

# A Comparison of Interposition and Femoropopliteal Bypass Grafts in the Management of Popliteal Artery Trauma

## Original Article

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### Abstract

**Background:** Peripheral vascular injury associated with lower limb trauma is a well-known emergency. The experience for the management of popliteal artery trauma have mainly come from managing the traumas of military personnels during Iran-Iraq war. The present study compared the effects of two currently-used surgical techniques in the management of popliteal trauma, namely femoropopliteal bypass graft and interposition vein graft on limb salvage.

**Methods:** A retrospective review of 40 patients with popliteal artery trauma admitted to the trauma unit of a university teaching hospital during 2003 to 2008. The patients had undergone femoropopliteal bypass graft (n=26) or interposition vein graft (n=14) for the management of popliteal trauma.

**Results:** The amputation rate among patients managed by femoropopliteal bypass or interposition vein graft was 35.7% and 61.5%, respectively. Knee stability among patients managed by interposition graft group was 57.7% and in those managed by femoropopliteal bypass graft was 85.7%.

**Conclusion:** The rates of knee stability achieved by the employed techniques indicate that femoropopliteal bypass vein graft is superior, and therefore, preferable to the interposition vein graft in the management of popliteal artery trauma.

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**Keywords** • Vascular surgery • vascular trauma • interposition graft

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### Introduction

Car accidents may cause acute trauma to lower limbs, and lead to popliteal vessel damage resulting in a high amputation rate. Early revascularization is the usual approach to avoid the amputation of the legs, and increase their salvage. Interposition graft and femoropopliteal bypass are the two recent techniques. Vascular injuries to the leg caused by war trauma have been reported to lead to three time more amputation than those caused by civilian accidental injuries.<sup>1</sup>

Vascular injuries to the legs constitute 15 to 20% of the battlefield arterial trauma. Blunt injuries of lower legs have also been included in several studies.<sup>2-4</sup> Most of the studies on trauma to the peripheral vessels of the lower legs have been published by military surgeons using patients' data from war fields.<sup>5-7</sup>

Although several case series studies describing popliteal vessel injuries from penetrating and blunt trauma have been published, we have a vast experience stemming from managing trauma injuries of military personnel during eight years war between Iran and neighboring Iraq. Moreover, current surgical practice in civilians has shown an higher incidence of vascular injuries, which seems to be caused by enlarging urbanization, increasing motor vehicles and car accidents than what has been reported in the text.<sup>3</sup> There is a plethora of literature on the management of combined arterial and musculoskeletal injuries of lower extremities.<sup>4</sup>

If left untreated, the widespread car vascular injuries caused by car accidents in Iran may lead to leg amputations. Various techniques have been employed to salvage the injured legs and prevent their amputation. Two of the most advanced techniques for managing vascular injuries to the legs include femoropopliteal bypass and interposition veinous graft. The objective of the present study was to compare the outcome and complications of the methods.

## Materials and Methods

The study is a case series performed at the Department of Vascular Surgery, Pour Sina Hospital in Rasht, Iran, recruiting 40 consecutive patients whom underwent surgical treatment for blunt and penetrating popliteal artery traumatic wounds from May 2003 to October 2008. The patients included 32 men and eight women with an age of  $39\pm 13$  years. As a routine hospital procedure, written consent were obtained from all patients.

The etiology of vascular injuries included penetrating trauma ( $n=6$ , 15%), blunt trauma ( $n=33$ , 82.5%), and unidentified cause ( $n=1$ , 2.5%). Twenty six (65%) of the patients were subjected to autogenous interposition grafts and 14 others (35%) underwent femoropopliteal bypass grafts.

The injuries associated with the focus of the study (blunt and penetrating popliteal artery traumatic injuries) included partial laceration ( $n=24$ , 60%), knee dislocation ( $n=22$ , 55%), popliteal vein injury ( $n=28$ , 70%), ligament injury ( $n=18$ , 45%) and fractures ( $n=14$ , 35%). The interval between the injury and the procedure ranged 6-18 hours.

Operative management included femoropopliteal bypass ( $n=14$ ) of the injured segment with the ligation of popliteal artery proximal and distal to the area of injury to prevent distal embolization and bleeding, and to promote effective revascularization. Some other patients

( $n=26$ ) were subjected to venous interposition bypass graft through medial longitudinal knee incision. Immediate recovery of pedal pulses was associated with the best long-term patency. For postoperative follow-up, bypass graft duplex scanning was performed before hospital discharge, three months after the surgery and every six months thereafter.

The patients' demography and clinical characteristics as well as the techniques used and the complications encountered were analyzed using Chi-Square or Fisher Exact test. Statistical Package for Social Sciences (SPSS version 10) was used for data analysis. A P value of 0.05 or less was considered statistically significant.

## Results

Thirty two (80%) cases were men with an age of  $39\pm 13$  years, and eight (20%) cases were females. Twenty six patients were operated within 12 hours of sustaining the wounds. Car accidents had caused the wounds in 34 (85%) patients, and in 28 (70%) patients the popliteal artery had been transected. Thrombosis and intimal damage occurred in 12 (30%) patients, and 36 (90%) patients suffered from blunt trauma with knee dislocation or fractures. Also, four (10%) patients suffered from penetrating type of trauma. Out of 40 patients, 26 (65%) were operated using interposition vein graft technique, and 14 (35%) cases with popliteal artery trauma were subjected to femoropopliteal bypass graft technique.

The rate of primary amputation in patients managed by femoropopliteal bypass was 2/14 (14%), but that in patients managed using interposition vein graft technique was 4/26 (15.4%) ( $P=0.926$ ). The rate of secondary amputation among patients with popliteal trauma managed using femoropopliteal bypass was 3/14 (21.4%) compared to the rate of 12/26 (46%) among the cases managed by interposition vein graft ( $P=0.123$ ). Knee stability was maintained in 12/14 (85.7%) of patients managed by femoropopliteal bypass graft compared to the rate of 15/26 (57.7%) among the patients managed by interposition graft ( $P=0.405$ ). No patient died during the operations. The mean period of hospitalization was eight days.

## Discussion

Traumatic popliteal artery injuries are uncommon, but they are highly lethal injuries.<sup>4,8</sup> Regardless of whether the injury is caused by blunt or penetrating trauma, the majority of the

patients need immediate surgical intervention.<sup>4,8,9</sup> Urgent surgical graft replacement is the standard emergency treatment in order to prevent popliteal artery rupture and death, but the surgical risk is high because these patients frequently have multiple other associated major traumatic injuries.<sup>5,10</sup>

In critical injuries, successful results were obtained by arterial reconstruction procedures which were performed within 6-8 hours after the event. Most of vascular surgeons working on patients injured in the war field or civilian trauma units did repair the cases of popliteal artery trauma cases of popliteal artery trauma without using grafts.<sup>6,11</sup>

Rich and colleagues,<sup>7</sup> from Vietnam Vascular Registry, who had experience on popliteal artery injury, advocated a progressive approach towards venous repair. Later on, through another study Bermudes et al.<sup>12</sup> showed that after ligation and repair of vascular injury in vessels of lower extremities, there was a late complication of venous insufficiency. Fasciotomy or complex venous repair were also complicated with maximal functional disturbances.<sup>8</sup> Therefore, in order to avoid such complications in the patients with popliteal artery injuries in the present study, we used the techniques of interposition graft in some cases and femoropopliteal bypass in others.

The experience gained by the management of a large number of vascular injuries during the war has resulted in a remarkable decrease of the limb amputation by our surgical team. However, the rate of limb loss is still high in civilian injuries.<sup>3,4,9</sup> Vascular repair preceded orthopedic fixation. Arterial continuity was restored by using autogenous saphanous vein graft.

The regular surgical management of popliteal vascular injury was the exploration of popliteal fossa. In this procedure, it is mandatory to cut and transect the tendinous and semitendinous muscles and the medial belly of gastrocnemius muscle to expose the popliteal trauma site. All of these structures are very important in knee stability. After the above-mentioned procedure there was no decrease in knee instability during stressed walking. This procedure was accompanied by greater instability of knee joint after arterial revascularization. It was realized that femoropopliteal bypass technique could be applied without damaging the supporting muscular structure of the knee and decreasing the level of knee instability. The cross leg saphenous veins was used for femoropopliteal bypass grafting through two small incision above and below the knee. Through this method of femoropopliteal bypass graft, there was no need to cut the above

mentioned muscles, and the duration of the operation was less than that in interposition vein graft. The more important point is the limb salvage, which was found to be at a rate much higher than that found using the other technique.

Gnanadev and Fandrich have recently suggested that liberal use of vein interposition grafts, routine intraoperative postreconstructive arteriogram and performance of fasciotomy were important steps taken to ensure limb salvage rate.<sup>9</sup> Nair and colleagues, who had experience in managing popliteal gunshot injuries experience with high amputation rates, suggest prompt revascularization to improve limb salvage.<sup>13</sup> The findings suggest that femoropopliteal bypass graft is a safe and easy to do technique, and is a more superior method than interposition vein graft for limb salvage. The findings of the present study should be viewed in the light of such limitations as the small number of cases, which led to taking a long than expected time, and not using the Mangled Extremity Severity Score (MESS).

## Conclusion

The findings of the present study indicate that the method of femoropopliteal bypass graft is superior than interposition vein graft in terms of limb salvage.

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**Conflict of Interest:** None declared

## References

- 1 Huynh TT, Pham M, Griffin LW, et al. Management of distal femoral and popliteal arterial injuries: an update. *Am J Surg* 2006; 192: 773-8
- 2 Wagner WH, Calkins ER, Weaver FA, et al. Blunt popliteal artery trauma: one hundred consecutive injuries. *J Vasc Surg* 1988; 7: 736-43.
- 3 Mohammadzade M, Akbar MH. Presenting features and Surgical outcome of Popliteal artery trauma in a civilian set-up. *Acta Medica Iranica* 2003; 41: 273-6.
- 4 Yahya MM, Mwipatayi BP, Abbas M, et al. Popliteal artery injury: Royal Perth experience and literature review. *ANZ J Surg* 2005; 75: 882-6.
- 5 Waikakul S, Sakkarnkosol S, Vanadurongwan V. Vascular injuries in compound

- fractures of the leg with initially adequate circulation. *J Bone Joint Surg Br* 1998; 80: 254-8.
- 6 Padberg FT, Rubelowsky JJ, Hernandez-Maldonado JJ, et al. Infrapopliteal arterial injury: prompt revascularization affords optimal limb salvage. *J Vasc Surg* 1992; 16: 877-86.
  - 7 Rich NM, Baugh JH, Hughes CW. Popliteal artery injuries in Vietnam. *Am J Surg* 1969; 118: 531-4.
  - 8 Weaver F A, Hood DB, Yellin AE, et al. Vascular injuries of the extremities; In: Rutherford, B; (ed.) *Vascular Surgery*. 5th ed, W.B Saunders, Philadelphia; 2000. p. 862-71.
  - 9 Gnanadev DA, Fandrich BL. Popliteal artery trauma: Update and recent advances in Management. *Ann Vasc Surg*. 1988; 2: 332-5.
  - 10 Sfeir RE, Khoury GS, Haddad FF, Fakh RR, Khalifeh MJ. Injury to the popliteal vessels: the Lebanese war experience. *World J Surg* 1992; 16: 1156-9.
  - 11 Velinovic MM, Davidovic BL, Lotina IS, et al. Complications of operative treatment of injuries of peripheral arteries. *Cardiovasc Surg* 2000; 8: 256-64.
  - 12 Bermudez KM, Knudson MM, Nelken NA, et al. Long-term results of lower-extremity venous injuries. *Arch surg* 1997; 132: 963-7.
  - 13 Nair R, Abdool-Carrim AT, Robbs JV. Gunshot injuries of the popliteal. *Br J Surg* 2000; 87: 602-7.