

Cannulated screw unraveling: a case series and literature-based review of an under-recognized complication

Eli Kupperman · Orrin Franko · Andrew Indresano · Paul Girard

Received: 15 August 2012
© Springer-Verlag Berlin Heidelberg 2012

Abstract Partially threaded cannulated screws have enhanced the orthopedic surgeon's ability to fix periarticular fractures. There are many reports of complications and hardware failure during screw removal, but those during fracture fixation are under-reported and under-recognized in the literature. We describe a 21-year-old healthy man with a grade 1 open displaced medial epicondylar humerus fracture. Upon fracture fixation in the OR using a partially threaded cannulated screw over a Kirschner wire, the threads of the screw unraveled. The operating surgeon felt increased resistance and the unraveling was demonstrated on intra-operative fluoroscopy. The screw was removed by hand without hardware retention and a new K-wire and cannulated screw were used for definitive fixation. We found seven previous cases reporting a similar complication with mixed presentations and results. All occurred in young healthy patients, six of which were males. Six of the seven cases made no mention of a tactile change in resistance during fixation and only one of the seven pre-drilled the cortex prior to placement of the cannulated screw. We believe that screw unraveling is an under-reported complication of fracture fixation with cannulated screws that

should be recognized by the orthopedic community. We found intra-operative fluoroscopy integral to the recognition of the problem in our case and recommend its use in fracture fixation with cannulated screws. We also suggest pre-drilling of cortices, especially when operating on young patients with strong bone.

Keywords Trauma · Internal fixation · Hardware failure · Cannulated screw · Complication

Introduction

The development of partially threaded cannulated screws has enhanced the orthopedic surgeon's ability to treat a variety of fractures [1]. However, the addition of these self-tapping, self-drilling devices to the orthopedic toolbox is associated with its own set of unique complications [2]. Many articles have been published reporting on the fracture of guide wires and screw heads during implantation and hardware removal [2, 3]; however, only a handful of case reports have identified failure of the screw during fracture fixation [4–8].

After experiencing a case of intra-operative screw unraveling, an informal query of the staff at our tertiary care academic institution demonstrated that no other surgeons were familiar with this potential complication. Yet, upon review of the literature, we identified five previous reports and a total of seven patients who experienced a similar complication. Based on our literature review, we believe that the unraveling of self-drilling, self-tapping partially threaded cannulated screws is a not-uncommon, but under-recognized, pitfall of cannulated screw fixation.

Thus, we present our case here, review the literature, and provide suggestions on how to avoid this potential complication.

E. Kupperman
School of Medicine, University of Pennsylvania, 1815 John F
Kennedy Blvd, Suite 624, Philadelphia, PA 19103, USA
e-mail: elikupp@mail.med.upenn.edu

O. Franko · A. Indresano · P. Girard (✉)
San Diego Department of Orthopaedic Surgery, University of
California, 200 West Arbor Drive, San Diego, CA 92103, USA
e-mail: pgirard@ucsd.edu

O. Franko
e-mail: ofranko@ucsd.edu

A. Indresano
e-mail: aindresano@ucsd.edu

Case report

A 21-year-old healthy male patient presented to the trauma bay at our tertiary care academic institution after a motorcycle accident. He was diagnosed with an isolated left open grade 1 medial epicondylar humerus fracture with 2 mm of displacement and was taken to the operating room for irrigation, debridement, and internal fixation.

The operation was performed under general endotracheal anesthesia and uneventfully proceeded with irrigation, debridement, and placement of a Kirschner wire across the fracture site from the medial column of the distal humerus into the lateral column. The medial cortex was then drilled with a cannulated drill prior to placement of a 46-mm Synthes 4.0 mm partially threaded cannulated screw. While inserting the screw by hand, the surgeon recognized an unusual change in resistance, and fluoroscopic images were obtained that revealed an unraveling of the entire screw threading, accounting for about 50 % of the total screw length (Fig. 1). The decision was made to reverse the screw over the wire, which proceeded completely without fracture of the threading. The K-wire and screw were removed (Fig. 2). A new K-wire was then repositioned across the fracture, drilled over the entire length of the wire, and a second screw and washer were placed without complication. The procedure concluded uneventfully and the patient had no neurovascular injury or other complication.

Discussion

This case represents our institution's first known experience with screw unraveling, but our review of the literature suggests this is a recognized complication of cannulated screw placement. We identified the first documented report of cannulated screw unraveling in 1999 during fixation of a Lisfranc injury [4]. However, four subsequent reports each neglected to reference this original article and each described their complication as a "previously unknown structural failure [5]," a "previously unrecorded failure [6]," a "highly unusual complication [7]," and a "previously unrecorded failure" using a different screw manufacturer and size [8]. In contrast, after reviewing the published literature, we posit that cannulated screw unraveling is an established, recognized, and preventable complication of fracture fixation that is not widely recognized by the orthopedic community.

There now exist eight documented cases of screw unraveling in various sizes, lengths, and manufacturers that we could identify in the literature (Table 1). An analysis of the pertinent details of these cases yields useful data that can guide future treatment. All but one patient were male



Fig. 1 Intraoperative anteroposterior fluoroscopic image showing the unraveled Synthes 4.0 mm cannulated screw over the guide wire

Fig. 2 Recovery of the cannulated screw and K-wire after slowly reversing with a hand-held screwdriver



with a mean age of 21 years (range 12–38 years). Screw sizes included diameters of 4.0, 4.5 and 5.0 mm, and in no case had the screw path been pre-drilled at the point of thread unraveling. Three cases involved the distal humerus, two cases involved the distal tibia, and one each involved the proximal humerus, proximal tibia, and medial cuneiform. The surgeons made an attempt to pre-drill over the guide pin in only two cases, and in both cases only the outer cortex was drilled. In addition, 75 % of the reports

Table 1 Relevant details of cases of cannulated screw unraveling in the literature

References	Age	M/F	Location	Screw	Company	Pre-drill?	Tactile?	Recovered?
Brown [4]	25	M	Medial cuneiform	4.0 mm × 30 mm	–	No	No	Yes
Mooney [5]	12	M	Distal tibia	4.5 mm	AO	No	No	NA
Mooney [5]	15	M	Proximal tibia	4.5 mm	–	No	No	Yes
Mooney [5]	13	M	Distal humerus	4.0 mm	AO	No	No	NA
Levene [6]	38	M	Distal humerus	4.0 mm × 50 mm	AO	No	No	No
Sabnis [7]	14	F	Distal tibia	4.5 mm × 50 mm	–	No	Yes	Yes
Chen [8]	30	M	Proximal humerus	5.0 mm	ASNIS	Prox	No	No
Kupperman [This study]	21	M	Distal humerus	4.0 mm	Synthes	Prox	Yes	Yes

documented no recognizable change in insertion resistance suggestive of failure. Rather, in all cases failure was confirmed only after intra-operative fluoroscopy. In 50 % of cases, the screw was re-wound over the guide wire, removed and replaced, in 25 % of cases the screw could not be removed without hardware fracture, and in 25 % of cases no attempt was made at removal or revision.

An explanation for the mechanism of hardware failure was proposed by Brown [4] as a “weakness [that develops] at a portion of the self-cutting flute and then [travels] along the groove of the thread with the metallic fragment unwinding as the screw [is] inserted.” Mooney [5] noted that none of their cases involved screw contact with cortical bone and proposed that their series of young, healthy males had unusually dense cancellous bone, resulting in “catching” of the self-drilling teeth that “in combination with the rotating motion of the insertion process [causes] the screw to unravel or unwind.” Levene, Sabnis, and Chen [6–8] all suggest the same mechanism of failure in their reports as a result of the screw catching on dense cortical bone. In our case, we believe the cutting flutes engaged the dense cortical bone, which initiated and propagated the unraveling.

All previous reports highlight this complication as a type of hardware failure unique to cannulated screws that occurs primarily in young patients with dense bone. As a result, most authors have suggested pre-drilling the screw path or utilizing intra-operative fluoroscopy to identify this complication early and allow for screw removal prior to complete hardware failure preventing a retained foreign body. We agree with these recommendations. In addition, we encourage surgeons to be cognizant of potential changes in resistance during screw insertion that might suggest failure or, at the least, warrant intra-operative fluoroscopic imaging.

Conclusion

We believe that cannulated screw unraveling is an established and documented complication that should be

recognized by the orthopedic community. Avoidance of this complication may be preventable by pre-drilling the entire length of the screw path when placing cannulated screws into dense cancellous or cortical bone in teenagers and young adults. In addition, we encourage the regular use of intra-operative fluoroscopy to identify this complication while it can still be reversed allowing for complete screw removal without hardware retention.

Conflict of interest Each author certifies that he or she has no commercial associations (e.g., consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted article.

References

1. Moehring HD, Johnson PG (1994) The use of cannulated screws in musculoskeletal trauma. A review of surgical techniques. *Orthop Rev. Suppl*:10–21
2. Schwend RK, Hennrikus WL, O'Brien TJ, Millis MB, Lynch MR (1997) Complications when using the cannulated 3.5 mm screw system. *Orthopedics* 20(3):221–223
3. Robb JE, Annan IH, Macnicol MF (2003) Guidewire damage during cannulated screw fixation for slipped capital femoral epiphysis. *J Pediatr Orthop B* 12(3):219–221
4. Brown CH, Cullen NC (1999) Disassembly of a small cannulated cancellous screw. *Foot Ankle Int* 20(7):468–469
5. Mooney JF III, Simmons TW (2003) A previously unreported complication of the AO cannulated 4.0- and 4.5-mm screw systems: a review of three cases. *J South Orthop Assoc* 12(3):160–162
6. Levene AP, Templeton P (2008) Previously unreported failure of a Synthes 4.0 mm diameter cannulated screw. *Injury Extra* 39:212–215
7. Sabnis B, Brenkel I, Chesney D, Weir I (2009) Unusual mode of mechanical failure of an AO cannulated self drilling screw. A case report. *Acta Orthop Belg* 75(4):557–560
8. Chen A, Willis-Owen C, Akhtar K, Kamineni S (2010) Failure of asnis iii 5.0 mm cannulated screw: a case report. *Cases J* 7(3):9