Vascular Injury after Osteotomy around Knee
(Case Report)

Abstract
Lower limb malalignment around the knee may be a risk factor of knee osteoarthritis (OA) progression. A surgical treatment method for preventing OA progression is osteotomy and one of the rare side effects of this surgery is injury to the arteries. We present three cases, two men (24 and 42 years old) and one woman (15 years old) who were diagnosed with lower limb malalignment and received high tibial or distal femoral osteotomies and were complicated with arterial injury. Delay in diagnosis of the injury varied from about an hour to about one month after surgery.
Keywords: Bone malalignment, Osteotomy, Popliteal artery.

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Introduction

Lower limb malalignment around the knee is an independent risk factor of knee osteoarthritis (OA) and its progression[1,3]. One of the surgical treatment methods for preventing OA is osteotomy[7] which is done by different methods in distal femur and proximal tibia depending on the deformity type[2,4].

High tibial osteotomy (HTO) is a common treatment option for symptomatic isolated OA of the medial femorotibial compartment that includes medial open wedge osteotomy, lateral closed wedge osteotomy, arch osteotomy, and oblique osteotomy, of which the most used are the former 2 techniques[5,6]. The most common complications of the medial opening-wedge technique are infection, deep vein thrombosis, loss of reduction, fracture of the lateral tibial plateau and delayed- or non-union of the tibial osteotomy[8] Some other rare complications are compartment syndrome and injuries of the popliteal neurovascular bundle[9,10].

Although several studies of popliteal artery injury during osteotomy have been reported[11-14], but in most studies, popliteal artery injury have not been delayed or asymptomatic. Therefore, in this study, we will present three cases in which popliteal artery injury after osteotomy was delayed and asymptomatic in two of them and in one case it was immediate.

Case report

Case 1

The patient is a 24-year-old male with bilateral genuvarum deformity who was a candidate for high tibial osteotomy by medial opening-wedge technique. After preparation, he underwent surgery and deformity corrected by tomofix plaque and locking screws. During the operation, fluoroscopy was used to check the correction and position of the screws which were favorable so the fascia and skin were closed by routine method.

The tourniquet was released after completion of the surgical procedure and patient was transferred to the ward with normal neurovascular examination of the distal limb and was discharged on the second day after the operation. Two weeks later at the clinic, he had slight pain at the proximal site of the leg and dehiscence at the site of the surgical wound and ecchymosis in the medial and posterior part of the knee; But the patient's pulse and the leg compartments were normal. He was admitted for the possibility of infection and the next day she underwent debridement and washing of the surgery site in the operating room and antibiotics were started for him.

The culture result was negative three days later so the patient was discharged with relative improvement. Upon return to the clinic in the second week after discharge, there was relative swelling behind the knee in the lateral part, but there was no neurovascular disorder and the wound was healed. The patient underwent color Doppler ultrasound of the lower extremity vessels, which showed a mass of vascular origin with the possibility of arterial aneurysm in the peroneal artery.

He was admitted immediately and consulted for vascular surgery. In the angiographic examination, a false aneurysm of the peroneal artery branch with a diameter of 2 * 2 cm was reported. Arterial repair surgery was done by vascular surgeon and he was discharged from the hospital after the wound healed.

Case 2

A 42-year-old male patient with bilateral genuvarum deformity who underwent high tibial osteotomy by medial opening-wedge technique. Tomofix plaque was used with locking screws for fixation of the ostomy site. following completion of surgery, the tourniquet was deflated and he was checked in the recovery room that the distal pulse examination was normal. About thirty minutes later he was checked again which the pulses of posterior tibial artery (PTA) and dorsalis pedis artery (DPA) dropped compared to the opposite side also pulse oximeter showed decreased in PaO2. In the operating room, she underwent emergency ultrasound, which was monophasic in the spectral examination of the above artery waves. Then, with suspicion of arterial injury, she underwent emergency angiography. Due to the popliteal artery injury behind the knee and intra-arterial thrombosis, she underwent vascular surgery and arterial graft repair. In this patient, a part of the bone, behind the tibia and at the site of the osteotomy, perforated the arterial wall and damaged the vascular endothelium.

Case 3

A 15-year-old female patient, known case of bilateral genuvalgum deformity (Figure 1) and a candidate for correction surgery by distal femur osteotomy (medial close-wedge technique). She underwent surgery and deformity correction by medial angle-blade plate with displacement (Figure 2). During the operation, the correction and position of the screws was check by fluoroscopy, then the fascia and skin were repaired by routine method. after completion of the surgery the tourniquet was released. she was checked in the ward about 6 hours later that neurovascular examination was normal. At the next day after surgery, she had complaint of pain but in physical exam neurovascular were normal with mild swelling. Due to the normal findings, patient was discharged two days after surgery. Two days after that she came back to emergency ward complaining of severe pain and swelling, physical exam was done in which distal pulses were undetectable. Color-doppler sonography performed that showed a hypoecho area around popliteal artery (proposing hematoma) and absence of blood flow in PTA and DPA. Vascular surgery consult was requested which asked for CT-angiography which reported absence of blood flow in following of popliteal artery (Figure 3), then she underwent embolectomy and vascular repair, also fasciectomy was done because of compartment syndrome occurring which led to peroneal and tibial nerve damage.

Figure 1: Alignment view, preop

Figure 2: Postop X-Ray

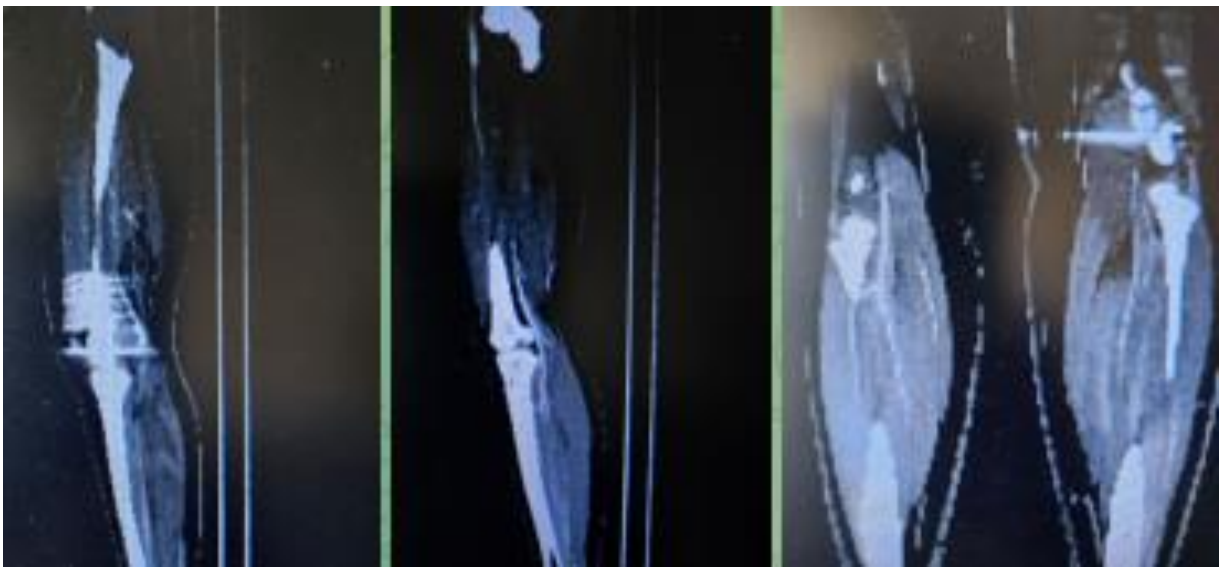

Figure 3: Cronal and sagittal views from both lower limbs

Discussion

Various types of complications may occur after osteotomies around the knee, vascular injury, compartment syndrome, VTE, neurologic injuries and etc. The most common vascular injuries are intra-operative bleeding and subsequently acute ischemia, non-healing wounds, and limb oedema[16]. In orthopedic procedures, the most common iatrogenic vascular injury occurs in the popliteal artery[15]. K. Bernhoff et al reported an incidence of 0.05% associated popliteal artery injury after HTO, these injury's detection time vary from immediate (due to bleeding) to 29 days after surgery (because of pseudo-aneurysm) also a compartment syndrome was detected after 48 hours[17].

In this article we described three cases with vascular injury which two of them were asymptomatic for few days. Early diagnosis of injury is important in preventing more complications, for instance in the case 3 the arterial injury led to a chronic compartment syndrome with irreversible consequences. Studies shows greater than 12 hours delay always results in poor outcome and regular post-operative distal pulse examination remains an essential observation. Patients who suffered from vascular injury during an elective surgery are more likely to pursue litigation[18,19].

Conclusion

Although popliteal artery injuries are uncommon but may cause catastrophic results. Time of diagnosis and repair of the vascular injury is crucial for limb salvage. Outcome is better when the injury is detected early in the operation room and repair is instant. Delay in diagnosis and surgical reconstruction, increases the risk of complication so as an approach to the early diagnosis and the improvement of outcome during injury we suggest regular documented post-operative assessment of peripheral pulses and circulation, use of pulse oximeter in case of any suspected weak pulse, warning the patients for special attention to alarm signs of vascular injury to immediate refer to hospital.

References

1 Tanamas SK, Hanna FS, Cicuttini FM, Wluka AE, Berry P, Urquhart DM. Does knee malalignment increase the risk of development and progression of knee osteoarthritis? A systematic review. Arthritis Rheum. 2009;61(4):459-467. doi:10.1002/art.24336.
2 Brouwer GM, van Tol AW, Bergink AP, Belo JN, Bernsen RM, Reijman M, et al. Association between valgus and varus alignment and the development and progression of radiographic osteoarthritis of the knee. Arthritis Rheum. 2007;56(4):1204-1211. doi:10.1002/art.22515.
3 Gardiner A, Richmond JC. Osteotomies about the knee for tibiofemoral malalignment in the athletic patient. Am J Sports Med. 2010;38(5):1038-1047. doi:10.1177/0363546509335193.
4 Gardiner A, Richmond JC. Osteotomies about the knee for tibiofemoral malalignment in the athletic patient. Am J Sports Med. 2010;38(5):1038-1047. doi:10.1177/0363546509335193.
5 Webb M, Dewan V, Elson D. Functional results following high tibial osteotomy: A review of the literature. Eur J Orthop Surg Traumatol. 2018;28:555-563. doi:10.1007/s00590-017-2112-8.
6 Hoorntje A, Witjes S, Kuijer PPFM, Koenraadt KLM, van Geenen RCI, Kerkhoffs GMMJ, et al. High rates of return to sports activities and work after osteotomies around the knee: A systematic review and meta-analysis. Sports Med. 2017;47:2219-2244. doi:10.1007/s40279-017-0726-y.
7 Sabzevari S, Ebrahimpour A, Roudi MK, Kachooei AR. High tibial osteotomy: A systematic review and current concept. Arch Bone Jt Surg. 2016;4(3):204-212. PMID: 27517063; PMCID: PMC4969364.
8 Miller BS, Downie B, McDonough EB, Wojtys EM. Complications after medial opening wedge high tibial osteotomy. Arthroscopy. 2009;25(6):639-646. doi:10.1016/j.arthro.2008.12.020.
9 Motycha T, Eggerth G, Landsiedl F. The incidence of thrombosis in high tibial osteotomies with and without the use of a tourniquet. Arch Orthop Trauma Surg. 2000;120(3-4):157-159. doi:10.1007/s004020050034.
10 Howell GE. Case report: avascular necrosis of the proximal tibia following upper tibial osteotomy. J R Nav Med Serv. 1997;83(3):127-129. https://doi.org/10.1136/jrnms-83-127.
11 Rubens F, Wellington JL, Bouchard AG. Popliteal artery injury after tibial osteotomy: report of two cases. Can J Surg. 1990;33(3):294-297. PMID: 2383838.
12 Tandon SC, Kharbanda Y, Fraser AM. Aneurysm complicating high tibial osteotomy. Acta Orthop Scand. 1996;67(1):73-74. doi:10.3109/17453679608995615.
13 Georgoulis AD, Makris CA, Papageorgiou CD, Moebius UG, Xenakis TA, Soucacos PN. Nerve and vessel injuries during high tibial osteotomy combined with distal fibular osteotomy: a clinically relevant anatomic study. Knee Surg Sports Traumatol Arthrosc. 1999;7(1):15-19. doi:10.1007/s001670050114.
14 Zaidi SH, Cobb AG, Bentley G. Danger to the popliteal artery in high tibial osteotomy. J Bone Joint Surg Br. 1995;77(4):449-451. https://doi.org/10.1302/0301-620X.77B3.7744920.
15 Freischlag JA, Sise M, Quinones-Baldrich WJ. Vascular complications associated with orthopedic procedures. Surg Gynecol Obstet. 1989;169(2):147-152. PMID: 2667173.
16 Wilson JS, Miranda A, Johnson BL, Shames ML, Back MR, Bandyk DF. Vascular injuries associated with elective orthopedic procedures. Ann Vasc Surg. 2003;17(6):641-644. doi:10.1007/s10016-003-0074-2.
17 Bernhoff K, Björck M. Iatrogenic popliteal artery injury in non-arthroplasty knee surgery. Bone Joint J. 2015;97-B(2):192-196. doi:10.1302/0301-620X.97B2.34353.
18 Rudström H, Bergqvist D, Ogren M, Björck M. Iatrogenic vascular injuries in Sweden; a nationwide study 1987-2005. Eur J Vasc Endovasc Surg. 2008;35(2):131-138. doi:10.1016/j.ejvs.2007.09.010.
19 Rudström H, Bergqvist D, Ahlberg J, Björck M. Insurance claims after vascular surgery in Sweden. Eur J Vasc Endovasc Surg. 2011;42(4):498-505. doi:10.1016/j.ejvs.2011.04.026.