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Functional capacity of elderly woman with Bilateral Transtibial amputation after prosthesis rehabilitation: a case study

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Abstract:

Background: Lower limb amputations present a striking correlation with the elderly diabetic population. The primary impact of lower limb amputation often manifests in compromised functional capacity. The primary aim of training programs for amputees is to enhance and encourage a functional walking pattern.

Objective :

A 60-year-old female patient was referred to the physiotherapy department for pre-prosthetic rehabilitation and prosthetic prescription after bilateral transtibial amputations. Prosthetic rehabilitation was given for 4 weeks. This study aims to investigate the functional capacity of the patient after prosthetic rehabilitation on 1st and 3rd month of follow up.

Method

The Functional Ambulation Classification (FAC), Barthel Index (BI), and Pfeffer questionnaire were used in this study to assess the functional capacity after prosthesis adaptation on 1st month and 3rd month follow-up.

Result

The results showed that on Functional Ambulation Classification, from category 1 to category 2, there was an improvement in ambulatory abilities. Similarly, Barthel Index scores improved from 55 to 85, highlighting enhanced overall functional performance. Furthermore, the Pfeffer scale showed a decline in dependency, with scores decreasing from 11 to 6, reflecting increased independence in daily activities.

Conclusion

In this study, the patient reported improved mobility and independence, and prosthesis use with more efficiency. This analysis and positive feedback should be helpful in prosthetic rehabilitation and gait training of patients with Bilateral Transtibial Amputation. Further research in this area is essential to refine rehabilitation strategies and improve outcomes for amputees.

Keywords:

Bilateral below-knee amputation, Lower limb amputation, prosthetic rehabilitation, functional capacity

Functional capacity of elderly woman with Bilateral Transtibial amputation after prosthesis rehabilitation: a case study

Introduction:

Lower limb amputations present a striking correlation with the elderly diabetic population. (1) Common complications from diabetes mellitus include peripheral vascular disease (2,3) and diabetic neuropathy, both of which impact the lower extremities. (4) These complications often contribute to the necessity for lower limb amputations, particularly in individuals affected by long-standing diabetes. (2)

The primary impact of lower limb amputation often manifests in compromised functional capacity (5) Individuals who have experienced lower limb loss encounter significant hurdles that directly affect their mobility and independence (6) Common concerns within this population are reduced cardiovascular endurance and walking capacity, diminished muscular strength, and an increased vulnerability to falls, particularly when using prosthetic devices (3) Therefore, the primary objective of prosthetic rehabilitation is to enhance both mobility and strength, leading to a better quality of life. (7) It is recommended that amputees receive a prosthesis within 4-8 weeks after full healing of their limb stump. (8) Furthermore, intensive physiotherapy plays a critical role in the early post-operative phase and extends into the period following prosthetic acquisition, aiming to restore pre-existing functional capabilities. (8)

Lower limb amputation significantly impacts physical functioning and quality of life.(9) Diminished functional capacity presents hurdles for amputees, particularly in achieving proper ambulation while using a prosthetic limb (2) The primary aim of training programs for amputees is to enhance and encourage a functional walking pattern.(3) However, there is a gap in studies that investigated the influence of rehabilitation on functional capacity, particularly in elderly diabetic individuals with bilateral transtibial amputation.

In a study, conducted among the Brazilian population, the reliability and validity of the Functional Ambulation Category (FAC) were assessed by correlating it with the 10-minute walk test. The findings concluded that FAC serves as a valid and reliable clinical measure, effectively categorizing individuals' gait into different ambulation categories (10) A study involving the geriatric population in Iran, analyzed the reliability and validity of Barthel Index and concluded that BI is a reliable and valid tool to apply in assessment of elderly patients. The study also found a good correlation between BI and FAC to evaluate ambulatory functions in screening of geriatric outpatients. (11) In a Brazilian study, the accuracy and reliability of the Pfeffer Questionnaire (Functional Activity Questionnaire) were examined through a comparative analysis with the Mini-Mental State Exam (MMSE) and the Lawton & Brody scale. The findings indicated that the Pfeffer Questionnaire had higher specificity than sensitivity in assessing both cognitive state and functional ability. (12)

In this case report, the prosthetic rehabilitation included exercise prescription to enhance range of motion, foundational training with a prosthesis to improve balance and gait, and advanced gait training on inclines and stairs. This case study compared the functional capacity of a subject after prosthetic rehabilitation on 1st and 3rd month follow up. By providing a detailed comparison of these factors, this research looks to offer insights into the effectiveness of prosthetic rehabilitation for individuals with bilateral below-knee amputation that supports better outcomes **Significance of the study:**

This study investigated the impact of prosthetic rehabilitation on functional capacity which influences the ability to perform activities of daily living. By addressing these issues, this research will contribute to the development of more tailored and effective rehabilitation strategies for individuals with bilateral below-knee amputation, ultimately improving their overall quality of life.

Case Presentation:

A 60-year-old female patient, weighing 86 kg and measuring 155 cm in height, was referred to the physiotherapy department for pre-prosthetic rehabilitation and prosthetic prescription after bilateral transtibial amputations. The amputations resulted from severe infection due to peripheral vascular disease, a complication of chronic diabetes mellitus, occurring within a year, with the right leg amputation occurring 15 months prior (stump length of 9cm) and the left leg amputation occurring 6 weeks ago (stump length of 11cm). Both surgical wounds had healed, and the stumps exhibited cylindrical surfaces. Initial prosthetic fitting was completed over a 2week period. However, challenges began during prosthetic use and training due to compromised overall physical strength and functional capacity. The initial phase of prosthetic rehabilitation focused on teaching sit-to-stand, stand-to-sit, and standing with support. Later, training

progressed to include balance and walking exercises with parallel bars on a flat surface. However, the patient experienced fear of falling and required crutches and aid in walking, impeding the development of adequate prosthetic gait ability. Prosthetic training sessions were conducted thrice weekly for a duration of 4 weeks, planned according to the patient's specific needs and capabilities.

Methodology:

In this case study, data was gathered from the selected patient by 1 evaluator employed with the assessment forms. The Functional Ambulation Classification (FAC), Barthel Index (BI), and Pfeffer questionnaire were used in this study to assess the functional capacity after prosthesis adaptation on 1st month and 3rd month follow-up.

Gait assessment was conducted by the Functional Ambulation Classification scale (FAC), which categorizes the subject's gait into distinct ambulation levels. The FAC scale has 6 classification levels:

- Level 0 represents an absolute inability to walk independently.
- Level 1 shows the ability to walk with external help.
- Level 2 signifies the capability to walk solely on flat surfaces
- Level 3 is the capacity to ambulate within and outside the home but with limited distances.
- Level 4 illustrates the ability to walk in varied environments.
- Level 5 represents normal or unrestricted ambulation (10)

The Barthel index was used to check functional abilities in elderly population by evaluating 10 activities of daily living. These activities include feeding, grooming, bathing, dressing, continence, toilet use (all classified under self-care), as well as ambulation, transferring, and climbing stairs (categorized as mobility). The score of BI ranges from 0-100, where a higher score reflects enhanced functioning and greater independence, while a lower score indicates dependence and the need for assistance in daily activities. (11)

The Pfeffer questionnaire is a tool to evaluate the decline in functional ability among individuals. This questionnaire consists of 10 items, which assesses functioning based on the level of independence in Instrumental Activities of Daily Living (IADLs). The score ranges from 0-30, a score of 0 shows independence, and higher scores reflect increased dependency level of the patient. (12)

Ethical consideration and Informed Consent

The subject and her husband were informed about the parameters of the study and consented to a series of investigations.

Results:

Table 1 shows the use of the Functional Ambulation Classification scale to assess a patient's functional capacity. At the 1st month assessment, the patient was classified under category 1, and by the third month, there was an improvement to category 2.

Table 2 outlines the assessment of functional capacity using the Barthel Index scores. The initial follow-up at one month indicated a BI score of 55, while at the three-month follow-up, it showed an improved score of 85.

In Table 3, the evaluation of functional capacity was performed using the Pfeffer scale. During the first month assessment, the recorded value was 11, indicating higher dependency. However, by the third month, the score demonstrated improvement, measuring 6 and indicating increased independence.

Table 1: Functional ambulation classification scale		
Follow Up	**1st month**	**3rd month**
Category	**1 (required external help to walk)**	**2 (only walk on flat surfaces)**

Table 2: Barthel Index score		
Follow Up	**1st month**	**3rd month**
Feeding	**10**	**10**
Bathing	**0**	**0**
Grooming	**5**	**5**
Dressing	**5**	**5**
Bowels	**5**	**10**
Bladder	**5**	**10**
Toilet use	**5**	**10**
Transfer	**5**	**10**
Mobility	**10**	**15**
Stairs	**5**	**10**
Total	**55**	**85**

Table: 3 Pfeffer FAQ		
Follow Up	**1st month**	**3rd month**

1. Writing checks, paying bills, balancing checkbook.	**0**	**0**
2. Assembling tax records, business affairs or papers.	**1**	**0**
Shopping alone for clothes, household necessities or groceries.	**3**	**2**
4. Playing a game of skill, working on a hobby.	**0**	**0**
5. Heating water,	**2**	**1**
making a cup of coffee, turning off stove after use.		
6. Preparing a balanced meal.	**2**	**1**
7. Keeping track of current events.	**0**	**0**

8. Paying attention to, understanding, discussing TV, book, Magazine.	**0**	**0**
9. Remembering appointments, Family occasions, holidays, medications.	**0**	**0**
10. Traveling out of the neighborhood, driving. arranging to take buses.	**3**	**2**
Total	**11**	**6**

Discussion:

As older people age, their functional capacity and independence decline due to multiple complications. (13) Managing diabetic older adults with multiple complications is more complex and requires highly personalized approaches. (14) Bilateral amputations have more drawbacks than unilateral amputations. (6) Older adults with lower limb amputations have significantly reduced functional capacity compared to younger patients. Patients were unable to regain their functional capacity after LL Prosthetic rehabilitation (1), which has a negative impact on their quality-of-life post-amputation (8).

In this case, an elderly patient who had undergone bilateral amputation due to diabetic complications. She was confined to a wheelchair due to her reduced physical activity and impaired ADLs, which decreased her functional capacity. After a month of prosthetic rehabilitation, she showed improvements in her balance and gait, functional capacity, and daily living activities. A study showed that prosthetic rehabilitation and adaptation over time improved the patient's functional capacity and gait, and their overall well-being. (4)

Transtibial amputees presented a better prosthesis adaptation than transfemoral amputations at the same age. (15) Modern rehabilitation approaches are needed for better outcomes. Some of them are Anti-gravity treadmill rehabilitation (2), Functional training through wave gymnastics, hypoxic training, (16) and Resistance training for lower limbs. (17)

Functional capacity includes not only one's ability to move around physically but also one's psychological health and overall quality of life. Patients' quality of life can be affected by major amputations, so attempts

should be made to prevent anything that could worsen their situation. (18) The 3rd month follow-up evaluation of functional capacity in this study produced better results than the 1st month follow-up. Current studies have highlighted the significance of assessing the effect of prosthetic rehabilitation on the ability to carry out activities of daily living to enhance patients' results. A study proved that following non-traumatic LLA, age and degree of amputation affected daily living activities, prosthesis satisfaction, and physical balance. (19)

Physical therapy sessions for individuals with LLA have been seen limited, implying 2-6 weeks for prosthetic gait training is suggested. For people with LLA, supervised training and a continuum of care may improve their functional ability and active community participation. (3)

In this study, Rehabilitation was based on the needs and determination of the patients. Additionally, current evidence emphasizes patient-centered outcomes while concentrating on amputees' perspectives and experiences. (20) In order to address occupational restoration as well as mobility, recent studies highlight the necessity of rehabilitation services that guarantee patient-centered rehabilitation and measure outcomes holistically (21). It is critical to implement individualized and sustainable rehabilitation strategies that aim to reintegrate individuals with LLA into their pre-LLA lives. (22)

Conclusion:

In this study, a significant increase in functional capacity was seen. Our patient reported improved mobility and independence, and prosthesis use with more efficiency. This analysis and positive feedback should be helpful in prosthetic rehabilitation and gait training of patients with Bilateral TTA. Measuring health outcomes after six months of prosthesis adaptation would increase knowledge and better understanding of different outcome measures in older patients with BL-LLA. Further research in this area is essential to refine rehabilitation strategies and improve outcomes for amputees.

Conflict of Interest:

The authors have disclosed that there are no conflicts of interest.

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Abbreviations

TTA	Transtibial Amputation
LLA	Lower limb amputation
BL	Bilateral
FC	Functional Capacity
DM	Diabetes Myelitis
FAC	Functional Ambulation classification
BI	Barthel Index
FAQ	Functional Activity Questionnaire
MMSE	Mini-Mental State Exam
IADLs	Instrumental Activities of Daily Living
Cm	Centimeter
Kg	Kilogram
LL	Lower limb
ADLs	Active Daily Living