

Intra-operative fatigue failure of hexagonal screwdriver tip – case report of a potential complication in trauma surgery

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ABSTRACT

Intra-operative instrument breakage is a potential complication that not only leads to increased surgical time and agony to the patient but also is a source of frustration to the surgeon. The retrieval of the broken hardware may pose another challenge and sub optimal outcome in certain cases. There are numerous reports describing breakage of different sorts of medical devices and instruments and improvised methods of their successful retrieval. Orthopedic surgery requires use of manual force with instrumentation and thus the risk for important hardware failure remains omnipresent. The hexagonal screw-driver is widely used to fasten bone screws and is subjected to higher torque leading to rotation and torsion forces that may lead to excessive stress on it that at times goes past its yield point. The present case report describes an untoward event of breakage of screwdriver tip during surgery and its management. The presented report underlines importance of anticipation of this underreported complication of a common procedure.

KEY WORDS: Orthopedic Procedures; Complication; Trauma; Surgical Instruments; Equipment failure; Device removal; Fatigue failure.

INTRODUCTION

Lambotte brothers first gave the concept of ‘osteosynthesis’ – the art and science of fixation of fractures with plates, screws, wires and other metal constructs. The core principle was to attain anatomical reduction and stable fixation leading to union [1]. Orthopedic surgery requires use of many instruments and manual force. Instrument breakage is well known complication in trauma and orthopedic settings with most of cases pertaining to various implants. The overall rate reported in some studies is 0.35% [2]. The accessory instrument breakage is uncommon and may affect the further propagation of surgery depending on type of instrument involved. Drill bits are common instruments to break due to their inherent mechanical properties [3]. Other common failures are interlocking screws, reamers and nails. The removal of broken hardware was based on surgeon’s choice and not attempted in all cases [2,3]. The causes of broken screw driver has like wrong fitting and wrong direction of force are usually surgeon specific apart from the variables like design of the screw and mismatch between the driver tip and recess of the screw head. Whatever be the cause, the broken tip necessitates quick removal and supplementary drivers for smooth propagation of the surgery.

CASE REPORT

The present case report is about the incident during the surgical procedure of femoral interlocking nail procedure for the treatment of fracture of shaft femur in a 23 year old male patient. The patient was an army recruit with athletic body who sustained a road traffic accident and fractured right femur in the middle third region. He could

not bear weight on the limb and was brought to us by an ambulance. The injury was closed one with characteristic deformity and abnormal mobility suggesting a fracture that was later confirmed on radiological evaluation. There was no other injury and patient was planned for operative fixation after pre-anesthetic clearance. The procedure was closed intra-medullary interlocking nailing that is standard procedure as per his fracture was done in standard manner. The introduction of an interlocking nail (material- stainless steel, 316L) over a guide wire was uneventful and the next step of putting interlocking bolts to secure the nail with the bone was attempted. The length, alignment and rotation with regard to fracture fixation and implant was assessed fluoroscopically to be satisfactory before the successful proximal bolt fixation through jig. As the distal bolts were tightened under the guidance of image intensifier using free hand technique, the penultimate screw appeared to be jammed as that was not tightening well. As the image was taken after repeated failed attempt to introduce and fasten the bolt smoothly, the breakage of the screwdriver tip evident as the cause of failure of the procedure was revealed (Fig. 1). The screw- driver tip breakage was confirmed on bi-planar imaging views and its location ascertained within adjacent soft tissue. A long curved artery forceps was maneuvered under fluoroscopic guidance to catch hold of the broken part appropriately (Fig. 2). The part was retrieved cautiously out in further three minutes and the imaging confirmed successful removal of the tip as whole (Fig. 3). The proximal bolts were tightened without complication as well as the closure of the wound. The broken instrument was placed aside for further evaluation after the procedure. The surgery was completed with another screwdriver from

our stock as it was readily available. The screwdriver tip as examined later was found to be sharp cut at the junction of base of tip with remainder of the screwdriver. There was sudden change of shape and that might be reason for higher stresses over it. The facility of advance retrieval analysis was not present in our centre. The failure appeared as fatigue failure as the junctional area and cyclic loading may lead to it as these instruments undergo numerous surgeries and not replaced frequently. Frequent auto-clave submission may also contribute to decrease strength and micro-cracks that may eventually fail during usual torsion force.

RESULT

The supplemental arrangement of new screwdriver and careful use of instrument was instrumental in smooth and uneventful surgery. There was no post-operative or future complication recorded as the fracture united with satisfactory clinical outcome.

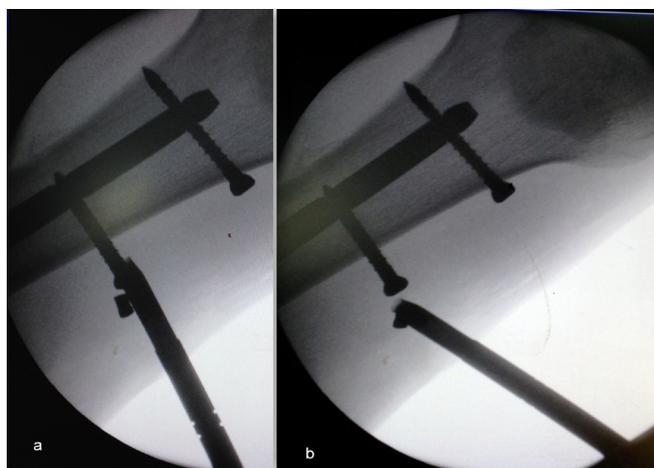


Fig. 1. Intra-operative image of broken screwdriver tip and inability to fasten screw.

DISCUSSION

The broken instruments are potential but avoidable complication in trauma surgery. The retrieval decision should be based on ease of removal and risk benefit ratio. Proper documentation however in all the cases has been advocated in previous studies [2,3]. The screw is basic element of fracture fixation with diverse mode of action whether used with other implants or in isolation. A screwdriver provides a mechanical advantage to fasten the screws tightly within a pre-drilled hole. Most common screwdrivers have hexagonal tip corresponding to hexagonal recessed screw head, however various other patterns are described. The inter-fragmentary compression with the help of cortical screws in a lag manner is widely used technique of fracture surgery [4]. The screw may face a great amount of forces across it eg. possible torque in range of 2000-3000 N (Newton) in lag fixation [5,6].

In our presented case the use of a form of screw used in intra-medullary interlocking nails, interlocking bolts were being fastened and secured with screwdriver. The ‘free-hand’

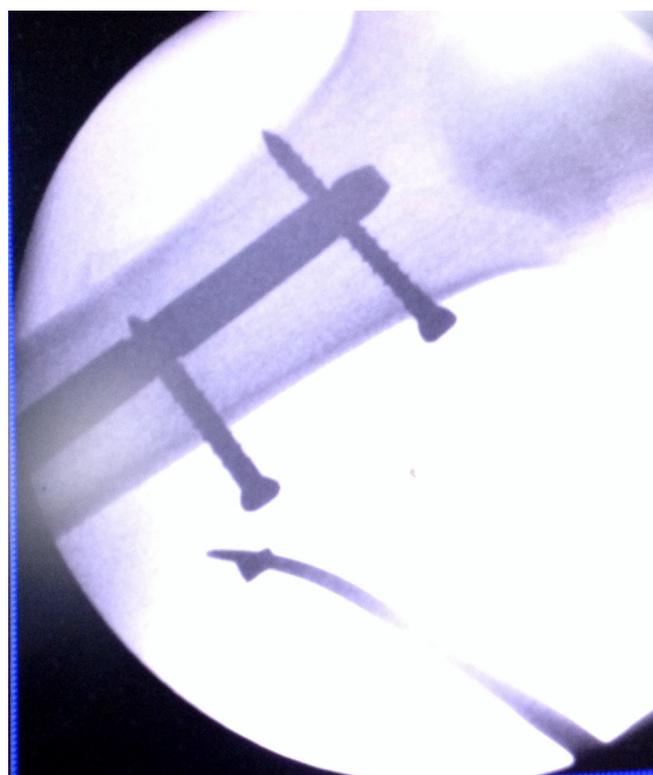


Fig. 2. Fluoroscopic localization of the broken part and its retrieval with an artery forceps.



Fig. 3. Picture of screwdriver and broken tip.

technique under the guidance of image intensifier was used for the purpose. The hard diaphyseal cortex and wrong direction of trajectory, apart from ill fitting screw head and driver tip may increase the force and resultant torque to an advancing screw with potential for failure of either screw head or the driver tip. Free hand technique may also complicate the situation by posing difficulty to retrieve broken hardware as it is buried in thigh musculature. Judicious use of image intensifier is instrumental in this regard.

The screw was broken at junctional point and these areas of sudden change in diameter have propensity for higher stresses. Regular loading also makes instruments prone to micro-cracks that may yield in future in the backdrop of cyclic loading. The other potential risk factor is prolonged use of the instruments that leads to wear and frequent evaluation of instruments for signs of wear along with regular replacement with newer ones is critical for good surgical experience for patient and doctor alike.

The broken screwdriver tip has limited case reports as per the literature search by the authors, despite it being a widely used instrument in orthopedic surgery. The presented report highlights an uncommon complication in a common settings and its management.

CONCLUSION

Anticipation of potential hardware failure during operative procedures is necessary to avoid them with proper supplemental sets and sail past them in the advent of facing the problem. The on-site retrieval avoids later embarrassment or potential legal issues. A careful explanation to patient and proper documentation of the incident are another points of concern. Frequent replacement of overused instrument and evaluation for micro-cracks may be a good policy to avoid such events.

CONFLICTS OF INTEREST

None.

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