Original Article

Problems related to prosthetic components seen in amputees of Pakistan law enforcement agencies during prosthetic episodes

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Objectives: To identify the common issues related to prosthetic components among amputees of law enforcement agencies reporting for follow-up in Armed Forces Institute of Rehabilitation Medicine (AFIRM), Rawalpindi and calculate the life for the frequently changed components.

Methodology: It was a cross-sectional descriptive study carried out in AFIRM Rawalpindi from October 2013 to December 2014. Through non-probability consecutive sampling, we included individuals with amputations of any etiology. Information was recorded about the type, side, and etiology of amputation, place of injury, time passed in months since previous consultation, the reasons for follow-up (damaged prosthetic foot, damaged liner, socket problems, accessories problems, and problems with cosmetic gloves and sleeves), and the average life of the frequently changed components.

Results: Of 98 individuals (mean age 27±6 years, range: 18-43 years), majority suffered from IED blast injury (n=44, 44.9%) in Federally Administered Tribal Areas (FATA) region (n=58, 59.2%). Transtibial amputation (n=78, 79.6%) was the most common level of amputation, with equal percentage for the side of body involved (46 each). The average follow-up time from the last consultation was 17±15 months (range 2-32 months). The primary prosthetic concerns for the follow-up were regarding prosthetic foot and liner (34 each). The average times after which prosthetic foot and liner were replaced since initial provision were 22±10 months (range12-32 months) and 5±3 months (range 2-8 months), respectively.

Conclusion: Maximum patients reported with issues related to prosthetic foot and liner. The average life reported for these components was shorter than previous studies. (Rawal Med J 202;45:656-660).

Keywords: Amputation, rehabilitation, follow-up, prosthesis failure, prosthesis fitting, artificial limb.

INTRODUCTION

Loss of a limb is a traumatic incident with lots of grave implications. The amputee suffers not just from the physical and psychological trauma but the long-term prosthetic complications also add to the problem if not timely managed. The prosthesis and its maintenance is a lifelong event. It is part of the evolving science of biomechatronics.

There has been a surge in the number of traumatic amputations during the last few years in Pakistan, trauma being cause in 75% of all amputations.[1] Among the traumatic events, approximately 67% amputations occurred because of traumatic events owing to terrorism and counter-terrorism activities e.g. gun shot injuries, mine blasts, bomb blasts and shelling, and different punishment acts.[1] Complete prosthetic rehabilitation of these amputees not only involves provision of prostheses but also demands regular follow-ups for the success of prosthetic rehabilitation. Any lapse in these phases adversely affects the outcome, increasing the financial burden on the health care system as well as reducing patient compliance with wearing of prosthesis.

In one study, amputees with a late entry into prosthetic rehabilitation (mean time 156.6±121.5 days) had a significantly higher rate of failure (p=0.013) of prosthetic rehabilitation than those with an earlier entry (mean time:108.8±77.7 days).[2] In another study, the late provision of prosthesis was associated with increased risk of septicemia, cardiac arrhythmia, congestive heart failure, chronic pulmonary disease, fluid and electrolyte imbalance,

and stroke, putting extra pressure on the health care system.[3] The three-year mortality rate was also higher (hazard ratio of 0.68 (95% CI, 0.60-0.77) in patients who received appropriate prosthetic limb after a year than those who received prosthetic limb within the year.[3]

There are many reasons for not using the prosthesis even after provision. Issues related to the residual limb, prosthetic components, and the other limb and medical comorbidities, fear of fall, poor training in donning the prosthesis, and lack of motivation are the some frequently reported issues.[4,5] The specific prosthesis related issues include breakage/ loosening of socket, torn liners, breakage of foot/terminal device components, and cosmetic sleeve issues, etc. The amputees must visit the rehabilitation centers where the problems are rectified under guidance of experts. These visits in the medical language are sometimes called "Prosthetic Episodes". Nair et al[6] observed that the unilateral transfemoral amputees needed on the average 0.96 new prostheses, 3.27 new sockets, 2.31 major repairs, 3.36 component changes and 21.85 minor repairs for each amputee over a 10-year period.

Datta et al[7] observed that the transtibial amputees needed an average of 5.04 new prostheses, 6.25 refits, 2.28 major repairs and 17.04 day repairs over a 10-year period. In Pakistan, however, to the best of our knowledge, no study has been available addressing prosthetic issues in the amputee population. The purpose of this study was to identify the common prosthesis related issues during prosthetic episodes for the amputees of law enforcement agencies who reported to our institute during the study period. Comparison of the mean life of the most frequently changed components with the previous literature was secondary goal of the study.

METHODOLOGY

It was a cross-sectional study carried out at Armed Forces Institute of Rehabilitation Medicine (AFIRM) Rawalpindi from October 2013 to December 2014. AFIRM is a tertiary care rehabilitation facility providing rehabilitation facilities to a variety of population groups. A sample size of 89 amputees was calculated according to the World Health Organization sample size calculator for single proportion while taking confidence level of 90%, anticipated population proportion of 20%,[4] and absolute precision of 0.07. We included in-service personnel of law enforcement agencies of Pakistan, with amputations of any etiology after approval from the hospital ethical committee. The individuals were sampled through consecutive sampling. Verbal informed consent was taken from all participants.

Face to face semi structured interviews were conducted. Information was recorded about the type of amputation (both in upper and the lower limbs), side of amputation, cause of amputation (mine blast injury, improvised explosive device (IED) blast injury, gunshot injury, frostbite, tumor, etc.), place of injury, time passed in months since previous consultation, the reasons for follow-up [damaged prosthetic foot (Fig-1A), socket problems (Fig-1B), accessories problems (Fig-1C), damaged liner (Fig-1D), and problems with cosmetic gloves and sleeves], and the average life for the most frequently changed components.

Statistical Analysis: The data were analyzed using SPSS version 19.0. Means and standard deviations were calculated for age, mean follow-up time from the last consultation, and the mean time for the replacement of prosthetic foot and liner since initial provision. Independent samples *t*-test was used to compare the mean times for replacement of the frequently changed components with the described life span of those components. A $p<0.05$ was considered significant.

RESULTS

Of 98 individuals (mean age: 27 ± 6 years, range: 18-43 years), majority suffered from IED blast injury (n=44, 44.9%) in Federally Administered Tribal Areas (FATA) region (n=58, 59.2%) (Table 1). Transtibial amputation (n=78, 79.6%) was the most common level of amputation, with equal percentage for the side of body involved (46 each). Mean follow-up time from the last consultation was 17±15 months (range 2-32 months).

Figure. Damaged prosthetic foot (1A), socket problems (1B), damaged socket adapter (1C), and damaged silicone gel liner (1D).

Table. Descriptive statistics of study population.

Characteristics	Number (%)	Characteristics	Number (%)
Type of amputation		**Place of injury**	
Transtibial	78 (79.6%)	Federally Administered Tribal Areas	58 (59.2%)
Transfemoral	10 (10.2%)	Balochistan	8 (8.2%)
Transhumeral	2 (2%)	Kashmir & Northern Areas	8 (8.2%)
Partial hand	4 (4.1%)	Operations in peace areas	16 (16.3%)
Multiple amputations	4 (4.1%)	Nonoperational tasks	8 (8.2%)
Side of Amputation		**Reason for follow-up****	
Right	46 (46.9%)	Damaged foot	34 (34.7%)
Left	46 (46.9%)	Damaged liner	34 (34.7%)
Bilateral	6 (6.1%)	Socket problems	20 (20.4%)
Cause of Amputation		Accessories problems	10 (10.2%)
Mine blast injuries	34 (34.7%)	Cosmetic gloves or sleeves	6 (6.1%)
IED* blast injuries	44 (44.9%)		
Gunshot injuries	10 (10.2%)		
Motor vehicle accidents	4 (4.1%)		
Frost bite	4 (4.1%)		
Tumor	2 (2%)		

*Improvised explosive device. **Some patients had problems with more than one category of items

The primary prosthetic concerns for the follow-up were regarding prosthetic foot and liner (34 each). Mean times for the replacement of prosthetic foot and liner since initial provision was 22±10 months (range 12-32 months) and 5±3 months (range 2-8 months), respectively. They were significantly shorter than the described life of these components ($p<0.001$ each).

DISCUSSION

Prosthetic rehabilitation looks into all facets of amputee care for an early and successful community reintegration. An effective discharge and regular follow-up is of utmost importance especially for personnel of law enforcing agencies as they have to return back to their active duties in diverse climate and terrain.

Amputations due to IED blasts were the most frequent (44.9%) in our study followed by mine blast injuries (34.7%) and gunshot injuries (10.2%). Earlier studies from this institute have also observed blast injuries as the leading cause (59.3% and 72.8%, respectively) of amputation.[8,9] A study on civilian population from Khyber Pakhtunkhwa has mentioned blasts (37.2%) and gunshot injuries (22.6%) as the primary etiologies behind amputations.[1] The study of Indian Armed Forces database, maintained from 1944 to 2003 revealed mine blast injuries as the most common cause of amputations in Indian military personnel followed by road traffic accidents and gun-shot injuries.[10] Similarly, Afghan and the American militaries operating in the same conflict zone under similar circumstances reported maximum amputations due to IED or mine blast injuries.[11]

The majority of our sample comprised of young male patients with a mean age of 27±6 years. Rathore et al, reported that most of the amputees (57.7%) were 21–30 years old.[8] Another similar study reported a mean age of 29±7 years.[12] However, a study from Sindh province has reported an older mean age of 38.4±17 years.[13] The reason behind a younger mean age among amputees of law enforcement agencies and Khyber Pakhtunkhwa is due to the fact that the acts of terrorism and counter terrorism activities mainly affect the younger people who are either employed in law enforcement agencies or they are

the civilians who become victims when they come out to earn bread for their families.

Our study revealed that majority of the injuries were sustained in FATA (59.2%), while 16.2% were sustained during operations in peace areas; 8.2% got injured in Baluchistan, and 8.2% in Kashmir and Northern Areas. This is for the reason that major military operations and the blast injuries during the time period of study were occurring in the FATA region.

In our study, majority of the amputations were encountered in the lower limbs and the highest percentage (39%) of amputations were transtibial amputations. Previous studies from the same center have also reported lower limb amputations as much more common than upper limb amputations.[8,9,12,14,15] Similarly, the transtibial level was the most frequent level of amputation in all these studies.[8,9,12,14,15] Other Pakistani studies from Khyber Pakhtunkhwa and Sindh have also found the commonest amputation level to be the transtibial level varying in frequency from 26.3 to 90.5%.[1,8,9,12,14-16]

We discovered that the most common prosthetic issues for follow-up were broken foot and torn liner (34.7% each). Problems with the socket were found in 20.4% of the amputees. Ten (10.2%) amputees had problems with the prosthetic accessories e.g. socket and foot adaptors and six (6.1%) had problems with cosmetic gloves and sleeves. Datta et al[7] reported the mean requirement for prosthesis components over a ten-year period for each amputee. The amputees needed an average of 5.04 new prostheses, 6.25 refits, 2.28 major repairs, and 17.04 day repairs. Nair et al[6] observed that the unilateral transfemoral amputees needed on the average 0.96 new prostheses, 3.27 new sockets, 2.31 major repairs, 3.36 component changes, and 21.85 minor repairs for each amputee over a 10-year period. The statistics for unilateral transtibial amputees were 1.44 new prostheses, 3.16 major repairs, 14.19 minor repairs, and 2.89 new sockets.

The liner is generally the most worn and fragile part of a prosthesis after cosmetic glove or sleeve. The silicon liner commonly provided to the amputees has an average life of six months as claimed by the manufacturer. However, an earlier study observed an average life of 21.02±14.48 months.[17] We found a significantly shorter ($p<0.001$) mean life of five months for the silicon liner. The predominantly hot and humid weather that reduces life of these silicon liners and rough usage are the reasons that probably attributed to the early wear of these liners.

The minimal life-expectancy target for prosthetic feet in low-income countries is three years,[13] but in this study, the average time for foot replacement was less than two years that was significantly shorter statistically ($p<0.001$). This is probably ascribed to life style of personnel of our law enforcement agencies, their active involvement in service, and working in rough mountainous terrain of northern and western areas of Pakistan where operations against terrorism were being carried out.

For an amputee, the prosthesis must serve as an extension of his/her limb. He must have good control over it and should have the confidence to use it. In both upper and lower limb prostheses, optimum functioning of each component is the key to efficient performance in activities of daily living for the amputee. This study has given us an idea of the life span, these components are expected to have in our environment. Future studies involving comparison of different feet and appraisal of different life enhancing strategies for these components involving a larger sample is need of the hour.

CONCLUSION

Maximum patients reported with issues related to prosthetic foot and liner. The average life reported for these components was shorter than previous studies. All prostheses related complications should be addressed promptly in order to ensure amputee's comfort and long-term compliance.

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