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Stump complications leading to stump revision surgery and related factors in individuals with trauma-related lower limb amputation: A 7-year retrospective cohort study

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ABSTRACT

Aims: Stump complications (SCs) are common in individuals with lower extremity amputations due to trauma, and these complications may require revision surgeries. This study aimed to describe SCs leading to revision surgery and to determine the factors associated with these complications.

Methods: This retrospective cohort study included individuals with traumatic lower extremity amputation who underwent stump revision surgery due to SCs and were admitted to a tertiary rehabilitation hospital between January 2016 and November 2023. Demographic, clinical and amputation data were recorded.

Results: The study included 84 patients [age, mean±standard deviation: 39.4±10.5 years; 100% male]. The reason for the first revision was infection in 30 patients (35.7%), neuroma in 22 patients (26.2%), bone spur formation in 21 patients (25%), and stump socket incompatibility in 11 patients (13.1%). The time from amputation to the first revision and the duration of prosthesis use before the operation were significantly longer in patients who underwent revision surgery due to neuroma (p=0.016 and p=0.018, respectively). In patients who had revision surgery due to infection, these times were significantly shorter (p=0.028 and p=0.015, respectively).

Conclusions: This study demonstrated that stump infection was the leading cause of revision surgery in trauma-related lower limb amputations, followed by neuroma. While neuroma-related surgeries were associated with longer amputation and prosthesis use durations, infection-related revisions occurred earlier in the post-amputation period.

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Introduction

Stump complications (SCs) are common in individuals with trauma-related amputations (1). Delayed wound healing, stump scar, or infection, residual limb pain, painful bone spur, neuroma, and skin and circulatory problems are among SCs (2). Despite the developments in amputation surgery and prosthesis technology, these complications negatively affect the rehabilitation process and make it difficult to wear a prosthesis (3,4).

Stump revision surgery should be considered in selected cases where recovery cannot be achieved with comprehensive rehabilitation management (2). It has been reported in the literature that the most common cause of hospitalization after traumatic lower extremity amputations is SCs (5), and the stump revision surgery rate is 61% due to the complications (6). Since stump revisions will cause recurrent surgeries, repeated hospitalizations, difficulty in returning to social life, and increased costs, it is essential to analyze the causes of stump revisions and determine the associated factors.

Our current understanding of the causes and associated factors of stump revision surgery after traumatic lower limb amputation is limited. Only a small number of studies has been conducted on the reasons for stump revision surgery (3,7), but some of these also include non-traumatic amputations. This study aimed to share the demographic and clinical data of individuals with traumatic lower extremity amputation, who underwent stump revision surgery, to describe the SCs that lead to the revision, and to determine the factors associated with these complications.

Methods

Study design and participants

This study designed as a retrospective cohort trial. The study cohort consisted of 1031 lower limb amputees. These patients were identified by scanning patients with ICD diagnosis codes S78, S78.0, S78.1, S78.9, S88, S88.0, S88.1, S88.9, S98.0, T13.6, T05.4, T05.6, T05.8, T05.9 who were admitted to a tertiary rehabilitation hospital between January 2016 and November 2023. Among these, patients with traumatic lower extremity amputation who were between the ages of 18-65 and underwent stump revision surgery due to SCs were included in the study. Patients who had amputation due to a reason other than trauma, who did not undergo revision surgery, and whose amputation and revision data were missing were excluded from the study.

The Clinical Research Ethics Committee of Ankara Bilkent City Hospital approved the study (decision number: E1-23-4070, date: 04.10.2023). The study was carried out in accordance with the principles of the Declaration of Helsinki.

Assessments

Demographic data (age, gender, occupation, body mass index, marital status) and clinical data (comorbidities, knowledge of amputation and stump revision surgery) of the patients were collected. “Stump revision number 1” was used to indicate the total number of stump revision surgeries of the amputee, and “Stump revision number 2” was used to indicate that the revision operation was performed one or more times. Etiology of traumatic amputation, amputation duration, amputation level (transfemoral, knee disarticulation, transtibial, Syme, Chopart), and amputation side (right/left/bilateral) were noted.

Prosthesis use duration before revision, type of prosthesis used, concomitant pathology of the operated limb and non-operated limb, number of revisions, time from primary amputation to stump revision (month), revision etiology (bone spur, infection, neuroma, and stump socket incompatibility), and type of revision operation were recorded. In individuals with bilateral amputation, the amputation level and prosthesis type of the side on which the revision operation was performed were noted.

Activity level was assessed with the Amputee Mobility Predictor Scale. It is a valid and reliable scale developed to help assign activity level in individuals with lower limb amputation, and is considered nearly the gold standard. It scores 21 activities, including transfers, static and dynamic sitting and standing balance, walking, climbing stairs, and using assistive devices, on a total scale of 0-47. Higher scores indicate better activity level. This scale can be used with and without prostheses (8,9).

Outcomes

The primary outcome of this study is to identify the most common SCs leading to revision surgery in individuals with trauma-related lower limb amputations. Secondary outcomes include the factors associated with each type of complication.

Statistical Analysis

The research data were analyzed using the Statistical Package for the Social Sciences for Windows, version 23.0 (IBM Corp., Armonk, NY, USA). The Kolmogorov-Smirnov test was performed to confirm whether the data were normally distributed. Categorical data were expressed as frequencies (percentages). Continuous data were presented as mean and standard deviation, median (interquartile range), or minimum-maximum values. The Chi-square test was used for comparisons of categorical variables. The Mann-Whitney U test or Student’s t-test was performed to compare continuous variables for abnormally or normally distributed data, respectively. Statistical significance was determined as $p<0.05$.

Results

Demographic and clinical data

Eighty-four patients who met the inclusion criteria were included in the study. The mean age of the patients was 39.4±10.5 years and all of the patients were men. The mean time since amputation was 179.5±131.9 months, and the mean time from primary amputation to stump revision was 87.8±103.5 months. A total of 48 patients (57.1%) were employed. Twenty (23.8%) of the patients had at least one comorbid disease, 3 (3.6%) had concomitant pathology in the operated extremity, and 28 (33.3%) had concomitant pathology in the non-operated extremity. In 54 (64.1%) patients, the amputation level was transtibial, and the amputation side was right in 38 (45.2%) of these patients.

Table 1. Demographics and clinics of the individuals with lower limb amputation (n=84)

Demographic and clinical characteristics	Value
Age (years), mean±SD	39.4±10.5
Body mass index (kg/m²), mean±SD	25.8±3.4
Occupation, n (%)	
Employed	48 (57.1)
Unemployed	36 (42.9)
Marital status, n (%)	
Married	49 (58.3)
Single	35 (41.7)
Comorbidity, n (%)	
None	64 (76.2)
Present	20 (23.8)
Hypertension	4 (4.8)
Diabetes mellitus	8 (9.5)
Hyperlipidemia	1(1.2)
Coronary artery disease	1(1.2)
Other	6 (7.1)
Time since amputation (month), mean±SD	179.5±131.9
Amputation etiology, n (%)	
Mine	44 (52.4)
Explosives	19 (22.6)
Gunshot	17 (20.2)
Earthquake	2 (2.4)
Car accident	1 (1.2)
Electric shock	1 (1.2)
Amputation side, n (%)	
Right	38 (45.2)
Left	30 (35.7)
Bilateral	16 (19)
Amputation level, n (%)	
Transfemoral	15 (17.9)
Knee disarticulation	6 (7.1)
Transtibial	54 (64.1)
Syme	4 (4.8)
Chopart	5 (6)
Concomitant pathology of the operated limb, n (%)	
None	81 (96.4)
Fracture	1 (1.2)
Peripheral nerve injury	1 (1.2)
Vascular injury	1 (1.2)
Concomitant pathology of the non-operated limb, n (%)	
None	56 (66.7)
Fracture	4 (4.8)
Peripheral nerve injury	4 (4.8)
Others	4 (4.8)
Amputation	16 (19)
Prosthesis use period before revision (month), mean±SD	83.1±101.6
Activity level before revision, n (%)	
K2	3 (3.6)
K3	17 (20.2)
K4	64 (76.2)
Type of prosthesis, n (%)	
Microprocessor-controlled knee prosthesis	18 (21.4)
Hydraulic controlled knee prosthesis	1 (1.2)
Active vacuum system modular prosthesis	45 (53.6)
Passive vacuum system modular prosthesis	7 (8.3)
Pin lock system modular prosthesis	3 (3.6)
Syme prosthesis	3 (3.6)
Chopart prosthesis	4 (4.8)
None	3 (3.6)

SD: Standard deviation

Demographic and clinical data including prosthesis use period before revision, activity level, and type of prosthesis are presented in detail in Table 1.

Stump revision data

More than one revision operation was performed in 32 (38.1%) of the patients. The first revision of SCs was due to infection in 30 (35.7%) of the patients, neuroma in 22 (26.2%), bone spur formation in 21 (25%), and stump socket incompatibility in 11 (13.1%). The types of revision operation were spur excision (21, 25%), soft tissue revision (42, 50%), and reamputation (21, 25%) (Table 2).

Relationship between demographic and clinical characteristics and stump complications

The relationship between demographic and clinical characteristics and SCs was shown in Tables 3 and 4. In patients who underwent revision surgery due to neuroma, the time from amputation to the first revision and the duration of prosthesis use before the operation were significantly longer than in patients who underwent surgery for reasons other than neuroma ($p=0.016$ and $p=0.018$, respectively). The time from amputation to the first revision and the duration of prosthesis use were significantly shorter in patients operated on because of infection than in those operated on because of other complications ($p=0.028$ and $p=0.015$, respectively) (Table 4).

Discussion

Continuity of prosthesis use is necessary for the social integration of amputated individuals. Stump revision operations interrupt the prosthesis usage and negatively affect the success of rehabilitation. This study shared epidemiological data on individuals with traumatic lower extremity amputation who underwent stump revision surgery, examined the SCs that lead to stump revision, and defined the factors associated with these complications. The most common complication that led to stump revision operation was infection in the stump area followed by neuroma. It seems that the time from amputation to the first revision, and the duration of prosthesis use before the operation, are related to revision operations due to neuroma. It appears that stump operations due to infection are needed earlier after amputation than those due to other reasons.

In this study, individuals with traumatic lower extremity amputation who underwent stump revision surgery were mostly young, with a mean age of 39 years, and more than half were employed. The main causes of the trauma were mines, explosives and gunshot. The most common level of amputation was transtibial, and the average time from amputation to revision was 88 months. Three-quarters of the individuals were at the K4 activity level. In this respect, the study population is mostly active individuals for whom continuity of prosthesis use is important.

Table 2. Stump revision data (n=84)	
Stump revision parameters	**Value**
Number of stump revision 1, mean±SD	1.7±1.3
Number of stump revision 2, n (%)	
Single	52 (61.9)
Multiple	32 (38.1)
Time from amputation to stump revision (month), mean±SD	87.8±103.5
Stump revision etiology, n (%)	
Neuroma	22 (26.2)
Infection	30 (35.7)
Bone spur	21 (25)
Stump socket incompatibility	11 (13.1)
Revision operation, n (%)	
Spur excision	21 (25)
Soft tissue revision	42 (50)
Reamputation	21 (25)
SD: Standard deviation	

There are limited data in the literature regarding the frequency of SCs requiring its revision. In a study conducted by Kumar et al. (3), poor initial stump (38%) was the most common reason for revision operation, followed by infection (25%), recurrent ulceration (19%), abscess (6%), neuroma (6%), and necrosis (6%) in individuals with both traumatic and non-traumatic amputations. In the study of Liu et al. (7), in which 80 stump revisions were examined, 53% of the patients with above-ankle traumatic amputation had severe scarring, 48% had neuroma, 30% had excessively soft tissues, and 18% had ulcers. SCs leading to revision in this study were infection in approximately 36% of patients, neuroma in 26%, bone spur formation in 25%, and stump socket incompatibility in 13%. These results suggested that the rate of neuroma leading to stump revision was higher in studies that included only traumatic amputees. However, in the study of Kumar et al. (3), which included amputees due to vascular, infectious, and malignant causes other than trauma, the frequency of neuroma caused by revision surgery seems to be low. In a study, it was determined that approximately half of the individuals with residual stump pain who were amputated due to traumatic reasons had neuroma (10). It is known that neuroma is a non-neoplastic proliferation at the end of the injured nerve (11,12) and its size is directly related to the number of damaged axons (13). For this reason, neuroma formation is more common in traumatic amputations and may be due to the injuries caused to the nerve by the trauma itself, as well as the trauma due to amputation surgery. However, a previous study has reported that the incidence of neuroma was not significantly different in patients who underwent amputation for traumatic indications and those with non-traumatic indications (14). More studies are needed to investigate the frequency and formation mechanism of neuromas in traumatic and non-traumatic amputees to fully understand this relationship.

In this study, excess soft tissue in the stump, scar formation, poor stump condition, and inconvenient shape were evaluated as socket-stump incompatibility. Compared to the other two studies, the frequency of stump incompatibility, requiring stump revision, was lower in this study. We believe this situation may depend on developments in amputation surgery and post-amputation rehabilitation.

The relationship between demographic and clinical factors and the four complications, which we determined as causes of revision operation in this study cohort, was examined. However,

Table 3. The relationship between demographic and clinical characteristics and stump complications

Variables	Neuroma			Bone spur			Infection			Stump socket incompatibility		
	Yes	No	p	Yes	No	p	Yes	No	p	Yes	No	p
Occupation			0.086			0.611			0.148			0.401
Employed	16 (72.7)	32 (51.6)		13 (61.9)	35 (55.6)		14 (46.7)	34 (63)		5 (45.5)	43 (58.9)	
Unemployed	6 (27.3)	30 (48.4)		8 (38.1)	28 (44.4)		16 (53.3)	20 (37)		6 (54.5)	30 (41.1)	
Marital status			0.557			0.523			0.817			0.702
Married	14 (63.6)	35 (56.5)		11 (52.4)	38 (60.3)		17 (56.7)	32 (59.3)		7 (63.6)	42 (57.5)	
Single	8 (36.4)	27 (43.5)		10 (47.6)	25 (39.7)		13 (43.3)	22 (40.7)		4 (36.4)	31 (42.5)	
Comorbidity			0.161			0.805			0.708			0.825
None	16 (72.7)	48 (77.4)		17 (81)	47 (74.6)		21 (70)	43 (79.6)		10 (90.9)	54 (74)	
Hypertension	2 (9.1)	2 (3.2)		0	4 (6.3)		2 (6.7)	2 (3.7)		0	4 (5.5)	
Diabetes mellitus	1 (4.5)	7 (11.3)		2 (9.5)	6 (9.5)		4 (13.3)	4 (7.4)		1 (9.1)	7 (9.6)	
Hyperlipidemia	1 (4.5)			0	1 (1.6)			1 (1.9)		0	1 (1.4)	
Coronary artery disease	1 (4.5)			0	1 (1.6)			1 (1.9)		0	1 (1.4)	
Other	1 (4.5)	5 (8.1)		2 (9.5)	4 (6.3)		3 (10)	3 (5.6)		0	6 (8.2)	
Trauma etiology			0.909			0.839			0.429			0.544
Mine	12 (54.5)	32 (51.6)		10 (47.6)	34 (54)		16 (53.3)	28 (51.9)		6 (54.5)	38 (52.1)	
Explosives	5 (22.7)	14 (22.6)		6 (28.6)	13 (20.6)		7 (23.3)	12 (22.2)		1 (9.1)	18 (24.7)	
Gunshot	5 (22.7)	12 (19.4)		5 (23.8)	12 (19)		4 (13.3)	13 (24.1)		3 (27.3)	14 (19.2)	
Earthquake	0	2 (3.2)		0	2 (3.2)		1 (3.3)	1 (1.9)		1 (9.1)	1 (1.4)	
Car accident	0	1 (1.6)		0	1 (1.6)		1 (3.3)			0	1 (1.4)	
Electric shock	0	1 (1.6)		0	1 (1.6)		1 (3.3)			0	1 (1.4)	
Amputation level			0.472			0.699			0.127			0.058
Transfemoral	6 (27.3)	9 (14.5)		5 (23.8)	10 (15.9)		3 (10)	12 (22.2)		1 (9.1)	14 (19.2)	
Knee disarticulation	1 (145)	5 (8.1)		2 (9.5)	4 (6.3)		0	6 (11.1)		3 (27.3)	3 (4.1)	
Transtibial	14 (63.6)	40 (64.5)		13 (61.9)	41 (65.1)		22 (73.3)	32 (59.3)		5 (45.5)	49 (67.1)	
Foot amputations	1 (4.5)	8 (12.9)		1 (4.8)	8 (12.6)		5 (16.7)	4 (7.4)		2 (18.2)	7 (9.6)	
Amputation side			0.992			0.413			0.161			0.637
Right	10 (45.5)	28 (45.2)		10 (47.6)	28 (44.4)		12 (40)	26 (48.1)		6 (54.5)	32 (43.8)	
Left	8 (36.4)	22 (35.5)		9 (42.9)	21 (33.3)		9 (30)	21 (38.9)		4 (36.4)	26 (35.6)	
Bilateral	4 (18.2)	12 (19.4)		2 (9.5)	14 (22.2)		9 (30)	7 (13)		1 (9.1)	15 (20.5)	
Activity level			0.655			0.199			0.870			0.138
K2	1 (4.5)	2 (3.2)		1 (4.8)	2 (3.2)		1 (3.3)	2 (3.7)		0	3 (4.1)	
K3	3 (13.6)	14 (22.6)		7 (33.3)	10 (15.9)		7 (23.3)	10 (18.5)		0	17 (23.3)	
K4	18 (81.8)	46 (74.2)		13 (61.9)	51 (81)		22 (73.3)	42 (77.8)		11	53 (72.6)	

Table 3. Continued

Variables	Neuroma			Bone spur			Infection			Stump socket incompatibility		
	Yes	No	p	Yes	No	p	Yes	No	p	Yes	No	p
Concomitant pathology of the amputated limb			0.317			0.299			0.405			0.926
None	21 (95.5)	60 (96.8)		20 (95.2)	61 (96.8)		29 (96.7)	52 (96.3)		11 (100)	70 (95.9)	
Fracture	0	1 (1.6)		1 (4.8)	0		0	1 (1.9)		0	1 (1.4)	
Peripheral nerve injury	0	1 (1.6)		0	1 (1.6)		1 (3.3)	0		0	1 (1.4)	
Others	1 (4.5)	0		0	1 (1.6)		0	1 (1.9)		0	1 (1.4)	
Concomitant pathology of the non-amputated limb			0.624			0.357			0.228			0.151
None	13 (59.1)	43 (69.4)		16 (76.2)	40 (63.5)		19 (63.3)	37 (68.5)		8 (72.7)	48 (65.8)	
Fracture	2 (9.1)	2 (3.2)		1 (4.8)	3 (4.8)		1 (3.3)	3 (5.6)		0	4 (5.5)	
Peripheral nerve injury	2 (9.1)	2 (3.2)		0	4 (6.3)		0	4 (7.4)		2 (18.2)	2 (2.7)	
Amputation	4 (18.2)	12 (19.4)		2 (9.5)	14 (22.2)		9 (30)	7 (13)		1 (9.1)	15 (20.5)	
Others	1 (4.5)	3 (4.8)		2 (9.5)	2 (3.2)		1 (3.3)	3 (5.6)		0	4 (5.5)	
Type of prosthesis			0.885			0.391			0.104			0.890
Microprocessor-controlled knee prosthesis	6 (27.3)	12 (19.4)		7 (33.3)	11 (17.5)		2 (6.7)	16 (29.6)		3	15 (20.5)	
Hydraulic controlled knee prosthesis	0	1 (1.6)		0	1 (1.6)		1 (3.3)	0		0	1 (1.4)	
Active vacuum system modular prosthesis	12 (54.5)	33 (53.2)		8 (38.1)	37 (58.7)		19 (63.3)	26 (48.1)		6	39 (53.4)	
Passive vacuum system modular prosthesis	1 (4.5)	6 (9.7)		2 (9.5)	5 (7.9)		3 (10)	4 (7.4)		1	6 (8.2)	
Pin lock system modular prosthesis	1 (4.5)	2 (3.2)		2 (9.5)	1 (1.6)		0	3 (5.6)		0	3 (4.1)	
Syme prosthesis	1 (4.5)	2 (3.2)		0	3 (4.8)		1 (3.3)	2 (3.7)		1	2 (2.7)	
Partial foot prosthesis	0	4 (6.5)		1 (4.8)	3 (4.8)		3 (10)	1 (1.9)		0	4 (5.5)	
None	1 (4.5)	2 (3.2)		1 (4.8)	2 (3.2)		1 (3.3)	2 (3.7)		0	3 (4.1)	
Number of stump revision 2			0.480			0.604			0.461			0.428
Single	15 (68.2)	37 (59.7)		12 (57.1)	40 (63.5)		17 (56.7)	35 (64.8)		8	44 (60.3)	
Multiple	7 (31.8)	25 (40.3)		9 (42.9)	23 (36.5)		13 (43.3)	19 (35.2)		3	29 (39.7)	

Data are presented as n (%)

no relationship was found between SCs and age, body mass index, active employment, amputation side, amputation level, amputation duration, trauma etiology, activity level, and type of prosthesis used. Additionally, there was no relationship between SCs and accompanying comorbid diseases, the presence of other pathologies on the side where the revision surgery was performed, or the presence of other pathologies on the other side.

In a systematic review by Huang et al. (15), including 1329 patients and 13 studies, symptomatic neuromas were diagnosed more frequently when the follow-up period was longer than 3 years and were observed less frequently in studies with short follow-up periods. In this study, the average time from amputation to first revision in patients who had revision surgery due to neuroma was 122 months, and this period was significantly longer in patients who underwent stump revision operation due to neuroma than in those revised for other reasons. This result may support the notion that neuromas continue to enlarge over time (16) and may remain asymptomatic for long periods (17).

Neuromas that occur after amputation of a limb or complete transection of a nerve are known as terminal neuromas. All neuroma formations, including terminal neuromas, result from nerve damage followed by inappropriate internal nerve repair (18). Nerve damage can occur due to chronic irritation, pressure, ischemia, stretch, transection, and iatrogenic causes (19). We did not come across any studies in the literature investigating whether wearing a prosthesis has an effect on neuroma formation. In this study,

Table 4. The relationship between demographic and clinical characteristics and stump complications

Variables	Neuroma			Bone spur			Infection			Stump socket incompatibility		
	Yes	No	p	Yes	No	p	Yes	No	p	Yes	No	p
Age, median (IQR)	45.5 (34.0-50.5)	37.0 (28.8-48.0)	0.103	37.0 (27.0-46.5)	41.0 (31.0-50.0)	0.198	38.0 (31.0-47.5)	38.5 (29.0-48.3)	0.769	38.0 (26.0-51.0)	39.0 (31.0-48.0)	0.958
BMI (kg/cm^2), median (IQR)	26.4 (24.9-29.01)	24.81 (22.9-27.3)	0.072	23.9 (22.4-27.9)	25.6 (23.9-28.4)	0.131	25.2 (23.5-26.5)	25.4 (23.5-28.8)	0.634	24.2 (23.4-31.0)	25.2 (23.5-28.4)	0.791
Time since amputation (month), median (IQR)	221.5 (72.5-321.0)	162.0 (37.5-312.0)	0.16	204 (56.5-312)	168 (46-312)	0.934	162.0 (26.5-300.0)	197.0 (56.7-315.0)	0.207	78.0 (27.0-360.0)	168.0 (49.5-312.0)	0.905
Time since first revision (month), median (IQR)	72.5 (27.8-219)	30.0 (5.8-108.3)	**0.016**	42.0 (9.0-114.0)	36.0 (8.0-144.0)	0.856	16.0 (1.8-108.3)	41.5 (12.8-186.0)	**0.028**	17.0 (6.0-324.0)	40.0 (9.0-132.0)	0.801
Prosthesis use period before revision (month), median (IQR)	60.0 (24.5-200.0)	25.0 (0-104.75)	**0.018**	42.0 (7.5-165.0)	32.0 (0-120.0)	0.492	5.0 (0-100.8)	45.0 (8-200)	**0.015**	14.0 (0-300.0)	35.0 (3.5-120.0)	0.626

BMI: Body mass index, IQR: Interquartile range, Significant difference between groups $p<0.05$ demostrated with bold

the duration of prosthesis use before the operation was higher in patients who had revision surgery due to neuroma than in those who had revision surgery for other reasons. This result may raise the question of whether prosthesis use causes pressure and ischemia to the nerve and contributes to neuroma formation over time. This situation can be further clarified by comparing neuroma formation in amputees who use and do not use prostheses. However, in this study, the long duration of prosthesis use may also be a natural consequence of the long period between amputation and revision in patients operated on due to neuroma.

Stump infections are still among the leading causes of stump revision surgery. The most common reason for revision surgery in this study cohort was stump infections. In the study of Kumar et al. (3), it was observed that a significant portion of those with infected stumps and abscesses had a disease that suppresses the immune system, such as diabetes. However, in this study, there was no significant difference in terms of comorbidities between those who were operated on due to infection and those who were operated on for other reasons. On the other hand, the time from amputation to revision was significantly shorter in patients who underwent revision surgery due to stump infection. Stump revisions due to infection appear to be needed earlier than revisions due to other reasons in the post-amputation process.

The limitation of the study is missing data, such as, alcohol and cigarette use, which may be associated with SCs. Another limitation is that patients included in the study were only male, which may prevent the results from being generalized to the entire population.

Conclusion

The majority of individuals with traumatic lower extremity amputation who underwent stump revision surgery were young and active patients for whom continued use of the prosthesis in daily life was important. The most common SC leading to stump revision surgery was infection, followed by neuroma. Although most of the demographic and clinical factors evaluated had no relationship with SCs, it appears that the time from amputation to the revision and the duration of prosthesis use before the operation are related to neuroma- and infection-related revision operations. It would be useful to investigate the presence of other factors that may be associated with SCs, leading to recurrent operations in this population already having undergone a major operation.

Ethics

Ethics Committee Approval: The clinical research ethics committee of Ankara Bilkent City Hospital approved the study (decision number: E1-23-4070, date: 04.10.2023).

Informed Consent: Retrospective study.

Footnotes

Authorship Contributions

Surgical and Medical Practices: N.K., İ.Ç.G., G.K.K., Y.D., K.A., Concept: N.K., Design: N.K., G.K.K., Data Collection or Processing: İ.Ç.G., H.C., G.K.K., Analysis or Interpretation: N.K., H.C., Y.D., Literature Search: N.K., İ.Ç.G., K.A., Writing: N.K.

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