

Measuring Mobility in People with Amputation: The Use of “Amputee Mobility Predictor-AMP” in Greece

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Abstract

Lower limb amputation is an important cause of disability and, therefore it is necessary to search for a way of rehabilitating such patients, in order to improve their physical efficiency and quality of life. Aim of this research was the application of a valid evaluation tool of the patients' mobility, discovering their quality of life after surgery. Fifty-eight patients whose lower shin had been amputated, participated on the research where the “Amputee Mobility Predictor (AMP)” questionnaire was used. Data analysis was performed using methods of descriptive statistics for the description of the sample, inductive statistics for hypothesis control of the research questions and for the control of the factors studied, while, and at the same time, a validity test (of the questionnaire) was performed. Results showed that for the sample of study, the use of a prosthetic limb was not necessarily an aid to small, every-day movements, especially for patients unaccustomed to its use. In conclusion, the results of this research could help attending physicians and physiotherapists focusing on problem-solving during patients' rehabilitation, benefiting the patients themselves and their familiarization with the prosthetic limbs which is necessary for their movement, and aiming at enhancing their overall quality of life.

Keywords: Lower Limb Amputation; AMP; Disability Rehabilitation; Questionnaire Evaluation

Introduction

Lower limb amputation and the prosthetic approach remain typical patient rehabilitation methods. Rehabilitation and prosthetic surgery greatly facilitate the improvement of physical function of individuals who have suffered amputation, as well as the improvement of their emotional well-being and quality of life [1]. Approximately five thousand people in Greece suffer amputation of one or both limbs every year of whom a percentage of 80 - 85% suffer lower limb amputation (referring to the whole leg) and a percentage of 15 - 20% suffer upper limb amputation (referring to the whole arm) [13]. Several factors have caused the amputation for most individuals with an amputated limb. These factors may refer to the side-effects of an underlying illness, such as diabetes mellitus or accidents.

Despite the progress in medicine, industry, and technology, amputation remains the main source of disability. Lower limb amputation is considered the last possible choice of surgical treatment when maintaining the limb is impossible [2]. Secondary amputations are caused by intra-vascular or blood circulation disorders up to a percentage of 54%, which represents the mostly lower limb amputations, and two-thirds of such cases are accompanied by a diabetes mellitus diagnosis [3]. Main amputation areas are the shin, the knee or the thigh. This depends on how poor blood circulation is [4].

Individuals who have undergone shin amputation are, in most cases, treated by a multi - disciplinary team of rehabilitation. Rehabilitation treatment is commenced and coordinated by a psychiatrist or a specialized doctor [5]. Several specialties, such as physiotherapists, occupational therapists, nurses, psychologists, social workers, orthopedic mechanics etc. may contribute to rehabilitation treatments [6]. As a result, biomedical, psycho - social and mechanical interventions are combined to treat the damaged functions and structures of the body [7]. After a lower limb amputation, one of the main goals of rehabilitation is to restore mobility [8]. Mobility is regarded as the most important aspect of their quality of life by people who have suffered leg amputation [9]. Mobility is an ultimate ingredient of independent living that allows the execution of every - day activities. Mobility provides independence and higher quality of life to people who have undergone lower limb amputation [10].

As research indicated [11], suitable staff were chosen and trained for the correct scoring of the questionnaire. This gradual training took place in one clinic only. After that, the questionnaires were handed out to the patients and patient evaluation was completed by rating their degree of mobility. The research lasted for six months and included a final sample of one hundred and twenty people, who had suffered either knee or shin amputation. Data recording was conducted in a standardized manner by means of an electronic medical record which allows subsequent execution of instructions on a data base (Queries) and easy re - examination of data. The benefits of following research protocol procedures were understanding the limits of the patients’ mobility, focusing on their individual needs with an eye to a targeted and effective intervention, and communicating the results to the companies and colleagues (sponsors) involved to be used for the upgrading of their services.

Vozanis and colleagues’ publication [12] on the quality of life of amputated patients, noted that leg amputation has a serious impact on the patients’ physical and psychological health, while, at the same, it constitutes a great socio - economic problem, as it is associated with increased illness, multiple surgery, extended periods of hospitalization and higher percentages of disability. The same study showed differences as to the research goals and tools used for the evaluation of the quality of life. The factors that affect the Life Quality (LQ) of patients with an amputated lower limb are depression, consciousness of prosthetic mobility, social support, simultaneous ill health, prosthetic problems, age, participation in social activity. Initially, right after the amputation, subjects reported lower quality of life, however as time lapsed the level increased due to adjusting to their condition.

Additionally, the study cases report depression as the most important defining factor for their quality of life, less crucial factors being consciousness of the prosthetic mobility and social support. To be more specific, patients suffering from a bone tumor reported poorer quality of life besides emotional function and psychological health [13]. Even for patients with a lower limb amputation since childhood, gender is an important factor, as women mentioned notably poorer quality of life, but not some higher percentages of disability. Also, another significant factor is the level of amputation on the lower limb. Other factors found to be detrimental to the amputated patients’ quality of life were heat or sweating around the prosthesis holder, skin wounds or irritation caused by the prosthesis, inability to walk in forests or fields and inability to walk fast.

The problem of kinetically rehabilitating amputated patients is complicated and includes the restoration of the individual’ s overall kinetic spectrum in special rehabilitation centers with the help of specialized medical staff and physiotherapists. Therefore, the aim of this study whether and to what extent the mobility level of patients with an amputated shin is related to the demographic characteristics of the participants, that is, their age, sex, the leg that has been amputated (right or left), the number of years since the amputation, the cause of amputation, the condition of the other leg, medical history and comorbidities. Another important factor is whether mobility level is related to the patient having a prosthetic limb or not. It should be noted that the uniqueness of the study underlies on the aspect that no similar research has been conducted in Greece, yet.

Materials and Methods

Participants

The subjects were patients who had been subjected to shin amputation independently of their age or sex. They had hospitalized in hospitals, rehabilitation centers and extensive care units of the Eastern Macedonia and Thrace region. To describe the sample in short, it included 58 individuals, 31 (N = 46,6%) men and 27 (N = 53,4%) women. Also, the sample was divided into 2 age groups. More specifically: (a) from 41-50 yrs. old (N = 13, 22,4%), and (b) the main age group, from 51-60 yrs. old (N = 21, 6,2%).

It should be noted the inclusion criteria of research participants that they have had amputation of the shin, not any other part of the leg, while the exclusion criteria where that they did not suffer from any psychological problems, neurological disorders, cardiovascular failure, angina, obstructive pulmonary disease, severe ulcers or inflections related to jeopardizing blood circulation in the other leg, extreme knee defects and hip contracture. These conditions could interfere with the psychological adjustment of the participants during the rehabilitation process and for this reason, participants who had a history of the above conditions were excluded from the study.

Instrument

For the rating of the mobility of shin amputees the standardized questionnaire for rating mobility "Amputee Mobility Predictor - AMP. Amputee Mobility Predictor" (AmpPro/AmpNoPro) [13] was used. This tool was designed to ensure a more objective approach to rating the kinetic ability of people with leg amputation by means of kinetic ability levels or K-levels. This tool is perhaps thought to produce under - rated mobility results for people who have only recently been amputated, although it is generally acknowledged that it can help choose the proper type of prosthetic limb. The questionnaire consists of two parts:

- 1) The first part consists of 7 general questions concerning sex, age, the amputated leg (right or left), the number of years since the amputation, the cause of amputation, the condition of the other leg, medical history and comorbidities.
- 2) The second part concerns the mobility rating tool which comprises of 21 questions - tasks the patient must complete with or without a prosthetic limb and from which the final score is calculated by adding all previous scores and dividing the number by 43 for an AMPnoPRO index score and by 47 for an AMPPRO index score.

Scoring system: The scoring system is simple. The majority of AMP items are multiple-choice and involve 3 choices: 0 shows inability to complete the task, 1 suggests that some support is necessary for the completion the task, and 2 indicates absolute independence regarding the completion of the task [13].

Rating procedure: In order to collect the data through research, a questionnaire was created containing clearly defined questions related to the field of reference of this study, so that the validity of the final results is ensured. The questions included cloze multiple choice or graded scale questions. These specific forms of questions were selected so that the questionnaire would be easy to complete, the possibility of misunderstanding answers would be minimized, and time would be saved. The answers went through descriptive and inductive analysis by using appropriate method. Questionnaire reliability was proved statistically through a reliability analysis test.

Procedure

For the completion of the questionnaire, each participant had to seat in a hard chair with arms. Then, each participant had to perform the maneuvers involved in the questionnaire with or without the employment of the prosthesis. The participants had guidance from trained researchers while during the procedure, it was necessary to avoid pointless conversation.

Statistical Analyses

Overall 58 questionnaires were completed. The research questionnaire contained 35 questions (variables), the first 9 of which are descriptive of the sample (demographic variables) and the next 26 are in reference to the research issues. The codification of the variables was completed on SPSS 18. Six new variables were created in codification according to the use instructions of the questionnaire. More specifically, the sum of the ratings was calculated for each case separately (with or without a prosthetic limb), as well as the score and the mobility levels as described in the beginning of this paper.

Questions are divided into quantitative, qualitative and categorical ones. Quantitative are the variables that contain calculations, qualitative are those relating to a description and categorical are the variables that are classified according to certain categories, whether they are satisfaction scale questions (e.g. A lot, A little, Not at all) or grading questions (0 - 5).

Results

According to tables 1 and 2, it is shown that the greatest portion of the sample has suffered left leg amputation (N = 32, 55,2%). In fact, it is notable that the largest percentage of the sample (N = 26, 44,8%) consists of individuals who had an amputation no longer than 2 years ago, while the percentage of individuals who were amputated more than 5 years ago is also notable.

	Frequency	Percentage
Right leg	26	44,8
Left leg	32	55,2
Total	58	100

Table 1: Table of frequency of the amputated leg side.

	Frequency	Percentage	Total percentage
< 6 months	4	6,9	6,9
6 months - 1 yr.	10	17,2	24,1
Up to 2 yrs.	12	20,7	44,8
Up to 3 yrs.	4	6,9	51,7
Up to 4 yrs.	7	12,1	63,8
Up to 5 yrs.	9	15,5	79,3
> 5 yrs.	12	20,7	100

Table 2: Table of frequency of time length since amputation date.

Table 3 points out that the greatest percentage (N = 41, 70,7%) had an amputation because of a pathological problem which had a direct (N = 33, 39,7%) or an indirect (N = 18, 31,0%) effect on the circulation system of the cases under study, whereas only 12,1% of amputations were due to injury.

As a confirmation of the results above, an examination of tables 4-6 shows that 60% of the sample suffer from a pathological condition which has led to the amputation, the most common condition being diabetes mellitus.

	Frequency	Percentage	Total percentage
Vascular Disease	12	20,7	20,7
Infection	18	31,0	51,7
Thrombosis	11	19,0	70,7
Aneurysm	10	17,2	87,9
Injury	7	12,1	100

Table 3: Table of frequency of sample amputation causes.

	Frequency	Percentage	Total percentage
Yes	24	41,4	41,4
No	34	58,6	100

Table 4: Table of frequency of non - comorbidities.

	Frequency	Percentage	Total percentage
Yes	33	56,9	56,9
No	25	43,1	100

Table 5: Table of frequency of comorbidities.

	Frequency	Percentage	Total percentage
Diabetes	23	69,7	69,7
Dialysis	2	6,1	75,8
Pulmonary disease	2	6,1	81,8
Heart disease	6	18,2	100

Table 6: Table of frequency of types of comorbidities.

Table 7 presents the average rates and standard deviations of the grading of the questions in the second part of the questionnaire. Also, the highest rate for each question is presented, as well as the fraction of average rate to highest rate as a measure of the performance of the participant. Also, the results show no great differences among the ratings provided by participants to the majority of evaluation tasks, apart from the task “Balance standing on one leg - With prosthetic limb”, which had the highest rating, the task “Stairs - Descending” and the task “Continuous steps”. The task “Height and length of step - swaying walk; without prosthetic limb” had the lowest rating, with the task of “slight push” following.

Mobility level examination: In the last part of the questionnaire the mobility levels of patients with and without a prosthetic limb were examined. The results of the score variable codification produced the results of table 8.

Description of task	Average rate	Standard rate	Highest rate	Average rate/highest rate
Balance while seated	,48	,504	1	0,48
Flexibility	1,05	,804	2	0,53
Transition from chair to chair	1,00	,795	2	0,50
Stand up from the chair	1,12	,818	2	0,56
Try to stand up	,98	,805	2	0,49
Find your balance quickly when standing	,97	,794	2	0,48
Find your balance when standing (in 30 seconds)	1,09	,823	2	0,54
Balance standing on one leg - without prosthetic limb	1,07	,835	2	0,53
Balance standing on one leg - with prosthetic limb	1,48	,682	2	0,74
Bending from upright position	1,12	,839	2	0,56
Push slightly	,88	,796	2	0,44
Eyes closed	1,02	,783	2	0,51
Picking up object from the floor	1,03	,816	2	0,52
Sitting	1,09	,801	2	0,54
Beginning to walk	,52	,504	1	0,52
Height and length of step - swaying walk - with prosthetic limb	,59	,497	1	0,59
Height and length of step - swaying walk - without prosthetic limb	,29	,459	1	0,29
Height and length of step - free walk - with prosthetic limb	,53	,503	1	0,53
Height and length of step - free walk - without prosthetic limb	,57	,500	1	0,57
Continuous steps	,60	,493	1	0,60
Turning	1,14	,826	2	0,57
Change in walking	,97	,794	2	0,48
Stepping on a hurdle	,95	,826	2	0,47
Stairs - Ascending	1,03	,794	2	0,52
Stairs - Descending	1,29	,593	2	0,65
Choice of supporting device	2,48	1,699	5	0,50

Table 7: Average rate, highest rate and fraction of average rate.

	Mobility levels with a prosthetic limb		Mobility levels without a prosthetic limb	
	Frequency	Percentage	Frequency	Percentage
Category 1	44	75,9	14	24,1
Category 2	14	24,1	42	72,4
Category 3	0	0	2	3,4

Table 8: Mobility level frequencies with and without a prosthetic limb.

It is obvious that mobility levels without a prosthetic limb are more than those of the corresponding category with a prosthetic limb, as well as that the degree of mobility is higher.

Discussion

The research showed that none of the demographic characteristics of the sample is statistically important on a scale of importance 0,05. Statistically important demographic factors on a scale of importance 0,10 are sex (AMPRO p-value = 0.076, AMP no PRO p-value = 0.062), position of the amputated limb (AMPRO p-value = 0.058, AMP no PRO p-value = 0.069), and, to limited extent cause of amputation (AMPRO p-value = 0.095, AMP no PRO p-value = 0.116). As regards to mobility levels, individuals without a prosthetic limb had better scores than individuals with a prosthetic limb.

Similar results as to the non - importance of demographic factors under study sex and age were produced by Raya and colleagues [14]. Kaluf’s research [11], based on a sample of 120 people revealed age as a statistically important factor, with higher mobility levels attributed to younger age, while it also informed us that both questionnaires under study (AMPRO and PEQ) showed the same mobility levels. Age was also found to be a statistically important factor by Gailey and colleagues [13], as well as the time length since the amputation and additional non - comorbidities.

Results on table 5 can be interpreted as follows. The men of the sample are more likely to have had their lower left limb amputated, older individuals are expected to suffer amputation due to a dysfunction in blood circulation and, when it comes to patient with no additional comorbidities, they are expected to have suffered right leg amputation. As regards the total results of the questionnaire, the very low degree of correlation among qualitative variables is expected to have a negative effect on questionnaire validity.

Mobility levels were found higher in the cases of people without a prosthetic limb, which is not surprising, although the prosthetic limb would be expected to enhance the mobility of the cases under study. Important factors for the results above are the significant percentage of individuals aged over 50 years old, the pathological cause of the amputation as well as the instinctive conclusion of the sample’s poor adjustment to the prosthetic limb. At this point it should be noted that the initial ratings showed the opposite results as the total sum of the ratings of cases with a prosthetic limb was larger than the ones of the cases without.

As a result, it can be said that the research showed that men who had suffered amputation due to an infection, had the best mobility ratings.

Finally, researchers came to the following notifications according to the answers to the questionnaire:

- **General mobility measurement:** The sample had average but stable mobility levels without notable fluctuations and with similar ratings.
- **Complicated movements:** Movements requiring a combination of physical skills had a lower rating than simple ones.
- **Prosthetic limb:** Movements made with the help of a prosthetic limb had a higher rating than those executed without the help of a prosthetic limb, except for free walking, possibly because of the easiness of the task, which was performed by people not yet accustomed to the use of the prosthetic limb.

It is observed that the importance of demographic factors depends on the sample on the condition that these factors affect the life quality of the sample [13]. We do not necessarily mean the size of the sample but other factors as well which may or may not be included in the factors under research, e.g. smoking, habits that affect the physical stamina of the sample or the patients’ psychological condition. What does become clear through the research is that the use of a prosthetic limb does not seem to have the expected results with patients.

Taking for granted the assumption that no systematic and standardized mobility measurements are conducted on a national level and that the kinetic rehabilitation of patients is realized without following a common strategy and if these results in fact represent the sum of practices applied and their results, then it can be said that this research succeeded in identifying a weakness of the system of kinetic rehabilitation, which should be remedied [15].

Conclusion

The results of the study depicted that the AMPPRO questionnaire successfully measured the levels of general mobility, the ability of the patients to complete complicated movements as well as the potential of the prosthetic limb to improve the patients' functioning. Furthermore, it was found that the prosthetic limb could not generally apply to all people who had lower limb amputation given that our sample consists only of people who had shin amputation. Therefore, it will be very important to conduct additional research later, using a greater and more representative sample. The sample could include patients who had over - the - knee amputation, hip dislocation, knee dislocation, thigh amputation and amputation of leg extremities.

Nevertheless, it should be mentioned that a study of this kind, apart from the difficulty in its application, may not produce the intuitively expected results for the following reasons:

1. The complexity and specialized use of measuring tools requires an in - depth study of the execution factors before the application of a certain tool on a sample.
2. The difficulty in finding an appropriate sample that contains all categories of qualitative demographic variables.
3. Not taking into account demographic variables that may be typical of the sample, as mentioned in the previous paragraph.
4. Preceding work done by the rehabilitation staff.

The final reason indirectly shows the great importance of the work done by physiotherapists in-patient rehabilitation, since mobility levels are, in fact, as expected without going to extremes, e.g. high mobility levels. These results show strengthening of muscles and stable kinetic habits, thus allowing us to assume a specific rehabilitation method. This method, although it seems to be effective, is expected to improve after this present research.

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