Case Report

A Technique to Remove a Jammed Locking Screw from a Locking Plate

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Abstract

Background Locking titanium plates revolutionized the treatment of osteoporotic and metaphyseal fractures of long bones. However as with any innovation, with time new complications are identified. One of the problems with titanium locking plates is removal of screws, often attributable to cold welding of screw heads into the locking screw holes. Several techniques have been described to overcome this problem. We describe a new easy technique to remove a jammed locking screw in a locking plate that is easily reproducible and suggest an algorithm to determine the method to remove screws from locking plates.

Case Description A 57-year-old man underwent removal of a locking titanium plate from the distal femur. Because the screws could not be readily removed, we used a new technique to remove the jammed locking screws. A radial cut was made in the plate into the locking screw hole and wedged with an osteotome. This released the screw head from the locking screw hole. The screw holes were

connected with radial cuts and jammed locking screws were removed in a similar fashion.

Literature Review Instruments used for removal of locking screws, including conical extraction screws, hollow reamers, extraction bolts, modular devices, and carbide drill bits, have been described. However, these do not always work.

Purposes and Clinical Relevance Removing screws from locking titanium plates can be difficult. There is no method of implant removal that can be universally applied. Therefore, this new technique and our algorithm may be used when removing screws from locking titanium plates.

Introduction

The advent of locking plates has brought new problems in implant removal [3, 11]. Difficulty in removing screws from a locking plate is well-known. These difficulties include cold welding between the screw head and locking screw hole [2], stripping of the recess of the screw head for the screwdriver [4], and cross-threading between threads in the screw head and screw hole [2, 6]. Several reports described risks, tips, and techniques to remove these locking plates [3, 6]. These include using a conical extraction screw [5], cutting the plate [1], and using high-speed carbide drill bits and burrs to remove the screw heads, and removing the shanks with conical extraction screws [4]. The available screw removal kits make implant removal successful more often than not [11]. However, there are cases in which removal is difficult.

We describe a new technique for removing a jammed locking screw from a locking plate. We discuss the options available to remove a jammed screw and report a technique and its rationale in removing a jammed locking screw.

We certify that we have no commercial associations (eg, consultancies, stock ownership, equity interest, patent/licensing arrangements, etc) that might pose a conflict of interest in connection with the submitted article.

Each author certifies that his or her institution approved the reporting of this case report, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.

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Case Report

A 57-year-old man received a Less Invasive Stabilization System plate (LISS®; Synthes Inc, West Chester, PA, USA) for a distal femoral fracture 5 years previously (Fig. 1). The patient returned with symptoms of pain over the distal plate during flexion and extension of the knee. Nonoperative management did not improve the symptoms. The patient consented to implant removal, with the express understanding that implant removal might be impossible.

The five proximal unicortical locking screws were removed using either the standard screwdriver (one screw) or the conical extraction screw (Synthes) (four screws). However, only one of the distal bicortical locking screws could be removed with the standard torque-limiting screwdriver while the others were jammed in the locking screw hold. The conical extraction screw was used for the second screw, but the conical extraction screw broke. Another extraction screw was used to attempt removal of

the next distal bicortical screw, but that failed. The attempt was stopped before the conical extraction screw broke. We then decided not to use the extraction screw but to proceed with the new technique. The rest of the distal screws were removed using a technique not previously described.

A high-speed disc (The Anspach Effort® Inc, Palm Beach Gardens, FL, USA) was used to make a radial cut from the plate edge to the edge of the screw hole, and a 10-mm osteotome was wedged in that cut (Fig. 2). When the osteotome was wedged in the radial cut, the circumference of the threaded portion of the screw hole increased. This released the screw head and removing the distal bicortical screws was possible with the conical extraction screw. All screw heads were released by radial cuts to each of the distal screw holes (Fig. 3).

Overall, three high-speed discs were required to perform all the cuts. As the high-speed disc was pressed onto the plate and went through the thickness of the plate, the give in the disc was a distinct tactile sensation (similar to the

Fig. 1A–C (A) An AP view of the distal femur shows a healed fracture and the lower half of the LISS plate. (B) This AP view shows the proximal half of the LISS plate with bony growth around the screws between the plate and femur. (C) A lateral view of the right femur shows the whole LISS plate.

Fig. 2 A radial cut is made from the plate edge to the screw hole (thick black arrow), and an osteotome placed in the cut releases the screw head (arrows around screw hole).

Fig. 3 Radial cuts in the plate are extended to connect all screw holes to release the screw heads.

sensation when using an electric plaster cutter to cut casts), and the pressure was released without causing any damage to the underlying bone. Care was taken, while making these radial cuts in the plate, not to extend the cut into the screw heads by advancing the disc slowly. When we were unsure about the cut extending into the screw hole, an osteotome was wedged gently in the cut to check whether it released the screw hole. If it did not, the cut was carefully extended and an osteotome again was wedged in the cut to check whether it released the screw hole. At the end of the procedure, the surgical wound was washed thoroughly with normal saline to remove metal debris. The procedure took approximately 3.5 hours mainly owing to making the cuts in the plate slowly to avoid overheating despite using saline to cool the disc and the plate.

Discussion

Implant removal is considered for pain related to implants, part of treatment (eg, removing syndesmosis screws in the ankle), and patient-requested implant removal. Removing implants is often more difficult than the index operation to insert the implant. Risks of implant removal include wound-healing problems [10], neurovascular injury [10], failure to remove all of the implant [8], and refracture [12]. Locking screws have several advantages to stabilize peri-articular fractures, comminuted fractures, and osteoporotic fractures. However, as with any new technology, with time, difficulties and problems associated with it become more obvious. Difficulties in removing a titanium locking screw include jammed screws, damage to the recess in the screw head (stripping) for the screwdriver, and broken screws. Tips, techniques, and pitfalls of implant removal are well

described [4]. Instruments including conical extraction screws, hollow reamers, extraction bolts, modular devices, and carbide drill bits have been described in the methods used for removing locking screws [3, 6]. It also is accepted that no one technique can solve all problems in implant removal. The more options available the better.

The generally accepted reason for titanium locking screws getting jammed in the threaded screw holes is cold welding of the screw head in the threads of the locking screw holes [2, 4]. However, our experience with our patient showed this is not always the case, especially when a torque-limiting screwdriver was used to introduce the screws. In cold welded screws, a radial cut in the plate and using an osteotome to wedge the radial cut could break the cold weld. If it does not, then we follow an algorithm based on whether the screw head is stripped (Fig. 4). None of the distal bicortical screws in our case were cold welded. We believe failure to remove the distal screws directly with the conical extraction screw was attributable to the following factors: (1) jamming of the screw head in the locking screw hole, owing to cross-threading and not necessarily cold welding; (2) grip of the screw threads in the far cortex; (3) bony growth over the titanium screw at the far cortex; and (4) as the conical extraction screw was inserted, the screw head jammed farther in the screw hole by expanding the screw head (Fig. 5). Regardless whether the locking screw is just jammed or cold welded, when a conical extractor is introduced into the screw head recess, logic suggests that as the conical extraction screw is introduced it tends to push out the metal causing hoop stress. However, we found no mention of this hoop stress effect in our literature search.

Risk of cold welding in titanium plates and screws should be low if the screws have been inserted in an orthogonal fashion to the plate with a torque-limiting screw driver.

Fig. 4 A flowchart shows an algorithm for removing locking screws from plates.

Fig. 5 As the conical extraction screw engages, hoop forces could jam the screw farther in the screw hole (arrows).

We did not microscopically examine the screw holes after removal, but gross visual examination did not reveal any metal transfer. Even if a cold weld spot was present, our technique is less destructive when compared with cutting the whole plate or screw and overdrilling the screws. A locking screw that cannot be removed with a torque-limiting screw driver is technically jammed whether it is attributable to cold welding or cross-threading or just over-tightened. Bony overgrowth is a substantial problem in titanium implants [4, 7]. As the screws were so tightly jammed that the conical extraction screw failed to remove the screw, the technique of using a foil [9] in the stripped screw head recess before the conical extraction screw would have failed. If only the central screw is jammed, then our technique of making a radial cut all the way to the central screw hole will still work, as would destroying the screw head with carbide drills and burs and removing the plate followed by removing the screw shank with a conical extraction screw. However, we still think our technique is less destructive.

There is always the danger of thermal bone necrosis or iatrogenic bony injury when using high speed burs and discs. We have no experimental data regarding whether heat generated by cutting the plate is lesser or greater than heat generated in burring out the screw heads and removing the plate. The principle we follow when we have used high-speed instruments has been to have adequate flow of normal saline to absorb the heat generated and remove debris. As mentioned earlier, several possible factors alone or in combination can make screw removal difficult or impossible. Bony overgrowth around orthopaedic implants is well known in pediatric patients. However, bony overgrowth can occur even in adults and could add to the difficulty in removing titanium screws.

It is essential to have all the appropriate implant removal instruments, including carbide drill bits and high-speed burs and discs, and prepare for a long procedure [5]. A conical extraction screw is not always successful in removing the jammed screw [1]. The risks of high-speed burs and discs are high local temperature and metal debris. This technique requires running normal saline solution (to keep the temperature low) and continuous suction to remove all the metal debris.

As with any problem, prevention is the best treatment. All precautions should be taken to ensure the locking screws are inserted perpendicular to the plate without cross-threading using a torque-limiting screw driver. The problem of screw head jamming is not seen with stainless steel screws [3]. The technique described here would be a good addition to the armamentarium of a trauma surgeon for removing jammed screws from locking plates.

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