

# Case Report: Cold welding of barrel plate to Richard screw: an unusual complication witnessed during sliding hip screw removal

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## ABSTRACT

Case Report: Cold welding of barrel plate to Richard screw: an unusual complication witnessed during sliding hip screw removal. Abstract Implant removal is one of the most common procedures performed in orthopaedics. More often than not, it is more difficult than the index operation to insert the implant. The sliding hip screw (SHS) is one of the most commonly used devices for the fixation of intertrochanteric fractures. The screw and barrel are designed to allow for smooth gliding. Titanium implants are often associated with the complication of cold welding. Stainless steel implants are less commonly associated with this phenomenon. We report an unusual case of cold welding of the barrel and Richard screw encountered during the removal of a stainless steel sliding hip screw construct in a routine case of peri-implant fracture in a 80 year old female who had sustained household trauma due to a slip. Keywords: sliding hip screw, peri-implant fracture, implant removal, cold welding, hip fractures.

**KEY WORDS:** Sliding Hip Screw; Peri-Implant Fracture; Implant Removal; Cold Welding; Hip Fractures

## INTRODUCTION

Implant removal is one of the most common procedures performed in orthopaedics. Many a time as an elective procedure following fracture union, implant removal is often necessitated by peri-implant fractures, fixation failures and non-unions wherein secondary operative fixation is required [1]. Although a routine procedure, implant removal is often associated with complications like neurovascular injury [2] incarcerated implants [3], and new fractures [4].

The treatment of osteoporotic fractures was revolutionized by the advent of locking plates [5]. They also heralded a new set of problems in implant removal. Stripping of screw head recess, cross threading and cold welding of screw with plate are described complications of titanium locking plate removal [5]. Cold welding or contact welding is a solid-state welding process in which joining takes place without fusion/heating at the interface of the two parts to be welded. Unlike in the fusion-welding processes, no liquid or molten phase is present in the joint. The reason for this unexpected behavior is that when the atoms in contact are all of the same kind, there is no way for the atoms to "know" that they are in different pieces of copper [6].

The sliding hip screw (SHS) is one of the most commonly used devices for the fixation of intertrochanteric fractures. It allows for controlled collapse of by the sliding compression principle originally described by Godoy-Moreira F in 1940 [7]. The screw and barrel are designed to allow for smooth gliding.

Screw cutout from femoral head [8], pullout of side plate cortical screws, dissociation of hip screw from barrel, failure

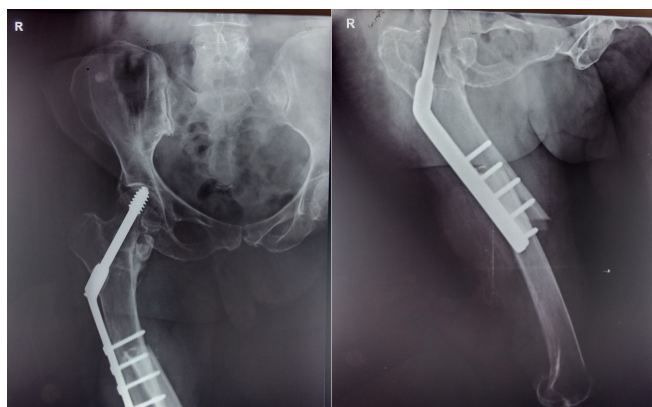
to slide in barrel [9] and rarely implant breakage [10] itself are the main modes of SHS failure described. Besides device failure, failure of fixation (improper reduction [11], osteoporosis [12], unstable fractures, position of screw within the femoral head [8], nonunion and peri-implant fractures are other reasons that necessitate implant removal.

We report an unusual case of cold welding of the barrel and Richard screw encountered during sliding hip screw removal in a routine case of peri-implant fracture.

## CASE REPORT

An eighty year old female presented to our outpatient department having sustained trivial trauma due to slip and fall in the bathroom. Patient had previously undergone operative fixation with a sliding hip screw for an intertrochanteric fracture sustained due to a fall from height about 10 years back at our institution. X-rays revealed that the previous fracture had united uneventfully; however the patient had now sustained a fresh fracture at the subtrochanteric level passing above the penultimate screw on the side plate (Fig 1) Patient was taken up for implant removal and operative fixation with 2nd Gen AO Synthes Expert Antegrade Femoral Nail (A2FN). Following regional block, the fracture site was exposed by lateral approach through preexisting scar. The side plate was exposed and the cortical screws were removed one by one easily. Next, the compression screw was removed from the Richards screw. While attempting to remove the side plate from the Richard hip screw, we found that it would not budge and repeated attempts with Vise grip plier and levering the plate out with bone levers

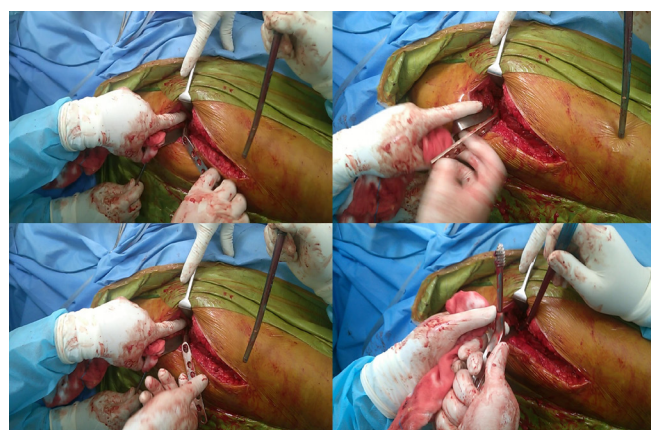
at the plate bone interface failed to take the plate out. The screw had cold-welded to the barrel of the side plate (Fig 2). Given the osteoporotic bones we were dealing with, the use of force to remove the same was unwarranted for that could have resulted in peritrochanteric fractures. The incision was enlarged by 2 centimeters proximally and the device was then removed by rotating the plate screw construct as a whole like a spanner (Fig 3, 4). The rest of the procedure (reduction and A2FN insertion) was carried out uneventfully and no complications ensued (Fig 5). The post operative period and rehabilitation were uneventful.



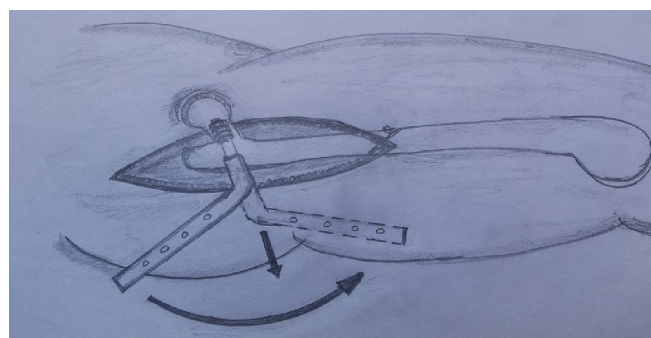
**Figure 1.** Preoperative X-ray (Antero-posterior and Lateral View) showing peri-implant fracture with SHS in situ



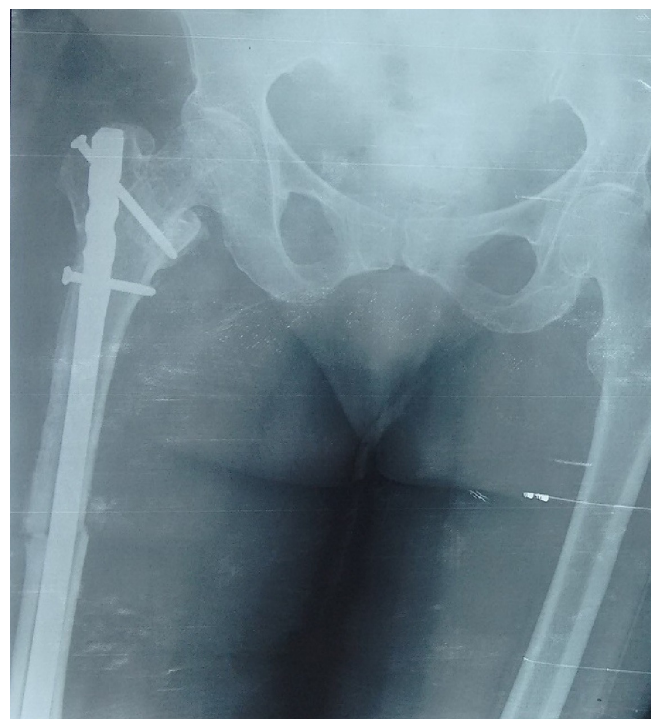
**Figure 2.** Photograph showing cold welding of barrel plate to Richard screw seen end on



**Figure 3.** Photo collage illustrating the operative technique used



**Figure 4.** Line diagram illustrating the spanner-like unscrewing motion used to remove the plate-screw construct as a whole



**Figure 5.** Postoperative X-ray showing Antegrade Femoral Nail in place



## DISCUSSION

The indications of implant removal include pain, procedural (dynamisation, syndesmotic screw removal) peri-implant fractures, fixation failures, and patient-requested implant removal. More often than not, it is more difficult than the index operation to insert the implant. Risks of implant removal include wound-healing problems[2], neurovascular injury[2], failure to remove all of the implant[3], and refracture[4].

Titanium implants are often associated with the complication of cold welding. Cold or contact welding is a solid-state welding process in which joining takes place without fusion/heating at the interface of the two parts to be welded[6].

This usually occurs when the coefficient of friction ( $\mu$ ) between two polished metal surfaces is extremely low such that the metal atoms in contact have no way of knowing whether they belong to one piece of metal or the other[13].

It is postulated that cold welding in locking plates may result from over tightening without the use of a torque-limiting screwdriver or cross threading due to mal-positioning of the screw within the plate. Titanium is a soft metal when compared to stainless steel; it deforms easily and has lower notch resistance[5]. This means over tightening of the screw deforms the screw hole in the plate, leads to cross threading, and subsequent stripping of threads. The use of even greater force to unscrew the jammed [14,15,16,17] screw usually ends up deforming the screw head recess rendering the screwdriver useless.

Although limited, there is literature available describing cold welding/jamming in locking plates and the numerous improvised techniques to remove them. However it is advised that the removal of locking plates not be undertaken as a routine procedure [14,16,18,19].

The use of sophisticated instruments such as carbide drill bit, diamond tipped burr, high [16,18,19,20] speed disc cutters and conical extraction screw may not be available to all surgeons. Use of bolt [14,16,18] cutters to cut the plate, hollow mills to extract screw shanks, metal foils to create interference [21,22] between screw driver and deformed screw head have all been described with varying degrees of success. Levering out the plate screw construct as a whole can be attempted in osteoporotic bones with less number of screws with the grave risk of iatrogenic fracture possible [23].

Stainless steel implants are less commonly associated with this phenomenon. However in our present case, we did find cold welding at the barrel plate and screw interface in a stainless steel implant. Jamming and cold welding are more commonly associated with locking screws wherein there is greater surface area of contact between the screw head threads and those in the plate[5]. The barrel plate junction in a sliding hip screw is devoid of any such threads and is smooth to ensure gliding of screw within the barrel for controlled collapse. To the best of our knowledge there has been only one reported case in a series of pediatric proximal femoral osteotomies where this complication was encountered[24]. The technique described here is simple and should be attempted before resorting to other complicated methods. The possible mechanism in our case could be because of

transfer of atom between the contact surfaces occurred due to prolonged contact of the Richard screw with the barrel plate. As after controlled collapse of fracture Richard screw might get jammed within the barrel that did not allow sliding of the screw within in the barrel and got cold welded with the barrel.

A surgeon should be mindful of such a complication during routine orthopaedic implant removal surgery. Although prevention is the best treatment for any complication, improvisational techniques are often required when unforeseen complications are encountered.

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