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ORIGINAL ARTICLE

The effect of post-amputation pain and phantom sensations on prosthesis use, body image, and quality of life in patients with lower-extremity amputation

Alt ekstremite amputasyonu olan hastalarda postamputasyon ağrısı ve fantom duyusunun protez kullanımı, vücut imajı ve yaşam kalitesi üzerine etkisi

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Summary

Objectives: The aim of this study was to investigate phantom limb pain (PLP), PL sensation (PLS), and residual limb pain (RLP) after lower-extremity amputation and their effect on patients' effective prosthesis use, body image, and quality of life in prosthetic users.

Methods: Fifty-seven patients with lower-extremity amputation who used prosthesis for at least 3 months were included in our study. PLP, PLS, and RLP were evaluated through the prosthesis evaluation questionnaire (PEQ). Prosthetic use, locomotor skills, body image, and quality of life were measured by administering Houghton scale, locomotor capabilities index (LCI), amputee body image scale (ABIS), and short-form health survey (SF-36), respectively.

Results: On the PEQ, 43.9% of the patients reported PLP, while 63.2% reported PLS, and 40.4% reported RLP. Correlation analyses revealed that as the frequency and duration of PLP increased, the patients' basic and advanced locomotor skills and quality of life decreased. When the intensity of PLP and the degree of distress caused by it increased, the patients' quality of life decreased, and when the frequency of PLS increased, the patients' emotional state worsened. When the intensity of PLS and the degree of bother caused by it increased, the patients' body image, emotional state, and social status worsened. There was no correlation between the rate, frequency, severity, or duration of RLP and scores on Houghton scale, LCI, ABIS, or SF-36.

Conclusion: The presence of PLP and PLS decreases the use of prostheses and impairs body image and quality of life in prosthetic users.

Keywords: Amputation; phantom limb sensation; phantom limb pain.

Öz

Amaç: Bu çalışmada amacımız protez kullanan, alt ekstremite amputasyonu olan hastalarda fantom ağrısı (PLP), fantom hissi (PLS) ve güdük ağrısı (RLP)'nın değerlendirilmesi; bu ağrıların protez kullanımı, lokomotor beceriler ve vücut imajı ile ilişkisinin incelenmesidir.

Gereç ve Yöntem: Çalışmamıza ampute polikliniğimize başvuran alt ekstremite amputasyonu olan, en az 3 aydır ampute alt ekstremite için protez kullanan 57 hasta dahil edildi. Fantom ağrısı, fantom hissi ve güdük ağrısı Protez Değerlendirme Anketi (PEQ) ile ölçüldü. Protez kullanımı Houghton Skalası ile, lokomotor becerileri Lokomotor Kapasite İndeksi (LCI) ile, vücut imajı Ampute Vücut İmaj Skalası (ABIS) ile, yaşam kalitesi Kısa Form Sağlık Anketi (SF-36) ile değerlendirildi.

Bulgular: PEQ'ya göre hastaların %43.9'unda fantom ağrısı, %63.2'sinde fantom hissi ve %40.4'ünde güdük ağrısı tespit edilmiştir. Korelasyon analizleri fantom ağrısı sıklığı ve süresi arttıkça hastaların temel ve ileri lokomotor becerileri ile yaşam kalitesinin düştüğünü ortaya koymuştur. Fantom ağrısı'nın yoğunluğu ve neden olduğu stres derecesi arttığında, hastaların yaşam kalitesinin düştüğü; fantom hissi sıklığı arttığında, hastaların emosyonel durumunun kötüleştiği tespit edilmiştir. Fantom hissi'nin yoğunluğu ve rahatsızlık derecesi arttığında, hastaların vücut imajı, emosyonel durumu ve sosyal durumu kötüleşmiştir. Güdük ağrısının oranı, sıklığı, şiddeti veya süresi ile Houghton ölçeği, LCI, ABIS veya SF-36 skorları arasında korelasyon bulunmamıştır.

Sonuç: Fantom ağrısı ve fantom hissi, protez kullanım sıklığını azaltmasının yanı sıra ampute hastaların vücut imajını ve yaşam kalitesini de olumsuz etkiler.

Anahtar sözcükler: Amputasyon; fantom hissi; fantom ağrısı.

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Introduction

Phantom pain is the perception of a painful, unpleasant sensation in the distribution of the missing or deafferented body part.[1] Pain felt in an extremity after amputation is called phantom limb pain (PLP), and the duration and severity of this type of pain are highly variable.[2] Approximately 58–79% of patients who undergo limb amputation experience PLP during the acute post-operative period.[3,4] There is phantom sensation in patients with amputation. This feeling is thinking that the amputated extremity is still there, itching, and a tickling sensation.[5] However, PL sensation (PLS) should be distinguished from PLP. PLS is defined as the feeling that the amputated part of the extremity is still present. Patients also describe "telescoping," which means the distal limb parts feel like they are close to the amputated stump.[6] Most amputees experience PLS at some point during their lifetime, but it is almost always experienced during the early recovery period. Although this feeling decreases overtime, it typically does not disappear completely.[4]

Residual limb pain (RLP) is the sensation of pain in the remaining limb at the stump after amputation. RLP is also known as stump pain. About 90% of patients with limb amputation complain of pain, including PLP and RLP.[3] Approximately 61–76% of patients have RLP. The most common cause is improper prosthetic fit, but it can also be caused by prosthetic socket pressure, skin abrasions, infections, scars, neuromas, nerve entrapment, myofascial pain, bone spurs, heterotopic ossification, and complex regional pain syndrome.[3,4]

The aim of this study was to investigate the effect of PLP, PLS, and RLP on amputee's effective prosthesis use, body image, and quality of life.

Material and Methods

This is a cross-sectional observational study. Fifty-seven patients with lower-limb amputation and prosthesis use for at least 3 months were included in the study (Ethics Committee number: 2018/450).

Evaluation parameters

The patients' demographic characteristics, amputation level, etiology, type of prosthesis, and duration of prosthesis use were recorded. PLS, PLP, and RLP scores were evaluated with prosthesis evaluation questionnaire (PEQ); prosthesis use in daily living activities evaluated with Houghton scale; locomotor skills were evaluated with locomotor capabilities index (LCI). Amputee body image was evaluated with amputee body image scale (ABIS) and quality of life was evaluated with short form 36 (SF36).

The PEQ evaluated the rate, intensity of PLS, PLP, and RLP, and degree of bother of caused of them. PEQ consists of nine subscales. According to the PEQ scoring guide, the scales are not related to each other, so they can only be used in scale studies related to the subject being investigated.[6] We used the first 10 questions on the second scale (i.e., very specific bodily sensations) in our study. The first four questions evaluated the rate and intensity of PLS and the degree of bother caused by it within the previous 4 weeks, and the following four questions evaluated the rate, duration, and intensity of PLP and the degree of bother caused by it within the previous 4 weeks. The last three questions assess the rate and intensity of RLP and the degree of bother caused by it over the previous 4 weeks. High rates and duration scores are bad status indicators, while high intensity and degree of bother ("bother") scores are good status indicators.[6,7] Turkish reliability was tested,[8] and intensity and bother scores were ranged between evaluated between 0 and 100 points. Rate scores ranged between 0 and 10 points.

The Houghton scale is a series of questions that elicit lower-limb amputees' perceptions of prosthesis use.[9] This scale evaluates the duration of prosthesis use during the day, places where the prosthesis is used (i.e., in the home or outside the home), the need for a walking aid while wearing the prosthesis, and the ability to walk on different surfaces (i.e., flat, inclined, or rugged) while wearing the prosthesis. The highest possible score on this scale is 12, and high scores are associated with greater performance and comfort. There is no Turkish validation for the Houghton scale.

The LCI evaluates the basic and advanced locomotor skills and independence level of lower-limb amputees who use a prosthesis.[10] One subscale (i.e., the "basic" scale) has seven tasks that assess basic activities, such as "Get up from a chair," and another subscale (i.e., the "advanced" scale) has seven tasks that evaluate ad-

vanced activities, such as "Go down a few steps without a handrail." The 4-point rating scale ranges from 0 (i.e., cannot do) to 3 (i.e., can do it independently). Higher scores represent better ambulatory skills.[11] It has been reported that the Houghton scale and LCI are valid and reliable in clinical subjects with lower-extremity amputations and are useful in clinical practice.[12] There is no Turkish validation for the LCI.

The ABIS is a 20-item scale designed to evaluate body image disorders in amputees and asks amputees questions related to their perceptions and feelings about their body experiences.[13] The scale produces scores that range from 20 to 100, where higher scores indicate greater body image disturbance. Participants are asked to indicate their responses to the questions using a 5-point rating scale of 1 (i.e., none of the time) to 5 (i.e., all of the time). Three questions (i.e., 4, 12, and 16) are reverse scored. It has been shown that the Turkish version of ABIS is a reliable measurement tool to evaluate deterioration in body image perception in patients with lower limb amputation.[14]

The short-form health survey (SF-36) is a widely used and well-documented health-related quality of life index. The SF-36 survey has eight subdimensions, including physical functioning, role limitations due to physical problems, pain, general health perception, mental health, role limitations due to emotional problems, vitality, and social functioning, which are evaluated individually.[15] The questions in each domain are scored, coded, summed, transformed, and presented as a final score from 0 to 100. A higher score indicates a better quality of life. A validity and reliability study of SF-36 was conducted in Turkish.[16]

Statistical analysis

The Kolmogorov-Smirnov with Lilliefors significance correction test was used to determine whether the data were normally distributed. Descriptive data are given as the arithmetic mean±standard deviation for normally distributed variables or as the median (interquartile range) for non-normally distributed variables. Categorical data were summarized as frequency (percent). While investigating the associations between non-normally distributed or ordinal variables, the correlation coefficients and their significance were calculated using the Spearman test. Correlation coefficient (r)> 0.25 and p<0.05 were considered statistically significant. Data were analyzed using PASW Statistics software (SPSS Inc., Chicago, IL, USA).

Table 1. Participants' PEQ scores

	Median	IR
PEQ PLS		
Rate	2.0	2.0
Intensity	60.0	80.0
Bother	60.0	80.0
PEQ PLP		
Rate	1.0	1.0
Duration	1.0	1.0
Intensity	0.0	60.0
Bother	0.0	60.0
PEQ RLP		
Rate	1.0	1.0
Intensity	0.0	70.0
Bother	0.0	70.0

IR: Interquartile range; PEQ: Prosthesis evaluation questionnaire; PLS: Phantom limb sensation; PLP: Phantom limb pain; RLP: Residual limb pain.

Results

The mean age of the patients was 44.6±17.2 years, and there were 57 patients (female=12 and male=45). The mean duration of amputation was 14.6±11.8 years. The mean duration of prosthesis use was 11.1±10.1 years. Amputation levels were 56.1% transtibial, 29.8% transfemoral, 12.3% knee disarticulation, and 1.8% hip disarticulation. The causes of amputation were 26.6% vascular pathologies, 24.1% traffic accidents, 8.8% congenital absence, 7.0% work-related accidents, 17.0% diabetic wounds, 9.3% cancer operations, 1.8% earthquake related, and 8.4% were due to other causes.

The participants' PEQ results are presented in Table 1. In the previous month, 63.2% of the patients had PLS, while 43.9% had PLP, and 40.4% had RLP.

There were positive correlations between Houghton scale and PEQ-PLS scores (intensity and bother), as well as PEQ-PLP scores (duration, intensity, and bother). There were negative correlations between Houghton scores and rate PEQ-PLS score, as well as rate PEQ-PLP score (Table 2).

Table 2. PEQ scores' correlation with prosthesis use (Houghton scale), locomotor skills, and body image

	PEQ PLS			PEQ PLP				PEQ RLP		
	Rate	**Intensity**	**Bother**	**Rate**	**Duration**	**Intensity**	**Bother**	**Rate**	**Intensity**	**Bother**
Hougton scale										
r	**-0.335**	**0.401**	**0.356**	**-0.282**	**0.392**	**0.347**	**0.359**	-0.069	0.168	0.173
p	**0.007**	**0.001**	**0.004**	**0.025**	**0.002**	**0.005**	**0.004**	0.582	0.178	0.166
LCI basic										
r	-0.106	-0.038	-0.060	**-0.283**	**-0.315**	-0.259	-0.283	-0.237	-0.128	-0.114
p	0.466	0.793	0.677	**0.046**	**0.026**	0.069	0.050	0.098	0.380	0.437
LCI advanced										
r	0.002	-0.009	0.005	**-0.297**	**-0.298**	-0.272	-0.216	-0.090	-0.063	-0.049
p	0.988	0.953	0.974	**0.036**	**0.035**	0.056	0.135	0.536	0.668	0.738
ABIS										
r	0.256	**0.356**	**0.316**	0.189	0.169	0.046	0.052	0.061	0.122	0.098
p	0.070	**0.010**	**0.024**	0.184	0.235	0.748	0.718	0.673	0.399	0.500

LCI: Locomotor capabilities index; ABIS: Amputee body image scale; PEQ: Prosthesis evaluation questionnaire; PLS: Phantom limb sensation; PLP: Phantom limb pain; RLP: Residual limb pain. Statistically significant correlations are shown in bold.

There was a negative correlation between PEQ-PLP scores and LCI "basic" and "advanced" scores (Table 2) and SF-36 subscale scores (i.e., physical function, physical role, vitality, mental health, social function, bodily pain, and general health) (Table 3). There was no correlation between PEQ-PLP and the SF-36 emotional role subscale (Table 3). There was a positive correlation between PEQ-PLS and ABIS scores (Table 2).

According to a Spearman correlation analysis, when the frequency and duration of PLP increased, the patients' basic and advanced locomotor skills and quality of life decreased. As PLP severity and "bother" increased, the patients' quality of life decreased. When the frequency of patients' phantom sensation increased, their emotional state worsened, and as phantom sensations increased in intensity and "bother," the patients' body image, emotional role, and social status were found to be worse. There was no correlation between PEQ-RLP scores and Houghton, LCI "basic," LCI "advanced," body image, or SF-36 subscale scores.

Discussion

PLS, PLP, and RLP are common among limb amputees (70–90%).[2,3] These pain sensations decrease amputees' quality of life by reducing their compliance with prosthesis use and cause additional problems. We evaluated PLS, PLP, and RLP in patients with a lower-extremity amputation and aimed to investigate the effects of these types of pain and sensation on amputees' prosthesis use, locomotor skills, body image, and quality of life.

The mean age of our patients was 44.6 years, and 78.9% were male. The average length of time since amputation was 14.6±11.8 years. Devan et al.[17] investigated post-amputation pain in 208 patients with lower-extremity amputation. Similar to our study, their study's participants had a mean age of 52 years, and 74% were male. In a study conducted by Amtmann et al.[18] 1091 lower-extremity amputations were reported as 63.5% transtibial, 31.7% transfemoral, and 3.7% knee disarticulation. Similar to Amtmann et al.'s study population, the patients in our study had undergone transtibial (46.4%), transfemoral (42.0%), and knee disarticulation (10.1%), respectively.

The frequency and causes of amputations vary from country to country, depending on the country's level of development.[19] According to a study conducted by Geertzen et al.[20] which included 433 patients, 28.8% of the lower-extremity amputations were due to vascular causes, while 20.6% were due to diabetes mellitus, 34.3% were due to trauma, 8.7% were due to cancer, 2.3% were due to congenital deformities, and 4.3% were due to other reasons. Similar to the data in our study, 26.6% of the causes of amputation were vascular pathologies, while 32.9% were due to

Table 3. PEQ scores' correlation with quality of life (SF-36) subscales

	PEQ PLS			PEQ PLP				PEQ RLP		
	Rate	**Intensity**	**Bother**	**Rate**	**Duration**	**Intensity**	**Bother**	**Rate**	**Intensity**	**Bother**
Physical function										
r	0.004	-0.100	-0.041	**-0.323**	**-0.329**	**-0.348**	**-0.336**	0.007	0.033	0.051
p	0.980	0.504	0.785	**0.027**	**0.024**	**0.016**	**0.023**	0.961	0.826	0.736
Physical role										
r	-0.112	-0.116	-0.131	-0.228	-0.257	-0.263	**-0.338**	0.089	0.080	0.084
p	0.448	0.434	0.375	0.119	0.078	0.071	**0.020**	0.549	0.591	0.572
Emotional role										
r	**-0.285**	**-0.299**	**-0.313**	-0.127	-0.164	-0.169	-0.200	-0.055	-0.034	-0.042
p	**0.047**	**0.037**	**0.029**	0.384	0.259	0.247	0.172	0.707	0.819	0.778
Vitality										
r	-0.123	-0.189	-0.197	**-0.283**	**-0.280**	-0.151	-0.251	-0.135	-0.120	-0.094
p	0.394	0.188	0.170	**0.046**	**0.049**	0.295	0.081	0.349	0.411	0.518
Mental health										
r	-0.116	-0.246	-0.255	**-0.393**	**-0.420**	**-0.283**	**-0.365**	-0.150	-0.093	-0.068
p	0.419	0.081	0.071	**0.004**	**0.002**	**0.044**	**0.009**	0.292	0.521	0.639
Social function										
r	-0.240	**-0.303**	**-0.339**	**-0.432**	**-0.463**	**-0.347**	**-0.393**	-0.103	-0.113	-0.107
p	0.101	**0.036**	**0.018**	**0.002**	**0.001**	**0.016**	**0.006**	0.487	0.448	0.475
Bodily pain										
r	-0.072	-0.102	-0.103	**-0.541**	**-0.548**	**-0.426**	**-0.473**	-0.038	-0.020	-0.014
p	0.621	0.485	0.483	**0.000**	**0.000**	**0.002**	**0.001**	0.797	0.894	0.924
General health										
r	-0.102	-0.196	-0.148	**-0.289**	**-0.317**	-0.255	**-0.311**	-0.034	0.028	0.055
p	0.493	0.186	0.321	**0.049**	**0.030**	0.084	**0.036**	0.823	0.853	0.717

LCI: Locomotor capabilities index; ABIS: Amputee body image scale; PEQ: Prosthesis evaluation questionnaire; PLS: Phantom limb sensation; PLP: Phantom limb pain; RLP: Residual limb pain. Statistically significant correlations are shown in bold.

trauma [i.e., traffic accidents (24.1%), work-related accidents (7.0%), and earthquakes (1.8%)], while 8.8% were due congenital absence, 17.0% were due to diabetic wounds, 9.3% were due to cancer operations, and 8.4% were due to other causes.

Visual analog scale assessment criteria have been used in most studies to evaluate post-amputation pain. Among these scales, the most detailed evaluation of PLP, PLS, and RLP is the "very specific bodily sensations" section of the PEQ,[6] but only one published study uses this section of the PEQ scale for PLP and PLS.[21] No published studies have used the PEQ scale for RLP, although Brunelli et al.[21] did use the PLP and PLS section of the PEQ in their evaluation of 40 amputee patients. Unlike the previous studies, we evaluated PLP, PLS, and RLP with the PEQ scale. In Brunelli et al.'s study, the frequency of PLS was fairly often (i.e., 2–3 times/week) in a month, while the severity of PLS was 70.0 (pain severity decreases as the score increases), and the "bother" or distress caused by PLS was 70.0 points. In our study, the frequency of PLS was evaluated a few times a month (i.e., about once per week), while the intensity of PLS was 60.0 (pain severity decreases as the score increases), and the "bother" or distress caused by PLS was 60.0 points. Brunelli et al. reported that the mean frequency of PLP in the control group was once per month, while the duration was a few seconds, the intensity was 60 points (pain decreases as the score increased), and the "bother" or distress caused by PLP was 80 points. In our study, the frequency of PLP was once or twice per month, while the duration of a phantom pain was a few seconds, the intensity of PLP was 0.0

(pain severity decreases as the points increase), and the "bother" or distress caused by PLP was 0.0 points (pain scores decreased with increasing scores). In the literature, no other studies have evaluated RLP with PEQ scores. Our PEQ-RLP frequency among patients was evaluated once or twice a month. The RLP intensity was 0.00 (pain decreases with increasing points), and the "bother" or distress caused by RLP was evaluated at 0.0 points. Our PLP and PLS results are similar to those reported in Brunelli et al.'s study.

Pain experienced while wearing prosthesis may affect future prosthesis use. Patients' prosthesis compliance may increase as PLP and PLS decrease. In the research literature, few studies have examined the relationship between prosthesis use and pain. In a study conducted Morgan et al. [3] patients used their prostheses for an average of 12 h/day, and it was shown that prosthesis use was significantly limited as pain (i.e., PLP and RLP) severity increased. In our study, the Houghton scale results show that PLP and PLS decrease prosthesis use, and there is no relationship between RLP and prosthesis use.

In our study, when PLP (rate, intensity, and bother) scores increased, LCI "basic" scores decreased on some items, such as getting up from the chair while wearing the prosthesis, walking into or out of the house, and stair descent. This shows that when PLP increases, the performance of walking with prosthesis worsens in daily life. Increased pain severity experienced by amputees decreases their use of the prosthesis, and their level of functioning decreases. [22,23] Dietrich et al.[22] reported that the severity of PLP among amputees was reduced, and they reported more stable, better control while walking, especially on bumpy and soft surfaces, as well as longer walking distances.

Holzer et al.[24] reported that body perception was significantly impaired in patients who have undergone limb amputation. In a study conducted by Pucher et al.[25] a relationship between body image and PLP was found.[25] PLS is a perception disorder related to the lost limb.

According to the results obtained in our study, when the patients' PLP and PLS increased, their body perception deteriorated. We observed that due to pain, our patients' prosthesis use and performance decreased in daily life. We think that this situation causes the patients' body perceptions to deteriorate by defining themselves as more disabled than they actually are. The results of our study show that this perception disorder may not be limited to the lost limb, but may also impair general body image perception.

Davidson et al.[26] found that when limb amputated patients' quality of life was assessed by SF-36, it was lower than in the healthy population. As the duration and severity of PLP increase, patients' quality of life tends to decrease.[27] In our study, almost all the parameters of quality of life decreased as PLP increased. However, no significant correlation was found between RLP and quality of life.

Post-amputation pain decreases as the time elapsed after amputation increases.[2] According to our study, there was no correlation between amputation time and PLS, PLP, or RLP. This finding is, perhaps, due to the length of time since amputation (i.e., 96 months) among the patients in our study.

The primary limitations of our study are that most patients were the elderly, and the average length of time since amputation was 96 months. Therefore, finding a correlation between the length of time since amputation and post-amputation pain was unlikely. In the future, similar studies may be planned that include younger patients and those with more recent amputations.

Conclusion

The presence of PLP and PLS decreases the use of prostheses, impairs body image and quality of life in prosthetic users. RLP has no effect on prosthesis use, body image, and quality of life.

Ethics Committee Approval: The Dr. Sadi Konuk Training and Research Hospital Clinical Research Ethics Committee granted approval for this study (date: 17.12.2018, number: 2018-23-06).

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