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Case Report

Medial Displacement of the Proximal Femur is a Major Risk for Vascular Injury during Cerclage Wiring: A Case Report

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Abstract

Introduction: Vascular injury during cerclage wiring of the proximal femur is a rare but potentially 3 devastating complication. Interest in this technique has increased in the context of increasing numbers 4 of periprosthetic fractures. Based on our case this article discusses the technique and provides 5 recommendations for risk reduction in proximal femoral cerclage application.

Case Presentation: We report a case of a 75-year-old female who sustained vascular strangulation 7 of the superficial and deep femoral artery and the femoral nerve from cerclage wiring of an extended 8 trochanteric and femoral osteotomy for stem removal during a hip arthroplasty revision procedure. 9 Medialized position of the proximal femur during cerclage application led to accidental strangulation of both arteries and the femoral nerve.

Conclusion: Both patient-related and technical factors determine the risk of vascular injury. Special attention must be paid to the position of the femur in relation to the medial structures of the thigh; any kind of medialization increases the risk of vascular and neural injury.

Keywords: Proximal femur cerclage; Revision Hip Arthroplasty; Vascular Injury

Introduction

Cerclage wiring is a well-established technique in the operative management of fractures and might date back as far as 1775 [1]. With the growing number of periprosthetic fractures and the advent of uncemented, tapered stem designs, this technique has gained increased interest [1,2]. The benefits and safety of the technique have been repeatedly described [3]. However, injury to and strangulation of major vessels and adjacent neural structures is the major risk associated with this technique. The incidence of vascular injury due to cerclage wiring along the proximal femoral shaft has been reported at a rate of 1.59% [4-6]. Nevertheless, cerclage wiring of the proximal femur is widely regarded as a safe and reliable procedure. The section of the proximal femur was even identified as the safe zone for its application [7]. We report a case of a 75-year-old patient who experienced a vascular occlusion of the superficial as well as of the deep femoral artery following cerclage wiring at the proximal femur. Based on our case analysis this article discusses this technique and provides recommendations for risk reduction in proximal femoral cerclage application.

Case Presentation

A 75-year-old woman was scheduled for re-osteosynthesis of the right femur and exchange of the femoral shaft component of her total hip arthroplasty. The procedure became necessary due to a progressive painful disfiguration of the right thigh originating from a pseudoarthrosis of the proximal femoral shaft and subsequent progressive varus tilting of the proximal femur. The patient had a history of multiple operative interventions due to an insufficiency fracture through a bone metastasis secondary to breast cancer followed by a composite osteosynthesis and subsequent palliative irradiation after resection of the solitary metastasis. Surgery began via a subvastus approach, removing the existing osteosynthesis composed of a plate fixed with cerclage wires. Cerclages were present around the original stem component, with screws distal to it (Figure 1A). To remove the stem component, a trochanteric osteotomy was performed supplemented by a lateral longitudinal osteotomy of the proximal femur, which allowed the stem to be

detached from the bone and removed. To secure the proximal femur for further surgical steps, a first cerclage was applied in the area of a previously applied cerclage, followed by re-osteosynthesis of the femur with correction of varus malalignment by means of a 16-hole locking compression plate, which was fixed to the femur with 4 cerclages in combination with plate inserts (Inwifix). The operation was completed by implantation of a curved Revitan (16 x 260 + 95mm) modular revision stem and refixation of the greater trochanter with two cerclage wires placed in a figure-of-eight configuration (Figure 1B).

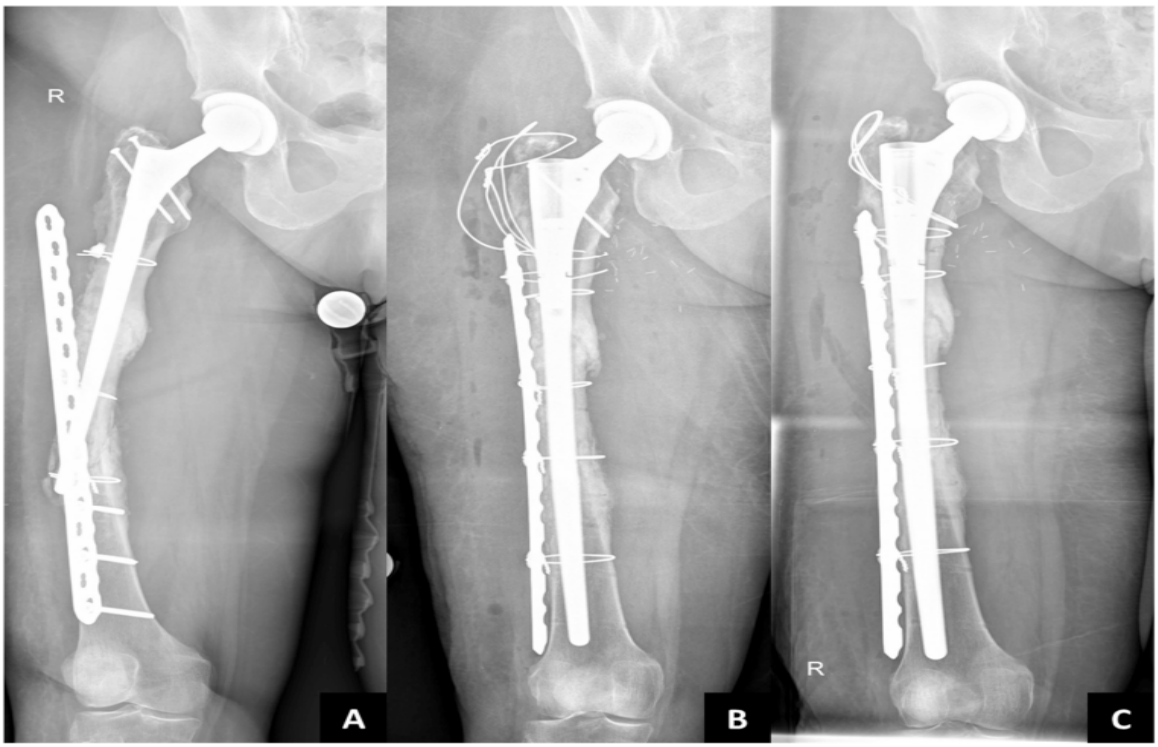

Figure 1: Right hip and full femur anteroposterior radiographs: **A)** Situation before initial operation, showing failed osteosynthesis with pseudoarthrosis in the femoral midshaft and obvious varus malalignment. **B)** Situation after initial operation and vascular surgical intervention, depicting the cut cerclage wires and multiple vascular clips around the proximal femur. The trochanteric cerclages are loose, and the tip of the trochanter shows signs of beginning displacement. **C)** Final situation after revision of the cerclages with restored alignment stabilized with a plate and cerclage osteosynthesis, and a well anchored modular revision stem.

Immediately after surgery, the right leg was cool, pale, and flaccid. After evaluation by computed tomography angiography (CTA) and evidence of complete vessel occlusion around the femoral arteries (Figure 2), the patient was transferred to vascular surgery for revision. Intraoperatively, there was strangulation of both the superficial and deep femoral artery by 4 cerclage wires, the one securing the cortical fragment, the most proximal one, the wire around the plate and the two wires holding the trochanter in place. After severing the cerclages and vascular patch-plasty of both arteries, blood flow to the leg was restored. Radiological control a few days later revealed signs of instability of the greater trochanter, slight subsidence of the stem and widening of the proximal femur necessitating stabilisation (Figure 1B). In the subsequent operation the cut cerclage wires were replaced by two new wires at the level of the proximal femur and two wires for trochanter fixation (Figure 1C). During this procedure the blood flow to the leg was continuously monitored and exhibited stable perfusion throughout the procedure. At the time of discharge from our care to a rehabilitation facility, the quadriceps showed reduced motor activity (M2) and a numbness on the anterior thigh persisted. Strength for dorsal and plantar flexion had fully recovered. The patient was independently mobile on forearm crutches with weight bearing limited to half bodyweight. Written informed consent was obtained from the patient to publish her anonymized data and images prior to publication. Ethical Committee approval was sought where necessary.

Figure 2: Lower extremities computed tomography angiography after the initial operation depicting the strangulation of the right superficial and deep femoral arteries by the most proximal cerclage wires (in grey) securing the trochanter, while the left perfusion remains intact.

Discussion

Latrogenic injury to the neuro-vascular structures of the hip and thigh is a rare but potentially devastating complication during cerclage wiring of the proximal femoral shaft as well as in total hip arthroplasty (THA) [8, 9]. The incidence of vascular injury in THA is reported to be 0.25% and effects usually the external iliac artery, common femoral artery, and the external iliac vein [8,10]. However, the incidence of vascular injury during cerclage wiring of the proximal femoral shaft is reported to be more than six times higher at 1.59% [5]. The involved vasculature also differs and includes the Superficial Femoral Artery (SFA) and the Deep Femoral Artery (DFA) [4-6]. Both of which were involved in our case. Revision procedures are one of the known risk factors for vascular injury in THA [8]. A circumstance that came to bear in our case with multiple prior surgical interventions. In addition, our patient underwent radiation therapy for metastatic breast cancer at the surgical site 6 years earlier. Previous radiation therapy impairs tissue dissection and orientation within the surgical site because of irregular scar formation and sclerosis, thus increasing the risk for surgical complications such as vascular injury. Furthermore, excessive scarring might lead not only to increased stiffness but also to decreased vascular mobility, contributing to potential vascular injury. Experience in other surgical fields tends to confirm this assertion [11,12]. The SFA is the main stem of the blood supply to the lower extremity and runs along the medial aspect of the thigh from anteromedial in the region of the groin, where it arises below the inguinal ligament from the common femoral artery, to posterior, where it transitions into the popliteal artery just proximal to the level of the knee joint line. The second main branch of the common femoral artery is the DFA, which travels straight posteromedially to the proximal femur and supplies blood via several side branches (perforating arteries) to the entire proximal half of the femur. Apivatthakakul et al. could demonstrate in a study of 40 vascularly healthy patients using lower limb run-off CTA that the SFA gets on average not closer to the proximal femur than 22.2 mm and the DFA not closer than 5.8 mm, which should allow for enough space to pass a cerclage wire around the femur. Consequently, they deemed the proximal half of the femur to be the safe zone for cerclage wiring [7].

We identified post hoc the medialized position of the proximal femur during the application of the first cerclage wire as the main cause leading to the accidental strangulation of both arteries and the femoral nerve. The medial position of the proximal femur developed intraoperatively. The removal of the femoral component of the THA in combination with the trochanteric osteotomy let to the proximal femur coming to rest at the level of the teardrop figure and thus in close proximity to the nerve and vessels. In this situation, the first cerclage wire encircled these neurovascular structures, pulling them towards the bone and strangulating them. Subsequent cerclage wires inevitably did the same, resulting in multi-wire, multi- level strangulation.

Similar circumstances with relative medial displacement may also lead to such injuries, for example from valgus impacted proximal femur fractures, from secondary shortening of the femoral neck, or from comminuted fractures of the femoral shaft. Conversely, approximation of the arteries to the femur is conceivable, e.g, during positioning on a fracture table for the treatment of proximal femoral fractures by means of an intramedullary nail [5,8,9,13]. Under such circumstances meticulous dissection and careful cerclage passer advancement is paramount. Still, this might not be sufficient, as in our case even the reuse of the previous cerclage wire pathway by a highly experienced surgeon did not prevent the injury. Therefore, to reduce the risk of nerve and vascular injury, the medialized femur must be lateralized before preparing the pathway for cerclage wires and during their placement, thus increases the distance to the neurovascular structures for save cerclage passage. This can be achieved by manual elevation and lateralisation of the proximal femur with a blunt retractor or an instrument inserted into the medullary canal. In complex cases with increased risk for vascular injury, we recommend continuous monitoring of the peripheral perfusion, as was performed during our revision procedure to remove and replace the cut wires.

Conclusion

Cerclage wiring at the proximal femur is a safe reduction and fixation method. In cases where the proximal femur is medialized or lacks offset for any reason, it is mandatory to increase the distance between the bone and the neurovascular structures. This

can be achieved by lateralizing the femur. If there is an increased intraoperative risk of injury to the neurovascular structures, continuous monitoring of peripheral perfusion is recommended.

References

1. Angelini A, Battiato C (2015) Past and present of the use of cerclage wires in orthopedics. Eur J Orthop Surg Traumatol 25: 623-635.
2. Herzwurm PJ, Walsh J, Pettine KA, Ebert FR (1992) Prophylactic cerclage: a method of preventing femur fracture in uncemented total hip arthroplasty. Orthopedics 15: 143-146.
3. Perren SM, Fernandez Dell'Oca A, Lenz M, Windolf M (2011) Cerclage, evolution and potential of a Cinderella technology. An overview with reference to periprosthetic fractures. Acta Chir Orthop Traumatol Cech 78: 190-199.
4. Aleto T, Ritter MA, Berend ME (2008) Case report: superficial femoral artery injury resulting from cerclage wiring during revision THA. Clin Orthop Relat Res 466: 749-753.
5. Devendra A, Avinash M, Chidambaram D, Dheenadhayalan J, Rajasekaran S (2018) Vascular injuries due to cerclage passer: Relevant anatomy and note of caution. J Orthop Surg 26: 2309499018762616.
6. Mehta V, Finn HA (2005) Femoral artery and vein injury after cerclage wiring of the femur: a case report. J Arthroplasty 20: 811-814.
7. Apivatthakakul TP, Siripipattanamongkol CW, Sananpanich K, Phornphutkul C (2018) Safe zones and a technical guide for cerclage wiring of the femur: a computed topographic angiogram (CTA) study. Arch Orthop Trauma Surg 138: 43-50.
8. Shoenfeld NA, Stuchin SA, Pearl R, Haveson S (1990) The management of vascular injuries associated with total hip arthroplasty. J Vasc Surg 11: 549-555.
9. Won YKH, Yang KK, Kim MJ, Weaver, EM Allen (2016) Amputated limb by cerclage wire of femoral diaphyseal fracture: a case report. Arch Orthop Trauma Surg 136: 1691-1694.
10. Nachbur B, RP Meyer, K Verkkala, R Zurcher (1979) The mechanisms of severe arterial injury in surgery of the hip joint. Clin Orthop Relat Res 1979: 122-133.
11. Fosnot JJP, Fischer JMJ, Smartt DW, Low SJI, et al. (2011) Does Previous Chest Wall Irradiation Increase Vascular Complications in Free Autologous Breast Reconstruction? Plastic and Reconstructive Surgery 127: 496-504.
12. Gotto GT, Yunis LH, Vora K, Eastham JA, Scardino PT, et al. (2010) Impact of Prior Prostate Radiation on Complications After Radical Prostatectomy. Journal of Urology 184: 136-142.
13. Manner MB. Rosch, K. Roy (1999) Vascular injuries complicating osteosynthesis in proximal femur fractures]. Unfallchirurg 102: 227-231.