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ORIGINAL ARTICLE • GENARAL ORTHOPAEDICS - LOWER LIMB

The effect of amputation level and age on outcome: an analysis of 135 amputees

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Abstract
Introduction In this retrospective study, the impact of age, amputation level and the cause of amputation were examined using the Hospital Anxiety and Depression Scale (HADS) and Medicare *K* scores of amputees with unilateral lower-limb amputation.
Materials and methods In total, 135 patients with unilateral transfemoral (TF) or (TT) transtibial amputations were examined. All data were collected using questionnaires that were either self-administered or administered during an interview. The HADS was developed as a self-reporting questionnaire to detect adverse anxiety and depressive status. *K* code is used to describe the functional abilities of amputees.
Results The mean age at the time of surgery was 52.79 ± 13.08 years. The mean time since amputation was 59.20 ± 24.41 months for TT, and 60.89 ± 22.09 months for TF amputation. The HADS-A scores of the transfemoral amputation group were determined as significantly high compared to those of the transtibial group ($p < 0.05$). The *K* index of the group aged 35 years and below was significantly higher than that of the other groups (p 0.002, p 0.001, $p < 0.01$).
Conclusion The data show higher HADS-A scores with traumatic transfemoral amputation. Therefore, adequate psychiatric evaluation and rehabilitation should be applied to all amputees, especially in cases of young, traumatic, transfemoral amputations.
Level of Evidence Level 3, retrospective comparative cohort study.

Keywords Amputation · HADS-A · HADS-D · *K* index

Introduction

Lower-limb amputation is performed for a variety of reasons such as peripheral vascular diseases, trauma, tumor or congenital anomalies [6, 10]. Amputation causes disability and results in economic, psychological and social effects. There have been several studies on clinical depression and functional outcomes in persons with limb loss. Cansever et al. [4] reported that patients with limb loss encounter a series of complex psychological responses.

There are multiple tests to analyze depression in patients with limb loss. Some authors have preferred to use a clinician-administered structured interview, whereas others have preferred standardized self-reporting measures such as the Beck Depression Scale [1], the Center for Epidemiologic Study Depression Scale [21] or the Hospital Anxiety and Depression Scale (HADS). All these scales are used for the early diagnosis and treatment of psychological morbidity of patients with limb loss, so that long-term disabilities in an amputee can be

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prevented [25]. The aim of this retrospective study was to evaluate the impact of age, amputation level and the cause of amputation that were examined using the HADS [9] and *K* scores of amputees with unilateral lower-limb amputation [27]. It was hypothesized that a higher amputation level and older age would be significant predictors for worse HADS-A, HADS-D and *K* level scores.

Materials and methods

This hospital-based study comprised 205 amputees who underwent amputation between 2005 and 2011. Exclusions from the study were 6 amputees with knee disarticulation, 10 amputees of syme or foot amputations, 11 amputees who died, 8 bilateral amputations, 12 amputees who did not want to participate in the study and 23 amputees with prior psychiatric disorders and associated physical disabilities other than amputation. Thus, the study was limited to a total of 135 patients with unilateral transfemoral (TF) or transtibial (TT) amputations. The patients were 111 (82.2 %) males and 24 (17.8 %) females with a mean age at the time of surgery of 52.79 ± 13.08 years (range 21–82 years). The inclusion criteria were age of 18 years or older, unilateral TT or TF amputation from any cause, and sufficient cognitive skills to accurately respond to the questionnaires. All data were collected using questionnaires that were either self-administered or administered during an interview depending on the participant's ability to answer (e.g., no visual problems or difficulty in understanding certain questions). Interviews were conducted by the same evaluator, a senior physical therapist with over 5 years of experience. The following information was extracted from the patient's medical chart: age, gender, side, level and date of amputation, the cause of amputation, duration of prosthetic usage and associated medical conditions.

The Hospital Anxiety and Depression Scale (HADS) was developed as a self-reporting questionnaire to detect adverse anxiety and depressive status. It has good sensitivity and specificity for formal psychiatric assessment and diagnosis. Participants were asked to choose one of the four given choices. The questions relating to anxiety are marked 'A' and those relating to depression, 'D'. There are 14 items in the scale: 7 related to anxiety and 7 to depression. Scoring is from 0 to 3, and total scores may range from 0 to 21. According to the final scores at the interview, HADS-A and HADS-D are classified into three groups. A score of 0–7 is normal, 8–10 borderline and 11–21 abnormal [8].

Medicare *K* code is used to describe the functional abilities of persons who have undergone lower-limb amputation. Using this system, the physical therapist determines the patient's ability to reach a "defined functional state within a reasonable period of time." It has 5 levels defined as *K* levels 0–4.

K level 0: Does not have the ability to ambulate or transfer safely with or without assistance, and a prosthesis does not enhance quality of life or mobility.
K level 1: Has the ability to use a prosthesis for transfers or ambulation on level surfaces at a fixed cadence. Typical of the limited and unlimited household ambulator.
K level 2: Has the ability for ambulation with the ability to transverse low-level environmental barriers such as stairs or uneven surfaces. Typical of the limited community ambulator.
K level 3: Has the ability for ambulation with variable cadence. Typical of the community ambulator who has the ability to transverse most environmental barriers and may have vocational, therapeutic or exercise activity that demands prosthetic use beyond simple locomotion.
K level 4: Has the ability for prosthetic ambulation that exceeds basic ambulation skills, exhibiting high impact, stress or energy levels. Typical of the prosthetic demands of the child, active adult or athlete. *K* level 0 was defined as poor, *K* levels 1 and 2 were defined as fair and *K* levels 3 and 4 were defined as good.

The study group was separated into two groups of TT and TF amputees. Transfemoral amputation was made at mean 12 cm distal from the trochanter major, and transtibial amputation was accepted as mean 15 cm distal from the level of the knee joint. Reasons for amputation were determined as trauma and vascular disease (DM, peripheral vascular disease). Amputations made for neoplastic or congenital reasons were excluded from the study. The HADS and Medicare *K* levels were completed by a physical therapist blind to the study for amputees in both groups.

Statistical evaluation

For the statistical analysis of data obtained in the study, SPSS (statistical package for social sciences) for Windows 15.0 software program was used. In the evaluation of the study data, descriptive statistical methods (mean, standard deviation) were used, and in the evaluation of age with HADS-A, HADS-D and the *K* index, the Kruskal–Wallis test was used. The Mann–Whitney test was applied in the evaluation of amputation level with HADS-A, HADS-D and the *K* index. Values of $p < 0.05$ and $p < 0.01$ were accepted as statistically significant.

Results

Of the 205 amputees with lower-limb amputation admitted to the study group, only 135 (66 %) met the eligibility criteria. These comprised 24 females and 111 males. The reasons for amputation were trauma in 58 cases (43 %) and vascular

disease in 77 (57 %). In 65 cases (48.1 %), the amputation was TT and in 70 cases (51.9 %), TF. The amputation was on the right side in 82 cases (60.7 %) and on the left in 53 cases (39.3 %). The mean time since amputation was 59.20 ± 24.41 months (range 24–110 months) for transtibial, and 60.89 ± 22.09 months (range 24–110 months) for transfemoral. The mean duration of prosthetic usage was 54.77 ± 24.23 months (range 18–105 months) for the TT group and 56.06 ± 21.89 months (range 20–102 months) for the TF group. The demographic properties of the participants are summarized in Table 1.

No statistically significant difference was determined between the two groups in respect of age, gender, reason for amputation, side, HADS-D and *K* level ($p > 0.05$). The HADS-A scores of the TF group were determined as statistically significantly high compared to those of the TT group ($p < 0.05$) (Table 2).

No statistically significant difference was determined between the HADS-A and HADS-D scores according to age groups ($p > 0.05$). A statistically significant difference was determined in the *K* index according to age groups ($p < 0.01$). The result of the paired comparisons that were made to determine in which group the difference originated was that the *K* index of the group aged <35 years was significantly higher than that of the 36- to 50-year age group (p 0.002, $p < 0.01$) and of the over-50-year age group (p 0.001, $p < 0.01$). The *K* index of the 36- to 50-year age group was statistically significantly higher than that of the over-50-year age group (p 0.001, $p < 0.01$).

Discussion

Lower-limb amputation is a permanent surgical procedure that has important functional, psychological and social sequelae [26]. The present study was based on hospital data records and interview at the outpatient polyclinics. The most important findings of the present study were that the

Table 1 Distribution and evaluation of general characteristics

	Transtibial	Transfemoral	*p*
Age	52.37 ± 13.71 (21–80)	53.17 ± 12.57 (23–82)	0.723[a]
Follow-up period (months)	59.20 ± 24.41 (24–110)	60.89 ± 22.09 (24–110)	0.674[a]
Duration of prothesis use (months)	54.77 ± 24.23 (18–105)	56.06 ± 21.89 (20–102)	0.746[a]
Gender			
Female	10 (15.4 %)	14 (20 %)	0.63[b]
Male	55 (84.6 %)	56 (80 %)	
Amputation			
Traumatic	23 (35.4 %)	35 (50 %)	0.087[c]
Vascular	42 (64.6 %)	35 (50 %)	
Side			
Right	37 (56.9 %)	45 (64.3 %)	0.381[c]
Left	28 (43.1 %)	25 (35.7 %)	
HADS-A	7.77 ± 3.16 (3–15)	9.09 ± 3.89 (1–17)	0.043*[d]
Normal	34 (52.3 %)	28 (40 %)	
Borderline	13 (20 %)	15 (21.4 %)	
Abnormal	18 (27.7 %)	27 (38.6 %)	
HADS-D	8.57 ± 3.86 (2–17)	9.21 ± 4.01 (2–18)	0.392[d]
Normal	27 (41.5 %)	25 (35.7 %)	
Borderline	20 (30.8 %)	20 (28.6 %)	
Abnormal	18 (27.7 %)	25 (35.7 %)	
K index	2.14 ± 1.13 (0–4)	1.80 ± 1.23 (0–4)	0.154[d]
Poor	22 (33.8 %)	26 (37.1 %)	
Fair	34 (52.3 %)	39 (55.7 %)	
Good	9 (13.8 %)	5 (7.1 %)	

* $p < 0.05$

[a] Student's *t* test

[b] Continuity correction (Yates) test

[c] Pearson's Chi-square test

[d] Mann–Whitney *U* test

Table 2 HADS-A, HADS-D and *K* index evaluation

	HADS-A Mean ± SD (median)	*p*	HADS-D Mean ± SD (median)	*p*	*K* index Mean ± SD (median)	*p*
Age						
≤35	9.25 ± 3.13 (10)	0.539[a]	9.13 ± 5.11 (8.5)	0.875[a]	3.44 ± 0.81 (4)[a]	0.001**
36–50	8.39 ± 3.64 (7)		8.61 ± 3.86 (9)		2.52 ± 1.03 (3)	
>50	8.33 ± 3.69 (8)		8.98 ± 3.77 (9)		1.48 ± 0.98 (1)	
Level						
Transtibial	7.77 ± 3.16 (7)	0.531[b]	8.57 ± 3.86 (9)	0.901[b]	2.14 ± 1.13 (2)	0.154[b]
Transfemoral	9.09 ± 3.89 (9)		9.21 ± 4.01 (9)		1.80 ± 1.24 (2)	

** $p < 0.01$

[a] Kruskal Wallis test

[b] Mann–Whitney *U* test

most common etiologies of the amputation are trauma and vascular disease and that amputations are performed at an older age due to vascular diseases. In the current study, the most common cause of amputation was vascular disease at a rate of 57 %, whereas in a study by Dogan et al. [7] which evaluated 475 amputees, trauma was reported to be the main cause of amputation (40.2 %). The mean age was over 50 years old in both groups in the current study. In a study by Rommers et al. [22], it was stated that 94 % of the amputations were performed as a result of vascular diseases and the mean age was older than 65 years in 79 % of the study population. Settakorn et al. [24] reported that the major cause of lower-limb amputation was vascular diseases (51 %). The data of this present study confirm the results of Settakorn et al. and Rommers et al. [22, 24].

Several studies have been published in the literature on the prevalence of depression and anxiety in individuals with limb loss. In the present study, 33.3 % of the amputees had abnormal anxiety. Hawamdeh et al. [10]. reported that of 56 amputees, 37.5 % ($n = 21$) had an abnormal anxiety (HADS-A) score. When the TT amputations were compared with the TF amputations in respect of HADS-A, there was a statistically significant difference between the amputation level and HADS-A scores. The HADS-A scores of the TF amputees were significantly higher than those of the TT amputees ($p = 0.043$, $p < 0.05$). This may result from the etiology of the amputation, as trauma has higher psychological sequelae than vascular-related amputations [8]. In the present study, trauma was the main cause of 50 % ($n = 35$) of the TF amputees, and 35.4 % of the TT amputees. The current study also confirmed the findings of the study by Hawamdeh [10] which reported that patients with limb loss due to trauma were more anxious than amputees with vascular diseases. In the current study of 135 amputees, 32 % ($n = 43$) were classified as abnormal according to the HADS-D. In a study by Seidel et al. [23] of patients with lower-limb amputation, 27 % of the amputees had depression. Hawamdeh et al. [10] reported that 20 % ($n = 11$) of the amputees were abnormal according to the HADS-D scores, and there was no significant difference between the amputation level and HADS-D scores. The results of the current study confirm those results. In the present study, it was observed that amputees with trauma and TF were more likely to have higher HADS-A scores and were more anxious than those with TT and vascular-related amputations. Patients undergoing TF amputation as a result of trauma may need psychological support, and therefore, by taking the necessary precautions, anxiety problems of the patient following amputation would be able to be reduced.

The Medicare *K* level is a predictor of prosthetic satisfaction. Several factors, such as age, time since amputation, number and severity of comorbidities, residual limb pain and prosthetic fit, have been shown to have a significant impact on the amputee patient's ability to ambulate with a prosthesis [7, 11–16]. In the present study, there was a significant correlation between age and *K* level. With increased patient age, the *K* level reduced ($p = 0.001$, $p < 0.01$), but there was no correlation between the amputation level and *K* level. In a study by Gailey et al. [9], it was stated that as the mean age of the participants decreased, the *K* level increased correspondingly. This was an expected result and reflects the outcome of the amputee patient population as described throughout the literature [16, 18, 20]. In the present population, the amputee patients with higher ages had comorbidities such as diabetes mellitus or cardiopulmonary comorbidities. It is well known that as comorbidities increase, the *K* level status is diminished [2].

Gender and age had an impact on outcomes following amputation. Hawamdeh et al. [10] and Pezzin et al. [19] reported that women were more likely to suffer anxiety and depression after amputation surgery. In the present study, gender and age had no impact on HADS-A or HADS-D scores, and these results were in line with those of Bradway et al. [3]. However, the results of the current study cannot be generalized, as females only comprised 17.8 % ($n = 24$) of the study group. Similar gender representations have been reported by Cavanagh et al. [5] as 25 %, and by Muzaffar et al. [17] as 21 %. It would be beneficial to conduct further research on this topic. The dominance of the male gender could be a result of a patriarchal society, and also the use of tobacco and alcohol is prevalent among males.

The current study had some limitations, namely the wide variety in age, the low number of patients and the low representation of females in the study sample. Other demographic characteristics (marital status, employment and education status) could affect the depression and anxiety levels of the amputees. The Medicare *K* level scoring system is a subjective and nonstandardized method. The lack of a standardized and objective system for assigning *K* levels makes possible both over- and under-prescription of prosthetic components.

In conclusion, the results of the current study confirm the prevalence of psychological disorders after lower-limb amputation. The data also show higher HADS-A scores with traumatic transfemoral amputation. Therefore, adequate psychiatric evaluation and rehabilitation should be applied to all amputees with lower-limb amputations, especially in cases of young, traumatic, above-the-knee amputations. Orthopedic surgeons should give more attention to the psychological status and should be a part of a multidisciplinary team.

Compliance with ethical standards

Conflict of interest None.

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