AMPUTATION RATIONALE – RECUPERATING WITH PROSTHETIC REHABILITATION

Vani Saraswathi V
Research Scholar Asst Prof

Visalakshi Rajeswari
Professor, Department of Resource Management, Avinashilingam Institute for Home Science and Higher Education for Women, Coimbatore - 641043.

ABSTRACT

Major limb amputation is reported to be a major but preventable public health problem that is associated with profound economic, social and psychological effects on the patient and family. The purpose of this study was to outline the patterns, indications and short term complications of major limb amputations and rehabilitation. This is a study that was conducted at a voluntary centre among the amputees from 2010-2011 February 2010. All patients who underwent major limb amputation were, after informed consent for the study, enrolled into the study. Data were collected using a questionnaire

A total of 500 patients were entered into the study. Their ages ranged between 2–78 years Males outnumbered females by a ratio of 2:1. The majority of patients had primary or no formal education and were unemployed. The most common indication for major limb amputation was diabetic foot complications in 43.6 per cent, followed by trauma in 37.2 per cent and vascular disease in 13.6 per cent respectively. Below knee amputation was the most common procedure performed in 55.2 per cent. There were 16 bilateral limb amputees.

Complications of diabetic foot ulcers and trauma resulting from road traffic crashes were the most common indications for major limb amputation in our environment. The majority of these amputations are preventable by provision of health education, early presentation and appropriate management of the common indications. Musculoskeletal pathologies often develop as secondary complications in people with amputation, which may affect their mobility and quality of life. Prosthesis is a step ahead in the life of an amputee that would allow patients to experience some sensation of "feeling" again. Not only does this make for a truly significant return to some level of normalcy, but it also

greatly improves the functionality of replacement devices. While the effect of replacement prosthetics is to improve quality of life for patients, the ultimate goal is the restoration of initial quality of life

Keywords: Major limb amputation, Amputation indications, Prosthesis, Gait.

Introduction

Limb amputation is one of the most ancient of all surgical procedures with a history of more than 2500years dating back to the time of Hippocrates (Van 1995). Limb loss is one of the most physically and psychologically devastating events that can happen to a person (Paudel et al 2005).Not only do the lower limb amputation causes major disfigurement, it renders people less mobile and at risk for loss of independence (Gitter and Bosker 2005). Amputation has been practiced for punitive, ritual and therapeutic reasons including trauma, peripheral vascular disease, tumor, infection and congenital anomalies (Umaru et al 2004). Limb amputation is considered the last resort when limb salvage is impossible or when the limb is dead or dying, viable but non functional or endangering the patient's life person (Paudel et al 2005). Unfortunately, most often patients in developing countries presents late when limb salvage is not a viable option

The incidences of different pathologies leading to limb amputation have been reported to vary from one place to the other. In developed countries peripheral vascular disease ranks first as cause for amputation whereas trauma, infections, uncontrolled diabetes mellitus and malignancies are the leading cause for amputation in developing countries(Abou-Zamzam 2003).Most amputee patients in developed countries are older than 60years of age, and 80-90% of lower limb amputations are performed as a result of vascular problems (Masood et al 2008). "Major" limb loss is defined as amputation above the elbow, below the elbow, above the knee, below the knee, or the foot. "Minor" limb loss is defined as amputation of the hand or digits (fingers or toes) (Tseng et al. 2007). Lower limb amputations are much more frequent than upper limb and are most commonly the result of disease followed by trauma.

Yet with appropriate rehabilitation, many people can learn to walk or function again and live high quality lives.

Lower limb amputation

This study is aimed at the lower limb amputee population. As compared to the upper limb amputees, the lower limb amputees experience more changes in their life after the amputation (Rommers et al 1997). Incidence of lower limb

amputation is also greater than the upper limb. There is meagre data regarding the overall incidence and etiological background of lower limb amputation in India. According to World Health Organization, India has the highest number of road accidents in the world with 16.8 fatal injuries per 100,000 population, and 38.9 non-fatal injuries per 100,000 populations as per the data from 2006 (Demet 2003). From these figures, it can be postulated that traumatic road accidents would be a significant cause of lower limb amputation. A cross-sectional study reported vehicle accidents as the major cause of amputation (Ziegler-Graham 2008). Apart from road accidents, train accidents especially due to over-crowding, and other traumatic injuries due to infrastructural challenges posed by increasingly growing population and rapidly expanding economy would be contributing towards this (WHO 2009).An optimum access to healthcare within the stipulated time that the injured limb could be saved from infection is crucial. However, delays due to civil formalities in case of accidents and the quality of treatment being received by the individual may determine the outcomes after amputation.

Following traumatic accidents, diabetes mellitus is the second major cause of lower limb amputation in India. As a matter of fact, India is the diabetic capital of the world, and by 2030; India will have the highest number of diabetic people in the world (WHO). As per the estimates of the World Diabetes Foundation, about 40,000 lower limb amputations are performed each year in India due to diabetic complications. Studies conducted by Viswanathan et al (2007) about diabetic foot complications in India projected that almost 90 per cent of the people had diabetic foot infection, 30 per cent of which underwent a major amputation, and 70 per cent a minor amputation. It has also been reported that primarily socio-cultural practices are a cause of diabetic foot infection in India. Also, vascular problems are on rise due to ageing population. Only a very few studies have been done recently in amputees about diabetic foot ulcers leading to amputation and about depression and psychiatric issues in the amputee population. Malik et al (2010) found Quality of life to be poor in traumatically handicapped patients, and found it to be worse when they had psychiatric morbidity. From these perspectives, it is imperative to understand amputees' adjustments to amputation and prosthesis and satisfaction with prosthesis, as it could have an effect on the use of prosthesis and thereby their Quality of life (Mozumdar 2010)

Methods

The primary aim of this study was to investigate key conditions associated with lower extremity amputations in Coimbatore. Secondary objectives were to

determine the influence of age and sex on lower extremity amputations and to determine the pattern, indications and short-term outcome of major limb amputations.

Study design

This was a study involving all patients who underwent major limb amputations at Coimbatore from 2010-2012.

Study population

The study population included all patients of all age group and gender who underwent major limb amputations and rehabilitated with the lower limb prosthesis at a voluntary centre in Coimbatore within the period of study.

Selection criteria

All patients of all age group and gender who underwent major limb amputation who consented for the study were included in the study.

Data collection and analysis

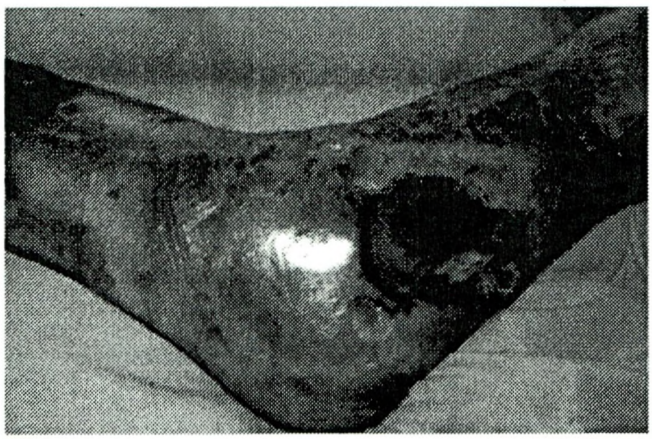

Figure 1 Diabetic Foot

Data were collected using a questionnaire. Data included in the questionnaire were: demographic data (e.g. age, gender, education level and occupation status) and clinical data (e.g. indications, level of amputation, post-operative complications,

Results

A total of 500 patients underwent major limb amputations during the study period. The patients were aged 2–78 years .The majority of patients 482 (96.4 %) were aged above 10 years of age. (Table 1) 475 patients (95 %) were males and

females were 25 (5 %) The modal age group was 41–50 years .The majority of patients (382; 76.4%) had primary or no formal education. Three hundred and twenty five (65 %) patients were unemployed.

Table 1 Age group distribution

Age group (years)	Number of patients	Percentage
0–10	18	3.6
11–20	36	7.2
21–30	90	18
31–40	41	8.2
41–50	129	25.8
51–60	102	20.4
61–70	59	11.8
>70	25	5

Complication of diabetes mellitus was the main indication for the major limb amputations in 218 (43.6%) patients followed by trauma in 186 (37.2%) patients and vascular disease in 68 (13.6%) patients respectively.

Table 2 Indications for amputations

Indication	Frequency	Percentage
Diabetic foot	218	43.6
Trauma	186	37.2
Peripheral vascular disease	68	13.6
Malignancy	24	4.8
Congenital limb deformity	4	0.8

Trauma (mainly road traffic accidents and falls) and malignancies were most common indications for amputations in young adults (2^{nd} to 3^{rd} decades) whereas complications of diabetes and peripheral vascular diseases were the main indications in the 4^{th} to 5^{th} decades of age. Congenital limb deformities were the most common indications in children aged 10 years and below.

Age group versus indications(Table 3)

The major indications for upper limb amputations were trauma (37.2%) and malignancies (4.8 %) while diabetic gangrene (43.6%) and trauma (37.2%) were the most common causes of amputation in lower limbs.

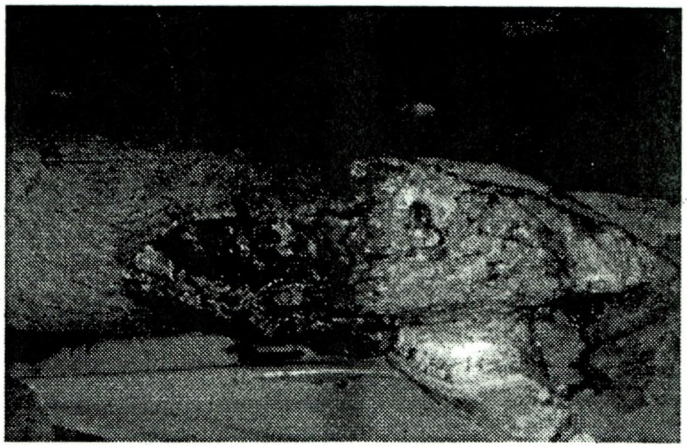

Figure 2 Crush Injury-RTA

Table 3 Age group versus indications for Limb amputations

Age group	D.F	Tr	PVD	M	CLD	T
0-10	-	-	-	-	4	4
11-20	-	28	-	6	-	34
21-30	-	82	-	8	-	90
31-40	4	40	-	-	-	44
41-50	92	22	16	6	-	136
51-60	68	8	18	-	-	94
61-70	44	4	16	4	-	68
>70	10	2	18	-	-	30
Total	218	186	68	24	4	500

D.F-Diabetic Foot; Tr-Trauma; PVD-Peripheral Vascular Disease; M-Malignancy; CLD-Congenital Limb Disorder

Levels of amputations

There were 16 bilateral limb amputations. A total of 276 patients (55.2%) had below knee amputation with 23.2 per cent, 30.6 per cent and 1.4 per cent on the right, left and bilateral leg amputation, about 44.8 per cent had above knee amputation with 25 per cent, 18 per cent and 1.8 per cent on the right, left and bilateral leg amputation respectively.

Prostheses

A prosthetic device is intended to assist with ambulation and performance of daily life activities. However wearing a prosthesis that does not fit correctly can lead to complications which can adversely affect the gait and activity level of

Table 4 Levels of amputations

Level of amputation	**Below knee amputation**		
	Right Leg	**Left Leg**	**Bilateral**
Frequency	116	153	7
Per cent	23.2	30.6	1.4
Total	**276**		
	Above knee amputation		
Level of amputation	**Right Leg**	**Left Leg**	**Bilateral**
Frequency	125	90	9
Per cent	25	18	1.8
Total	**224**		

people with amputation (Paul 2012). Approximately 68 to 88 per cent of people with amputation wear prosthesis at least 7 hours a day to aid mobility and performance of everyday activities (Breakey 1976). Only a small number of people with amputation do not wear their prosthesis for at least part of the day. The vast majority of people with amputation who use prosthesis walk with at least one gait deviation as a result of improper prosthetic fit or alignment, lack of proper gait training, development of poor habits, or compensation for a secondary physical limitation. Over time, the altered forces on the skeletal and soft tissues of the intact limb can lead to degenerative conditions (Taillefer et al 2003)

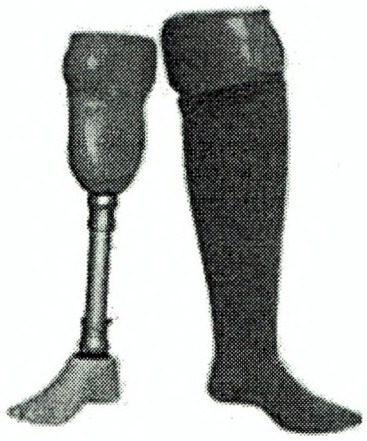

Figure 3 Prostheic limb

Regardless of the cause of the gait deviation, people with amputation spend more time on the intact limb than the prosthetic limb during ambulation

(Sherman 1999). As a result, the load that people with amputation place on their intact limb is greater than the force that people without amputation exert on their lower limbs during natural cadence walking (Pohjolainen et al 1990). Long-term exposure to higher repetitive loading forces leads to the degeneration of weight-bearing joints and subsequent joint pain (Walker et al 1994).

With a "good prosthetic fit," the forces acting across the joints of the contra lateral limb of a person with transtibial amputation are not significantly greater than the forces acting across the joints of a person without amputation (Jones 1997). However, if good prosthetic fit is not maintained throughout the wearer's lifetime, minor compensations can increase stress on the contra lateral limb and possibly predispose the long-term prosthesis wearer to premature degenerative arthritis (Burger e al 1997). Hurley et al. also suggested that people with amputation might walk slower than people without amputation in an attempt to reduce the forces placed across the joints of their contra lateral limb (Nolan et al 2003).

Socket Fit and Prosthetic Alignment

Between 30 and 100 per cent of people with lower- limb amputation report problems that cause discomfort or residual-limb complications that alter their walking ability (Engsberg et al 1994). Their inability to walk interferes with daily activities and prevents them from wearing their prosthesis, which ultimately reduces quality of life (Murray et al 1983). Only 43 per cent reported satisfaction with the comfort of their prosthesis and 24 per cent reported skin irritation and wounds due to prosthesis use. Although many subjects with amputation complained about their prosthesis, the majority were satisfied enough with its overall performance to use it most of the day (Engsberg et al 1993).

While socket fit may be considered the most important parameter in the success of lower-limb prosthesis, correct alignment also affects walking ability and

stress on the contra lateral limb (Silver-Thom et al 1996). Alignment of prosthesis is the relative position and orientation of the prosthetic components and affects comfort, function, and cosmesis. Improper alignment can contribute to poor socket fit; either would result in undesirable pressure distribution at the residual-limb/socket interface and cause discomfort, pain, and potential tissue breakdown (Suzuki 1972). Currently, the effects of alignment on the gait of people with amputation are not fully understood and acceptable alignment appears to range (Engsberg et al 1991).

Clinical implications and future research

Studies are needed to determine the differences between socket designs and prosthetic components with respect to forces placed on the contra lateral limb and spine (Herzog et al 1985). Similarly, studies that investigate prosthetic socket alignment and prosthetic length and the relationship to the hip, pelvis, and spine in people with transfemoral amputation may have significant clinical value. Studies investigating therapeutic interventions such as balance training, strengthening, gait training, and other movement strategies should be investigated with respect to load sharing with the prosthetic limb and to stress reduction on the contra lateral limb (Menard et al 1992). Finally, research exploring the effects of physical conditioning, especially to stabilize the trunk muscles to reduce back pain and maintain an active lifestyle, may guide clinicians and prosthesis users alike (Schneider et al 1993).

Conclusion

Complications of diabetic foot ulcers and trauma resulting from road traffic crashes were the most common indications for major limb amputation in our environment. The majority of these indications are potentially preventable through provision of health education, early presentations and adequate treatment of these conditions (Nolan et al 2003). Good diabetic control and early recognition and management of risk factors for foot complications, measures on prevention of road traffic crashes and community health education to encourage early presentation to hospital will reduce the number of patients undergoing major limb amputations in this region and subsequently reduce the number of amputee.

Musculoskeletal pathologies often develop as secondary complications in people with amputation, which may affect their mobility and quality of life (Engsberg 1991). An alteration of biomechanics occurs with the use of one or more prostheses. Individuals with amputation tend to favor their intact

limb and stress it more during mobility and daily activities (Zernicke 1985). This tendency can cause degenerative changes of the intact limb, such as osteoarthritis of the knee and/or hip joints. Since people with amputation spend less time on their residual limb, osteopenia and subsequent osteoporosis often occur secondary to insufficient loading of the bones (Zernicke 1985). Prosthetic fit and alignment can influence posture and comfort, which may promote greater equal force distribution across the intact and prosthetic sides during gait and tentatively decrease the susceptibility to osteoarthritis.

Acknowledgement

Author is grateful to all members of voluntary organizations who were involved in one way or another in the conduct of the study.

References

1. Van der Meij W. K N: No leg to stand on. Historical relation between amputations. Surgery and Prostheseology. 1995;7:1–256.
2. Paudel B, Shrestha BK, Banskota AK. Two faces of major lower limb amputations. Kathmandu University Medical Journal. 2005;7(11):212–216. [PubMed]
3. Umaru RH, Gali BM, Ali N. Role of inappropriate traditional splintage in limb amputation in Maiduguri, Nigeria. Annals of African Medicine. 2004;7(3):138–140.
4. Abou-Zamzam AM, Teruya TH, Killeen JD. Major lower extremity amputation in an academic vascular center. Ann Vasc Surg. 2003;7:86–90. doi: 10.1007/s10016-001-0340-0. [PubMed]
5. Masood J, Irfan A, Ghulam M. Current indications for major lower limb amputation. Pakistan J. Surg. 2008;7(4):228–231
6. Rommers GM, Vos LD, Groothoff JW, Schuiling CH, Eisma WH. Epidemiology of lower limb amputees in the north of The Netherlands: aetiology, discharge destination and prosthetic use. Prosthet Orthot Int. 1997;7(2):92–9. [PubMed]
7. Demet K, Martinet N, Guillemin F, Paysant J, Andre J-M. Health related quality of life and related factors in 539 persons with amputation of upper and lower limb. Disabil Rehabil 2003;25(9):480–6.
8. Ziegler-Graham K, MacKenzie EJ, Ephraim PL, Travison TG, Brookmeyer R. Estimating the prevalence of limb loss in the United States: 2005 to 2050. Arch Phys Med Rehabil 2008;89(3):422–9.
9. Global status report on road safety. World Health Organisation; 2009.
10. Viswanathan V. The diabetic foot: perspectives from Chennai, South India. Int J Low Extrem Wounds 2007;6(1):34–6.
11. Viswanathan V. Epidemiology of diabetic foot and management of foot problems in India. Int J Low Extrem Wounds 2010;9(3):122–6.
12. Mozumdar A, Roy SK. Depression in adult males with lower extremity amputation and its bio-social correlates. Health 2010;2(8):878–89.

13. Malik P, Garg R, Gulia A, Kumar N, Sidhu B, Sharma K. Quality of life in post-traumatic orthopedically handicapped patients. Indian J Med Sci 2010;64(5):224–33.
14. Paul R, Masilamani S, Dwyer AJ. Evaluation of rehabilitated bilateral lower limb amputees – an Indian study. Disabil Rehabil 2012;34(12):1005–9.
15. Taillefer M, Dupuis G, Roberge M, LeMay S. Health-related quality of life models: systematic review of the literature. Soc Indic Res 2003;64(2):293–323.
16. Sherman RA. Utilization of prostheses among US veterans with traumatic amputation: A pilot survey. J Rehabil Res Dev. 1999;36(2):100–108. [PMID: 10661526]
17. Pohjolainen T, Alaranta H, Kärkkäinen M. Prosthetic use functional and social outcome following major lower limb amputation. Prosthet Orthot Int. 1990;14(2):75–79.[PMID: 2235304]
18. Walker CR, Ingram RR, Hullin MG, McCreath SW. Lower limb amputation following injury: A survey of long-term functional outcome. Injury. 1994;25(6):387–92. [PMID: 8045644]
19. Jones ME, Steel JR, Bashford GM, Davidson IR. Static versus dynamic prosthetic weight bearing in elderly transtibial amputees. Prosthet Orthot Int. 1997;21(2): 100–106.[PMID: 9285953
20. Burger H, Marincek C, Isakov E. Mobility of persons after traumatic lower limb amputation. Disabil Rehabil.1997;19(7):272–77. [PMID: 9246543]
21. Nolan L, Wit A, Dudzinski K, Lees A, Lake M, Wychowanksi M. Adjustments in gait symmetry with walking speed in trans-femoral and trans-tibial amputees. Gait Posture. 2003;17(2):142–51. [PMID: 12633775]
22. Engsberg JR, Herbert LM, Grimston SK, Fung TS, Harder JA. Relation among indices of effort and oxygen uptake in below-knee amputee and able-bodied children. Arch Phys Med Rehabil. 1994;75(12):1335–41. [PMID: 7993173]
23. Silver-Thorn MB, Steege JW, Childress DS. A review of prosthetic interface stress investigations. J Rehabil Res Dev.1996;33(3):253–66. [PMID: 8823673]
24. Breakey J. Gait of unilateral trans-tibial amputees. OrthotProsthet. 1976;30:17–24.
25. Murray MP, Mollinger LA, Sepic SB, Gardner GM,Linder MT. Gait patterns in above-knee amputee patients:Hydraulic swing control vs constant-friction knee components. Arch Phys Med Rehabil. 1983;64(8):339–45.[PMID: 6882172]
26. Engsberg JR, Lee AG, Tedford KG, Harder JA. Normative ground reaction force data for able-bodied and below-knee amputee children during walking. J Pediatr Orthop.1993;13(2):169–73. [PMID: 8459005]
27. Suzuki K. Force plate study on the artificial limb gait. J Jpn Orthop Assoc. 1972;46:503–16.
28. Engsberg JR, Lee AG, Patterson JL, Harder JA. External loading comparisons between able-bodied and below-knee amputee children during walking. Arch Phys Med Rehabil. 1991;72(9):657–61. [PMID: 1859261]
29. Herzog W, Nigg BM, Read LJ, Olsson E. Asymmetries in ground reaction force patterns in normal human gait. MedSci Sports Exerc. 1989;21(1):110–14. [PMID: 2927295]
30. Zernicke RF, Hoy MG, Whiting WC. Ground reaction forces and center of pressure patterns in the gait of children with amputation: Preliminary report. Arch Phys Med Rehabil. 1985;66(11):736–41. [PMID: 4062525]

31. MR, McBride ME, Sanderson DJ, Murray D. Comparative biomechanical analysis of energy-storing prosthetic feet. Arch Phys Med Rehabil. 1992;73(5):451–58. [PMID: 1580773]

32. Schneider K, Hart T, Zernicke RF, Setoguchi Y, Oppenheim W. Dynamics of below-knee amputee child gait: SACH foot versus Flex foot. J Biomech. 1993;26(10): 1191–1204. [PMID: 8253824]