Adjustments to amputation and artificial limb, and quality of life in lower limb amputees

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CHAPTER 4

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ABSTRACT

Background: Positive adjustments to amputation and artificial limb play important roles in the rehabilitation process.

Objectives: To study the different facets of adjustments to amputation and artificial limb in lower limb amputees, and to assess the role of different background and amputation-related factors that could potentially influence these adjustments.

Study design: Cross-sectional.

Methods: Adult unilateral and non-congenital lower limb amputees (n=368) met the in-/exclusion criteria. Face-to-face interviews were conducted using structured questionnaires including patient's background, amputation, and Trinity Amputation and Prosthesis Experience Scales (TAPES).

Results: Mean scores of TAPES subscales indicated that amputees were on an average satisfied with the functioning of the prosthesis, moderately psychosocially adjusted, and not restricted in performing functional and social activities, except for athletic activities. The regression results indicated that age, employment, daily use of prosthesis and assistive device use were the most important factors associated with adjustments to amputation and prosthesis, followed by gender, comorbidity and amputation level.

Conclusions: Most of the factors contributing significantly to the adjustments to amputation and prosthesis are addressable. Future studies are envisaged to understand the underlying factors which would determine the extent of daily use of prosthesis and the reasons for the use of assistive devices by amputees.

Key Words: Rehabilitation; Amputation; Lower extremity; Artificial limbs; Adaptation, Psychological.

INTRODUCTION

Adjustments to amputation and artificial limb are intricate physical, psychological and social processes.[1] Physically, the body has to adjust to amputation setback, phantom limb pain, achieve functional abilities and his/her functional expectations with the artificial limb to be able to perform activities of daily living, resume work and other activities with respect to his/her roles and responsibilities and expectations; psychologically, the individuals have to come to terms with the changed life situation, cope with the amputation and its consequences, accept the changed body-image and also get used to the physical and mechanical features of the artificial limb; and socially perform social roles and maintain social contacts. Thus, adjustments to amputation and artificial limb encompass the physical functioning, psycho-social functioning and satisfaction with the artifical limb[2] at individual level as well as in the society with respect to the physical change brought about by amputation and the challenges posed by the changed state, which truly reflects the degree to which the individual is adjusted to amputation and artificial limb, as can be derived from the ICF framework of WHO.[3]

Being adjusted to amputation and artificial limb is important for functioning, quality of life,[2] and to enable social participation of amputees. Adjustment has mostly been implied as limiting and negative consequence after amputation. Horgan and Maclachlan[4] studied psychological adjustment in amputees as depressive and anxious reactions, body-image anxiety, social functioning and social discomfort, sense of self and identity, and its relationship to physical limitations. On the other hand, Gallagher et al.[5] explored the perception of amputees about their amputated leg, and whether they perceived that something good had emerged out of their amputation, and found that almost half of the people thought positively about their amputation. It is to be noted that the study population mainly comprised of young and traumatic amputees.

There is a dearth of studies investigating the different domains of adjustment to amputation and artificial limb which would indicate the acceptance of artificial limb by the amputees and their performance with it, as well as the different factors which play a role in the adjustment process. The prominent self-reported scales which are being used to study functioning with prosthesis and assessment of prosthesis are PEQ (Prosthesis Evaluation Questionnaire)[6] and TAPES.[7]

Unwin et al.[8] analysed the influence of demographic and amputation variables on the positive adjustment to amputation and artificial limb as measured by positive mood

subscale of PANAS[9] and general adjustment subscale of TAPES,[7] and found no association for demographic and amputation-related variables. The study analyzed the effect of rather limited number of demographic and amputation-related variables (age, gender, level and cause of amputation, and intensity of phantom pain).

Considering the vital role of positive adjustment to amputation and artificial limb in enabling the full participation of amputees in the society, and limited information available about the role of socio-demographic, medical and amputation-related factors on the adjustment to amputation and artificial limb, we aim to study first the different facets of adjustment to amputation and artificial limb in amputees, that is perception and experience or self-assessment of amputees about their amputation and artificial limb, and second, the role of different background and amputation-related factors that could potentially influence this.

METHODS

Participants

The study population consisted of lower limb amputees aged 18 years and above from a limb fitting center and a rehabilitation center based in Mumbai, and four limb fitting camps in and around Mumbai. Camps are more common in developing countries through which medical/paramedical services are made available to a community where there is limited access to health care services, or in case of an epidemic, natural disaster, war, etc. Camps provide usually temporary services; however, they can also be run for a longer term, if required. The study was cross-sectional, and conducted during 2005-2006 following convenience sampling.

The Institutional Review Board of one of the co-authors' institute approved the study. The purpose of the study was explained to the subjects, and informed signed consent was requested. Face-to-face interviews were conducted by three trained interviewers. In total, there were 622 subjects; 360 (58%) from limb fitting centre, 99 (16%) from rehabilitation centre and 163 (26%) from camps. Out of this, 17 subjects were excluded from the study. The reasons for exclusion were non-willingness to participate (8), hearing or speech impairment (4), mental incapacities (3) and other reasons (2). From this study population, a cross-section of unilateral and non-congenital amputees, and who were using artificial limb, was included in this study, resulting in a total of 368 amputees. It was decided not to include bilateral amputees and congenital amputees due to their relatively low representation in the sample. Amputees who were undergoing gait training were also excluded.

Measures

Data was collected using structured questionnaires, which included patient's background (socio-demographic and medical information), amputation, artificial limb and assistive device use related information, and Trinity Amputation and Prosthesis Experience Scales (TAPES).[7]

TAPES is a multidimensional questionnaire assessing adjustment to amputation and prosthesis use developed specifically for use with lower limb amputees. TAPES consist of three psychosocial adjustment subscales (General adjustment, Social adjustment and Adjustment to limitation), three Activity Restriction subscales (Functional, Athletic and Social restriction) and three Prosthesis Satisfaction subscales (Functional, Aesthetic and Weight satisfaction). The higher score indicates better psychosocial adjustment, increased restriction in performing activities and greater satisfisfaction with artificial limb respectively.

Statistical Analysis

Statistical analyses were performed using Statistical Package for the Social Sciences (SPSS version 15).[10] Descriptive statistics were performed for background and amputation characteristics, and TAPES subscales. Cronbach's alpha coefficients[11] were calculated for the TAPES subscales to assess internal consistency.

Stepwise regression analyses[12] were performed with TAPES subscales as dependent variables, and background (sex, age, marital, educational and employment status, and comorbidity) and amputation, prosthesis, and assitive device use related (time with prosthesis, cause, level and side of amputation, daily prosthesis use, residual stump pain, phantom limb sensation and phantom limb pain, stump skin problem, use of canes or crutches as assistive devices) variables as independent variables. Binary coding was done for the categorical variables.[13] The regression procedure resulted in a parsimonious model based only on the factors which achieved statistical significance ($p<0.05$).

RESULTS

The majority of the amputees were men (88%) and the mean age was 43 years. On average, they had an amputation since 13 years, and trauma was the main cause of amputation. Over half of the amputees were employed (59%) and quite a significant percentage of amputees used assistive devices (40.8%), such as canes and crutches (Table 1).

Table 1: Study population characteristics.

	n	%	Mean (SD)
Background			
Age (years)	368		43.13 (14.8)
Sex			
Male	324	88.0	
Female	44	12.0	
Marital Status			
Single	70	19.0	
Married	264	71.7	
Others	33	9.0	
Missing	1	0.3	
Education			
No formal education	63	17.1	
Primary education	47	12.8	
Secondary education	213	49.2	
Tertiary education	43	20.3	
Missing	2	0.6	
Employment Status			
Non-working	152	41.3	
Working	216	58.7	
Comorbidities[a]			
Diabetes	56	52.8	
Hypertension	19	17.9	
Musculoskeletal/Neurological	32	30.1	
Others	22	20.7	
Amputation			
Time since amputation (years)	368		12.90 (10.1)
Time with prosthesis (years)	365		10.92 (9.3)
Daily prosthesis use (hours)	368		10.22 (3.7)
Amputation cause			
Trauma	280	76.1	
Diabetes	42	11.4	
Vascular	17	4.6	
Cancer	14	3.8	
Others	14	3.6	
Missing	1	0.3	
Amputation Level			
Above knee	76	20.7	
Through knee	11	3.0	
Below knee	281	76.3	
Side of amputation			
Left	177	48.1	
Right	191	51.9	
Stump skin problem			
Yes	68	18.5	
Missing	3	0.8	
Residual stump pain			
Yes	115	31.2	
Phantom limb pain			
Yes	67	18.2	
Assistive device use			
Yes	150	40.8	

[a] Includes single as well as multiple comorbidities.

TAPES[7] is a validated instrument with three scales (Prosthetic satisfaction, Psychosocial adjustment and Activity restriction). Each scale has three subscales. All the subscales of TAPES had an acceptable Cronbach alpha (>0.7), except for aesthetic satisfaction and general adjustment subscales (Table 2). Therefore, these were excluded from the regression analyses.

Table 2: Descriptive statistics for TAPES subscales.

	Min	Max	Mean	Std. Dev.	Cronbach's alpha
Prosthetic satisfaction					
Functional satisfaction	8	25	21.39	3.17	0.83
Aesthetic satisfaction	4	20	16.34	1.93	0.46
Weight satisfaction	1	5	3.48	1.32	NA
Psychosocial adjustment					
General adjustment	15	25	21.16	2.21	0.55
Social adjustment	5	25	17.93	5.38	0.91
Adjustment to limitation	5	25	12.83	5.11	0.85
Activity restriction					
Functional restriction	0	8	1.41	2.15	0.88
Social restriction	0	8	0.87	1.81	0.92
Athletic restriction	0	8	3.57	2.18	0.74

The scores of the TAPES subscales indicated that amputees were on an average satisfied with the way they could function with the prosthesis, were moderately psychosocially adjusted, as they scored relatively less on social adjustment and adjustment to limitation subscales of TAPES, and did not show much restriction in performing functional and social activities, except for athletic activities. The scores of social activity restriction subscale demonstated that the amputees did not feel socially restricted (Table 2).

Prosthetic Satisfaction

The regression analyses results (Table 3) revealed that not using assistive device, such as canes and crutches, not having phantom limb pain, and more hours of prosthesis use on a daily basis were associated with being functionally more satisfied with the prosthesis.

Table 3: Summary of stepwise regression results for TAPES.

Outcome Variable	R^2	df		F	p-value
		Regression	Residual		
Prosthetic satisfaction					
Functional satisfaction[a]	0.122	3	351	16.283	< 0.001
Weight satisfaction[b]	0.073	3	351	9.255	< 0.001
Psychosocial adjustment					
Social adjustment[c]	0.112	4	351	11.061	< 0.001
Adjustment to limitation[d]	0.161	2	353	33.791	< 0.001
Activity restriction					
Functional restriction[e]	0.191	5	350	24.880	< 0.001
Social restriction[f]	0.221	5	350	19.827	< 0.001
Athletic restriction[g]	0.303	5	350	30.475	< 0.001

[a] Standardized regression coefficients: Constant (B = 20.450, $p < 0.001$), Assistive device use (B = -1.432 , $\beta = -0.221$, $p < 0.001$, $\Delta R^2 = 0.074$), Daily prosthetic use (B = 0.164 , $\beta = 0.192$, $p < 0.001$, $\Delta R^2 = 0.035$), Phantom limb pain (B = -0.946, $\beta = -0.115$, $p = 0.022$, $\Delta R^2 = 0.013$).

[b] Standardized regression coefficients: Constant (B = 3.052, $p < 0.001$), Sex (B= 0.814, $\beta = 0.202$, $p < 0.001$, $\Delta R^2 = 0.029$), Assistive device use (B = -0.455, $\beta = -0.170$, $p = 0.001$, $\Delta R^2 = 0.028$), Amputation level (B = -0.399, $\beta = -0.128$, $p = 0.013$, $\Delta R^2 = 0.016$).

[c] Standardized regression coefficients: Constant (B = 10.389, $p < 0.001$), Employment status (B = 2.142, $\beta = 0.196$, $p = 0.001$, $\Delta R^2 = 0.056$), Sex (B = 2.377, $\beta = 0.144$, $p = 0.006$, $\Delta R^2 = 0.026$), Daily prosthetic use (B = 0.211, $\beta = 0.146$, $p = 0.007$, $\Delta R^2 = 0.016$), Age (B = 0.047, $\beta = 0.128$, $p = 0.019$, $\Delta R^2 = 0.014$).

[d] Standardized regression coefficients: Constant (B = 8.695 , $p < 0.001$), Employment status (B = 3.536, $\beta = 0.343$, $p < 0.001$, $\Delta R^2 = 0.147$), Daily prosthetic use (B = 0.166, $\beta = 0.122$, $p = 0.019$, $\Delta R^2 = 0.014$).

[e] Standardized regression coefficients: Constant (B = 1.306 , $p < 0.001$), Age (B = 0.040, $\beta = 0.272$, $p < 0.001$, $\Delta R^2 = 0.123$), Daily prosthetic use (B = -0.103, $\beta = -0.176$, $p = 0.001$, $\Delta R^2 = 0.071$), Time with prosthesis (B = -0.041, $\beta = -0.178$, $p = 0.001$, $\Delta R^2 = 0.042$), Comorbidity (B = 0.645, $\beta = 0.135$, $p = 0.009$, $\Delta R^2 = 0.016$), Employment status (B = -0.506, $\beta = -0.115$, $p = 0.028$, $\Delta R^2 = 0.010$).

[f] Standardized regression coefficients: Constant (B = 1.176 , $p = 0.010$), Employment status (B = -0.619, $\beta = -0.166$, $p = 0.003$, $\Delta R^2 = 0.122$), Age (B = 0.036, $\beta = 0.288$, $p < 0.001$, $\Delta R^2 = 0.045$), Time with prosthesis (B = -0.033, $\beta = -0.166$, $p = 0.002$, $\Delta R^2 = 0.030$), Daily prosthetic use (B = -0.060, $\beta = -0.122$, $p = 0.019$, $\Delta R^2 = 0.014$), Sex (B = -0.585, $\beta = -0.104$, $p = 0.035$, $\Delta R^2 = 0.010$).

[g] Standardized regression coefficients: Constant (B = 3.431, $p < 0.001$), Age (B = 0.042, $\beta = 0.282$, $p < 0.001$, $\Delta R^2 = 0.140$), Time with prosthesis (B = -0.047, $\beta = -0.203$, $p < 0.001$, $\Delta R^2 = 0.086$), Daily prosthetic use (B = -0.093, $\beta = -0.160$, $p = 0.001$, $\Delta R^2 = 0.045$), Employment status (B = -0.708, $\beta = -0.161$, $p = 0.002$, $\Delta R^2 = 0.016$), Assistive device use (B = 0.649, $\beta = 0.147$, $p = 0.004$, $\Delta R^2 = 0.016$).

Psychosocial Adjustment

Being employed and more hours of prosthesis use on a daily basis were associated with being more socially adjusted as well as more adjusted to limitation. Being male and older age were associated with being more socially adjusted.

Activity Restriction

Being younger was associated with less functional and social restriction, as well as less restriction in performing athletic activity. Being employed was associated with less functionally and socially restricted, as well as less restricted in performing athletic activity. Less number of years with prosthesis was associated with more functional and

social restriction, as well as more restriction in performing athletic activity. More hours of prosthesis use on a daily basis indicated being less functionally and socially restricted, as well as less restricted in performing athletic activity. Additionally, having comorbidity was associated with increased functional restriction.

DISCUSSION

Age, employment, daily use of prosthesis and assistive device use were the most important factors associated with adjustment to amputation and prosthesis (TAPES subscales), followed by gender, comorbidity and amputation level. Employment contributed the most in influencing adjustment to amputation and prosthesis (explained by change in variance), followed by daily prosthesis use although to a much lesser extent. The other background, and amputation, prosthesis and assistive device use related variables were found not to affect amputees' adjustment to amputation and prosthesis.

Less use of assistive device, such as canes or crutches, more use of prosthesis on a daily basis and not having phantom pain were linked to being more functionally satisfied with the prosthesis. Murray et al.[14] also found similar results, except for use of assistive device as it was not included in the study. Also, McGill pain questionnaire[15] was used in the study which captures different aspects and feeling of pain, and therefore segregation of phantom or stump pain has not been provided in the study. Additionally, the study also found time with prosthesis to be contributing to functional satisfaction. The analysis was done in 40 amputees. In our study sample, 40% of the amputees were using assistive device, like canes and crutches, which intrigues the reason behind the use of assitive device. Different reasons could be hypothesized for this, for example, old age, comorbidity, inefficient gait training and therefore the amputees not being confident about their walking, prosthetic equipment not being up to the mark in terms of prosthetic prescription and also wear and tear in the prosthesis, or the quality of prosthetic equipment itself that could impede the expected functionality. Further research is envisaged to unravel the connection.

Gender, use of assistive device and amputation level were related with weight satisfaction. Murray et al.[14] found a different set of variables to be contributing to it, like pain, daily prosthesis use and time with prosthesis. However, the study did not include background, amputation and assistive device use related factors in the analyses.

The above results indicate that it is important to evaluate the functional satisfaction with the prosthesis during the rehabilitation program, and prosthesis prescription should also consider prosthesis weight and attributes of other prosthetic components to suit the individual requirements. Also, if amputees are functionally satisfied, then they would not need to use other assistive devices, as they would have confidence in the prosthesis. In certain situations, example, frail-elderly, weakness due to diseased condition, etc. use of assistive device will support independency. However, considering the average age of the current study population and the traumatic nature of amputation, it seems logical to believe that perhaps prosthetic prescription or the features of different prosthetic components, for example, weight, functionality, etc. might not be up to the level to suit the individual requirements. Probably, poor prosthetic prescription will be related to the resources available with the rehabilitation centres, and the economic boundaries within which the centres have to operate, and which also might be influencing the prosthetic prescription.

Unemployed amputees were found not to be socially adjusted and not adjusted to the limitations, and were also functionally and socially restricted, and also restricted in performing athletic activities. It might be that people who are adjusted to amputation and prosthesis have more chances of being employed. It could also be that economic independency due to employment status makes people more psychosocially adjusted and they tend to be more physically active. Commuting to work and performing the job would be requiring of amputees to perform some physical activity as compared to a non-working person, so the underlying motivation factor cannot be undermined, and the socio-economic status would be playing an important role here. Future research is required to unravel the relation (what affects what) between employment and psychosocial adjustment.

Age, employment and daily prosthesis use had an influence on the activity restriction. According to a study by Raichle et al.,[16] being employed was found to be a significant predictor of prosthesis use on a daily basis. This is especially relevant in the context of developing countries where there might not be adequate social and financial support available for conditions like disability and unemployment. Compounded with it, amputees would also have obligations and financial responsibilities towards their families. Generally, studies do not evaluate the influence of employment status on the functioning of amputees. It is recommended for studies to include this variable and analyse its influence. Women were less socially adjusted as compared to males, so this should be taken into account during the rehabilitation program.

Young people were found to be less functionally and socially restricted, and at the same time less number of years with prosthesis was associated with more functional and social restriction. It could be that young people even with less number of years with amputation might be getting adjusted better and faster. Contrary, older people with less number of years with amputation will take more time to get adjusted. As per Raichle et al.,[16] young age was found to be a factor influencing more hours of prosthesis use everyday.

Phantom limb pain or residual stump pain was found not to be important for adjustment to amputation and artificial limb. Phantom pain had a very small influence on prosthesis satisfaction scale, and did not have influence on psychosocial adjustment and activity restriction scales. Similarly, Desmond et al.[17] did not find phantom pain to influence the psychosocial adjustment scale, and its link to other TAPES scales was not assessed in the study.

Study Limitations

The current study population was not derived from a primary source, like hospital, therefore the possibility that the study population comprises of those people who are motivated, interested in their health and well-being and who can access the rehabilitation center/limb fitting center, and therefore visiting the limb fitting center for procuring leg cannot be totally disregarded. Longitudinal study with study sample derived from the primary source is envisaged as it will provide in-depth knowledge of the adjustment to amputation and prosthesis, and also rejection of prosthesis, if any.

Approximately, one-tenth of the study population was females. Low representation of females has also been observed elsewhere.[18, 19] It is highly uncertain that such a difference is just a matter of chance, as the study population was recruited from three different types of sources. Rather, it gives an indication about the amputee epidemiology in India. With the ageing population, and the increasing incidence of diseases which lead to amputation, as well as the infrastructural and growing population constraints posed by a developing economy, which poses more risk of traumatic accidents, it becomes important to investigate the adjustment to amputation and prosthesis more vividly in females as well. The current study findings indicate that females were found to be less socially adjusted.

Factors affecting aesthetic satisfaction and general satisfaction were not analyzed in the study as they did not meet the internal consistency criteria. However, Murray et

al.[14] found pain, daily prosthesis use and time with prosthesis to be influencing the aesthetic satisfaction with prosthesis.

Since the amputation-related questionnaires were self-reported, the chance of recall bias cannot be totally excluded.

CONCLUSIONS

Employment, daily prosthesis use, age, assistive device use, and to a lesser extent gender and amputation level are the most important factors contributing to adjustment to amputation and prosthesis. Except for age, the other factors predominantly contributing the most to adjustment to amputation and prosthesis are addressable. Therefore, future studies are envisaged to understand the contribution of the underlying factors on the extent of daily use of prosthesis, and the reasons for the use of assistive devices, like canes or crutches by amputees. Addressing these issues would be helpful in ensuring a higher level of adjustment to amputation and prosthesis by the amputees.

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