Clinical Case Report

Medicine®

OPEN

Deep femoral artery branch pseudoaneurysm formation and injury after hip fracture surgery

A case series and a literature review

Bin-Fei Zhang, MD, Yu-Xuan Cong, MD, Peng-Fei Wang, MD, Hai Huang, MD, Hu Wang, MD, Yan Zhuang, MD, PhD*

Abstract

Introduction: Complications involving vascular injuries after hip fracture are rare, and the diagnosis and management of deep femoral artery (DFA) injuries are challenging. We reported 4 cases of DFA injuries after hip fracture surgery and aimed to discuss their early detection, treatment, and prevention.

Methods: We reviewed 4 cases of deep femoral injury after hip fracture. Case 1: a 71-year-old woman suffered a fracture around a prosthesis. Cases 2–4: 2 men and 1 woman suffered subtrochanteric or intertrochanteric fracture. DFA branch pseudoaneurysm formation and injury were found via arteriography after surgery. All the patients were diagnosed with DFA branch pseudoaneurysm formation and injury. Percutaneous intervention therapy was used to block the pseudoaneurysms with coil or gel.

Results: Among the cases, the main symptoms were severe pain or swelling with large-scale ecchymosis in the thigh or perineum. We used arterial duplex to diagnose pseudoaneurysm and treated the injury using interventional intravascular embolization. In Case 1, damage by the guide wire used during surgery, and over-treatment with anticoagulants, may have occurred. In Case 2, the guide wire was a possible contributing factor to injuries. In Case 3, the displaced lesser trochanter fragment may have damaged the vessel. Lastly, a drill bit was a contributing factor to the injuries in Case 4.

Conclusion: There are many definitive causes of DFA pseudoaneurysm formation and injuries. Such injuries can be diagnosed via digital subtraction angiography or CT angiography, and a thorough understanding of the anatomy of the femur and damages from reductions is important.

Abbreviations: APTT = activated partial thromboplastin time, DFA = deep femoral artery, DVT = deep vein thrombosis, FBG = fibrinogen, FDP = fibrinogen degradation product, HGB = hemoglobin, INR = international normalized ratio, PT = prothrombin time, VAS = visual analog score.

Keywords: case series, deep femoral artery, hip fracture, pseudoaneurysm formation

1. Introduction

In recent decades, hip fractures have occurred increasingly in the elderly.[1] The complication rate of vascular injuries after hip fracture is also increasing, ranging from approximately 0.2% to 0.49%.[2–4] The first report of pseudoaneurysm formation was described in 1964.[5] Vascular damage after hip fracture can be caused by the movement of sharp bony fragments,[6–8] insertion of screws,[9] use of retractors,[10] or distal locking of intramedullary nails.[11] In addition, malpositioned retractors, plunging drill bits,[12] and corrective osteotomies with plate fixation [10] are other reported causes. Depending on the resulting defect in the vessel wall, massive intraoperative bleeding or the formation of a subacute hematoma can cause arterial pseudoaneurysm.

In this report, we present the diagnosis and management of 4 cases of deep femoral artery (DFA) injury after hip fracture in our hospital from 2012 to 2016. Based on a review of these cases and the related literature, we discuss the early detection, treatment, and prevention of DFA injuries.

2. Method

This study retrospectively analyzed the data of patients with hip fractures who were admitted between 2012 and 2016 to Xi'an Honghui Hospital. The study was approved by the Ethics Committee of the Xi'an Jiaotong University, and a signed informed consent form was obtained from each participant.

Patients with a history of DFA injuries were included, and the patients' characteristics, diagnosis, treatment during the hospital stay, surgical records, and x-ray, and angiography findings were

Editor: N/A.

B-FZ and Y-XC are the co-first authors.

Ethical review committee statement:

We certify that Ethics Committee of the Xi'an Jiaotong University has approved the human protocol for this cases report, and that informed consent for participation in the study was obtained.

The authors have no funding and no conflicts of interest to disclose.

Department of Orthopedic Trauma, Hong-Hui Hospital, Xi'an Jiaotong University College of Medicine, Beilin District, Xi'an, Shaanxi Province, China.

** Correspondence: Yan Zhuang, No. 555 Youyi East Road, Xi'an, Shaanxi Province, the People's Republic of China. Postal Code: 710054 (e-mail: zhuangyan2512@126.com).*

Medicine (2018) 97:6(e9872)

Received: 5 December 2017 / Received in final form: 5 January 2018 / Accepted: 24 January 2018

http://dx.doi.org/10.1097/MD.0000000000009872

recorded. We also communicated with the patients' particular surgeons to collect any further information.

3. Results

A total of 4 patients in different trauma wards suffered DFA injuries after hip fracture surgery.

3.1. Case 1

A 71-year-old woman experienced a fracture around the prosthesis after left hip hemiarthroplasty with a 3-day history of being bedridden. Preoperative ultrasound examination revealed the presence of deep vein thrombosis (DVT) in the injured lower limb (Fig. 1A). After 3 days of anticoagulation treatment (low-molecular-weight heparin), the thrombosis disappeared, and the patient underwent open reduction and internal fixation. On the fifth day after surgery, the patient developed a productive cough and was transferred to the respiratory department where her pneumonia was resolved. However, ultrasound examination revealed persistent DVT in the injured limb. During treatment of the thrombosis, severe pain developed in the injured limb (9 days after operation), especially in the middle of the femur; the visual analog score (VAS) was 9. Coagulation examination showed the following values: prothrombin time (PT): 17.8 s (normal, 10–15 s); fibrinogen degradation product (FDP) level: 14.18 mg/L (normal, 0–5 mg/L); and fibrinogen (FBG) level: 5.05 g/L (normal, 2–4 g/L). Blood tests showed that the hemoglobin (HGB) level decreased from 139 g/L at the beginning of soreness (at 11:41) to 120 g/L before the interventional intravascular embolization (at 19:00). Percutaneous intervention revealed that there were 2 bleeding sites in the femoral artery branch (Fig. 1B); a gel was injected into the sites to block the bleeding (Fig. 1C) and the pain was relieved quickly. Anticoagulation treatment was provided later (low-molecular-weight heparin and warfarin). After 3 days, severe pain developed once again in the injured limb (12 days after operation) and another pseudoaneurysm formation was suspected. Coagulation examination showed the following values: PT: 22.4 s (normal, 10–15 s); international normalized ratio (INR): 1.89 (normal, 0.8–1.5); activated partial thromboplastin time (APTT): 47.0 s (normal, 23–40 s); FDP level: 13.04 mg/L (normal, 0–5 mg/L); FBG level: 5.11 g/L (normal, 2–4 g/L); and D-dimer level: 7.37 mg/L (normal, 0–1.4 mg/L). The second percutaneous intervention revealed bleeding of the lateral circumflex femoral artery branch, and the interventional physician had to block the bleeding using a coil (Fig. 1D–F). Thereafter, anticoagulation treatment was stopped, and no other bleeding episodes occurred. The patient recovered well without complications.

3.2. Case 2

An 85-year-old man suffered from a left subtrochanteric fracture at home. Preoperative ultrasound examination did not reveal DVT. An operation was performed with proximal femoral nail

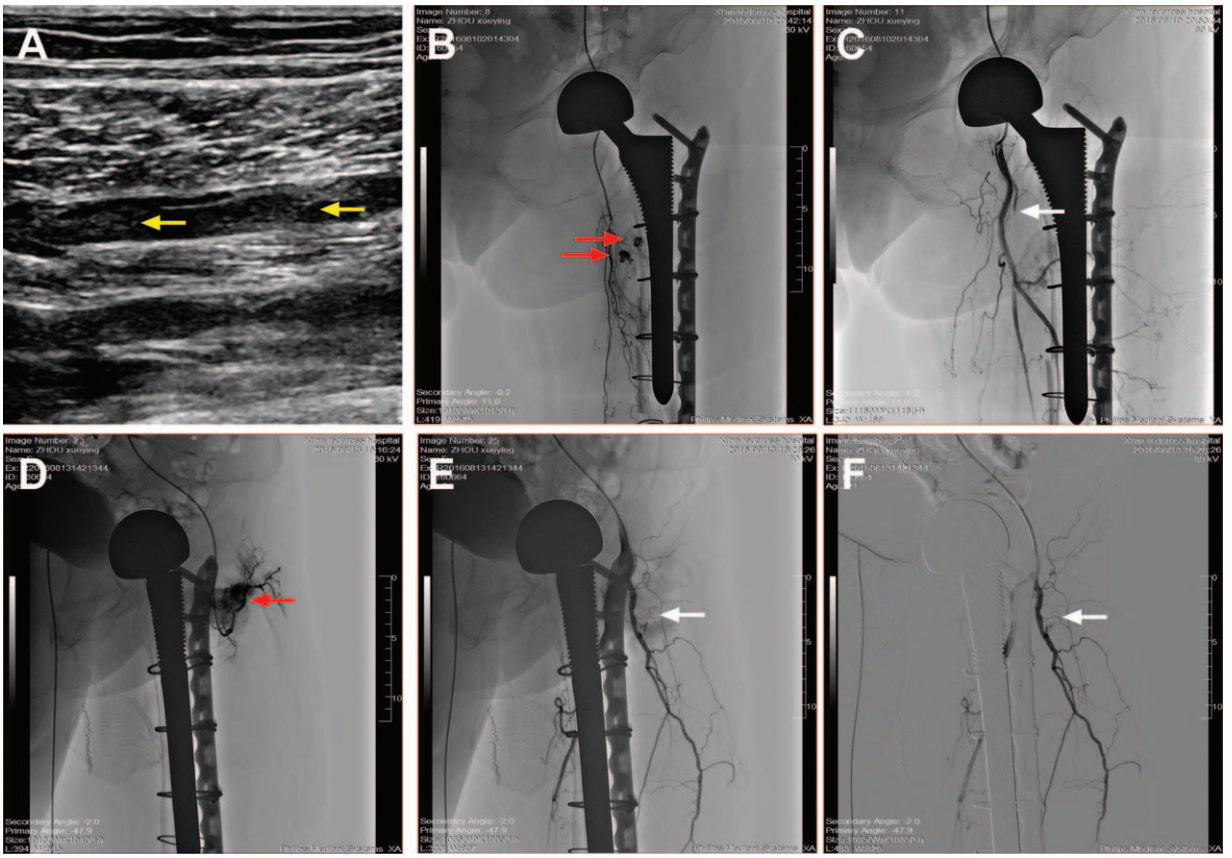

Figure 1. DFA branch pseudoaneurysm formation and injury possibly caused by anticoagulation treatment. A 71-year-old woman, fracture around a prosthesis. (A) DVT was present in the injured lower limb (yellow arrows show the sites). (B) Initial bleeding in the femoral artery branch (red arrows show the sites). (C) Pseudoaneurysm is blocked using a gel (white arrow shows the blocking gel). (D) Second bleeding in the lateral circumflex femoral artery branch (red arrows show the sites) and (E–F) pseudoaneurysm is blocked using a coil (white arrow shows the coil). DFA = deep femoral artery, DVT = deep vein thrombosis.

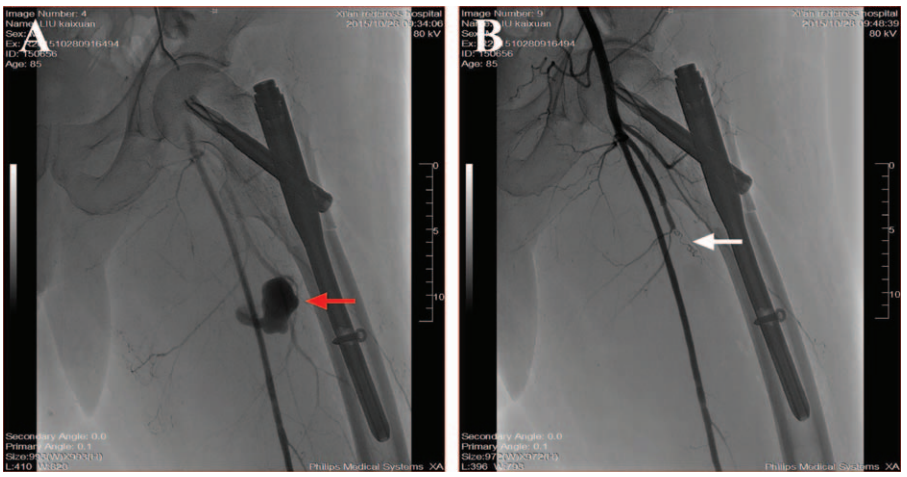

Figure 2. DFA branch pseudoaneurysm formation and injury possibly caused by guide wires. An 85-year-old man, left subtrochanteric fracture. (A) Bleeding in the femoral artery branch (red arrow shows the pseudoaneurysm) and (B) pseudoaneurysm is blocked using a coil (white arrow shows the coil). DFA = deep femoral artery.

placement 7 days after the injury. During the operation, the nail guide wire was inserted twice outside the femur. From the third day after the operation, obvious swelling of the lower limb and perineum ecchymosis occurred; frequent severe pain in the injured limb and repeated anemia also developed. A total of 8.0 U of red blood cells and 400 mL of plasma were transfused. However, the blood test showed that the lowest HGB level was 63 g/L. During the interventional treatment, 1 bleeding site was found in the distal DFA branch (Fig. 2A), and a coil was placed into the vessel to prevent bleeding (Fig. 2B). After the treatment, the pain was relieved quickly and the anemia was corrected. At present, the patient is experiencing a moderate level of dysfunction with no other complications.

3.3. Case 3

An 80-year-old woman experienced a left intertrochanteric fracture while in the street. An operation was performed with proximal femoral nail placement 3 days after the injury. From the second day after the operation, severe pain developed in the injured limb, and the lower limb was swollen. During the interventional treatment, 1 pseudoaneurysm was found in the deep middle femoral artery branch (Fig. 3A), and a coil was inserted into the vessel to prevent bleeding (Fig. 3B). Following treatment, the pain decreased quickly, but the patient was lost to follow-up.

3.4. Case 4

A 43-year-old man experienced an intertrochanteric fracture while in the street. An operation was performed with plate placement 4 days after injury. During the operation, a drill bit was inserted deeply at the medial cortex corresponding to the distal hole of the plate. From the first day after the operation, severe pain developed in the injured limb, and the lower limb had marked swelling. During the interventional treatment, one pseudoaneurysm was found in the deep middle femoral artery branch (Fig. 4A), and a coil was inserted into the vessel to prevent bleeding (Fig. 4B). After the treatment, the pain decreased

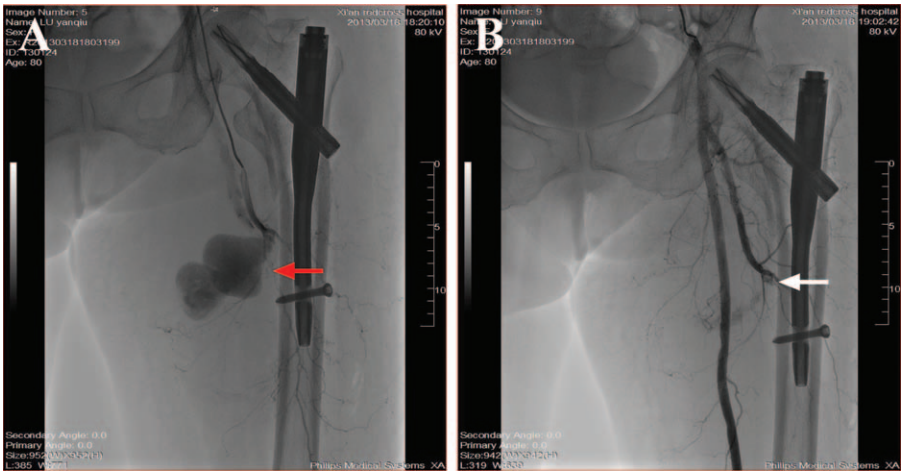

Figure 3. DFA branch pseudoaneurysm formation and injury possibly caused by a displaced lesser trochanter. An 80-year-old woman, left intertrochanteric fracture. (A) Bleeding in the femoral artery branch (red arrow shows the pseudoaneurysm) and (B) pseudoaneurysm is blocked using a coil (white arrow shows the coil). DFA = deep femoral artery.

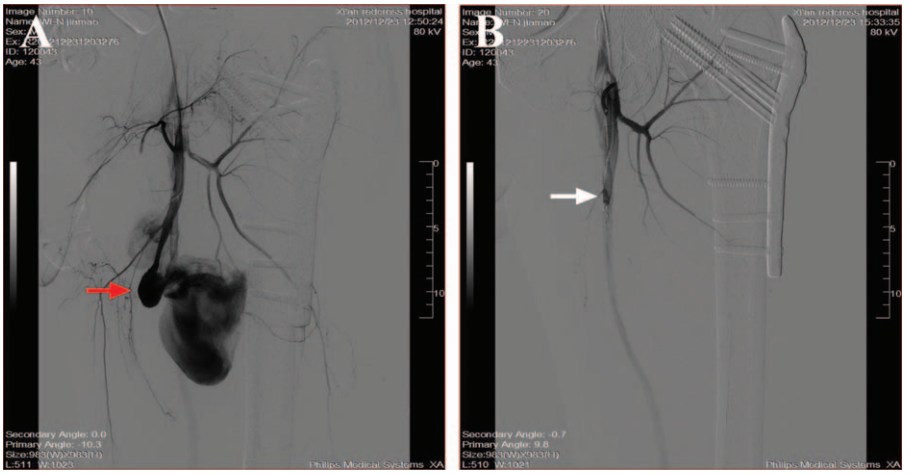

Figure 4. DFA branch pseudoaneurysm formation and injury possibly caused by a drill bit. A 43-year-old man, left intertrochanteric fracture. (A) Bleeding in the femoral artery branch (red arrow shows the pseudoaneurysm) and (B) pseudoaneurysm is blocked using a coil (white arrow shows the coil). DFA = deep femoral artery.

quickly. However, this patient was also lost to follow-up after fracture union.

4. Discussion

The clinical symptoms of DFA injuries after hip fracture vary from marked swelling[13] to pain.[14] In the 4 cases presented herein, the main symptoms were severe pain or swelling with large-scale ecchymosis in the thigh or perineum. Refractory anemia also occurred in Case 2, which is related to pseudoaneurysm formation and blood loss into the interstitial space.

Pseudoaneurysms can be diagnosed on digital subtraction angiography or computed tomography angiogram, which are less invasive than conventional angiography.[15] In these 4 cases, we used arterial duplex for the diagnosis. When aneurysms were identified, a blocking gel or coil was inserted into the body of the pseudoaneurysm. In all cases, the interventional treatment was successful in that the pain was relieved and anemia was managed.

The primary definitive causes of DFA injuries include the following: direct injuries due to fracture fragments [6–8] and a predominantly displaced lesser trochanter; damage due to the over-penetration of a drill bit [12]; prolonged irritation of the blood vessel wall owing to protruding screws [9]; and injuries caused by improperly positioned retractors.[16,17] Depending on the nature of the defect in the vessel wall incurred by the abovementioned factors, the injury will either cause massive bleeding or the formation of a pseudoaneurysm.[17] In the present study, there was a common phenomenon in Cases 2, 3, and 4 in which the obvious body of the pseudoaneurysms could be observed via arterial duplex. In Case 3, we agreed that the pseudoaneurysm was the result of a displaced lesser trochanter fragment following surgery; several previous case reports demonstrated that the lesser trochanter plays a vital role in vascular injuries.[13,18] Case 4 also had an obviously displaced lesser trochanter fragment, and the pseudoaneurysm was located near the fragment. Injury due to over-penetration of a drill bit in the farthest hole was also possible. Therefore, we were unsure of the accurate cause of vessel injury in that case. Case 2 suffered from a subtrochanteric fracture without a displaced lesser trochanter fragment; however, the nail guide wire was inserted twice outside the femur during the operation. Therefore, guide wires are a possible factor contributing to injuries in reduction and internal fixation procedures. For Case 1, we used a long incision for exposure and for the operation. After excluding common causes, we speculate that the DFA may have been damaged by the guide wire used during the surgery; however, it did not show any obvious symptoms and signs. During the treatment of DVT by anticoagulation, bleeding was induced twice in each site, as reported by Luria et al.[19] Thus, matching with suitable strength of anticoagulation in further surgeries is an important tip besides the 10 good tips summarized by Barquet et al.[4]

DFA injury after hip fracture in relation to the anatomy of the femur should also be considered. The DFA and its branches run posteriorly and laterally to the superficial femoral artery separated from the posteromedial site of the subtrochanteric area and fixed by the muscle septa. The reduction of proximal femoral fractures requires traction, adduction, and internal rotation. Traction potentially damages the arteries because of elongation, and it also compresses them between the perineal post and the bone. Most elderly individuals with hip fractures have atherosclerosis, with fragile and more rigid low-flow arteries, making their vessels easily vulnerable to injuries by fracture traction.[8] Adduction and internal rotation also allow the DFA and its branches to be located near the medial aspect of the subtrochanteric femur, making them easily vulnerable to injuries by fracture fragments.[20–22]

From 2012 to 2016, there were 7000 operations performed for hip fracture at least in our hospital. To date, we have collected 4 cases involving damage to the DFA, with an incidence rate of ~0.05%, which is less than those of other reports. This discrepancy may be attributable to missed cases. Barquet et al[4] reported that injuries to the arteries can occur either at the time of fracture, during or after surgery, during early or late postoperative mobilization, or even years after surgery. Thus, the short follow-up duration of the cases presented herein is another possible reason for the low incidence rate.

5. Conclusions

There are many conclusive causes contributing to DFA pseudoaneurysm formation and injuries. The clinical symptoms

of injuries after hip fracture range from marked swelling to pain, and such injuries can be diagnosed by digital subtraction angiography or CT angiogram. A thorough understanding of the anatomy of the femur and the potential damages incurred by reduction operations is necessary.

References

[1] Peeters CM, Visser E, Van de Ree CL, et al. Quality of life after hip fracture in the elderly: a systematic literature review. Injury 2016; 47:1369–82.

[2] Fruhwirth J, Koch G, Mischinger HJ, et al. Vascular complications in minimally invasive surgery. Surg Laparosc Endosc 1997;7:251–4.

[3] Karanikas I, Lazarides M, Arvanitis D, et al. Iatrogenic arterial trauma associated with hip fracture surgery. Acta Chir Belg 1993;93:284–6.

[4] Barquet A, Gelink A, Giannoudis PV. Proximal femoral fractures and vascular injuries in adults: incidence, aetiology and outcomes. Injury 2015;46:2297–313.

[5] Dameron TBJr. False aneurysm of femoral profundus artery resulting from internal-fixation device (screw). J Bone Joint Surg Am 1964;46: 577–80.

[6] Abraham E, Pankovich AM, Jansey F. False aneurysm of the profunda femoris artery resulting from intertrochanteric fracture. A case report. J Bone Joint Surg Am 1975;57:871.

[7] O'Donoghue D, Muddu BN, Woodyer AB, et al. False aneurysm of the profunda femoris artery due to malunion of a hip fracture. Injury 1994;25:681–2.

[8] Ryzewicz M, Robinson M, McConnell J, et al. Vascular injury during fixation of an intertrochanteric hip fracture in a patient with severe atherosclerosis. A case report. J Bone Joint Surg Am 2006;88:2483–6.

[9] Entwisle JJ, De Nunzio M, Hinwood D. Case report: Transcatheter embolization of pseudoaneurysm of the profunda femoris artery complicating fracture of the femoral neck. Clin Radiol 2001;56:424–7.

[10] Nachbur B, Meyer RP, Verkkala K, et al. The mechanisms of severe arterial injury in surgery of the hip joint. Clin Orthop Relat Res 1979;122–33.

[11] Yang KH, Park HW, Park SJ. Pseudoaneurysm of the superficial femoral artery after closed hip nailing with a Gamma nail: report of a case. J Orthop Trauma 2002;16:124–7.

[12] Canbaz S, Acipayam M, Gurbuz H, et al. False aneurysm of perforating branch of the profunda femoris artery after external fixation for a complicated femur fracture. J Cardiovasc Surg (Torino) 2002;43:519–21.

[13] Regus S, Lang W. Arterial injury and pseudoaneurysm formation after lesser trochanter fracture. Int J Surg Case Rep 2015;14:4–6.

[14] Yoon HK, Oh HC, Park J, et al. Rupture of the deep femoral artery during proximal femoral nailing following an intertrochanteric fracture: a case report. Hip Pelvis 2016;28:54–9.

[15] Wixon CL, Philpott JM, Bogey WMJr, et al. Duplex-directed thrombin injection as a method to treat femoral artery pseudoaneurysms. J Am Coll Surg 1998;187:464–6.

[16] Fordyce A. False aneurysm of the profunda femoris artery following nail and plate fixation of an intertrochanteric fracture. Report of a case. J Bone Joint Surg Br 1968;50:141–3.

[17] Singh S, Arora S, Thora A, et al. Pseudoaneurysm of profunda femoris artery following dynamic hip screw fixation for intertrochanteric femoral fracture. Chin J Traumatol 2013;16:233–6.

[18] Sharma G, Singh R, Kumar A, et al. Acute femoral artery pseudoaneurysm due to lesser trochanter fragment: an unusual complication of an intertrochanteric fracture. Chin J Traumatol 2013;16:301–3.

[19] Luria S, Eylon S, Peyser A. Vascular aneurysm secondary to a femoral intertrochanteric fracture concealed by anticoagulation therapy. Isr Med Assoc J 2015;17:777–9.

[20] Grimaldi M, Courvoisier A, Tonetti J, et al. Superficial femoral artery injury resulting from intertrochanteric hip fracture fixation by a locked intramedullary nail. Orthop Traumatol Surg Res 2009;95:380–2.

[21] Chan WS, Kong SW, Sun KW, et al. Pseudoaneurysm and intramuscular haematoma after dynamic hip screw fixation for intertrochanteric femoral fracture: a case report. J Orthop Surg (Hong Kong) 2010;18:244–7.

[22] Yang KH, Yoon CS, Park HW, et al. Position of the superficial femoral artery in closed hip nailing. Arch Orthop Trauma Surg 2004;124:169–72.