International Journal of Clinical Research

Case Report

A Special Technique to Remove a Jammed Cephalic Screw from an Intramedullary Nail: A Case Report

Raymond Massaad, MD[1], Said El Orra, MD[2], Dounia Massaad, MD[3], Antonella Massaad, MD[4], Abdallah El-Azanki, MD[5]

[1] Department of Orthopedic Surgery, West Bekaa General Hospital, Beirut, Lebanon
[2] Department of Orthopedic Surgery, Beirut Arab University, Beirut, Lebanon
[3] Department of Orthopedic Surgery, Carol Davila University, Bucharest, Romania
[4] Department of Orthopedic Surgery, Carol Davila University, Bucharest, Romania
[5] Department of Orthopedic Surgery, Mansoura University Hospital, Mansoura, Egypt

Corresponding Author's information: Said El Orra, Beirut - Lebanon, saidelorra@gmail.com

doi: https://doi.org/10.38179/ijcr.v3i1.37

Abstract

Background: The complexity of implant removal is a well-known problem in the field of orthopedics. It is encountered mainly during the removal of plates and screws and understood by the phenomenon of seizing or cold-welding, formerly known in mechanics. In this case study, we describe a complex experience during a gamma nail removal in a 21-year-old male patient, explained by the same phenomenon of seizing or cold-welding. The case is rather unusual and rare, with no similar reports in the literature, and required a special technique of extraction.

Case Report: A 21-year-old male presented to our clinic with a 5-months history of right groin pain radiating to the anterior thigh. The patient was a victim of a car accident three years ago that resulted in right femoral neck and shaft fractures, which were managed by open reduction and internal fixation by a long gamma nail with distal locking. After proper examination, the team decided to remove the implant. There was difficulty loosening the cephalic screw as it was welded to the nail. For this reason, we opted for a technique that involved making a transverse slit at the level of the anterior part of the nail which is in contact with the cephalic screw. It was followed by a hammer blow at the level of the cephalic screw, allowing it to loosen and thus allowing the screws along the femoral nail to be removed successfully.

Conclusion: Our report describes a rare case of a cephalic screw cold-welded/seized into the intramedullary nail, which can be an unexpected and serious complication during intramedullary nail removal. However, our technique described in this case can be an effective way to treat such a complication.

Keywords: Cold welding; Seizing; Intramedullary nail; Removal technique; Complications; Case Report

Received: 2021.02.05
Accepted: 2021.10.08
Published: 2022.05.15

Financial support: None
Conflict of interest: None
Patient Consent: Written consent was obtained from the patient for the publication of this case and accompanying images.

Introduction

Implant removal is a common procedure in orthopedics. It is usually done in cases of malunion, nonunion, infection, pain, discomfort, or simply due to the patient's request [1]. According to a study on 275 implant removals, the most common cause of implant removal was pain (45%) [2].

Removal of implants can be quite challenging for orthopedic surgeons as one of the underestimated complications encountered is cold welding/seizing of the implant. This phenomenon is not commonly reported in the literature and is mainly described in the setting of plates and screws [1, 3, 4]. To our knowledge, such a phenomenon was not previously reported at the level of a cephalic screw and intramedullary nail. In this article, we describe a special technique for the removal of a cephalic screw welded into a gamma nail, in a 21-year-old man.

Case Presentation

A 21-year-old man presented to our clinic with a 5-months history of right groin pain radiating to the anterior thigh. The patient was a victim of a car accident three years ago resulting in right femoral neck and shaft fractures, which were managed by open reduction and internal fixation using a long gamma nail with distal locking. Implant removal was attempted two months ago, lasting about four hours, but with the impossibility to remove the cephalic screw despite a good distal grip, due to the cold welding of the cephalic screw into the nail. Thus, the operative wound was closed, and the operation failed.

The patient denied any trauma to his right lower limb prior to his presentation. The pain was progressive, of 7/10 severity on a numeric rating scale, located on his right groin, radiating to the anterior thigh and knee, aggravated by walking, and relieved with rest. No clicking of the joints, morning stiffness, pain at night, or any other symptoms were reported. On physical examination, the patient was afebrile and had a normal gait. His right thigh showed no signs of redness, warmth, swelling, or tenderness, with a normal range of motion of the right hip and knee joints. Motor power of all right lower limb muscles was 5/5 (on muscle power grading). The rest of the examination was normal. Radiographic images of the right femur showed a well-positioned gamma nail in a good alignment, with no signs of infection, malunion, or pseudoarthrosis (Fig. 1a and 1b). Laboratory tests: Complete Blood Count (CBC), C-Reactive Protein (CRP), and Erythrocyte Sedimentation Rate (ESR) were within normal ranges. The implant was removed after taking consent from the patient and explaining all the risks and possible complications that may occur.

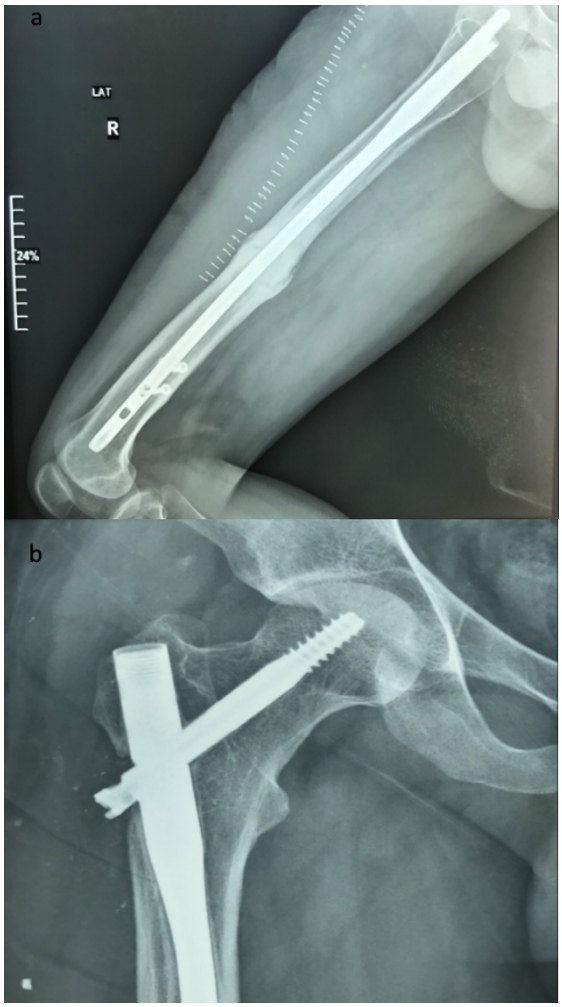

Figure 1: Radiographic imaging of the right femur showing a well-positioned gamma nail, with no signs of infection, malunion, or pseudoarthrosis; *1a: Anteroposterior view & 1b: Lateral view*

After spinal anesthesia, we positioned the patient in a hemi-lithotomy position on an orthopedic table, with the left leg placed on a leg holder. We opted for a lateral approach through the pre-existing scar. After exposing the implant, we failed to budge the cephalic screw using the pliers as it was welded into the nail. Our next approach was to make a transverse slit at the level of the anterior part of the nail in contact with the cephalic screw using a 4 mm metal drill bit mounted on a high-speed electrical motor, which allowed the drilling of the front part of the nail. The point of application of the drill bit was at the junction of the cephalic screw - the anterior part of the nail, and the direction of the drill bit was parallel to the axis of the cephalic screw. The drilling was done halfway in the screw and halfway in the front part of the nail. At the end of the transverse section of the nail, a horizontal hammer blow perpendicular to the cephalic screw allowed the screw to loosen, thus being easily removed along with the femoral nail (Fig.2, Fig.3a, 3b, and 3c). Continuous and abundant washing with normal saline was applied to the operative site to absorb the heat generated. Forceps were used to remove the metal debris caused by the drilling. The procedure lasted about two and a half hours, mainly due to the extra carefulness of the gestures in fear of an accidental fracture of the femoral neck. The operation was successfully done and had no intra- or postoperative complications. A clinical and radiologic follow-up was done four months later, showing no abnormalities on imaging, and the patient had no complaints.

Discussion

Cold welding, an entity well known in engineering, is a process by which two metals undergo constant pressure, breaking down the oxide barrier between them and joining each other by atomic diffusion [5]. In the orthopedic field, this phenomenon is encountered during the removal of implant.

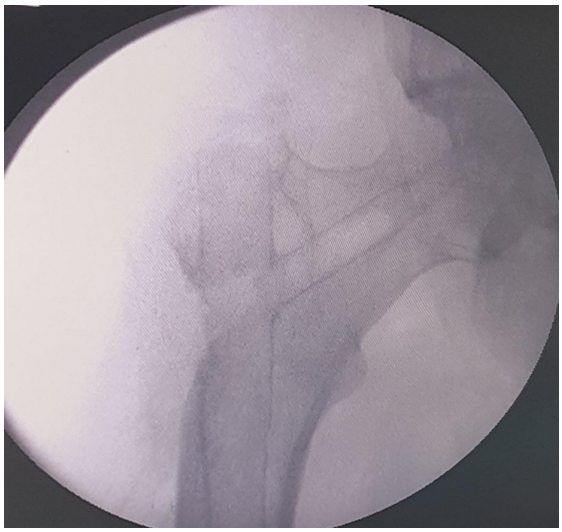

Figure 2: Intraoperative fluoroscopy image of the right femur after gamma nail removal

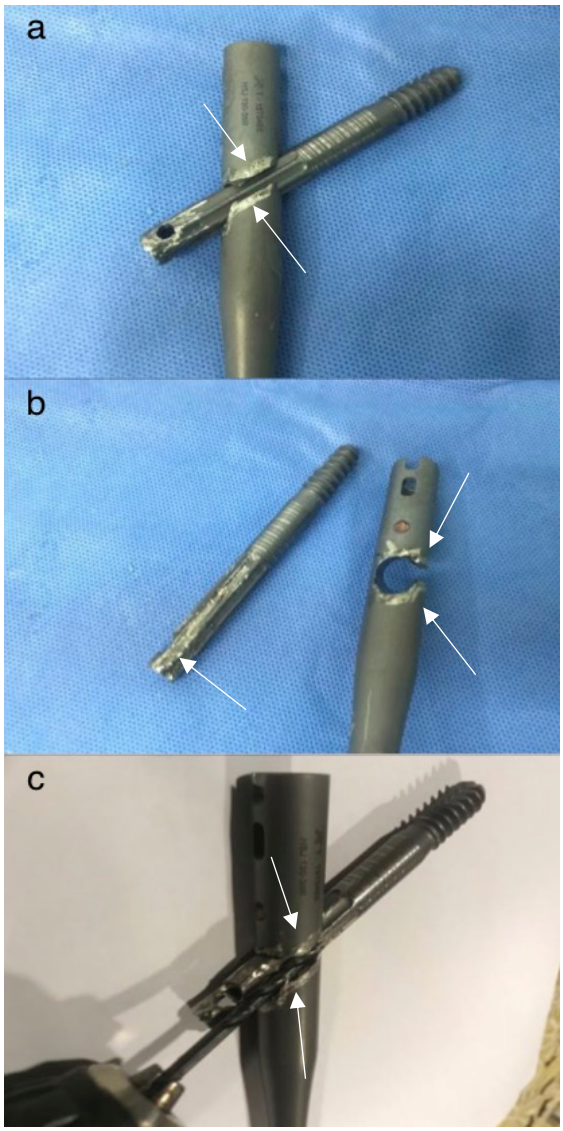

Figure 3 (a,b,c): Picture of the gamma nail with the cephalic screw after removal, note where the cut was made (arrows).

Cold welding often happens with titanium. For example, in the case of titanium plate, where the over-tightening of the screw causes a deformity in the screw hole of the plate, leading to cross-threading, stripping of threads, and eventual jamming of the screw [1]. The reason is that titanium is a soft metal that is easily deformed. In a comparative study between titanium and stainless steel nails, titanium nails showed to have a longer removal time and caused more bleeding, which can be explained by the same phenomenon [6].

Cold welding could be encountered in infection as well, where increased protons, coming from the acidic medium caused by the infection, play a role in the corrosion of the metallic implants, provoking the atomic diffusion [5].

Another term commonly mentioned along with cold welding is galling. Galling is a severe form of adhesive wear between two unlubricated metal surfaces after cyclic movements between them, leading to surface damage and eventual seizing of the metals [7].

The two phenomena of seizing and cold welding can be present in our patient: in fact, the material used in our case, which is the titanium gamma nail, allows the contact between the cephalic screw and the intramedullary nail, along with the sliding movement along the axis of the cephalic screw which is the result of the transversal and vertical compressive forces favored by the mobility of the fracture site before its consolidation, and therefore causing adhesion, friction and wearing of the metal surfaces.

The inability to remove titanium screws can be attributed to the following: an inadequate torque provided by the removal instrument, fracture or deformity of the screw head recess, or the slippage of the screwdriver in the screw head [4].

The authors described different removal techniques in the literature. In cases of stripping of drive connection, Pattinson et *al.* suggest interposing aluminum foil between the screwdriver and drive connection to enhance the stability of the connection [8]. In cases of stripped screws, conical extraction screws can be used. However, it is hard to disengage the extraction screw from the locking screw, and thus multiple extraction screws are needed during surgery. Furthermore, this technique proved to be frequently unsuccessful as the extraction screw may break or fail to engage the stripped screw [3]. If this method fails, it is recommended to cut the plate adjacent to the screw using an appropriate metal-cutting instrument, such as a carbide burr. This method generates a large quantity of metal debris and careful removal is required [3].

We opted for a technique similar to the previously mentioned method of cutting the plate adjacent to the screw. However, in our case, it was in the setting of a gamma nail and a cephalic screw, which involved making a transverse and oblique slit of the nail on its anterior side at the level of the screw. Once the slit is made, a few blows of hammer perpendicular to the screw allow to budge the screw, thus removing it.

In an attempt to decrease the occurrence of such complications, manufacturers encourage the use of torque-limiting screwdrivers [4]. Also, new locking plates and screws coated using the Dotize® system are available on the market. This new model reduces protein adsorption between metals and thus decreases the tendency of cold welding [9].

Studies have shown that the removal of implants can lead to good outcomes. In a follow-up on sixty patients who underwent implant removal due to pain, there was a high level of improvements in terms of function and pain [10].

However, nails removal should not be a routine procedure [1]. In a series done by Sanderson et *al.,* the overall complication rate following implant removal was 20% [11]. Some complications caused by nail removal included wound infection, refracture, deformity, and neurovascular injury [6].

Conclusion

The phenomena of seizing and cold welding are common in mechanics. They are responsible for the difficulties encountered during the removal of implant materials, particularly in plates and screws. Our report illustrates these phenomena at the level of the contact surfaces of the cephalic screw and that of the gamma nail, used during fixation of a bifocal fracture of the femoral neck and the femoral shaft. It is an unusual and exceptional case that required an innovative technique for removal. The technique used in our case can be considered suitable to solve this kind of difficulty and could be a good addition to the arsenal of an orthopedic surgeon.

References

1. Sreenivasan R, Chahar D, Verma N, Pathrot D, Pankaj A. Case Report: Cold welding of barrel plate to Richard screw: an unusual complication witnessed during sliding hip screw removal. Progress in Orthopedic Science. 2016;2(4):49. https://doi.org/10.5455/pos.20161126064847
2. Shrestha R, Shrestha D, Dhoju D, Parajuli N, Bhandari B, Kayastha S. Epidemiological and Outcome Analysis of Orthopedic Implants Removal in Kathmandu University Hospital. Kathmandu University Medical Journal. 2015;11(2):139-143. PMID: 24096221. https://doi.org/10.3126/kumj.v11i2.12489
3. Georgiadis G, Gove N, Smith A, Rodway I. Removal of the Less Invasive Stabilization System. Journal of Orthopaedic Trauma. 2004;18(8):562-564. PMID: 15475854. https://doi.org/10.1097/00005131-200409000-00014
4. Lehmen J, Della Rocca G, Murtha Y, Crist B. Removal technique for cold-welded titanium locking screws. Injury. 2011;42(11):1377-1379. PMID: 21232740. https://doi.org/10.1016/j.injury.2010.12.025
5. Frandsen J, Duensing I, Anderson L, Gililland J. Disassociation of a Cold-Welded Bimodular Titanium Femoral Stem by Intraoperative Ice Cooling. Arthroplasty Today. 2020;6(3):457-462. PMID: 32637516; PMCID: PMC7329910. https://doi.org/10.1016/j.artd.2020.05.018
6. Seyhan M, Guler O, Mahirogullari M, Donmez F, Gereli A, Mutlu S. Complications during removal of stainless steel versus titanium nails used for int ramedullary nailing of diaphyseal fractures of the tibia. Annals of Medicine and Surgery. 2018;26:38-42. PMID: 29348913; PMCID: PMC5767899. https://doi.org/10.1016/j.amsu.2017.12.012
7. Davis J. Surface engineering for corrosion and wear resistance. Materials Park, Ohio: ASM International; 2001. p. 75.
8. Pattison G, Reynolds J, Hardy J. Salvaging a stripped drive connection when removing screws. Injury. 1999;30(1):74-75. PMID: 10396464. https://doi.org/10.1016/s0020-1383(98)00207-1
9. Poitout DG. Biomechanics and Biomaterials in Orthopedics. London: Springer; 2004
10. Minkowitz R, Bhadsavle S, Walsh M, Egol K. Removal of Painful Orthopaedic Implants After Fracture Union. The Journal of Bone & Joint Surgery. 2007;89(9):1906-1912. PMID: 17768185. https://doi.org/10.2106/JBJS.F.01536
11. Sanderson P, Ryan W, Turner P. Complications of metalwork removal. Injury. 1992;23(1):29-30. PMID: 1541495. https://doi.org/10.1016/0020-1383(92)90121-8