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Relevance of Icidh based questionnaire and Houghton's scale as functional outcome measures among lower Limb amputees

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Abstract
Background Lower leg amputation is the commonest type of amputation severely affecting the quality of life of the patients. Even though the field of medicine has made a noteworthy development with enhanced amputation techniques and prosthetics, the rehabilitation of amputees is still lagging behind; and one of the main concerns during the rehabilitation of amputees is lack of optimum functional outcome measures. Objective to assess functional outcome of below knee amputees using prosthesis for more than 5 months in terms of ICIDH based questionnaire and Houghton's scale for the use of prosthesis, and to study relationship between potential prognostic determinants and functional outcome. Method A descriptive study was conducted with 60 below knee amputee subjects and were assessed using International Classification of Impairments, Disabilities and Handicaps (ICIDH) and Houghton's scale; and the data was statistically analyzed to find correlation between the functional outcome measures and various potential determinants. Results The potential determinants were found to have an influence on the final outcome i.e. function on ICIDH scale and prosthetic use on Houghton's scale. Patients with diabetes, history of smoking, time lag between surgery and prosthetic supply of more than 10 weeks, less duration of use of prosthesis had a higher ICIDH score and lesser Houghton's Score indicating poor function and lesser use of prosthesis. There was a negative correlation between ICIDH and Houghton's scale. Conclusion The Houghton's scale and the ICIDH-based questionnaire are both capable of predicting prosthesis usage and functional outcomes in lower limb amputees. It was also discovered that the Houghton's score and the ICIDH score had a negative association. Age, smoking, diabetes mellitus, the time lag between surgery and prosthesis supply, and the duration of prosthetic usage are all factors that impact the functional success of lower limb amputees.

Keywords: Amputation, prosthesis, ICIDH, Houghton's scale, rehabilitation

Introduction
Lower limb amputations are the most prevalent type of amputation (between 76 and 80 percent). Amputations due to dysvascular limbs caused by diabetes mellitus or primary peripheral vascular disease (PVD) account for 82 percent of hospital discharges. Peripheral vascular disease, which leads to amputations of lower limbs, is one of the most common illnesses among the elderly. Several studies have found that despite advancements in revascularization procedures, lower extremity amputation rates remain stable [1].

A lower extremity amputation can be devastating to a patient because it not only limits his or her ability to walk, but it also puts his or her future independence in jeopardy. Amputation is a long-term disability that can result in disabilities and handicaps. The major limitations of patients following lower-limb amputation include mobility issues, such as short-distance walking, the requirement for extra walking aids, and difficulties ascending stairs, walking on slopes, and utilizing public transit. Along with people's ability to walk, lower limb amputation affects their participation in valued activities, body image perception, and quality of life. The quality of life after lower limb amputation is significantly associated with mobility [2], and reduced ability to walk with a prosthesis is associated with lower activities of daily living scores [3, 4] and a lower level of social activity [5].

After an amputation, many patients' ultimate objective is to "walk with a prosthesis out of the rehabilitation unit." Because of breakthroughs in materials and technology, prosthetic legs have evolved drastically throughout time.

Many studies have shown that satisfactory prosthetic fit rates for transtibial (TT) amputees range from 60% to 90%; however, this figure drops to 50% to 70% for transfemoral (TF) amputees. A successful fit of prosthesis is stated as a minimum condition for functional prosthetic usage, defined as release from rehabilitation with a final prosthesis. Many TF amputees, unfortunately, only utilize their prosthesis to a limited extent [6].

Although a diseased limb can be easily removed, eliminating the extremity's ailment, the treatment does not end there. To guarantee that the patient can wear prosthesis comfortably, the procedure must be conducted effectively. Knee joint salvage improves rehabilitation efforts and reduces the amount of energy expended during ambulation. The patient must learn how to walk with prosthesis, put it on and take it off, care for it, monitor the skin for any pressure sites, ambulate on challenging terrain, and use the commode at night. The treatment team should include the surgeon, the primary care physician, a physical therapist, a prosthetist, and a social worker due to the intricacy of these concerns.

Age, smoking, sex, body mass index, stump length, time between surgery and prosthetic fitting, and diabetes mellitus all play a part in the lower limb amputee's rehabilitation process and impact functional result. These prognostic variables and their link to functional outcome are critical to understand [7].

Despite the fact that amputation of a limb or part of a limb is one of the oldest surgical procedures that has been conducted since prehistoric times, understanding of the critical components of leg amputation rehabilitation is limited. Predicting the functional outcome of amputee patients, for example, remains a tough challenge; the importance of vocational rehabilitation is just now becoming apparent; the efficacy of various treatments is unknown; and the functional benefits of various types of prostheses have still to be demonstrated.

The original ICIDH was developed in 1980 and has since been used for a variety of purposes, including statistical data collection and recording, research to measure outcomes, quality of life, or environmental factors, and clinical needs assessments to match treatment to specific conditions, among others. As a result, this tool can be used in healthcare practice, administration, research, and policy. It helps individuals throughout the world improve their health and quality of life by acting as a cross-cultural currency, providing uniformity in general concepts and vocabulary and encouraging standardization of results, which improves data comparability. The instrument's reliability has been demonstrated by Van den Berg and Lankhorst (1990) [8].

The Houghton's Scale is a tool that assesses prosthetic usage in persons who have had lower-extremity amputations; it represents a person's perspective on prosthetic use rather than that of a health care practitioner. It may be completed in a short amount of time and is simple to score [9].

In the Indian population, no study has been undertaken to determine the relationship between the ICIDH-based questionnaire and the Houghton's scale as a predictor of prosthetic usage and functional outcome in the presence of potential prognostic determinants. In light of the foregoing, the current study used a questionnaire based on the International Classification of Impairments, Disabilities, and Handicaps (ICIDH), a predictor of prosthetic use Houghton's scale, to assess functional outcome and its relationship with prognostic determinants among the population with unilateral below knee amputees using prosthesis.

Method

A descriptive study was conducted with data collected from artificial limb centre of KLES Dr. Prabhakar Kore Hospital and Medical Research Centre, Belgaum, District Disabled Rehabilitation Centre Belgaum, and The Association of the Physically Handicapped 1644 Alwan Galli, Beguam, during the period from April 2010 to December 2010. The inclusion criteria for the study comprised of subjects aged between 18 to 65 years with the history of below knee amputation and using prostheses for more than 5 months. [10] No restriction was placed on the gender of the subject. The subjects with bilateral amputation of below knee, subjects with altered mental status and those unwilling to participate were excluded from the study. The total of 60 subjects was selected to be included in the study after giving due consideration to inclusion and exclusion criteria and their written consent was obtained. Confidentiality was ensured and maintained throughout the study and no expenses were incurred on the part of the subjects. . The demographic data like age, gender, contact details, were obtained through personal interview and recorded on predesigned and pretested data collection sheet. Assessment of functional outcome using ICIDH based questionnaire consisting of 28 items in five disability fields and Houghton's scale for use of prosthesis was performed on all subjects and the data thus obtained was analyzed statistically, both manually as well as using statistics software SPSS 13 version with p value less than 0.05 considered as statistically significant.

Result

The result of the present study is categorized under several heading and depicted below:

Demographics

1. **Age distribution:** The mean age of the subjects in the study was 44.52 ± 12.42(SD) years with a range of 23-65 years. 36.6% and 63.3% of the subjects were more and less or equal to 50 years of age respectively. Chi-square analysis showed no statistical significant difference in mean age values in male and female (p=0.539). (Table I and II)
2. **Sex distribution over various variables:** Out of 60 subjects, 51(85%) were males and 9 (15%) were females. Chi-square analysis showed no statistical significant difference in sex distribution in terms of diabetics and non-diabetics (p=0.292). Also there was no statistical significant difference in sex distribution in terms smokers and non-smokers (p=0.87). (Table III and IV)
3. **Length of stump:** The mean length of the stump was 6.3 ± 1.46 cms while the range was between 3.9 to 10cms. (Table I)

Potential determinants of functional outcome

1. **Duration of prosthetic use:** The mean period of prosthetic use was 9.23 ± 4.26(SD) months. 25% of the participants had been using it for more than ten months while 45% used it for ≤ 10 months. The Student's' test revealed no statistical significance in male and female mean values of prosthesis usage time (p=0.497). (Table I and V)
2. **Time lag between surgery and prosthetic supply:** The mean time lag between the amputation and prosthetic supply was 11.36 ± 4.15 (SD) weeks for the entire sample. 51.6% of subject's time lag was >10 weeks and 48.3% of participant's time lag were ≤10 weeks. Student

't' test showed no statistical significant between mean values of time lag in male and females (p=0.507). (Table 1 and 5)

Co-morbidity

1. **Presence of diabetes mellitus:** Out of the total subjects, 27 (45%) were Diabetics, and 33 (55%) of them were non-diabetics. Non-parametric test of significance; Chi-square analysis showed no significant difference between number of subjects with diabetes and non diabetics (p=0.292). (Table VI)
2. **Ratio of smokers to non smokers:** There were 18(30%) smokers, and 42(70%) of non-smokers. Chi-square analysis showed no significant difference between number of smokers and non-smokers in the study population (p=0.875). (Table VI)

Houghton's Score: The average Houghton's score of the entire sample was 6.9 ± 2.89 with a range between 2 to 11. Overall 24(40%) of them had lower score on Houghton's scale indicating lesser use of prosthesis. 20 (33.3%) of them had average score on Houghton's scale indicating Moderate use. And 16 (26.7%) of them had better score on Houghton's scale indicating Good or Greater use of prosthesis. (Table 1)

Potential determinants and Houghton's score

Age: The mean Houghton's score for subjects with age more than 50 yrs was 6.2±2.8 and 8.1±2.7 for subjects with age less than 50 yrs. Non-parametric test of significance; Chi-square analysis was used. There was a statistically significant difference between the subgroups (p=0.01) indicating higher prosthetic use in subjects with age less than 50 yrs as compared to the subjects with age more than 50 yrs. (Table VII)

Sex: The mean Houghton's score for male subjects was 7.1±2.9 and 5.6±2.5 for female subjects. Chi-square analysis showed no statistically significant difference between male and female subjects (p=0.16) in terms of prosthetic use. (Table VII)

Diabetes mellitus: The mean Houghton's score for subjects with diabetes mellitus was 6.2±2.7 and 7.4±2.9 for non-diabetic subjects. Chi-square analysis showed statistically significant difference between the subgroups (p=0.01) indicating lesser prosthetic use in diabetics as compared to non-diabetics. (Table.VII)

Smoking: The mean Houghton's score were 5.16±2.2 and 7.64±2.8 for smoker and non-smoker subjects respectively. Chi-square analysis showed statistically significant difference between the subgroups (p=0.002) indicating lesser prosthetic use in smokers as compared to non-smokers. (Table VII)

Time lag between amputation and prosthetic supply

The mean Houghton's score for subjects with time lag more than 10 weeks was 5.1±2.3 and 8.8±2.1for subjects with time lag less than 10weeks. Chi-square analysis showed statistically significant difference between the subgroups (p=0.0001) indicating lesser prosthetic use in subjects with time lag more than 10 weeks as compared to the subjects with time lag less than 10 weeks. (Table VII)

Duration of prosthetic use

The mean Houghton's score for subjects with duration of prosthetic use less than 10 months was 6.4±2.8 and 8.4±2.4 for subjects with duration of prosthetic use more than 10 months. Chi-square analysis showed statistically significant difference between the subgroups (p=0.019) indicating higher prosthetic use in subjects who used prosthesis for a duration of more than 10 months as compared to those who used it for a duration of less than 10 months. (Table VII)

ICIDH Score: The mean ICIDH score of the entire sample was 20.45 ± 10.81 with a range of 6 to 36. Out of 60 subjects, 25(41.7%) of them had lower score on ICIDH questionnaire scale indicating good function. 7(11.7%) of them had average score of ICIDH Scale indicating average function. And 28(46.7%) of them had higher score on ICIDH scale indicating poor function. (Table 1)

Potential determinants and ICIDH score

Age: The mean ICIDH score for subjects with age more than 50yrs was 21.9±10.7 and 18±10.9 for subjects with age less than 50 yrs. Chi-square analysis showed statistically significant difference between the subgroups (p=0.01) indicating lower function in subjects with age more than 50 yrs as compared to the subjects with age less than 50yrs. (Table VII)

Sex: The mean ICIDH score for male subjects was 19.9±11and 23.5±9.5 for female subjects. Chi-square analysis showed no statistically significant difference between male and female subjects (p=0.35) in terms of function. (Table VII)

Diabetes mellitus: The mean ICIDH score for subjects with and without diabetes mellitus were 23.7±9.9 and 17.7±10.5 respectively. Chi-square analysis showed statistically significant difference between the subgroups (p=0.034) indicating lower function in diabetics as compared to non-diabetics. (Table VII)

Smoking: The mean ICIDH score for subjects who were smokers was 26.3±9.1 and 17.9±10.5 for non-smokers. Chi-square analysis showed statistically significant difference between the subgroups (p=0.005) indicating lower function in smokers as compared to non-smokers. (Table VII)

Time lag between amputation and prosthetic supply

The mean ICIDH score for subjects with time lag more than 10 weeks was 28.8±6.0 and 11.5±6.8 for subjects with time lag less than 10weeks. Chi-square analysis showed statistically significant difference between the subgroups (p=0.0001) indicating lower function in subjects with time lag more than 10 weeks as compared to the subjects with time lag less than 10 weeks. (Table VII)

Duration of prosthetic use: The mean ICIDH score for subjects with duration of prosthetic use less and more than 10 months were 22.09±10.6 and 15.53±10.04 respectively. Chi-square analysis showed statistically significant difference between the subgroups (p=0.041) indicating lower function in subjects who used prosthesis for a duration of less than 10 months as compared to those who used it for a duration of more than 10 months. (Table VII)

Correlation between Houghton's score and ICIDH score

Spearman's rho analysis of correlation was used to test the data for co-relation. Data analysis showed that there was a negative correlation between Houghton's score and ICIDH score with 'r' less than 6 times the p value; r = -0.89, (p =0.0001) This showed that the higher the Houghton's score in

terms of prosthetic usage lesser is the ICIDH score indicating better function. So there is a negative correlation between Houghton's score and ICIDH score. (Table No. 8)

Table 1: Mean values of all variables

Variables	Mean ± SD	Range
Age (years)	44.42±12.42	23 – 65
Duration of prosthetic use (months)	9.23± 4.26	5 – 22
Length of stump (Cms)	6.3±1.46	3.9 – 10
Time lag (weeks)	11.36±4.15	4 – 19
Houghton's Score	6.9±2.89	2 – 9
ICIDH Score	20.45±10.81	6- 3 6

Table 2: Sex Distribution

Sex	Number of participants (%)	Age (mean)	p-value
Male	51(85%)	44.09±12.99	0.539
Females	9(15%)	46.88±8.66	

Table 3: Sex Distribution in Diabetics, Non-diabetics and smoker, Non-smokers

Sex	Diabetes		Smoking	
	Yes	No	Yes	No
Male	21(41.2%)	30(58.8%)	16(31.4%)	35(68.6%)
Female	6(66.7%)	3(33.3%)	2(22.2%)	7(77.8%)
	X^2=1.110	P=0.292	X^2=0.25	P=0.87

Table 4: Sex Distribution in Houghton's Scores and ICIDH Score

Percentage of male: female	Houghton's score			Icidh score		
	Lower User	Average User	Better User	Good function	Average function	Poor function
Male	19 (37.3%)	17 (33.3%)	15 (29.4%)	23(45.1%)	5(9.8%)	23(45.1%)
Female	5(55.6%)	3(33.5%)	1(4.1%)	2(22.2%)	2(22.2%)	5(55.6%)
	X^2 =1.601		P=0.449	X^2=2.151		P=0.344

Table 5: Mean values of Potential Determinants according to gender

	Houghton's Score Mean	ICIDH Score Mean	Duration of use (Months) Mean	Time lag (weeks) Mean
Male	7.11±2.91	19.90±11.01	9.39±4.56	11.21±4.25
Female	5.67±2.54	23.55±9.54	8.33±1.81	12.22±3.63
T value	1.39	0.934	0.683	0.668
P value	0.167	0.354	0.497	0.507

Table 6: Number of Subjects in Various Subgroups

Subgroups	Number of subjects (%)
Diabetics	27(45%)
Non-diabetics	33(55%)
Smokers	18(30%)
Non-smokers	42(70%)

Table 7: Relation of Potential Determinants and Functional Outcome

	Outcome	Number of patients in subgroup	Mean Houghton's score (%)	P value	Mean ICIDH score (%)	p value
Age	≤ 50 Years	38	8.1±2.7	0.01*	18±10.9	0.01*
	> 50 Years	22	6.2±2.8		21.9±10.7	
Sex	Male	51	7.1±2.9	0.16	19.9±11	0.35
	Female	9	5.6±2.5		23.5±9.5	
Smoking	Yes	18	5.16±2.2	0.002*	26.3±9.1	0.005*
	No	42	7.64±2.8		17.9±10.5	
Diabetes Mellitus	Yes	27	6.2±2.7	0.01*	23.7±9.9	0.034*
	No	33	7.4±2.9		17.7±10.5	
Time Lag Amputation: Prosthetic Supply	≤ 10 Weeks	29	8.8±2.1	0.0001*	11.5±6.8	0.0001*
	> 10weeks	31	5.1±2.3		28.8±6.0	
Duration Of Prosthetic Use	≤ 10months	45	6.4±2.8	0.019*	22.09±10.6	0.041*
	>10months	15	8.4±2.4		15.53±10.04	

Table 8: Correlation between Houghton's scale and ICIDH scale

Scale	'r' value	'p' value
Houghton's scale	-0.89,	0.0001
ICIDH scale		

Discussion

The present descriptive study was conducted to investigate the functional outcome in terms of ICIDH based questionnaire and prosthetic use in terms of Houghton's Scale in patients with below knee amputation, and also was intended to find the correlation between the Houghton's scale and ICIDH based Questionnaire.

Results showed that there was reduced functional outcome as determined through ICIDH scores and its relation with use of prosthesis indicated by Houghton's' scores; in patients with below knee amputation in presence of co morbid conditions such as DM, PVD, and smoking history, and other potential prognostic determinants such as time lag between surgery and prosthetic supply of more than 10 weeks, age more than 50 years and duration of use less than 10 months. Results also showed a negative correlation between Houghton's scale and ICIDH based questionnaire scale. These findings are consistent with prior research that had comparable results [11, 12, 13, 14].

The findings of diabetics having a worse functional outcome and higher variety in functional outcome in ICIDH compared to non-diabetic amputees might be explained by the multi-organ effects of diabetes mellitus or an age effect [15]. A research by A.C Greive and G.J Lankhorst discovered a negative relationship between diabetes mellitus and functional outcome, which is consistent with the findings of this study [7]. Similarly, diminished function in those less than 50 years old might be linked to musculoskeletal problems, a lack of enthusiasm, or the presence of co-morbid conditions. According to Steinberg *et al.* it is unclear if age is the determinant or whether rising morbidity and physical condition with age impact functional outcome [15].

The findings of this study are likewise in line with those of B. Davies and Datta, who looked at mobility after unilateral trans-tibial or trans-femoral amputation. Almost all trans-tibial and trans-femoral amputees in the research were under the age of 50 and had effective home and community mobility. Around 50% of trans-tibial amputees over the age of 50 acquired independent community mobility, while around 60% gained household mobility. Although there was a significant worsening of community mobility rates as people

got older, the differences in household mobility did not reach statistical significance. Only about half of trans-femoral amputees over the age of 50 attained community mobility, while only about a quarter gained household mobility. With advancing age, both community and household mobility levels deteriorated statistically significantly. According to the findings, mobility rates for unilateral transtibial and trans-femoral amputees one year following prosthetic supply decline with increasing age at amputation and a higher level of amputation [16].

When the mean values of the ICIDH and Houghton's score of smokers were compared to the mean values of non-smokers, the difference was found to be statistically significant indicating that smokers have a lower functional result and utilize fewer prostheses than non-smokers. This supports the ICIDH and Houghton's Scale findings of a negative relationship between prosthesis usage and function outcome.

Reduced function in smokers relative to nonsmokers may be owing to concomitant PVD, which compromises wound healing, there by delaying prosthetic fitting, rehabilitation, and functional compromise. Pohjolainen and Alaranta (1991) discovered that smoking had a negative relationship with walking distance, capacity to walk outdoors, and walking duration in the male group of vascular trans-tibial (TT) amputees in a research on predicting determinants of functional ability following lower limb amputation [13]. By analyzing 553 consecutive patients, Taylor SM and Kalbaugh CA looked at preoperative clinical characteristics that predict post-operative functional outcomes following major lower limb amputation. The findings revealed a negative relationship between smoking and functional result (r= -0.75, p0.05) revealing an unfavorable correlation with a smoking history [17].

Similarly, subjects with a shorter period between surgery and prosthesis fitting performed better, with significant differences in both the ICIDH and Houghton's scores. It can be ascribed to a multitude of things. Time lag is undoubtedly a dependent component, since it is linked to wound healing, co-morbidity, and other factors. According to the findings of a study done by Pohjolainen and Alaranta in 1991, the time gap between amputation and prosthetic supply had a negative relationship with prosthetic usage [13].

Conclusion

Based on the findings of this study, it can be stated that the Houghton's scale and the ICIDH-based questionnaire are both capable of predicting prosthesis usage and functional outcomes in lower limb amputees. It was also discovered that the Houghton's score and the ICIDH score had a negative association. Age, smoking, diabetes mellitus, the time lag between surgery and prosthesis supply, and the duration of prosthetic usage are all factors that impact the functional success of lower limb amputees.

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