Vascular complications of osteotomies in limb reconstruction

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Osteotomies are commonly carried out in orthopaedic surgery, particularly in limb reconstruction. Complications are uncommon provided that sufficient care is taken and a sound technique used. We describe three cases of formation of false aneurysm after osteotomy, with acute, delayed and asymptomatic onset. The diagnosis was supported by ultrasound investigation, and confirmed by angiography. Embolisation with coils was a successful method of treatment. We recommend a safe method of osteotomy with good bone exposure and adequate soft-tissue protection.

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Limb lengthening is an accepted procedure for the correction of congenital and acquired discrepancy. Many reports have been published on the various techniques for this procedure¹ and the possible complications which may occur.²⁻⁴ The original methods of bone division described by Ilizarov and Deviatov⁵ and later De Bastiani et al,⁶ involve an incomplete corticotomy, using either osteotomes or drills. Closure is completed by osteoclasia using a rotational movement of the fixation device. This technique theoretically reduces damage to the medullary canal, nutrient vessels and the surrounding soft tissues. It does, however, involve uncontrolled rotation of the bone ends.

In order to reduce further the potential for damage we recommend a technique which involves drilling both cortices with the fixator applied and the bone under tension. The osteotomy is then completed with a small osteotome in such a way that the bone is divided without the osteotome protruding through the distal cortex.^{1,7} This technique

appears to be precise and safe in our experience of over 1000 osteotomies.

There is, however, a potential for vascular damage during the procedure and we report three cases which illustrate this and describe a safe method for managing such injury.

Case reports

Case 1. A 17-year-old boy with achondroplasia had bilateral lengthening of the femora and tibiae, but the progress of the right femur was unsatisfactory. A monolateral external fixator was therefore reapplied. A second osteotomy was carried out at the original site and lengthening commenced. No complications were noted either during the operation or immediately after surgery. Approximately four weeks later the patient presented with pain and swelling in his right upper and inner thigh. The swelling measured 12 × 7 cm. It was non-expansile, warm and tender. All peripheral pulses were present. Ultrasonography showed a large cystic mass 10 × 5 cm in size.

Angiography showed a large false aneurysm arising from the profunda femoris artery at the site of the osteotomy (Fig. 1a). The vessel was successfully embolised from above and below using Gianturco coils (Fig. 1b). No flow was detectable by ultrasound afterwards. The patient made a good recovery and was discharged five days later to continue lengthening.

Case 2. A 55-year-old man had sustained an unstable fracture of his right tibia and fibula in a fall. The fracture was treated by open reduction and internal fixation using a plate and screws. He developed osteomyelitis, which required resection of bone with the application of a monolateral external fixator. Six years later a further segment of infected bone was resected using a circular frame with a proximal osteotomy for bone transport. During this procedure pulsatile bleeding was noted which stopped after a period of tourniquet pressure. The patient was seen by the vascular surgeons, who recommended careful observation. Over the next few days the foot remained warm and sensation returned.

Ultrasonography suggested the presence of a false aneurysm. This was shown by angiography to arise from the tibioperoneal trunk (Fig. 2). Because of the pre-existing infection and previous loss of distal vasculature a below-knee amputation was carried out.

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Fig. 1a

Fig. 1b

Case 1. Angiograms showing a) a false aneurysm arising from the profunda femoris artery at the site of the osteotomy and b) no flow after successful embolisation from above and below using Gianturco coils.

Fig. 2

Case 2. An angiogram showing a false aneurysm of the tibioperoneal trunk.

Fig. 3

Case 3. An angiogram showing a false aneurysm in the area of the anterior tibial artery.

Case 3. A 14-year-old boy presented with shortening of the right leg because of congenital abnormalities. An external fixation device was applied to his right tibia and an osteotomy carried out to lengthen the limb. Two months later a small defect was noted in the callus formation within the distraction gap. Ultrasonography showed a small pulsating area and arteriography indicated the presence of a false aneurysm in relation to the anterior tibial artery (Fig. 3).

Again, this was successfully embolised from above and below using Gianturco coils. Satisfactory lengthening and mobilisation were achieved.

Discussion

While we accept that these are unusual cases, we believe that this important complication could arise from any

osteotomy. The proximal femur and tibia are popular sites for osteotomies for limb lengthening, typically around 5 cm below the lesser trochanter or tibial tuberosity. At these levels there are vessels close to the bone and drilling in their direction should be avoided. False aneurysms occur as a result of damage to the arterial wall. Haemorrhage is contained within the tissue spaces and subsequent liquefaction leaves a cavity with direct arterial communication. These cavities are prone to rupture. Of the three cases described, two presented with acute symptoms, one immediate and one delayed, and one was subacute and asymptomatic. All three were detected by ultrasonography and embolisation proved to be a successful method of treatment, requiring no further intervention at the operation site. It is 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.

The mechanism of injury was not clear. The artery may have been damaged directly by the drill, by a fragment of bone, or torn by continued distraction. The anatomical site suggests that arterial damage occurred during the osteotomy. Further soft-tissue disruption caused by distraction may initiate symptoms. Under normal circumstances as the drill protrudes through the distal cortex, but before it is halted by the drill stop, any surrounding tissues including vessels are mobile enough to slide out of its way. In case 1 it is possible that, after the osteotomy, scar tissue formed which then tethered the soft-tissue structures. The resultant decrease in their mobility increased the risk of damage during subsequent procedures. In older patients, as in case 2, the vessels may be less mobile due to atheromatous changes. With upper tibial osteotomy (case 3) the risk of

vascular damage is increased, since the tibial trifurcation is naturally less mobile.

We make several recommendations as a result of our experience. Adequate soft-tissue protection must be obtained during the osteotomy, encircling the bone if possible using instruments such as bone levers. Carrying out the osteotomy under tension^{1,6,7} removes the need to complete division of the bone with instruments, while the use of drill stops minimises protrusion of the drill through the distal cortex. Surgeons must be aware of the relevant anatomy, especially the anatomical site of the profunda femoris artery in relation to the femur, and of the possibility of late or asymptomatic presentation. If there is doubt regarding the possibility of an aneurysm ultrasonography, including Doppler studies, is the investigation of choice, followed by arteriography and embolisation if needed.

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