

Technique Tip for Removing Stuck Partial Threaded Screws

Introduction

Slipped capital femoral epiphysis (SCFE) is a condition occurring only during adolescence, when there is rapid growth, during which time there can be a progressive or an acute slip of femoral head epiphysis from the femoral neck. Untreated SCFE can eventually lead to osteoarthritis of the hip. The goal of treatment is to arrest the progression of SCFE, with the hope of avoiding or delaying avascular necrosis and secondary osteoarthritis. Pin or screw fixation has become the popular treatment of choice, but this operation is not without its complications.^{1,2} Also, even after successful treatment of SCFE with arrest of slip progression with surgery, screw removal can be particularly challenging. We report 3 cases of difficult screw removal, the technique of screw extraction, and recommend a specific screw design for SCFE.

Cases, Materials and Methods

We report 3 patients from whom we had difficulty removing a cannulated partially threaded cancellous screw after SCFE fixation, all using a similar operative technique. Our first patient was an obese 12-year-old student with a body mass index (BMI) of 33 who suffered an acute grade 1 (20% slip) slipped capital femoral epiphysis after a fall. In situ insertion of an AO 7.0 mm (16 mm threaded, 40 mm shaft) cannulated partially threaded cancellous screw with washer was performed under fluoroscopic guidance. Twenty months later, she was admitted electively for removal of the cancellous screw after physeal closure. Removal of the cancellous was a difficult process. Initial attempts with the screwdriver only allowed us to extract less than 1cm of the screw. Bone growth around the shaft of the proximal screw prevented further screw extraction. Repeated attempts at screw removal using a screwdriver led to stripping of the screw head. A vice grip was used to grip the screw head to remove the screw, but to no avail. The decision was then made to over-drill the head of the screw with the hollow-mill and break the washer with a strong cutter. The proximal femoral cortex and the underlying cancellous bone around the screw shaft were then over-drilled to the level of the proximal cancellous screw threads before the screw was removed using a strong vice grip. The cancellous screw was eventually removed completely.

Our second patient had his SCFE screws removed 22 months after in situ insertion for a grade 1 (10%) acute slip. Due to extensive bony overgrowth of the screw head coupled with a poor hold of the screw head, the operative technique described above was used with good results.

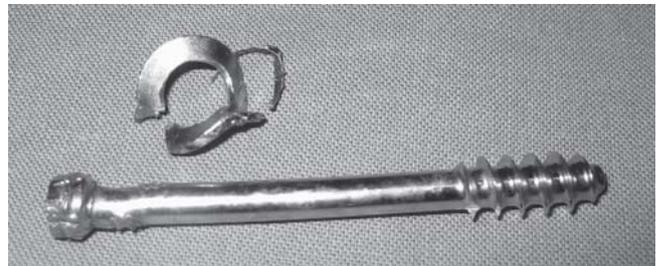


Fig. 1. Picture of an over-drilled screw and cut washer.

Both AO 7.0 mm cannulated partially threaded cancellous screws were removed completely without leaving any components within the femur.

When operating on our third patient, it took us 160 minutes to remove his SCFE screw using the above described operative technique. His case was that of a grade 1 (30%) acute slip in which a single AO 7.0 mm cannulated partially threaded cancellous screw was used to secure proximal femoral to the femoral neck. Difficulties in removing the screws 29 months after physeal plate had fused arose from cortical bony overgrowth of the screw head.

Results and Discussion

In a patient with difficult screw removal, cutting the head of the screw to leave the threaded portion within the femoral head is a possible option. However, there is a possibility of developing deep infection and osteomyelitis resulting in the patient requiring even more extensive surgery to remove the remnant implant to treat the infection.³ Our technique of removal of a partially threaded cancellous stainless steel has been described above. Factors that contributed to the difficulty of screw removal include increasing bone mass with age and a bony in-growth and sclerosis of bone around the proximal unthreaded screw shaft requiring considerable force for screw threads to cut through. The lack of a good hold on the head of the screw requires an increased amount of torque for screw removal. It is pivotal that the rotational torque should not be greater than the biomaterial strength that the screw is made of; otherwise this will result in breakage of the screw when excessive force is exerted. The presence of a hexagonal head with a large diameter coupling recessed socket would provide controlled insertion and removal.⁴

Traditionally, partially threaded screws have been used to hold slipped femoral epiphysis in position. In a study by Warner et al,³ only 4 out of 33 screws had the threaded segment of partially threaded screws completely within the

epiphysis. The other 29 could not have provided compression as it crossed the epiphysis.³ Using a partially as opposed to a fully threaded screw contributes to difficulty in screw removal. A partially threaded screw on removal will require the reverse cutting flutes to cut through a larger surface area, causing a more difficult removal. By using a fully threaded screw with a wider pitch, one could reduce the rotational torque needed for removal. Since no compression of femoral epiphysis is required, a fully threaded screw would be more appropriate in this situation.

Concerning screw biomaterial, currently available cannulated screws include those made of titanium or stainless steel. Vresilovic et al⁵ showed that titanium allows a greater pin-to-bone interface, contributing to greater bone apposition compared to stainless steel material. In this study, only 17 out of 24 cases of cannulated titanium screws were successfully removed.

Conclusion

From our experience of difficult removal of SCFE, we have described how to overcome this technical difficulty by first over-reaming the head, following by using cutters to break the washer, and finally by over-reaming the screw shaft to the level of the threaded portion. Using a strong vice grip, one can then remove the partially threaded cancellous screw from the patient without causing any fractures. Based on our literature review, we conclude that a single cannulated fully threaded cancellous screw with a hexagonal head coupled with recessed socket made of stainless steel would allow for easy insertion and removal of SCFE screw with the least complications. This is done without compromising its function of holding the slipped

epiphysis in place, allowing it to fuse. Lastly we would also recommend activity restriction for 6 months after successful screw removal to avoid any fractures in the region of femoral neck due to over activity.

REFERENCES

1. Crandall DG, Gabriel KR, Akbarnia BA. Second operation for slipped capital femoral epiphysis: pin removal. *J Pediatr Orthop* 1992;12:434-7.
2. Greenough CG, Bromage JD, Jackson AM. Pinning of the slipped upper femoral epiphysis – a trouble-free procedure? *J Pediatr Orthop* 1985;5:657-60.
3. Warner JG, Bramley D, Kay PR. Failure of screw removal after fixation of slipped capital femoral epiphysis: the need for a specific screw design. *J Bone Joint Surg Br* 1994;76:844-5.
4. Koval KJ, Lehman WB, Rose D, Koval RP, Grant A, Strongwater A. Treatment of slipped capital femoral epiphysis with a cannulated-screw technique. *J Bone Joint Surg Am* 1989;71:1370-7.
5. Vresilovic EJ, Spindler KP, Robertson WW Jr, Davidson RS, Drummond DS. Failures of pin removal after in situ pinning of slipped capital femoral epiphysis: a comparison of different pin types. *J Pediatr Orthop* 1990;10:764-8.

Chun-Hai Tan,¹MBBS, Yi-Jia Lim,¹MBBS, MRCSEd, MMed (Orthop),
Khee-Sien Lam,¹MBBS, FRCSEd, FAMS

¹ Department of Orthopaedic Surgery, Changi General Hospital, Singapore

Address for Correspondence: Dr Lim Yi-Jia, Department of Orthopaedic Surgery, Tan Tock Seng Hospital, 11 Jalan Tan Tock Seng, Singapore 308433.

Email: lim.yi.jia@singhealth.com.sg