

OUTCOMES OF FEMORAL ARTERY REPAIR WITH INTERPOSITION VEIN GRAFT: BLUNT VS PENETRATING TRAUMA

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ABSTRACT

Background: Fractures of the femur are life-threatening injuries of the limbs and must be treated immediately. Mechanism of injury (blunt or penetrating) affects vascular injury, complications, and clinical outcomes.

Objective: To compare six-month graft patency and limb salvage following femoral artery repair with interposition vein grafting in patients with blunt versus penetrating trauma.

Methods: This is a retrospective cohort study that was carried out in Shaheed Mohtarma Benazir Bhutto Institute of Trauma, Karachi from January 2020 to December 2025. One hundred and twenty seven patients were included (72 blunt trauma and 55 penetrating trauma). Medical records were used as a source for data collection which was done with the help of a structured proforma. Primary outcomes were the patency of the graft and salvage of the limb at six months; secondary outcomes were postoperative complications, hospital stay, recovery time and rehabilitation needs. SPSS (version 26.0) was used for statistical analysis.

Results: Patients with blunt trauma demonstrated lower graft patency compared with penetrating trauma (72.2% vs 85.5%, $p=0.048$) and reduced limb salvage rates (76.4% vs 89.1%, $p=0.041$). Early complications were more common with blunt trauma although this was not statistically significant. Blunt trauma was significantly associated with prolonged hospitalization (13.4 ± 4.8 vs 9.6 ± 3.9 days, $p<0.001$), longer recovery duration (9.5 ± 3.4 vs 6.8 ± 2.6 days, $p<0.001$), and increased rehabilitation requirements (63.9% vs 43.6%, $p=0.020$).

Conclusions: Blunt femoral artery trauma has a delayed presentation, compromises graft patency, hinders limb salvage, and prolongs recovery, thus emphasising the importance of early detection and prompt revascularization.

KEYWORDS: Femoral artery injury, vascular trauma, vein graft, blunt trauma, penetrating trauma, limb salvage

INTRODUCTION

The injury to the femoral artery is one of the most serious peripheral vascular injuries because of the possibility of massive bleeding, acute Limb Ischemia, and limb loss without immediate treatment. Injuries to the lower extremity arterial injuries are a significant component of civilian vascular trauma and the femoral artery is especially susceptible to high energy injuries involving adjacent soft tissue and bone because of its superficial location and exposure [1]. The timely diagnosis of a vascular problem and the prompt intervention in the vessels are still very important parameters for the achievement of limb salvage and patient's survival [2]. The pattern and extent of vascular damage is determined by the mechanism of injury. Arterial disruption is usually caused by penetrating trauma, usually from a gunshot or stab wound, and is mostly direct including laceration or transection with little surrounding tissue trauma [3]. Blunt trauma, on the other hand, often as a result of road traffic accident and crush mechanisms, leads to complex vascular pathology such as intimal disruption, thrombosis, segmental arterial loss and extensive soft tissue injury [4]. The differences can affect the complexity of surgery, the length of time it takes to be without blood flow, the complications that may occur after surgery, and the long-term outcomes.

Interposition vein grafting is still the reconstructive procedure of choice when the primary arterial repair is not possible due to segmental loss or extensive injury. The great saphenous vein is widely used due to its excellent biocompatibility, resistance to infection and excellent long term patency, especially in contaminated trauma settings [5]. Graft thrombosis, infection and re-intervention are however important issues that remain challenging the success of limb preservation [6].

Several factors have been shown to predict good vascular repair outcomes: ischemia time, associated fractures, soft tissue damage and patient comorbidities [7]. Delayed presentation is a significant part of the problem, as the longer the muscle is ischemic, the more necrosis will occur, the more damage will occur from reperfusion, and the higher the risk for amputation [8]. Despite a high limb salvage rate of nearly 80% in the world, in developing countries the time needed to refer, limited prehospital facilities, and lack of trauma care continue to affect outcomes [9].

In Pakistan, outcomes after the reconstruction of the femur remain poorly studied for the various mechanisms. In view of the high volume of trauma at Shaheed Mohtarma Benazir Bhutto Institute of Trauma, Karachi, is a suitable place for the evaluation of these outcomes. This study is designed to compare the patency of the graft and limb salvage following interposition vein graft repair in cases of blunt and penetrating injury of the femoral artery to draw some conclusions which will help improve trauma management.

METHODOLOGY

This is retrospective cohort study. It was carried out at the Shaheed Mohtarma Benazir Bhutto Institute of Trauma, Karachi. A total of 127 patients (72 or 56.7% with blunt trauma and 55 or 43.3% with penetrating trauma) were recruited for this research after obtaining IRB approval letter from Ethical review committee and records of patients treated from January 2020 to December 2025 were also reviewed. Adult patients having age ranging from 18-65 years with reported femoral artery injury who experienced interposition autologous vein graft repair were included in this study. Patients who underwent primary repair, prosthetic grafts, having pre-existing peripheral artery problem or with insufficient medical records for primary outcomes were excluded.

A well-structured proforma was used to collect data from emergency department records, operative notes, inpatient files and follow-up documentation. Documented variables contained mode of injury (blunt vs penetrating), duration from injury to surgery, and related operative parameters like type and length of vein graft and duration of operation. Postoperative data comprised of early challenges such as injury infection, graft thrombosis and re-operation), duration of hospitalization, recovery time and rehabilitation needs at the time of admission and discharge. The key outcomes include graft patency and limb salvage at six months, evaluated through clinical examination and Doppler investigations. Secondary outcomes were postoperative challenges, length of hospital stay, recovery time and rehabilitation requirements.

Data analysis was performed via SPSS version 2.0. Continuous data were demonstrated as mean $\pm$ standard deviation or median (interquartile range), while categorical data were illustrated as frequencies and percentages. Independent t-test and Mann-Whitney U test was performed to compare blunt and penetrating trauma groups for normally and non-normally distributed data respectively. Moreover, Chi-square test or Fisher's exact test were conducted where required for assessing categorical variables. A p-value of less than 0.05 was demonstrated as statistically significant.

RESULTS

This research recruited 127 patients, with 56.7% presenting blunt trauma and 43.3% comprising penetrating trauma. Patients diagnosed with blunt trauma were older than those detected with penetrating damage (39.8 ± 13.2 vs 34.5 ± 11.6 years, $p=0.02$). There was no statistically significant difference ($p>0.05$) between both groups regarding gender and other factors such as diabetes mellitus, hypertension, and smoking status. But, a substantial delayed presentation was observed in patients presenting blunt trauma, with a longer median time to surgery (11 hours vs 6 hours, $p=0.001$), demonstrating delay in revascularization among patients with blunt injuries.

TABLE 1: PRESENTING DEMOGRAPHIC AND BASELINE CLINICAL FEATURES

Variable	Blunt Trauma n=72 (56.7%)	Penetrating Trauma n=55 (43.3%)	P-value
Mean Age	39.8 ± 13.2	34.5 ± 11.6	0.02*

Male Gender	63 (87.5%)	50 (90.9%)	0.54
Diabetes Mellitus	18 (25.0%)	10 (18.2%)	0.36
Hypertension	22 (30.6%)	12 (21.8%)	0.27
Smoking	34 (47.2%)	32 (58.2%)	0.21
Time to Surgery in hours (Median IQR)	11 (6–18)	6 (4–10)	0.001**

**statistically significant ** strongly statistically significant*

Early postoperative complexities such as wound infection (36.1% vs 23.6%), graft thrombosis (25.0% vs 16.4%), and re-operation (20.8% vs 12.7%) were comparatively higher in patients diagnosed with blunt trauma. However, these variations were not statistically significant ($p>0.05$), demonstrating a trend towards higher rates of complexities in patients with blunt trauma without achieving statistical significance.

TABLE 2: EARLY POSTOPERATIVE COMPLICATIONS (≤30 DAYS)

Complication	Blunt Trauma n=72 (56.7%)	Penetrating Trauma n=55 (43.3%)	P-value
Wound Infection	26 (36.1%)	13 (23.6%)	0.12
Graft Thrombosis	18 (25.0%)	9 (16.4%)	0.23
Re-operation	15 (20.8%)	7 (12.7%)	0.24

At six months, significant association between penetrating trauma and better vascular results was observed. Graft patency was higher in patients with penetrating trauma (85.5%) in comparison to those with blunt trauma (72.2%), demonstrating p-value 0.048. Likewise, a significant improvement in limb salvage in penetrating trauma (89.1% vs 76.4%, $p=0.041$) has been observed. Conversely, higher rates of graft failure and major amputation in penetrating trauma exhibited weaker prolonged vascular outcomes in this group.

TABLE 3: PRIMARY OUTCOMES (6-MONTH VASCULAR OUTCOMES)

Outcome	Blunt Trauma n=72 (56.7%)	Penetrating Trauma n=55 (43.3%)	P-value
Graft Patency	52 (72.2%)	47 (85.5%)	0.048*
Graft Failure	20 (27.8%)	8 (14.5%)	
Limb Salvage	55 (76.4%)	49 (89.1%)	0.041*
Major Amputation	12 (16.7%)	4 (7.3%)	
Minor Amputation	5 (6.9%)	2 (3.6%)	

**statistically significant ** strongly statistically significant*

Patients experiencing blunt trauma faced long term hospital stay and delay in recovery. The average duration of hospitalization was significantly higher in patients diagnosed with blunt trauma (13.4 ± 4.8 days) in comparison to penetrating group (9.6 ± 3.9 days) ($p < 0.001$). Additionally, the length of recovery time was greater in participant with blunt trauma (9.5 ± 3.4 vs 6.8 ± 2.6 days, $p < 0.001$). Furthermore, a substantially greater number of patients in blunt trauma cohort required rehabilitation (63.9% vs 43.6%, $p = 0.02$), exhibiting enhanced postoperative functional impairment and management.

TABLE 4: HOSPITAL COURSE, RECOVERY & REHABILITATION

Variable	Blunt Trauma n=72 (56.7%)	Penetrating Trauma n=55 (43.3%)	P-value
Mean Length of Stay (in days)	13.4 ± 4.8	9.6 ± 3.9	$<0.001^{**}$
Mean Time to Recovery (in days)	9.5 ± 3.4	6.8 ± 2.6	$<0.001^{**}$
Rehabilitation Required	46 (63.9%)	24 (43.6%)	0.02 *

**statistically significant ** strongly statistically significant*

DISCUSSION

The present study evaluated outcomes of femoral artery repair with interposition vein graft in blunt versus penetrating trauma and demonstrated that mechanism of injury significantly influenced vascular outcomes, including graft patency, limb salvage, and postoperative recovery. The demographic profile of the current study showed a predominance of male patients, which is consistent with previous studies reporting that vascular trauma disproportionately affects males due to increased exposure to high-risk activities such as road traffic accidents and interpersonal violence [14,15]. Similar findings have been reported in Pakistani and regional studies, where young to middle-aged males constitute the majority of patients presenting with extremity vascular injuries [16]. The slightly higher mean age observed in blunt trauma patients in this study may reflect the epidemiological trend of road traffic accidents affecting a broader age group compared to penetrating injuries.

A key observation in this study was the significantly delayed time to surgical intervention in blunt trauma patients. This outcomes supports previously published studies, according to which blunt vascular trauma is commonly connected with delayed diagnosis, owing to the lack of observable clinical symptoms and existence of additional injuries that may hide vascular damage [17]. Many researches underscored the importance of revascularization within 6 hours for successful limb salvage, and addressed significantly enhanced risk of ischemia complexities and amputation because of delay beyond this timeframe [18]. Conversely, active bleeding and enlarging hematoma act as clear symptoms in case of penetrating trauma resulting in timely diagnosis and immediate surgical interventions.

This study also presented that patients with penetrating trauma experienced significantly improved graft patency and limb salvage rates in comparison to those diagnosed with blunt injuries. These outcomes support internationally published researches documenting a relationship among blunt artery injuries, extensive intimal damage, thrombosis, and damage to adjacent soft tissues, all of which adversely affecting surgical results [19]. A meta-analysis by Perkins et al. identified mechanism of injury and ischemia time as key predictors of limb loss in vascular trauma patients [20]. Similarly, Branco et al. reported that blunt trauma is associated with higher rates of delayed amputation and graft failure compared to penetrating injuries [21].

The limb salvage rates observed in this study (76.4% in blunt vs 89.1% in penetrating trauma) are comparable to those reported in regional studies, where salvage rates range from 70% to 85% following vascular repair [14,16]. International data from high-resource settings have reported slightly higher salvage rates, often exceeding 85–90%, likely due to more efficient trauma systems and earlier intervention [21,22]. The relatively lower salvage rates in blunt trauma patients in the present study may be attributed to delayed presentation, extensive tissue damage, and limitations in prehospital care commonly observed in low- and middle-income countries.

Although early postoperative complications such as wound infection, graft thrombosis, and re-operation were more frequent in blunt trauma patients, the differences were not statistically significant. However, this trend is clinically important and has been reported in other studies. Infection rates in vascular trauma have been reported to range between 15% and 30%, particularly in patients with delayed presentation or severe soft tissue injury [15,23]. Graft thrombosis remains a major concern following vascular reconstruction and is a significant predictor of limb loss, especially in cases with prolonged ischemia or poor distal runoff [24].

The present study also demonstrated that blunt trauma was associated with significantly prolonged hospital stay and delayed recovery, which is consistent with findings from both regional and international studies [17,21]. The increased length of stay in blunt trauma patients is likely related to the severity of associated injuries, need for multiple interventions, and higher rates of complications. Additionally, the significantly higher requirement for rehabilitation in blunt trauma patients reflects greater functional impairment and soft tissue involvement. Similar observations have been reported in studies evaluating functional outcomes after extremity vascular injuries, where patients with blunt trauma required prolonged rehabilitation and had delayed return to baseline function [25].

This study emphasizes the significance of early detection and timely revascularization in optimizing clinical results from surgical perspective. Because of better prolonged patency rates and excellent infection resistance, autologous vein grafts especially great saphenous vein, remain suggested conduit in vascular trauma [24]. However, reducing time of ischemia and effective handling of adjacent soft tissues and orthopedic damage are key determinants of reconstruction success. This study has some limitations in its scope because of its retrospective nature causing selection biasness and single center design lacking generalizability of findings. Despite sufficient sample size, this study might lack statistical power to identify differences in secondary findings. Moreover, assessment of late graft patency and functional outcomes was not feasible due to the absence of prolonged follow-up beyond six months.

CONCLUSION

The findings of this study are consistent with global evidence and highlight the significant impact of injury mechanism on vascular outcomes. Blunt trauma was associated with delayed presentation, increased surgical complexity, and poorer outcomes compared to penetrating trauma. These results underscore the need for targeted strategies to improve early diagnosis and management of vascular injuries in high-burden trauma settings.

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