

## Case Report

# Medial femoral circumflex artery pseudoaneurysm following intramedullary nailing for intertrochanteric fracture

Arthur S. Nguyen<sup>a</sup>, Arthur J. Only<sup>b</sup>, Naoko Onizuka<sup>b,c</sup>, Julie A. Switzer<sup>b,c,\*</sup>

<sup>a</sup> University of Minnesota Medical School, Minneapolis, MN, USA

<sup>b</sup> Department of Orthopaedic Surgery, Methodist Hospital, Saint Louis Park, MN, USA

<sup>c</sup> Department of Orthopaedic Surgery, University of Minnesota, MN, USA

## ARTICLE INFO

## Keywords:

Elderly  
Complication  
Pseudoaneurysm  
Intertrochanteric fracture  
IMN (intramedullary nail)

## ABSTRACT

**Case:** We present the case of a 92-year-old woman who developed a medial femoral circumflex artery (MFCA) pseudoaneurysm intraoperatively while obtaining reduction during intramedullary nailing (IMN) for intertrochanteric fracture.

**Conclusions:** Pseudoaneurysms are rare vascular complications in hip fracture surgery. Early recognition of signs and symptoms of this phenomenon are essential for diagnosis and treatment. Close post-operative monitoring and serial hemoglobin should be considered for unexplained intra-operative bleeding. A low threshold for angiography should be entertained if active bleeding and clinical decompensation occur during instrumented percutaneous peritrochanteric fracture reduction. This patient underwent conventional angiography with successful coil embolization and exclusion of the MFCA pseudoaneurysm.

## Introduction

Nearly half of proximal femur fractures are extra-capsular in nature with 20–40% classified as unstable intertrochanteric fractures [1]. Surgical interventions include trochanteric nailing or dynamic hip screw systems [1–3]. A rare, but serious complication in hip fractures and corrective surgery is arterial injury with 0.21–0.25% in incidence, with the profunda femoris artery and its branches involved in at least 80% of cases [2,4,5]. While reports in the orthopaedic literature describe pseudoaneurysm formation from iatrogenic and traumatic causes, specific rates of these are unclear.

Pseudoaneurysms form when the integrity of the arterial wall is disrupted, allowing blood to exit through the defect and form a communicating sac bound by media, adventitia, and/or surrounding soft tissues. In orthopaedics, pseudoaneurysms can be due to surgical instrumentation, intra-operative maneuvering/repositioning, and displaced fracture fragments [4,5]. Although non-invasive diagnostic modalities are available to evaluate pseudoaneurysms, conventional angiography remains the reference standard for diagnosis, allowing for real-time vascular assessment and endovascular intervention at time of study [6].

We share our experience with a medial femoral circumflex artery pseudoaneurysm that was discovered after intramedullary nail fixation for intertrochanteric fracture. The vascular injury was treated successfully with coil embolization.

The patient was informed that her case would be submitted for publication, and she provided consent.

\* Corresponding author at: Department of Orthopaedic Surgery, Methodist Hospital, Meadowbrook Building, 3931 Louisiana Avenue South, Suite E400, Saint Louis Park, MN 55426, USA.

E-mail address: [julie.switzer@parknicollet.com](mailto:julie.switzer@parknicollet.com) (J.A. Switzer).

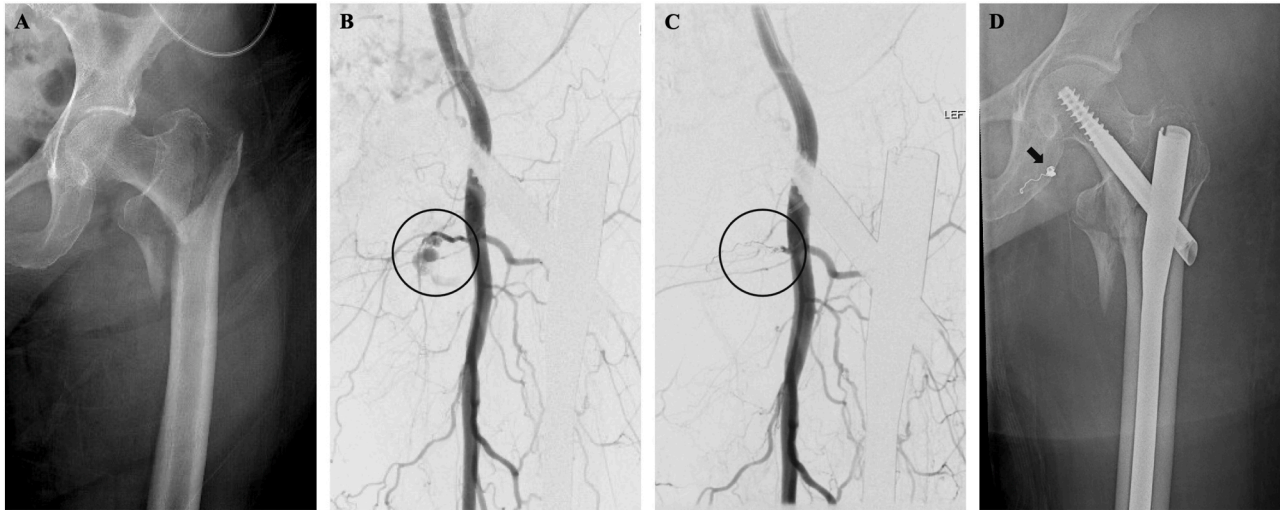
<https://doi.org/10.1016/j.tcr.2021.100577>

Accepted 5 December 2021

Available online 9 December 2021

2352-6440/© 2021 The Authors. Published by Elsevier Ltd. This is an open access article under the CC BY-NC-ND license

(<http://creativecommons.org/licenses/by-nc-nd/4.0/>).



**Fig. 1.** (A) Pre-operative anteroposterior (AP) X-ray of the left hip demonstrating a comminuted intertrochanteric fracture of the left femur with varus angulation and moderate displacement. (B) Computed tomography (CT) angiography revealing a pseudoaneurysm arising off the left medial femoral circumflex artery (circle). (C) CT angiography showing coil embolization of MFC pseudoaneurysm (circle). (D) Post-operative AP X-ray of the left hip showing fracture reduction, hardware placement, and embolization coils (arrow).

## Case description

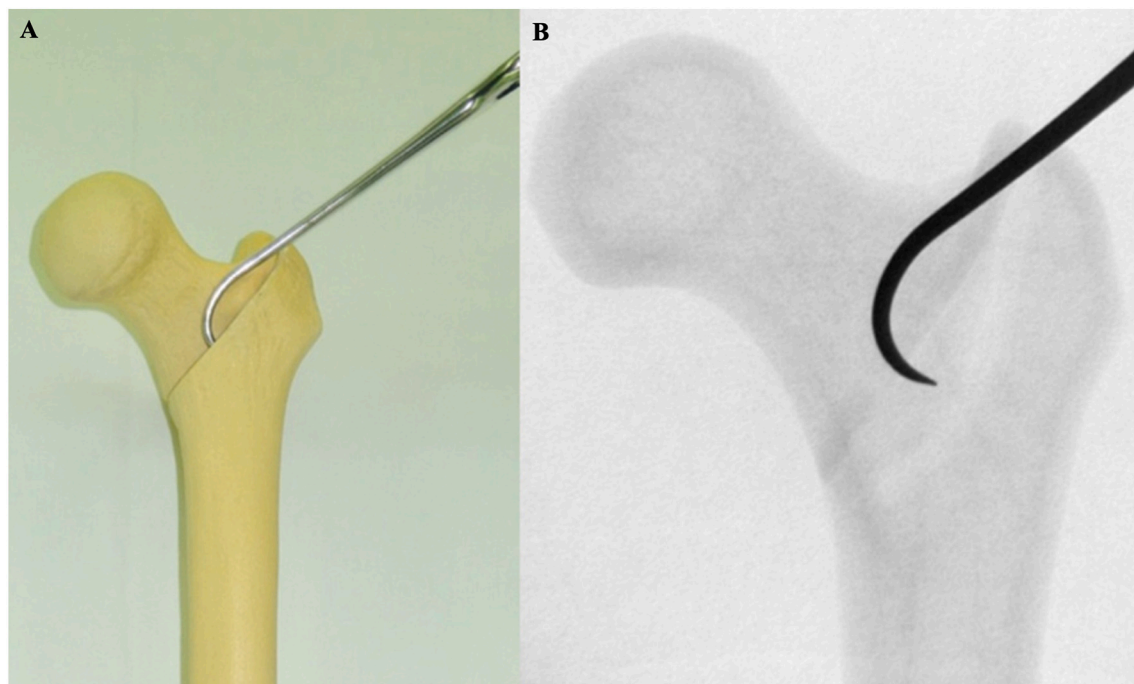
A 92-year-old woman with a history of osteoporosis and chronic thrombocytopenia presented to the Emergency Department following a mechanical ground-level fall onto her left hip. On exam, her left leg was in a flexed, externally rotated, and shortened position, but otherwise neurovascularly intact. A left, comminuted intertrochanteric fracture with varus angulation and moderate displacement was identified on imaging (Fig. 1A). Pre-operative hemoglobin (Hgb) was 10.3 g/dL and platelets were 62,000 per  $\mu$ L. One unit of platelets was transfused. Following shared decision-making, open reduction and internal fixation with intramedullary nailing (IMN) of her left intertrochanteric fracture for definitive surgical management was undertaken.

After obtaining informed consent, the patient was brought into the operating room where general anesthesia was performed. The patient was positioned on the traction table, and the left hip and lower extremity were prepped and draped in usual sterile fashion. An incision centered over the tip of the greater trochanter was made and a guide wire was advanced to capture the proximal segment. A bone hook was inserted through an anterolateral thigh incision to hold reduction throughout the procedure. Opening reamer was used to open the femoral canal and a ball-tip guide wire was introduced to the distal femur. Positioning was confirmed on imaging. The femoral canal was subsequently reamed and a 10  $\times$  400-mm, 130-degree IMN was introduced followed by a 100-mm lag screw inserted into the femoral head.

Fluoroscopic imaging confirmed intertrochanteric fracture reduction and reasonable hardware placement and fixation. The bone hook was removed and, immediately, brisk bleeding was noted arising from the incisions where the bone hook was placed and the lag screw was advanced. Pressure was held over the incision sites for approximately 10 min and Vascular Surgery was emergently consulted for possible femoral artery injury. Once the vascular surgeon scrubbed in, no active bleeding was noted. Dorsalis pedis pulses were palpable and the decision was made to refrain from open exploration of the femoral artery. Using the perfect circle technique, the remaining two distal interlocking bolts were inserted through the distal IMN. Estimated blood loss was 400 mL and immediate post-operative Hgb was 8.5 g/dL.

In the post-anesthesia care unit (PACU), the patient was borderline hypotensive (SBP 90–100 s) and tachycardic to the 120 s. Dorsalis pedis, popliteal, and femoral pulses on the operative side remained palpable, and no bleeding was noted on dressings. Given the continued hypotension and tachycardia despite IV fluid administration, a STAT repeat Hb was obtained and revealed a Hgb of 4.9 g/dL. The patient was promptly transfused 2 units of packed red blood cells and an emergent Interventional Radiology (IR) consultation was requested for evaluation and possible endovascular intervention.

Diagnostic arteriogram revealed a pseudoaneurysm arising off the left medial femoral circumflex artery (MFCA). The patient successfully underwent coil embolization of the pseudoaneurysm without complication (Fig. 1B, C). Repeat Hgb in the IR suite was 8.3 g/dL. Serial Hgb checks over the following 24 h remained stable at 8.1–8.8 g/dL. The remainder of her hospital course was uneventful.



**Fig. 2.** Example of bone hook insertion technique to acquire anatomical reduction of intertrochanteric fracture in (A) bone model and (B) radiograph. The tip of the bone hook is inserted into the fracture site and reduction is achieved by raising the proximal fragment into proper alignment for intramedullary nailing.

Figure adapted from “Hook leverage technique for reduction of intertrochanteric fracture,” by Kim et al. in *Injury* [3].

without recurrence of hemorrhage. Final radiographs demonstrated adequate fracture reduction, hardware placement, and embolization coils (Fig. 1D). She was discharged to her assisted living facility in stable condition.

## Discussion

Although vascular injuries in hip fracture and corrective surgery are rare, they remain a serious complication resulting in limb loss and significant morbidity. Here, we present a rare vascular complication of pseudoaneurysm in the medial femoral circumflex artery (MFCA) following use of a bone hook to facilitate intramedullary nailing for intertrochanteric fracture.

An extensive search of the orthopaedic literature yielded several reports describing iatrogenic and traumatic pseudoaneurysm formation in hip surgery, primarily involving the profunda femoris, superficial femoral, and lateral femoral circumflex arteries [2,7–9]. For instance, Singh et al. observed a profunda femoris artery pseudoaneurysm following dynamic hip screw fixation for an intertrochanteric fracture [7]. However, none of these studies specifically observed MFCA pseudoaneurysm formation with intertrochanteric fractures as we have reported.

Efforts to characterize mechanisms of arterial injury in hip surgery have highlighted drill bit/screw overpenetration, overextended atherosclerotic arteries from instrumentation/joint manipulation (e.g. hip adduction, internal rotation), and displacement of lesser trochanter fragments [4,5]. Relevant to our discussion is the impact of tension on surrounding vasculature. Our patient's intertrochanteric fracture necessitated the use of a bone hook to achieve and maintain adequate reduction for nailing (Fig. 2) [3]. Given that active bleeding occurred immediately following withdrawal of the bone hook and the circumflex arteries lie in the vicinity of the bone hook tip, it is likely that the positioning of and force exerted by the hook inadvertently placed undue strain on the adjacent vasculature and compromised the MFCA's wall integrity, resulting in active hemorrhage with subsequent pseudoaneurysm formation.

Iatrogenic vascular injuries are notable operative complications that require early recognition of signs and symptoms for timely treatment. Although pseudoaneurysms are a vascular injury, classic "hard signs" of pulsatile bleeding, audible bruit, pulse deficits, and expanding hematoma are often not present. Kinoshita et al. utilized Hgb and C-reactive protein (CRP) levels to track the post-operative course of a patient who developed a profunda femoris artery pseudoaneurysm after internal fixation of a trochanteric fracture [8]. While rising CRP levels are used to detect early signs of post-operative infections, Kinoshita et al. observed rising CRP levels with the development of their patient's anemia in the absence of infection, which all normalized after blood transfusions and embolization [8,10]. Notably, our patient experienced significant intra-operative bleeding for a short period during surgery, but it was the hemodynamic decompensation and precipitous drop in Hgb post-operatively that prompted further workup.

As such, following intertrochanteric fracture reduction and instrumentation, astute orthopaedic surgeons should keep MFCA pseudoaneurysm on the differential if a post-operative patient experiences increased pain, sudden derangements in vital signs, and marked declines in Hgb. In the setting of unexplained intra-operative bleeding, close post-operative monitoring and serial Hgb are paramount in guiding management. Furthermore, if there is concern for pseudoaneurysm and active bleeding with evidence of clinical decompensation, conventional angiography remains the gold standard for definitive diagnosis and allows for concurrent endovascular intervention [6].

## Funding disclosures

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

## Declaration of competing interest

No conflicts or disclosures were declared.

## Acknowledgements

Arthur S. Nguyen contributed to the conception, design, writing, and critical revision of the final manuscript.  
Arthur J. Only contributed to the conception, design, writing, and critical revision of the final manuscript.  
Naoko Onizuka contributed to the conception, design, writing, and critical revision of the final manuscript.  
Julie A. Switzer contributed to the conception, design, writing, and critical revision of the final manuscript.

## References

- [1] L. Mattisson, A. Bojan, A. Enocson, Epidemiology, treatment and mortality of trochanteric and subtrochanteric hip fractures: data from the Swedish fracture register, *BMC Musculoskelet. Disord.* 19 (1) (2018), <https://doi.org/10.1186/s12891-018-2276-3>.
- [2] L. Arbeloa-Gutierrez, A. Arenas-Miquelez, L. Muñoa, et al., Lateral circumflex femoral artery false aneurysm as a complication of intertrochanteric hip fracture with displaced lesser trochanter, *J. Surg. Case Rep.* 2019 (6) (2019), <https://doi.org/10.1093/jscr/rjz184>.
- [3] Y. Kim, K. Dheep, J. Lee, et al., Hook leverage technique for reduction of intertrochanteric fracture, *Injury* 45 (6) (2014) 1006–1010, <https://doi.org/10.1016/j.injury.2014.02.007>.
- [4] I. Karanikas, M. Lazarides, D. Arvanitis, G. Papayanopoulos, E. Exarchou, J. Dayantas, Iatrogenic arterial trauma associated with hip fracture surgery, *Acta Chir. Belg.* 93 (6) (1993) 284–286.
- [5] B. Nachbur, R.P. Meyer, K. Verkkala, R. Zurcher, The mechanisms of severe arterial injury in surgery of the hip joint, *Clin. Orthop. Relat. Res.* 141 (141) (1979) 122–133, <https://doi.org/10.1097/00003086-197906000-00014>.

- [6] P.D. Peng, D.A. Spain, M. Tataria, J.C. Hellinger, G.D. Rubin, S.I. Brundage, CT angiography effectively evaluates extremity vascular trauma, *Am. Surg.* 74 (2) (2008) 103–107, <https://doi.org/10.1177/000313480807400202>.
- [7] S. Singh, S. Arora, A. Thora, R. Mohan, S. Sural, A. Dhal, Pseudoaneurysm of profunda femoris artery following dynamic hip screw fixation for intertrochanteric femoral fracture, *Chin. J. Traumatol. Engl. Ed.* 16 (4) (2013) 233–236, <https://doi.org/10.3760/cma.j.issn.1008-1275.2013.04.010>.
- [8] H. Kinoshita, M. Hashimoto, J. Hirayama, et al., Huge pseudoaneurysm of the femoral artery after internal fixation of femoral trochanteric fracture, *Case Rep. Orthop.* 2018 (2018) 1–4, <https://doi.org/10.1155/2018/3182643>.
- [9] S. Regus, W. Lang, Arterial injury and pseudoaneurysm formation after lesser trochanter fracture, *Int. J. Surg. Case Rep.* 14 (2015) 4–6, <https://doi.org/10.1016/j.ijscr.2015.06.033>.
- [10] R. Schutz, B. Boukebous, P. Boutroux, P. Guillon, C-reactive protein levels for early detection of early postoperative complications after proximal femoral fracture surgery, *Eur. J. Orthop. Surg. Traumatol.* 28 (5) (2018) 907–913, <https://doi.org/10.1007/s00590-017-2080-z>.