RESEARCH ARTICLE

Relationship between muscular impairment and psychological health with lower extremity functions in patients with transtibial amputation

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Abstract

Objective: To determine the relationship of muscular impairment and psychological health with lower extremity functions in patients with transtibial amputation.

Method: The correlational study was conducted from March to September 2021 at the Fauji Foundation Hospital, Rawalpindi, Pakistan, and comprised male patients with transtibial amputation. Data was collected using the depression anxiety stress scale and the lower extremity functional scale. The correlation of muscular impairment and psychological health with lower extremity functions was determined. Data was analysed using SPSS 21.

Results: There were 85 male patients with a mean age of 53.74±11.30 years. There was weak iliopsoas muscle strength 4.64±0.50 and reduced muscle length of hamstrings 67.00±6.41 on the affected side. There was non-significant correlation in muscle atrophy of both amputated limb (p=0.82) and non-amputated limb (p=0.58) with lower extremity function. Significant inverse correlation was present between depression, anxiety and stress (p=0.001) with lower extremity function.

Conclusion: Weak iliopsoas muscle strength and tight hamstrings were observed on the amputated side. Muscle atrophy was more in non-amputated limb than amputated limb. There was significant inverse correlation of depression, anxiety and stress with lower extremity function.

Keywords: Anxiety, Depression, Muscle atrophy, Muscle length, Muscle strength, Stress. (JPMA 72: 1788; 2022)

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Introduction

Amputation is the irreversible surgical removal of an extremity by cutting through bone.[1] Transtibial amputation is the removal of the foot, ankle joint, and distal tibia and fibula with related soft tissue structures.[2] Muscular strength is a muscle's ability to put its effort on external resistance.[3] Muscle contracture refers to the physical shortening of muscle length that is often accompanied by shortening of other soft tissues, like fascia, nerve blood vessels and skin.[4] Muscle atrophy is one of the leading factors of lower extremity amputation that occurs due to reduced muscle activity, especially lower limb antigravity extensor muscles which are the most affected muscles, during immobilisation and bed-rest.[5] A study showed that loss of strength occurred in the lower limb amputees after one year of amputation. Reduced muscle strength of quadriceps and hamstring was also noted on the affected side in young adults with unilateral below-knee amputation. Patients with asymmetrical gait are at risk of less physical activity and muscle strength.[6] Flexion contractures are more common in trans-tibial amputated patients.[7] Lower limb amputation causes not only stress and anxiety because of limb-loss, but also due to activity limitation and the need for adaptations to the altered lifestyle. Amputated patients are at high risk of psychological distress due to various reasons, i.e. disgrace and having difficulty in overcoming impairments.[8]

The Depression Anxiety Stress-Scale (DASS-21) is a self-report scale that was designed to measure depression, anxiety, and stress. Responses are rated on a 4-point scale.[9] A study showed that populations of all-cause gained amputation went from 1.2 first major amputations per 10,000 women in Japan to 4.4 per 10,000 men in the Navajo Nation in the United States in the early to mid-1990s.[10] Transtibial amputation 52.8% was the most recurrent level, trailed by transfemoral 24.4%, partial foot 6.5%, Symes 7.3%, and knee disarticulation 3.3% in Pakistan.[11] Reasons for surgical amputations are war injuries, septic infections, malignant tumours, diabetes or gangrene, vascular insufficiency disease and congenital deformities of upper and lower extremities.[12] Studies on amputees show that the lower limb amputation is reduced and that strengthening exercises for residual limb thigh muscles should be done in order to return to a level of function following amputation.[13] Less involvement and activation of the amputated limb muscles in activities, such as standing and walking, leads to disuse atrophy of the thigh muscles of the affected limb.[14] Muscle contracture may develop when the leg muscles are shortened and tightened due to prolonged period of illness or lack of exercise.[7]

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A study revealed that there was significant decrease in the strength of the quadriceps and hamstrings in below-knee amputated limb. Thigh muscle strength in amputees over 7 years was not significantly weaker when compared with amputees where amputation had been performed more recently.[15] A study showed that in the group of below-knee amputees muscle atrophy was accompanied by decrease in thigh girth of over 5.9cm.[14]

As the prevalence of transtibial amputation is more common in Pakistan, the current study was planned to determine the relationship of muscular impairment and psychological health with lower extremity functions in patients with transtibial amputation.

Patients and Methods

The correlational study was conducted from March to September 2021 at the Artificial Limb Centre (ALC) at the Fauji Foundation Hospital, Rawalpindi, Pakistan. Study was conducted after taking the approval from ethical review committee of Riphah College of Rehabilitation and Allied Health Sciences, Riphah International University, Islamabad (Riphah/RCRS/REC/00987). The sample size was calculated using UCSF (University of California San Francisco) calculator[16] with r=0.30.[17] The sample was raised using purposive sampling technique. Those included were male transtibial amputated and patients aged 35 years and above who were with or without prosthesis and had undergone amputation more than 6 months earlier. Patients with bilateral amputation and patients failing to fall in this category were excluded. After obtaining consent from the subjects, data was collected using DASS-21 and the lower extremity function scale (LEFS), while muscle impairment was also assessed.

LEFS comprises 20 items, with scores ranging from 0 = extreme difficulty/unable to perform activity to 4 = no difficulty. The maximum score of 80 shows no functional limitations and the minimum score of 0 shows extreme limitations.[18]

DASS-21 measures symptoms of depression, anxiety and stress in both clinical and non-clinical samples of adults.[19]

Manual Muscle Testing (MMT) was performed on the amputated and non-amputated limbs of the patients to check the strength of the iliopsoas, quadriceps and hamstring muscles. Muscle atrophy was assessed on the amputated and non-amputated limbs of the patients by measuring mid-thigh girth circumference.

The Thomas test was performed to assess the hip extensibility for iliopsoas muscle of both sides by using goniometer.[20] The Modified Thomas test was performed to examine flexibility of the rectus femoris muscle at both knee joints by using goniometer.[21]

To assess the flexibility of the hamstring muscle, straight leg raise was performed of both sides by using goniometer.

Data was analyzed using SPSS 21. Shapiro-Wilk normality test was computed to examine the normality of data distribution. For demographic variables, descriptive analysis was used along with mean and standard deviation. The continuous variable were muscle atrophy, muscle length and muscle strength, while the categorical variables were side of amputation, occupation and use of prosthesis. Pearson correlation was applied in order to determine the various relationship. P<0.05 was taken as significant.

Results

There were 85 male patients with a mean age of 53.74±11.30 years. The sample included labourers 19(22.4%), former army soldiers 16(18.8%) and office workers 15(17.6%). The duration of amputation ranged 9-12 months. Right-side amputation cases were 45(52.9%) compared to left-side amputations 40(47.1%). The patients using prosthesis were 56(65.9%) and without prosthesis 29(34.1%).

The overall mean muscular impairment showed weak iliopsoas muscle strength 4.64±0.50 than quadriceps 4.45±0.58 and hamstrings 4.42±0.56 on the affected side. Also, there was reduced muscle length of hamstrings 67.00±6.41 than iliopsoas 16.36±5.14 and quadriceps 8.76±6.40 on the affected side. Muscle atrophy was observed more in the non-amputated limb 19.25±2.55 than in the amputated limb 17.57±2.38. There was significant correlation between muscle strength of quadriceps on both affected (r=0.230, *p*=0.034) and unaffected (r=0.453, *p*=0.0001) sides with lower extremity function. There was a significant inverse correlation between muscle length of quadriceps (r=-0.245, *p*=0.024)

Table-1: Correlation coefficient of muscular impairment with Lower Extremity Functional Scale (LEFS).

Muscular Impairment	Affected Side	Pearson correlation (r-value)	*p*-value	Unaffected Side	Pearson correlation (r-value)	*p*-value
Muscle Strength	Iliopsoas	0.20	0.05	Iliopsoas	0.36**	0.00
	Quadriceps	0.23*	0.03	Quadriceps	0.45**	0.00
	Hamstrings	0.16	0.12	Hamstrings	0.47**	0.00
Muscle Length	Iliopsoas	0.03	0.76	Iliopsoas	0.03	0.74
	Quadriceps	-0.18	0.08	Quadriceps	-0.24*	0.02
	Hamstrings	1.89	0.08	Hamstrings	0.17	0.10
Muscle Atrophy	Amputated limb	0.02	0.82	Non-amputated limb	0.06	0.58

Table-2: Correlation coefficient of Depression Anxiety Stress Scale (DASS) with Lower Extremity Functional Scale (LEFS).

LEFS	DASS Total Score	
	Pearson correlation (r-value)	p-value
	-0.50**	0.00

and lower extremity function on the unaffected side (Table 1).

There was significant inverse correlation between depression, anxiety, stress (r=-0.508, p=0.0001) and lower extremity functions.

There was a significant correlation between muscle strength of iliopsoas, quadriceps and hamstrings with lower extremity function (p<0.05). There was a significant inverse correlation between muscle length of quadriceps with lower extremity function (p<0.05).

There was a non-significant correlation between muscle atrophy with lower extremity function (p>0.05).

There was a significant inverse correlation of depression, anxiety and stress with lower extremity function (p<0.05).

Discussion

The present study found weak iliopsoas muscle strength than quadriceps and hamstrings on the affected side of amputation. It also showed reduced muscle length hamstrings than iliopsoas and quadriceps on the affected side. Muscle atrophy was observed more in the non-amputated limb than the amputated limb. There was significant inverse correlation between depression, anxiety, stress and lower extremity function.

A study showed weak muscle strength of quadriceps and hamstring on the affected side in young adults. Weak correlation between strength of quadriceps and total femur bone mineral density (BMD) was noted on the amputated limb.[6]

Another study reported significant differences in functional limitations, iliopsoas length, back extensor strength, and back extensor endurance between those with and without low back pain (LBP). A significant correlation was reported between bilateral iliopsoas length and visual analogue scale.[22]

One study showed below-knee amputees having muscular atrophy on both the amputated and non-amputated sides, with less and minor muscle fibres. Muscle atrophy reached about 25% in quadriceps, but it was non-significant for the hamstring muscle.[23]

Another study reported depression among 92.5% subjects and 57.5% were completely dependent. A significant inverse correlation was found between depression and functionality.[24]

The current study consisted only of male gender with unilateral transtibial amputation which is a limitation. Future studies should include bilateral transtibial amputation in both the genders Furthermore, comparison of psychological distress between amputees with and without prosthetics should be considered.

Conclusion

Weak iliopsoas muscle strength and tight hamstrings were observed on the amputated side. Muscle atrophy was more in non-amputated limb than the amputated limb. There was significant inverse correlation of depression, anxiety and stress with lower extremity function.

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Conflict of Interest: None.

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