Medial approach for popliteal artery injuries

ZHOU Yue-liang, XU Yong-qing, LI Jun, WANG Yi and LUO Guo

【Abstract】Objective: To evaluate the clinical application of the medial approach for repairing popliteal artery injuries.

Methods: From 2002 to 2008, 11 cases of popliteal artery injuries had been repaired via the medial approach. Of these cases, 8 had limb fractures, 1 had knee dislocation, and 2 had visceral injuries. Ten popliteal arteries were anastomosed directly while one was repaired with a great saphenous vein graft.

Results: The operation time ranged from 3 to 4 hours (averaging 3.6 hours). All the injured limbs survived. At the follow up, 8 legs recovered the full function, 2 had minor contracture, and 1 serious Volkmann's contracture without amputation.

Conclusion: The medial approach for repair of the popliteal artery is effective, applicable, and more advantageous to the management of multi-injuries.

Key words: Popliteal artery; Wounds and injuries; Wound healing

Conventionally there have been three approaches for the surgeries of the popliteal artery: the posterior, medial, and intravascular approaches. The intravascular approach is a favorite with vascular surgeons, but the posterior and medial approaches usually are the choice of orthopaedic surgeons. The posterior approach is far more used clinically than the medial one. The increased high energy injuries in recent years, however, result in more popliteal artery injuries accompanied with multi-injuries. The management of these multi-injuries, which may involve in the head, neck, chest, abdomen, or extremity, always requires a supine position. The exploration of the popliteal artery injuries via the posterior approach in these cases not only presents the trouble of changing the patients' positions during operation, but also increases the difficulty in anesthetic monitoring and operation time. The medial approach, on the contrary, avoids these embarrassments. It has been introduced as early as 1964,1 and described in the literature later.2-5 However it has not been the subject of a separate study. There is no relative report in China so far. This study reviews 11 cases of popliteal artery injuries which were repaired via the medial approach. Both the advantages and disadvantages of this approach are evaluated.

METHODS

Clinical data

From 2001 to 2007, 137 cases of popliteal artery injuries were treated at our center, among which 126 were managed via the posterior approach, and 11 (9 males and 2 females) via the medial approach of the knee. The average age of these 11 cases were 29 years (ranging from 23-38 years). Seven belonged to closed blunt injuries, and 4 open injuries. The causes included knife stabbing, stone crushing and traffic accidents. Three cases were accompanied by head, chest and abdomen visceral injuries, and 8 had limb fractures (≥1 site). During the operation, the popliteal arteries were either directly anastomosed (10 cases), or repaired via the greater saphenous vein graft taken from the contralateral side. The time from injury to operation ranged from 3-39 hours (averaging 7.9 hours). The operation time ranged from 3-5 hours (averaging 3.6 hours). In this series, injury severity score (ISS) was 12.4±5.3 (5-21), and mangled extremity severity score (MESS) of the injured extremity was 7.4±2.1 (5-11).

Surgical techniques

The patient was placed in a supine position, with the hip abducting 30° and knee flexing 45°. A small pillow was placed under the knee. The foot was not
The pes anserinus was cut with saphenous vein was exposed and retracted posteriorly. The pes anserinus was cut with “Z” figure. The medial head of the gastrocnemius was exposed and cut with “Z” figure. The vessels and nerves at the entrance of the medial gastrocnemius were preserved with cautions. The tibial nerve, the popliteal artery, and the popliteal artery were exposed and separated after careful ligations of the small branches of the popliteal vein and artery (very important). The injured segment of the popliteal artery was exposed and resected. Heparin saline (12 500 U/100ml physiological saline) was irrigated into the distal and proximal segments of the artery. The knee was flexed for direct anastomosis of the two ends. If the artery tension was too strong, the graft of the contralateral great saphenous vein was used instead. The injury of the popliteal vein was simultaneously repaired as long as patients’ general situation allowed. An external fixator could be used to immobilize the knee at a flexion position according to the tension of the reconstructed popliteal artery. The medial head of the gastrocnemius and the pes anserinus were sutured and the fascias and skin of the incision were closed. After the management of the fractures and other injuries, the dorsal pedal artery pulsing was rechecked. A fasciotomy may be performed if the leg was obviously swelling. The knee, if not fixed with external fixations during the surgery, would be fixed with plaster splints at the flexion position. The knee exercises began in half a month after operation when the external fixations or the splints were removed.

RESULTS

Nine cases underwent intraoperative fasciotomy of the leg and 2 had postoperative fasciotomy. Seven cases were given four-compartment-fasciotomy via lateral and medial incision, and 2 two-posterior compartment-fasciotomy via a single medial incision. During the exploration, the popliteal artery was found to be embolized (7 cases), totally broken (3 cases), or partially broken (1 case). One popliteal artery was broken at the site of its bifurcation of anterior and posterior tibial arteries; the others were broken at the trunk of the popliteal artery. Six cases had the injuries of the popliteal vein, of which 3 were repaired and 3 ligated. Of all the 11 popliteal arteries, 2 were anastomosed under microscope, 9 with naked eyes. Within the hospital stay, the patients received 2-8 times of operation, with the mean of 3.5 times. One case had serious outcomes of the extremity due to the misdiagnosis of popliteal artery injury and the rupture of the posterior cruciate ligament. The medial gastrocnemius artery of one case was injured in the operation without reconstruction. Necrosis of the muscle developed and the medial head of the gastrocnemius was resected two days later. Typical case sees Figures 1-10.

DISCUSSION

The advantages of the medial approach for popliteal artery exploration included: (1) Convenience for patient’s position at which other operations are performed. The cases in this study had relatively high scores of MESS and ISS, and the medial approach has advantage over the posterior approach in the management of other injuries where a supine position is required. It is useful in peacetime, let alone wartime. The supine position is convenient for the harvest of the contralateral great saphenous vein and more suitable for management of concurrent femoral and tibial fractures. An external fixator could easily be set for the fractures at a prone position, but it is difficult via the posterior approach. (2) Easy closure of the incision. The bulk of the medial head of the gastrocnemius can protect the popliteal artery, while there is only subcutaneous fascia and skin for the protection via the posterior approach. (3) Facility to exposure of the full length of the popliteal artery. At supine position, it is easier to expose the femoral artery through the hiatus of adductor magnus and the whole posterior tibial artery. The fasciotomy of the leg can be simultaneously finished by extending this approach distally. The posterior approach however is limited in exposure of the medial thigh or the medial and anterior leg.

There are some disadvantages for the medial approach used in popliteal artery exploration. In the supracondylar fractures of the femur, the epicondyles need to be firstly fixed with an external fixator to release the locked popliteal vessels, but sometimes the operating field is limited or difficult to expose. This approach cannot manage the injury of the common fibular nerve simultaneously. The exposure of the popliteal artery is
generally half an hour longer than the posterior approach. The reperfusion after reconstruction of the popliteal artery always leads to the swelling of the leg and foot which could not be invariably decreased by the fasciotomy. In this situation, a direct closure of the incision is hardly successful. Of the 11 cases in this study, 6 cases had this situation in which the medial head of the gastrocnemius had to be left for secondary coverage. The pes anserinus of the two cases also could not be resutured due to severe swelling of the wound. They were sutured later by the second operation. The swelling of the leg after reperfusion always leads to the difficulty of wound closure and this situation is more obvious when the medial approach is adopted. This approach is prone to injure the medial gastrocnemius artery. With rich collateral circulation, normally the injury of this artery will not lead to serious results, but necrosis of the medial gastrocnemius appeared in one case in this series. It is probably due to the fact that collateral circulation had already been injured during the blunt injury to the limb. Thus the injury of the single medial gastrocnemius artery may lead to the necrosis of the muscle. Taking these disadvantages into consideration, we propose that the posterior approach should be preferably chosen if the popliteal artery injury is simple and has no concurrent injuries.

Figure 1. Male, 32-year-old, open dislocation of his left knee, tibial plateau and fibular head fracture, avulsion fracture of the anterior cruciate ligament, and the popliteal artery injury caused by a traffic accident. Figure 2. The design of the medial approach. Figure 3. Careful ligation or electrocoagulation will decrease the blood loss in the surgery. Figure 4. After ‘Z’ figure incision over the pes anserinus (arrow), the medial head of the gastrocnemius is exposed. Figure 5. With the protection of the medial gastrocnemius artery, the tendon part of the medial gastrocnemius is incised with ‘Z’ figure. The embolism of the popliteal vein (arrow) and the deep popliteal artery can be found. Figure 6. The embolism of the popliteal artery is removed (arrow). The broken ends of the artery are debrided and irrigated with heparin saline. Figure 7. Anastomosis of the broken popliteal artery (arrow). Figure 8. External fixation to protect the fractures and the reconstructed popliteal vessels. Figure 9. The medial incision is closed at secondary operation due to severe swelling of the leg after reperfusion. Figure 10. With the protection of the external fixator, the injured bones and ligaments can be left for secondary reconstruction.
Controversy over the management of the simultaneous injuries of the popliteal vein remains. Traditionally injured popliteal vein is not treated. Some authors deem that it should be repaired with great efforts to decrease the occurrence of amputation and osteofascial compartment syndrome. Authors with this view, however, are generally vascular surgeons and the patients they treated are simple popliteal artery injuries. If general situation allows, the injured popliteal vein should be repaired. If not, reconstruction should be abandoned, for the anastomosis of the vein will take additional 30 minutes. And this does not accord with the damage control principle.

REFERENCES


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