Musculoskelet Surg (2013) 97:183–186
DOI 10.1007/s12306-011-0163-2

CASE REPORT

Pseudoaneurysm of the peroneal artery: an unusual complication of open docking site procedure in bone transport with Taylor Spatial Frame

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Received: 12 January 2011 / Accepted: 22 July 2011 / Published online: 5 August 2011

Abstract A docking site is the terminus of travel of two segments of bone that are gradually brought into approximation, normally associated with the bone transport technique in limb reconstruction. Traumatic pseudoaneurysm of the peroneal artery have been reported following different types of trauma and orthopedic procedures performed in the distal leg. One uncommon case of delayed peroneal artery pseudoaneurysm following surgical docking site is described. The diagnosis was supported by angiography. Embolization with coil was a successful method of treatment. We recommend a safe method of osteotomy with good bone exposure and adequate soft tissue protection.

Keywords Bone transport · Taylor Spatial Frame · Docking site · Tibia · False aneurysm of the peroneal artery

Introduction

A docking site is the terminus of travel of two segments of bone that are gradually brought into approximation, normally associated with the bone transport technique in reconstructive surgery.

Traditional Ilizarov approach consisted of simple compression of these tissues after the end of the bone transport, eventually associated with periods of distraction to stimulate osteogenesis [1, 2, 5]. More recently, however, some groups have expressed concern about the healing potential of this technique, and osteotomy of the docking ends with removal of the interpositioned tissue, frequently associated with bone grafting has been proposed [3, 7]. In this way, bone repair is brought back to what occurs in a fresh fracture, and the consolidation is considered more predictable. There are however, potential risks for skin closure, vascular damage bony extremities realignment during the procedure. Soft tissue closure is often difficult due to acute shortening of the ends of the bones and sinuses old scars. Transverse and Z-plasty incisions at the docking site allowing easy surgical skin closure [10]. Trauma to the leg or ankle is the most common cause of such pseudoaneurysms specifically of the peroneal artery. It has been documented in ankle sprain with soft tissue injury, penetrating or blunt injury and malleolar fracture of the ankle [6]. Iatrogenic causes have also been described including thrombo-embolectomy using a fogarty balloon catheter or after femoro-peroneal bypass grafting [11]. We report one case of traumatic peroneal false aneurysm and describe a safe method for managing such injury.

Case report

A nineteen-year-old man was involved in a motorcycle accident and presented to the emergency department of our hospital with a Gustilo Anderson grade-IIIB and AO type-42B1 open fracture of the right tibia. The wound was irrigated and debrided, and a Pro-callus monolateral frame (Orthofix, Richardson, TX, USA) was applied (Fig. 1). Ischemia of the right foot was suspected, and the patient was transferred to the vascular surgery unit. He was kept under observation for 5 days and then was transferred back

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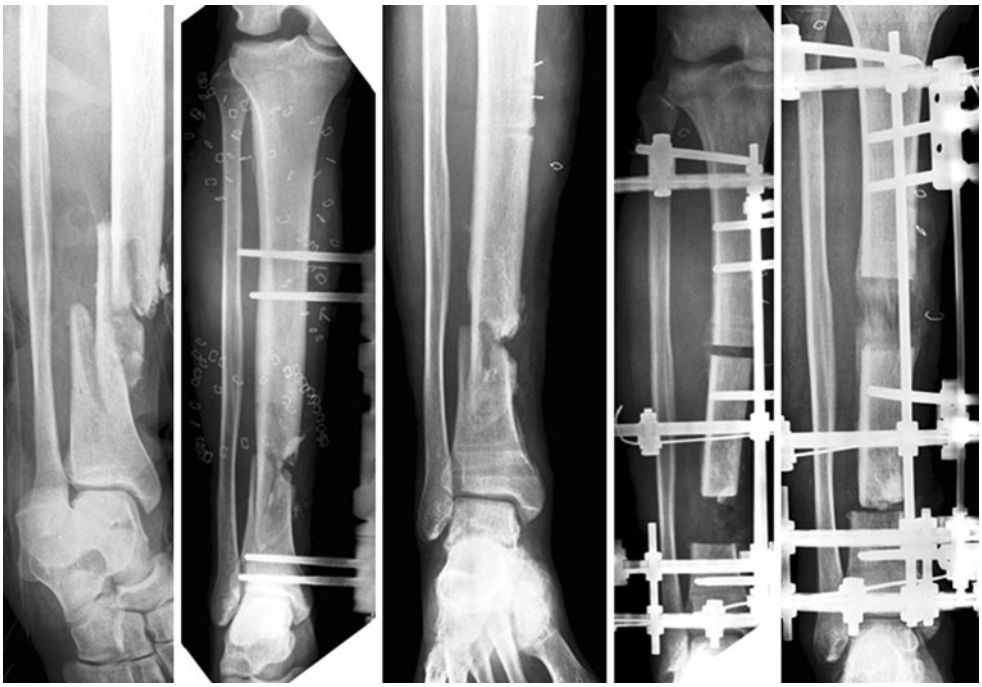

Fig. 1 Nineteen-year-old man with infected tibial nonunion in a 42B1 type III B Gustilo fracture treated with previous monolateral frame. The patient had a bifocal antegrade bone transport with Taylor Spatial Frame

to the orthopedic department of our hospital, where repeated wound debridements, vac therapy and skin grafting were done. The patient was discharged with instructions to return for regular follow-up visits at the outpatient clinic, but he needed to be readmitted after 7 months. On admission, to our unit, radiographs of the fracture revealed nonunion of the tibia, involving the distal diaphyseal region (Fig. 1). He had bone and wound infection complication with a positive culture for pseudomonas stutzeri isolated organisms. He was treated with prolonged systemic antibiotic therapy. The patient was brought back to the operating room, the external fixator removed and applied a preassembled Taylor Spatial Frame (TSF) (Smith and Nephew, Inc., Memphis, Tennessee) for bifocal antegrade bone transport. The construct was formed of one two-third-ring (perpendicular to the bone axis) for fixation of the proximal part of the tibia with one wire and three half-pins. Other two two-third-rings (perpendicular to the bone axis) fixed to the bone with five wires and one half-pin were used distally. An intermediate two-third-ring fixed perpendicularly to the bone with one wire and one half-pin was applied for bone transport in the distal directions. The Ilizarov rods were used for transport. Six millimeters hydroxyapatite-coated half-pins (Orthofix, Richardson, TX, USA) were used to avoid early pin loosening. All loose, exposed, and devitalized bone fragments were removed from the wound, after which one separate osteotomy was performed (percutaneously with a Gigli saw) in the middle fragment. Thus, one transport segment was created on a central fragment (which was fixed to the central TSF ring) for subsequent bone transport in distal direction to close the distal bone defect (Fig. 1). Early knee, ankle and forefoot motion was encouraged as tolerated, and pin-site care with hydrogen peroxide and povidone iodine was started on the first postoperative day. After a latency period of 14 days, bone transport was started. The segment was transported downward at a rate of 0.25 mm twice daily. Clinical and radiographic evaluations were done every month until the end of the follow-up period. The rate of bone transport was modified according to the quality of the regenerated bone. Fibrocartilaginous tissue capped the ends of bone at the docking with invagination of skin and subdermal tissues. Segmental excision of the fibula was accomplished. An incision was made over the docking region and the bone ends identified. The fibrous caps were removed and the medullary canals reopened through curettage and drilling. The periosteal surface was superficially decorticated and two transverse osteotomies of the bone extremities were transected using an osteotome to ensure good contact over a large surface area (Fig. 2). Iliac crest bone grafting was performed to promote healing. No complications were noted either during the operation or immediately after surgery. The patient was discharged but he needed to be readmitted after 2 weeks because he presented pain and he started to bleed profusely from the docking wound with the appearance of a large leg swelling. The hemoglobin level

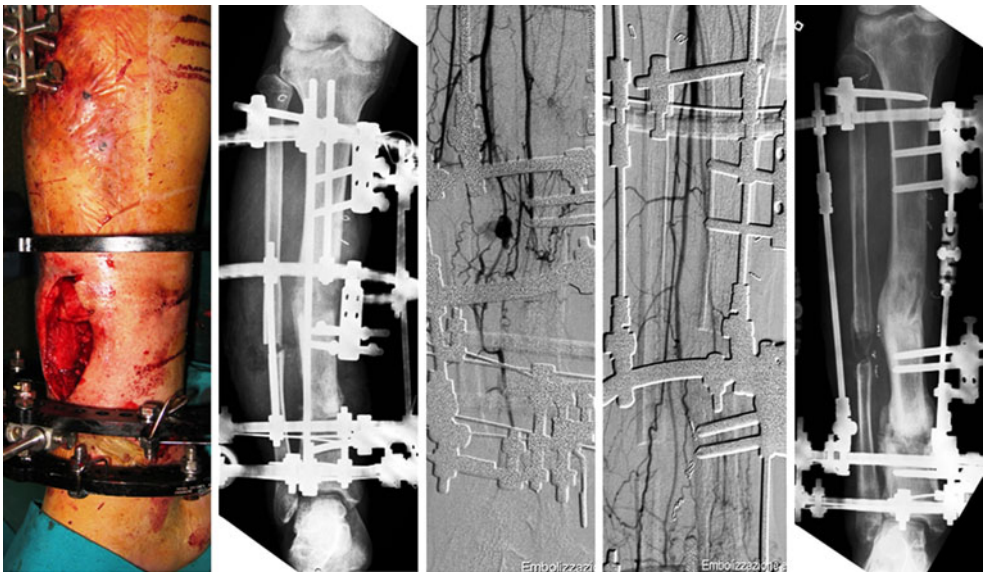

Fig. 2 From *left* to *right* images show the patient at the time of surgical docking site, during angiography and before removal the frame. Angiography shows a false aneurysm arising from the peroneal artery and after successful embolization from *above* and *below* using coils

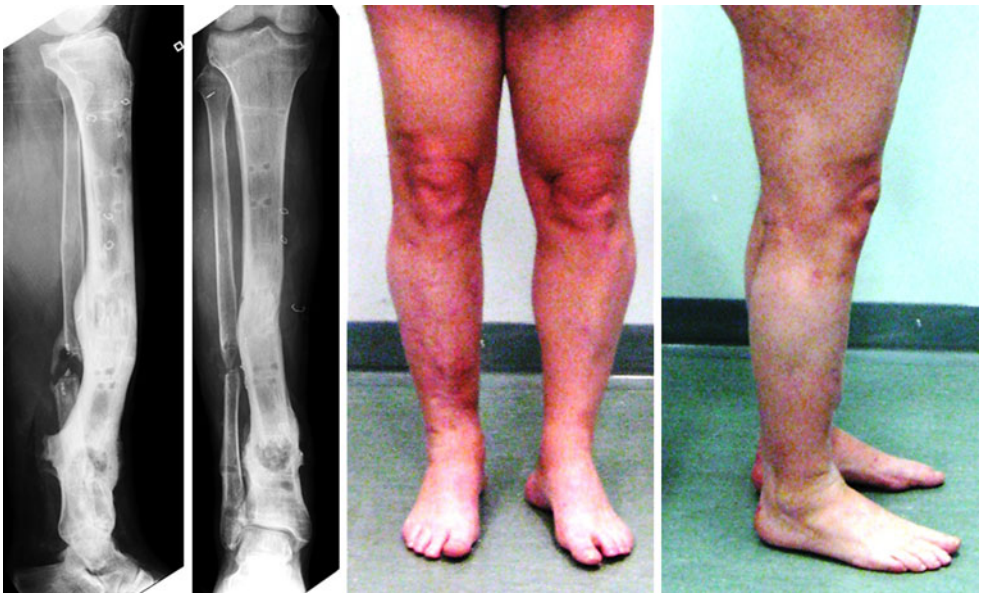

Fig. 3 From *left* to *right* images show, Lateral and AP radiographs with good consolidation of the docking site and clinical outcome. Treatment strategy = bifocal antegrade bone transport. Treatment time = 12 months. Lengthening = 68 mm. Lengthening index = 1.76 (mo/cm)

fell from 12.5 to 8.7 g/dl in 24 h. It was non-expansible, warm and tender. All peripheral pulses were present. Angiography performed on the same day showed a traumatic peroneal false aneurysm at the site of osteotomy (Fig. 2). The vessel was successfully and selectively embolized from above and below using glue (N-butyl-2-cyanoacrylate) (Fig. 2). No flow was detectable by ultrasound afterward. After the patient was returned to the ward, the injured extremity was elevated and care was taken to monitor intracompartmental pressure. Distal arterial pulses were monitored with a portable Doppler unit and transcutaneous oxygen was monitored. Intravenous antibiotic was continued for 24 h. The patient made a good recovery and was discharged from the hospital 7 days later to continue lengthening. The total time in the fixator was 365 days, the bone transport was 6.8 cm and the index lengthening (mo/cm) was 1.76. At the time of the 3-years follow-up visit, his clinical examination was normal and a radiograph of his leg showed a completely united docking site and a solid bony consolidation of the regenerate bone (Fig. 3).

The patient had no clinical infection, skin defect, deformity, or limb-length discrepancy. There were excellent range of motion of the knee and ankle, and the patient was bearing full weight without pain and had returned to work. He did give up soccer. The range of motion of the right knee was 0–150. The right ankle had 20 of dorsiflexion and 30 of plantar-flexion. Dorsiflexion strength of the right ankle was grade four of five with use of the manual muscle testing method (in which a grade of five indicates normal strength), and plantar-flexion strength was grade five of five.

Discussion

In classic bone transport, there is a higher proportion of union at the docking site when treated using open technique instead of closed technique [1, 7]. The rationale for this strategy is removal of interpositioned tissue and recreating a "fresh" fracture of the two opposed bone ends. Arterial damages are an important and unusual complication. It could happen because of displaced implants, tip of the screws, drills, bone spikes, retraction of surrounding tissue, and transverse resection of the bone ends [9, 13]. False aneurysms occur as a result of damage to the arterial wall. Hemorrhage is contained within the tissue spaces and subsequent liquefaction leaves a cavity with direct arterial communication. This cavity is prone to rupture [12]. The time to diagnose in our case was short. The follow-up is important for early diagnosis of pseudoaneurysm. Leg swelling, bleeding from the wound and falling hemoglobin level were the important warning signs after the operative procedures [12]. The mechanism of injury was not clear. The anatomical site suggests that arterial damage occurred during the osteotomies whereby segmental excision of the fibula and two bony tibial cuts were performed to shorten and to change the alignment of the leg. Further, soft tissue disruption caused by distraction and bone realignment may initiate symptoms. This condition may be inevitable although meticulous surgical technique. Osteotomies also differ in the extent of surgical exposure necessary to complete them. With larger exposure and greater dissection, the risk of injury to vascular and osteogenic tissue is increased [8]. The deleterious effect of greater exposure can be diminished by carefully preserving soft tissue sleeve surrounding the bone. The energy used to transect the bone is an additional factor that influences the viability of the osteotomy site. Low energy method includes both osteotomes and the Gigli saw [8]. Embolization of traumatic peroneal false aneurysm is proved to be a successful method of treatment, requiring no further intervention at the operation site. It is a conventional vascular practice to occlude the artery with metal coils both above and below the neck of the aneurysm in order to stop reperfusion from retrograde flow. Delayed diagnosis is associated with a greater magnitude of postoperative problems such as infection in adjacent soft tissue or bone [4]. Due to the rarity of the condition, if there is doubt regarding the possibility of an aneurysm the insertion of an endovascular stent with or without angiographic embolization is possible for many of these lesions, and it can be accomplished readily by an experienced interventional radiologist in modern trauma center.

Conflict of interest No one of authors have received financial support related to this study.

Ethical statement The Current study was approved by Ethical Board Review of Niguarda's Hospital, Milan, Italy.

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