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Contemporary outcomes of traumatic popliteal artery injury repair from the popliteal scoring assessment for vascular extremity injury in trauma study

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ABSTRACT

Objective: Traumatic popliteal artery injuries are associated with the greatest risk of limb loss of all peripheral vascular injuries, with amputation rates of 10% to 15%. The purpose of the present study was to examine the outcomes of patients who had undergone operative repair for traumatic popliteal arterial injuries and identify the factors independently associated with limb loss.

Methods: A multi-institutional retrospective review of all patients with traumatic popliteal artery injuries from 2007 to 2018 was performed. All the patients who had undergone operative repair of popliteal arterial injuries were included in the present analysis. The patients who had required a major lower extremity amputation (transtibial or transfemoral) were compared with those with successful limb salvage at the last follow-up. The significant predictors ($P < .05$) for amputation on univariate analysis were included in a multivariable analysis.

Results: A total of 302 patients from 11 institutions were included in the present analysis. The median age was 32 years (interquartile range, 21-40 years), and 79% were men. The median follow-up was 72 days (interquartile range, 20-366 days). The overall major amputation rate was 13%. Primary repair had been performed in 17% of patients, patch repair in 2%, and interposition or bypass in 81%. One patient had undergone endovascular repair with stenting. The overall 1-year primary patency was 89%. Of the patients who had lost primary patency, 46% ultimately required major amputation. Early loss (within 30 days postoperatively) of primary patency was five times more frequent for the patients who had subsequently required amputation. On multivariate regression, the significant perioperative factors independently associated with major amputation included the initial POPSAVEIT (popliteal scoring assessment for vascular extremity injury in trauma) score, loss of primary patency, absence of detectable immediate postoperative pedal Doppler signals, and lack of postoperative antiplatelet therapy. Concomitant popliteal vein injury, popliteal injury location (P1, P2, P3), injury severity score, and tibial vs popliteal distal bypass target were not independently associated with amputation.

Conclusions: Traumatic popliteal artery injuries are associated with a significant rate of major amputation. The preoperative POPSAVEIT score remained independently associated with amputation after including the perioperative factors. The lack of postoperative pedal Doppler signals and loss of primary patency were highly associated with major amputation. The use of postoperative antiplatelet therapy was inversely associated with amputation, perhaps indicating a protective effect. (J Vasc Surg 2021;74:1573-80.)

Keywords: Lower extremity trauma; Popliteal artery; Popliteal injury; Popliteal vein; Vascular trauma

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Lower extremity vascular injuries occur in <2% of all trauma patients, with 20% of these injuries occurring in the popliteal artery.[1,2] Despite their relatively low incidence, popliteal artery injuries are associated with devastating complications and the greatest rate of limb loss of any lower extremity vascular injury. Historically, the amputation rates ranged from 50% to 70% when the standard of care was ligation.[3-5] This treatment was not necessarily due to the lack of technical ability but was related to an underdeveloped trauma system (ie, the lack of advanced emergency medical services and antibiotic and blood bank availability). In the Korean and Vietnam wars, popliteal artery injury management shifted toward the goal of revascularization. After this shift, a decrease in amputation rates from the upward of 70% to ∼30% was observed, demonstrating the superiority of repair compared with ligation. The current studies have reported substantially decreased rates of amputation, with successful limb salvage achieved in nearly 85% of patients with this injury pattern.[3,6]

Much of the recent data on traumatic popliteal injuries has focused on an attempt to predict which patients will benefit from operative repair vs primary amputation.[7-12] The use of the Mangled Extremity Severity Score (among others) has not had any durable success in this attempt, likely owing to the limitation of small sample sizes and an overambitious aim to determine a clear threshold for the futility of limb salvage (which would require 100% sensitivity and specificity owing to the irreversible nature of an amputation). We have previously demonstrated in the POPSAVEIT (popliteal scoring assessment for vascular extremity injury in trauma) study that shock (initial systolic blood pressure [SBP] <90 mm Hg), associated orthopedic injuries, and a lack of preoperative pedal Doppler signals were independently associated with a greater risk of amputation, and these three factors constitute the POPSAVEIT score.[13] The POPSAVEIT scoring system has been proposed to be used as a risk stratification tool and reporting standard for patients with these injuries. However, because limb salvage will be attempted for >90% of patients presenting with traumatic popliteal injury, we believed it would be prudent to explore the perioperative factors that could also affect limb salvage outcomes. The purpose of the present study was to examine the outcomes of patients undergoing operative repair for traumatic popliteal arterial injuries and identify the perioperative factors associated with limb loss independently of the preoperative assessment.

ARTICLE HIGHLIGHTS

- **Type of Research:** A multicenter, retrospective cohort study
- **Key Findings:** The present multi-institutional review of 302 patients who had undergone revascularization of traumatic popliteal artery injuries demonstrated that the lack of immediate postoperative pedal Doppler signals and the loss of primary patency were highly predictive of major amputation, and postoperative antiplatelet therapy appeared to be protective.
- **Take Home Message:** Antiplatelet therapy and diligent postoperative surveillance are critical to successful limb salvage for patients with traumatic popliteal artery injuries.

METHODS

Institutions within the Western Vascular Society were invited to participate in the present multi-institutional retrospective review of all patients with traumatic popliteal vascular injuries from 2007 to 2018. The institutional review board at each respective institution approved the study protocol, with a waiver of the requirement for written informed consent owing to the retrospective design, with data use agreements used as necessary. Those patients who had not undergone operative repair of a popliteal arterial injury (primary amputation or death before revascularization) were excluded from the present analysis.

The demographic data, mechanism of injury (blunt vs penetrating), physiologic parameters on arrival (Glasgow coma scale score, initial SBP, laboratory values), vascular examination findings, Injury Severity Score, POPSAVEIT score, operative details, and postoperative course were recorded. The operative details included the time to vascular repair, orthopedic fixation type and timing, type of vascular repair, bypass details (ie, conduit and targets), the use of a shunt, and the need for fasciotomy. Preexisting patient comorbidities and the pre- and postoperative medications were also recorded. Patency data were collected and determined as any clinically patent revascularization recorded by the surgical team at the patient's last follow-up. The method of determining patency (Doppler ultrasound, duplex ultrasound, or clinical examination) was at the discretion of the surgical team according to their standard practice and could have varied among the institutions.

The POPSAVEIT score assigns points in three categories for each patient preoperatively: 1 point for an initial SBP of <90 mm Hg, 2 points for an associated orthopedic injury (ie, long bone fracture or dislocation on the affected limb), and 2 points for the lack of pedal Doppler signals (or 1 point for the lack of a palpable pedal pulse if the Doppler examination data were not available).[13] The POPSAVEIT score was defined as the sum of these points and was evaluated for all the patients.

The primary endpoint was major lower extremity amputation (transfemoral or transtibial). Patients undergoing major lower extremity amputation were compared with those with successful limb salvage at the last follow-up. The groups were compared using a

Table I. Baseline demographics

Variable	Total (n = 302)	Amputation required: No (n = 264)	Amputation required: Yes (n = 38)	*P* value
Sex				.98
Male	239 (79)	209 (79)	30 (79)	
Female	63 (21)	55 (21)	8 (21)	
Age, years	32 ± 14	32 ± 13	35 ± 17	.30
Comorbidity				
Diabetes	16 (5)	12 (5)	4 (11)	.12
Hypertension	40 (13)	35 (14)	5 (14)	.94
Coronary artery disease	2 (1)	2 (1)	0 (0)	.59
Active smoker	86 (28)	78 (33)	8 (23)	.22
Preoperative antiplatelet therapy				.89
Aspirin	20 (8)	18 (8)	2 (8)	
Plavix	2 (1)	2 (1)	0 (0)	
None	223 (91)	200 (91)	23 (92)	
ISS	13 ± 10	13 ± 9	16 ± 11	.07
Mechanism of injury				.047
Blunt	195 (65)	165 (62)	30 (79)	
Penetrating	107 (35)	99 (38)	8 (21)	
Concomitant venous injury	91 (30)	78 (30)	13 (34)	.56
Concomitant orthopedic injury	238 (79)	203 (77)	35 (92)	.032

ISS, Injury severity score.
Data presented as mean ± standard deviation or number (%).

Mann-Whitney *U* test for continuous data and a χ^2 test for categorical data. The variables that were significant predictors ($P < .05$) for major amputation on univariate analysis and those variables thought to be clinically significant were included in a multivariate logistic regression to identify the perioperative factors independently associated with major amputation. Statistical analyses were performed using the SPSS, version 24.0 (IBM Corp, Armonk, NY).

RESULTS

A total of 302 consecutive patients from 11 institutions met the criteria for inclusion in the final analysis. Their mean age was 32 ± 14 years, 239 were men (79%), and the overall major lower extremity amputation rate was 13% (38 patients; Table I). In this operative cohort, 301 patients had undergone open surgical intervention and 1 had undergone endovascular repair with a covered stent. Most of the patients (65%) had undergone definitive operative repair within 6 hours of injury and only 41 patients (13%) had undergone shunting. The injury location was identified as P1 (adductor canal to proximal edge of patella) in 71 patients (24%), P2 (proximal patella to center of knee joint) in 142 patients (47%), P3 (center of knee joint to origin of anterior tibial artery) in 84 patients (28%), and unknown in 5 patients (1%). Definitive open repair included primary repair in 50 patients (17%), patch repair in 6 (2%), and interposition or bypass in 245 patients (81%). Vein grafts were used in 98% of the cases, with only 2% receiving a prosthetic graft (Table II). Of the 82 patients with a concomitant venous injury, 37 (45%) had undergone ligation, 33 (40%) had undergone primary repair, 3 (4%) had undergone patch repair, and 9 (11%) had undergone bypass. Of the patients with a concomitant orthopedic injury, 49% had undergone fixation before vascular repair. Between the patients who had required amputation and those who had not, no difference was found in the number of fasciotomies performed prophylactically at the index operation, performed therapeutically for compartment syndrome at the index operation, or performed for the occurrence of delayed compartment syndrome.

Comparing the patients who had required amputation and those with successful limb salvage, no significant differences were found in the baseline demographics, comorbidities, preoperative anticoagulation and antiplatelet medication, time to vascular repair, or rate of popliteal vein injury. On univariate analysis, the factors associated with amputation were postoperative antiplatelet therapy, knee dislocation, lack of a postoperative pedal pulse and Doppler signal, and the loss of primary patency. The use of postoperative anticoagulation was not significant (Table II).

Table II. Univariate analysis of perioperative risk factors for amputation

Variable	Total (n = 302)	Amputation No (n = 264)	Yes (n = 38)	*P* value
ISS	13 ± 10	13 ± 9	16 ± 11	.07
POPSAVEIT score	3 ± 2	3 ± 2	4 ± 2	.002
Ischemia time >6 hours	91 (35)	77 (34)	14 (44)	.25
Injury location				.49
P1	71 (24)	65 (25)	6 (16)	
P2	142 (48)	123 (47)	19 (51)	
P3	84 (28)	72 (28)	12 (32)	
Type of repair				.95
Endovascular	1 (0)	1 (0)	0 (0)	
Primary	50 (17)	43 (16)	7 (18)	
Patch	6 (2)	5 (2)	1 (3)	
Interposition/bypass	245 (81)	215 (81)	30 (79)	
Inflow vessel				.39
CFA	2 (1)	2 (1)	0 (0)	
SFA	60 (26)	55 (27)	5 (17)	
AK popliteal artery	134 (50)	117 (58)	17 (59)	
BK popliteal artery	35 (15)	28 (14)	7 (24)	
Outflow vessel				.54
Popliteal artery	171 (74)	151 (74)	20 (69)	
Tibial artery	61 (26)	52 (26)	9 (31)	
Conduit				.08
RSVG	232 (95)	205 (95)	27 (90)	
NRSVG	4 (2)	3 (1)	1 (3)	
Spliced SVG	1 (0)	0 (0)	1 (3)	
Other autologous vein	3 (1)	2 (1)	1 (3)	
Prosthetic conduit	4 (2)	4 (2)	0 (0)	
Shunt	41 (14)	37 (14)	4 (10)	.56
Concomitant venous injury	91 (30)	78 (30)	13 (34)	.56
Venous repair				**.05**
Ligation	37 (45)	29 (41)	8 (73)	
Primary/patch/bypass	45 (55)	42 (59)	3 (27)	
Fasciotomy	239 (79)	206 (78)	33 (87)	.21
Index prophylactically	178 (59)	151 (57)	27 (71)	.10
Index compartment syndrome	51 (17)	45 (17)	6 (16)	.85
Delayed compartment syndrome	10 (3)	10 (4)	0 (0)	.22
Orthopedic details				
Knee dislocation				**.03**
No	196 (66)	177 (68)	19 (50)	
Yes	103 (34)	84 (32)	19 (50)	
Timing				.45
Before revascularization	94 (49)	82 (51)	12 (43)	
After revascularization	96 (51)	80 (49)	16 (57)	
Fixation type				.31
Permanent	25 (13)	23 (14)	2 (7)	
External fixation	165 (87)	139 (86)	26 (93)	
Postoperative details				
No antiplatelet therapy	74 (27)	57 (24)	17 (53)	**<.001**

Table II. Continued.

Variable	Total (n = 302)	Amputation		*P* value
		No (n = 264)	Yes (n = 38)	
No anticoagulation therapy	126 (42)	115 (44)	11 (29)	.43
No palpable pulse	106 (36)	87 (33)	19 (51)	**.03**
No pedal Doppler signal	12 (4)	6 (2)	6 (17)	**<.001**
Loss of primary patency	27 (9)	15 (6)	12 (32)	**<.001**
Loss of 30-day primary patency	20 (7)	8 (3)	12 (32)	**<.001**

AK, Above the knee; *BK*, below the knee; *CFA*, common femoral artery; *ISS*, injury severity score; *NRSVG*, nonreversed saphenous vein graft; *POPSAVEIT*, popliteal scoring assessment for vascular extremity injury in trauma; *RSVG*, reversed saphenous vein graft; *SFA*, superficial femoral artery; *SVG*, saphenous vein graft.
Data presented as mean ± standard deviation or number (%).
Boldface *P* values represent statistical significance.

On multivariate regression, the significant perioperative factors independently associated with major amputation included the lack of postoperative antiplatelet therapy, the absence of detectable postoperative pedal Doppler signals, and the loss of primary patency (Table III). The overall primary patency was 89% at a median follow-up of 72 days (interquartile range, 20-366 days). Of the 204 patients, 190 (93%) had documented primary patency at 30 days and 71 of 94 patients (76%) had documented patency at 1 year (Fig 1). Of the 26 patients who had lost primary patency, 12 (46%) had ultimately required a major lower extremity amputation, all of whom had experienced the early loss of primary patency within 30 days of their index operation. None of the six patients with the late loss of primary patency had required amputation (Fig 2). The details of those requiring an amputation are listed in the Supplementary Table (online only).

DISCUSSION

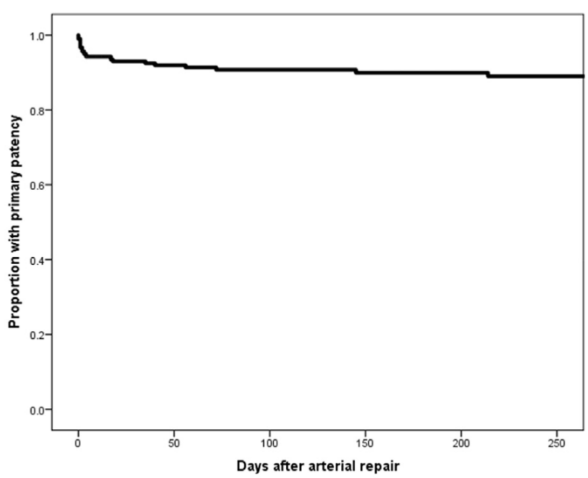
Although popliteal artery injuries continue to be associated with significant morbidity, with improved prehospital transportation, resuscitative efforts, and coordinated surgical efforts, it has been demonstrated that few patients will meet the criteria for primary amputation.[12,14,15] In the present study, we aggregated a large number of patients with traumatic popliteal artery injuries across 11 institutions with the goal of identifying the perioperative factors associated with major amputation. The initial report describing the POPSAVEIT score as a novel reporting standard analyzed all patients with popliteal vascular injuries (inclusive of 15 patients with primary amputation) and reported a total amputation rate of 16%.[13] In the present cohort who had undergone a revascularization attempt, major amputation had occurred in 13% of the patients, only a slight underestimation of the true amputation rate of all popliteal injuries. In the present study, one of the most significant predictors of limb loss was the lack of a detectable pedal Doppler signal immediately after vascular repair. This signifies the importance of adequate revascularization in this patient population. Thus, we strongly suggest further evaluation if a pedal Doppler signal is not immediately present using completion angiography or duplex ultrasound. However, the absence of an immediately palpable pedal pulse was not independently associated with amputation on multivariate analysis. Perhaps this had resulted because trauma patients can be more hemodynamically unstable and require ongoing resuscitative efforts postoperatively or because they will often be younger patients who are more apt to experience significant vasospasm postoperatively. Regardless of the cause, although the lack of a palpable pedal pulse might be acceptable, surgeons should attempt to never leave the operating room without the presence of a pedal Doppler signal, because its absence was associated with a 12-fold increased risk of amputation. Of the 12 patients in the present cohort who had left the operating room without a pedal Doppler signal, 6 had required a major lower extremity amputation. Of these 12 patients, 6 had undergone completion angiography, and of those 6, 3 had subsequently required a major amputation. Owing to the retrospective and multi-institutional nature of the present study, we were unable to determine why some patients without Doppler signals at the end of the case had not undergone completion imaging studies, the exact findings of the completion imaging studies that were performed, what further interventions might have been performed as a result of the completion imaging findings, nor the specific decision-making regarding whether to perform completion imaging studies. This was a limitation because such information could show why only one half of the patients without Doppler signals at the end of the operation had not undergone a completion imaging study and whether the findings from imaging studies that had been performed were reassuring.

The importance of adequate revascularization after popliteal artery injury was further highlighted because the loss of primary patency was also independently associated with the need for major amputation. In the present study, 26 patients had lost primary patency by 1 year, 20 within the first 30 days. Of the 26 patients who had lost primary patency, 12 (46%) had required a

Table III. Multivariate analysis outlining risk factors for major amputation

Variable	OR	95% CI	*P* value
No postoperative antiplatelet therapy	6.6	2.2-19.1	**.001**
POPSAVEIT score	1.9	1.3-2.8	**.001**
No postoperative pedal Doppler signal	21.9	4.0-121.2	**<.001**
Loss of primary patency	9.0	2.1-38.9	**.003**
Popliteal vein ligation	2.6	0.7-9.3	.14
ISS	1.0	1.0-1.1	.29
No postoperative palpable pulse	0.4	0.2-2.2	.59
Tibial outflow vessel	1.0	0.3-3.4	.94

CI, Confidence interval; *ISS,* injury severity score; *OR,* odds ratio; *POPSAVEIT,* popliteal scoring assessment for vascular extremity injury in trauma. Boldface *P* values represent statistical significance.



Number at risk 302 164 124 110 97 90

Fig 1. Graph showing overall primary patency.

major lower extremity amputation, and all had experienced an early loss of primary patency within 30 days. It has been well documented that revascularization is critical to limb salvage owing to the lack of collateralization around the popliteal artery in trauma patients. One can extrapolate from this that the early loss of patency returns the patient to the same degree of ischemia as had resulted from the original insult. This finding highlights the critical nature of early surveillance for these patients, especially within the first 3 months postoperatively, because this could potentially have enabled treatment of critical stenoses before graft failure. We strongly suggest that that, regardless of the specialty of the operating surgeon, all patients undergoing popliteal artery injury revascularization should be offered long-term vascular follow-up whenever possible to allow for the recognition and treatment of early signs of graft failure before thrombotic occlusion.

Although the utility of postoperative antiplatelet therapy for trauma patients after vascular repair has sometimes been called into question, the present study found that a lack of postoperative antiplatelet therapy was independently associated with lower extremity amputation, even after correcting for the severity of the injury. The magnitude of this association was substantial, with an odds ratio of 5.4. The presumption is that antiplatelet therapy might decrease the occurrence of postoperative neointimal hyperplasia and aid in maintaining patency; however, the concern with trauma patients has been that they frequently will have associated injuries that increases their risk of bleeding. In the non—trauma population, meta-analyses examining the secondary prevention of nonfatal vascular events with the use of antiplatelet therapy have demonstrated a substantial net benefit with a minimal risk of bleeding.[16] Furthermore, although it has been reported that clopidogrel is associated with increased blood loss and transfusion requirements, the use of aspirin appears to be safe.[17] Additionally, Bedenis et al[18] examined >5000 patients who had undergone lower extremity bypass and demonstrated a beneficial effect with aspirin on primary patency. From these findings, one might extrapolate that the protective effect of antiplatelet therapy will also apply to trauma patients who have sustained substantial endothelial injury. Taken together, these findings suggest substantial benefit of antiplatelet therapy for patients undergoing revascularization of popliteal artery injuries and that these patients should receive daily aspirin therapy as soon as the bleeding risk from other injuries allows.

Although conflicting results have been reported on the effects of concomitant popliteal vein injury and the effect of repair vs ligation of popliteal vein injuries, neither of these factors were independently associated with amputation in the present study.[19-21] Another topic of much debate has been whether orthopedic fixation should precede revascularization or vice versa. The present study found no differences in the outcomes when stratified by the timing or type of orthopedic fixation. Shunting of vascular injuries before orthopedic fixation is yet another controversial topic, with one multicenter study

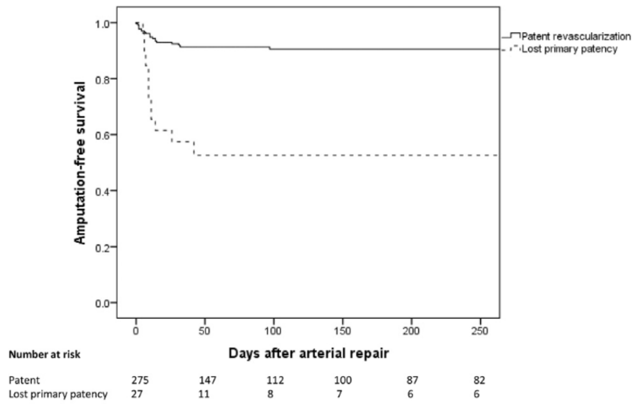


Fig 2. Graph showing amputation-free survival according to primary patency.

concluding shunting resulted in decreased morbidity. We found no benefit or harm associated with shunting before definitive revascularization.

As inferred from the data presented in Table II, 26 of the 38 patients who had required an amputation (68%) had had patent revascularization at amputation. Because the indication for amputation was not collected, the rationale of the decision for amputation in these situations is purely speculative. We hypothesized that amputation in this setting had likely resulted from either delayed patient decision (at a less time-sensitive decision point and/or an increased awareness of the need for numerous subsequent operations), poor options for soft tissue and musculoskeletal reconstruction, or the poor likelihood of a good functional result. In practice, the decision for amputation in these situations often involves multidisciplinary expert evaluation and opinions and a lengthy discussion with the patient and family (none of which will be practical at the initial presentation). We believe these factors highlight the importance for a new reporting standard for preoperative risk stratification for amputation. This was our goal with the POPSAVEIT score, and we hope it will be used as a tool to discuss the prognosis with patients, families, and providers and allow for comparisons across centers.[13]

The present study had several limitations inherent to its retrospective design, including missing data, treatment differences between institutions, center bias, treatment bias, and the lack of long-term follow-up data. The specific details of injury type (ie, focal intimal injury, pseudoaneurysm, occlusion, transection) and concomitant distal arterial injuries and which side the great saphenous vein had been harvested were not recorded. Detailed descriptions of the intraoperative imaging studies performed and decision-making were also unavailable. Therefore, these factors could not be analyzed in the present study. Additionally, although functional ambulatory status is an important metric, we were unable to obtain sufficient data to evaluate this as an outcome measure.[22] Furthermore, because patient follow-up protocols vary by institution, detailed assessments of the bypass grafts were not routinely available, limiting our ability to report detailed patency data. Long-term follow-up with graft surveillance for vascular trauma patients clearly remains an important unmet clinical need.

CONCLUSIONS

Traumatic popliteal artery injuries have continued to be associated with a significant rate of major amputation. The preoperative POPSAVEIT score was independently associated with amputation after including perioperative factors. The lack of postoperative pedal Doppler signals and the loss of primary patency were highly associated with the requirement for major amputation. Postoperative antiplatelet therapy was inversely associated with amputation, perhaps indicating a protective effect.

AUTHOR CONTRIBUTIONS

Conception and design: LO, RD, EF, GM
Analysis and interpretation: LO, RD, GM
Data collection: LO, RD, NS, EF, WY, CP, CF, AC, SS, MN, BB, JB, SK, HB, VC, VH, WZ, AL, NB, YC, KW, JU, GM
Writing the article: LO, RD, GM
Critical revision of the article: LO, RD, NS, EF, WY, CP, CF, AC, SS, MN, BB, JB, SK, HB, VC, VH, WZ, AL, NB, YC, KW, JU, GM
Final approval of the article: LO, RD, NS, EF, WY, CP, CF, AC, SS, MN, BB, JB, SK, HB, VC, VH, WZ, AL, NB, YC, KW, JU, GM
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Overall responsibility: LO

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Supplementary Table (online only). Comparison of patients requiring amputation[a]

Variable	Total (n = 35)	Patent revascularization (n = 23)	Patency lost (n = 12)	*P* value
Sex				.15
Male	28 (80)	20 (87)	8 (67)	
Female	7 (20)	3 (13)	4 (33)	
Age, years	35 ± 16	36 ± 15	34 ± 18	.46
Comorbidity				
Diabetes	3 (9)	3 (13)	0 (0)	.23
Hypertension	4 (12)	3 (13)	1 (9)	.74
Active smoker	7 (22)	5 (23)	2 (20)	.86
Preoperative antiplatelet therapy				.27
Aspirin	2 (8)	2 (12)	0 (0)	
None	23 (92)	14 (88)	9 (100)	
POPSAVEIT score	4 ± 2	4 ± 2	4 ± 1	.23
ISS	16 ± 11	16 ± 11	17 ± 12	.96
Mechanism of injury				.83
Blunt	27 (77)	18 (78)	9 (75)	
Penetrating	8 (23)	5 (22)	3 (25)	
Ischemia time >6 hours	13 (45)	12 (60)	1 (11)	.014
Injury location				.14
P1	6 (18)	2 (9)	4 (33)	
P2	17 (50)	11 (50)	6 (50)	
P3	11 (32)	9 (41)	2 (17)	
Type of repair				.14
Primary	5 (14)	2 (9)	3 (25)	
Patch	1 (3)	0 (0)	1 (8)	
Interposition/bypass	29 (83)	21 (91)	8 (67)	
Inflow vessel				.89
SFA	5 (18)	4 (20)	1 (13)	
AK popliteal artery	16 (57)	11 (55)	5 (62)	
BK popliteal artery	7 (25)	5 (25)	2 (25)	
Outflow vessel				.70
Popliteal artery	19 (68)	14 (70)	5 (62)	
Tibial artery	9 (32)	6 (30)	3 (38)	
Conduit				.34
RSVG	26 (90)	19 (90)	7 (88)	
NRSVG	1 (3)	0 (0)	1 (12)	
Spliced SVG	1 (3)	1 (5)	0 (0)	
Other autologous vein	1 (3)	1 (5)	0 (0)	
Shunt	3 (9)	2 (9)	1 (8)	.97
Concomitant venous injury	12 (34)	8 (35)	4 (33)	.93
Venous repair				.90
Ligation	8 (73)	5 (71)	3 (75)	
Primary	3 (27)	2 (29)	1 (25)	
Fasciotomy	31 (89)	21 (91)	10 (83)	.48
Index prophylactically	25 (71)	18 (78)	7 (58)	.22
Index compartment syndrome	6 (17)	3 (13)	3 (25)	.37
Orthopedic details				
Concomitant orthopedic injury	33 (94)	22 (96)	11 (92)	.63
Knee dislocation				.28

(Continued on next page)

Supplementary Table (online only). Continued.

Variable	Total (n = 35)	Patent revascularization (n = 23)	Patency lost (n = 12)	*P* value
No	19 (54)	14 (61)	5 (42)	
Yes	16 (46)	9 (39)	7 (58)	
Timing				.55
Before revascularization	11 (44)	9 (47)	2 (33)	
After revascularization	14 (56)	10 (53)	4 (67)	
Type of fixation				.41
Permanent	2 (8)	2 (10)	0 (0)	
External fixation	23 (92)	17 (90)	6 (100)	
Postoperative details				
No antiplatelet therapy	17 (57)	12 (60)	5 (50)	.60
No anticoagulation therapy	11 (44)	7 (41)	4 (50)	.68
No palpable pulse	18 (53)	13 (59)	5 (42)	.33
No pedal Doppler signal	5 (15)	4 (18)	1 (9)	.49

AK, Above the knee; *BK,* below the knee; *ISS,* injury severity score; *NRSVG,* nonreversed saphenous vein graft; *POPSAVEIT,* popliteal scoring assessment for vascular extremity injury in trauma; *RSVG,* reversed saphenous vein graft; *SFA,* superficial femoral artery; *SVG,* saphenous vein graft.
Data presented as mean ± standard deviation or number (%).
[a]Patency information was unknown for three patients in the amputation group.