique. In this method, a high-speed diamond-tipped burr is applied to opposite sides of the screw head to form 2 parallel faces located slightly away from the recess of the screw head. The 2 faces can then be grasped solidly with locking pliers, allowing removal of the implant by unscrewing it with a gentle upward pulling action. The locking plate was cut from the plate edge to the edge of the screw hole. While making these radial cuts in the plates, the authors were careful not to extend the blade into the screw head. After removal of the locking plate from the screw, the authors were able to extract the jammed screw uneventfully using this technique. This technique can be performed without difficulty and does not require a special device. It is a useful option for extraction of damaged screws. [Orthopedics. 2017; 40(5):e911-e914.]

Removal of an orthopedic implant may become necessary at the patient’s request, or if implant-related pain, nonunion, hardware failure, or infection occurs. Unlike stainless steel screws, titanium screws can become encased or stripped during the process of initial open reduction and internal fixation or at the time of hardware removal because of their higher degree of biocompatibility and subsequent osteointegration. Furthermore, the use of titanium locking plates has brought new problems related to cold welding of the screw heads into the locking screw holes. Removal of screws from locking plates can be extremely difficult because of stripping of the screw heads. During surgical removal of an implant, a good-quality hexagonal screwdriver must be selected, and no attempt at forcible removal should be made if osteointegration has occurred. Repeated attempts at removal will damage the hexagonal recess of the screw. Previously described techniques for removal of these screws have required larger incisions or more invasive methods. The use of pliers is often attempted, but it is generally impossible to remove such screws by grasping their rounded heads with pliers. The authors present a simple technique for extracting such screws that is applicable to screws.
of all types and sizes. The authors also review the literature related to techniques for removal of damaged hexagonal recess screws.

CASE REPORTS

Patient 1

A 22-year-old woman was treated with an intramedullary nail (Antegrade Femoral Nail; Synthes GmbH, Solothurn, Switzerland) after suffering a left femoral diaphyseal fracture. The nail was originally inserted using the manufacturer’s recommended technique, and the fracture healed without complications. Radiographs revealed a healed bone and good union (Figure 1). The intramedullary nail was removed 3 years after insertion at the patient’s request.

A full open surgical approach was used. However, removal of the reconstruction screw using a screwdriver was extremely difficult because of solid screw fixation. This resulted in damage to the hexagonal recess of the screw.

The stripped screw was successfully removed employing the authors’ so-called parallel planes technique, which is a safe and promising option for this purpose. In this method, a high-speed diamond-tipped burr is applied to opposite sides of the screw head to form 2 parallel faces located slightly away from the recess of the screw head (Figures 2A-B). The 2 faces can then be grasped solidly with locking pliers, allowing removal of the implant by unscrewing it with a gentle upward pulling action (Figure 2C).

Patient 2

A 74-year-old man had been treated with a locking plate (LCP Proximal Lateral Tibia; Synthes GmbH) for repair of a right tibial diaphyseal fracture 7 years earlier. Radiographs revealed a healed bone and good union (Figure 3). The locking plate was scheduled for removal at the patient’s request. However, 1 of the proximal unicortical locking screws was jammed. Therefore, the authors decided to employ their parallel planes technique. A high-speed metal-cutting carbide-tipped burr was used to make a cut from the plate edge to the edge of the screw hole (Figure 4A). While making these radial cuts in the plate, the authors were careful not to extend the blade into the screw head. After removal of the locking plate from the screw (Figures 4B-C), the authors were able to extract the jammed screw uneventfully.

The entire procedure should require less than 15 minutes per isolated screw and 30 minutes per locking screw. While using the burr, dispersal of metal debris into the surrounding soft tissues can be avoided by placement of an adequate shield. Continuous saline irrigation is used to wash away the debris and to keep the burr cool, thus avoiding thermal damage. The postoperative courses were uneventful in both cases.

DISCUSSION

The advent of locking plates for the treatment of periarticular fractures and comminuted fractures was a paradigm shift in orthopedic procedures. However, the development of locking plate technology has led to problems with the cold welding of screws to plates, as well as cross-threading between threads in the screw head and the screw hole. Removal of locking screws is extremely difficult due to stripping of the recess of the screw heads when using a screwdriver. Several reports have described techniques for removal of such damaged

Figure 1: Anteroposterior radiograph of the left femur of patient 1 taken 3 years after insertion showing good bone union of the femoral diaphyseal fracture.

Figure 2: Intraoperative photograph showing the cut portion of the screw head (A). Drawing illustrating the details of the cut portion of the screw head (B). The screw is gripped with locking pliers and extracted (C).

Figure 3: Anteroposterior radiograph of the right tibia of patient 2 taken 7 years after insertion showing healed bone and good union.

Figure 4: Intraoperative photograph showing the cut portion of the locking plate (A). Drawing illustrating the details of the cut portion of the locking plate (B). The locking plate is removed from the screw (C).
Titanium has a high degree of biocompatibility, which leads to increased osteointegration and thus a greater risk of screws becoming encased. Once screw threads have become fixed to bone, stripping of the screw recess head may occur during attempted removal. Furthermore, after one slippage event, the maximal torque that can be applied in both clockwise and counterclockwise directions is generally reduced to approximately half of the pre-slippage value. Few screws, except for those with a slipped capital femoral epiphysis, have been manufactured with reverse cutting flutes to assist removal. Local osteopenia, stress fractures, metal toxicity, corrosion, and malignancy are reportedly associated with retention of metal implants. In addition to the typical reasons for difficulty with implant removal, such as stripping of the screw head recess, it can be considerably difficult to remove a screw when the screw and the screw hole of the intramedullary nail or the locking plate have become cross-threaded. Further difficulty may be encountered when there is cortical bone ingrowth at the end flutes of the screw.

Many authors have reported a number of problems associated with screw removal, including screw breakage, screw retention, infections, scars requiring revision, and prolongation of the operation time. Several surgical techniques for removal of not only an isolated screw but also a locking screw with a damaged hexagonal recess have been described.

Pattison et al used a small swab or piece of foil wrapped around the tip of the screwdriver to create an interference fit between the screwdriver and the screw head, generating more torque for removal. However, such techniques are successful only when there is minimal screw head stripping. Several authors have described a technique in which both the plate and its screws are levered off the bone, but this can only be used for patients with osteoporotic bone. For patients with normal bone density, marked bone destruction or iatrogenic fracture may occur when the plate is removed.

Georgiadis et al used the Less Invasive Stabilization System (Synthes, Paoli, Pennsylvania) and described cutting the plate at the screw hole to remove the screws. This technique requires sophisticated instruments, such as a conical extraction screw. A conical extraction bolt can be used for cold welding, but breakage of the bolt may occur. Alternatively, a carbide drill bit can be used to drill out the screw head, but the shank of the screw needs to be removed with a hollow reamer afterward.
Williams and Kunzru\textsuperscript{17} described a technique involving an AO screw remover that is not universally applicable to all screw sizes and types. In addition, this instrument is not commonly available. At the high cost of $\text{7129 per set, removal of cannulated AO screws can be performed percutaneously. However, the conical screw may fail to engage the stripped screw because of high torque. Therefore, an alternative technique should be considered.}

\text{A previous report described a method similar to the current one in which the central core of the screw head was drilled with a carbide-point drill bit, and the remaining screw head was grasped with pliers and crushed.\textsuperscript{18} However, the junction of the screw became weakened and unable to withstand the subsequent torque as a result.}

The parallel planes technique described here can be performed rapidly and avoids extensive bone loss secondary to the use of osteotomes, trephines, or overdrilling. The technique is advantageous because of its universal applicability to screws of all types and sizes, including locking screws.

\section*{Conclusion}

The authors described a simple and useful technique for screw removal that works for all types of screws. It can be performed using only a metal-cutting carbide- or diamond-tipped burr, a high-speed drill, and locking pliers. It is less destructive than cutting the screw and overdrilling and can be applied universally. Orthopedic surgeons should keep this option in mind when dealing with screw extraction difficulties.

\section*{References}