

## **Analyses of prosthetic episodes in trans-tibial amputees**

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### **Abstract**

The prosthetic episodes, i.e. actual processes of provision, identifying number of prostheses, their maintenance, repairs and replacements were analysed for 104 trans-tibial amputees aged 16 and over, over a 10 year period. The purpose of this investigation was to identify how frequently a new prosthesis is actually required for this group of amputees and what are their maintenance requirements. Variations of requirement between the amputee groups of aged 16-60 and over 60 years are also addressed.

In the 10 years period of the study the amputees needed an average of 5.04 new prostheses, 6.25 refits, 2.28 major repairs and 17.04 day repairs. The younger amputees, i.e. below the age of 60 years, required significantly more new prostheses ( $p=0.003$ ), more refit of sockets ( $p=0.0012$ ) and more day repairs ( $p=0.01$ ). Traumatic amputees below the age of 60 years needed significantly more day repairs compared to the non-traumatic amputees in the older age group ( $p=0.003$ ).

### **Introduction**

The prosthetic rehabilitation programme and prosthetic maintenance need the amputee's commitment to regular attendance at the Prosthetic Centre as well as on-going expenditure related to the cost of the artificial limbs and their maintenance and replacement. In the United Kingdom prostheses are provided free of charge under the National Health Service (NHS) to the patients who need them. The number and type of prostheses provided in the

UK are generally related to amputees' rehabilitation needs rather than being strictly controlled by the number and frequency of supply fixed by the payers of the service. It is however, to be noted that the authors' centre do not provide swimming prostheses and certain sporting prostheses, e.g. Flex-foot, under the NHS scheme. This paper describes the results of the above investigation and discusses the prosthetic maintenance needs of 104 unilateral trans-tibial amputees attending a sub-regional prosthetic and amputee rehabilitation centre over a period of 10 years.

### **Patients and methods**

This retrospective survey was carried out at a sub-regional centre, in the North Trent region of England serving a population of 1.8 million. This centre gets referrals of about 200 new amputees per year and has an active amputee population of around 2,000.

Admission criteria for this study identified unilateral trans-tibial amputees age 16 and above who had been wearing prostheses between 10-20 years at the time of the study. In total 104 amputees met all the criteria and were therefore included. Their medical notes and prosthetic records were reviewed and analysed manually as were their computerised prosthetic records. All prosthetic episodes which occurred over the last 10 years were examined. The mobility level of these patients was not examined. Though a detailed breakdown of various types of prosthesis was not collected for this study, the overwhelming majority of the subjects were using patellar tendon bearing modular endoskeletal prostheses with a multi-axial ankle joint.

Excel software package was used and 2 tailed t-tests were carried out for statistical significance.

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Four different types of prosthetic episodes were analysed.

#### 1. New prosthesis

Most of the new amputees have a new prosthesis after assessment at the primary clinic, if it is felt appropriate. This usually happens fairly soon after the amputation, i.e., within the first few weeks. Thereafter, as the stump alters in shape and size, a duplicate prosthesis is prescribed to retain patients' independence if minor adjustments are not adequate or appropriate. The first or the primary prosthesis would then be refitted at some stage depending on the individuals' progress and requirements. Once either of these two prostheses are worn out and become uneconomical to repair they are then usually replaced with new prostheses. It is not the practice to provide a duplicate prosthesis as a matter of routine. This is undertaken only on clinical grounds when it is considered that patients' independence and safety will be at risk without a useable, comfortable and safe prosthesis.

#### 2. Refit socket

If and when the prosthetic socket fitting becomes poor or damaged, the socket is refitted if minor adjustments and repairs cannot resolve the problem. This would be carried out on both prostheses (primary and duplicate) if required, but usually not concurrently.

#### 3. Major repairs

When major repairs and refurbishment work and other components are required which cannot be carried out while the patient waits, the prosthesis is kept in the workshop for a few days. Such repair work is categorised as major repair work. Major repair work due to the work content is usually less expensive than refitting a limb but more expensive than minor day repairs.

#### 4. Minor repairs

Minor repair or refurbishment of prostheses can be accomplished on the same day. Such work is categorised as minor repairs. Examples of this type of repair include adjustments, lining of the socket, renewal of cosmesis, adjustment of ankle joints etc. With the use of modular endoskeletal prostheses, which has been the clinic's usual practice for the last 10-15 years, realignment of limbs, putting on a new ankle joint or foot etc. are also usually carried out as day repairs.

### Results

One hundred and four (104) patient records were analysed. Trauma was given as the cause of amputation in 56 patients and 48 had amputations due to non-traumatic reasons. Some 54 patients were aged between 16 years and 60 years and 50 patients were above the age of 60 years. Detailed reasons for amputation are presented in Table 1.

Overall, in a 10 year period each of this group of amputees on average needed 5.04 new prostheses, 6.25 refits, 2.28 major repairs and 17.04 minor/day repairs to their prostheses.

The group of amputees over the age of 60 years required significantly less number of prostheses ( $p=0.003$ ), less number of refits ( $p=0.0012$ ) and significantly less number of minor repairs ( $p=0.01$ ). Overall, the older group had less number of major repairs carried out but this did not reach statistical significance. Details of provision of new prostheses, repairs, and refits are presented in Table 2.

The mean number of minor repairs amongst the traumatic younger amputees ( $N=36$ ) was significantly higher at 22.17 compared with that of older traumatic amputees ( $N=20$ ) at 12.95 for 10 years ( $p=0.003$ ). There was no significant difference in the number of refit sockets carried

Table 1. Causes of amputation for the study group of unilateral trans-tibial amputees

Cause of amputation	No. of amputees (%) 15-60 years (N=50)	No. of amputees (%) 60 years + over (N=54)	No of amputees (%) All ages (N=104)
Trauma	36 (66.6%)	20 (40%)	56 (53.8%)
PVD ± DM	2 (3.7%)	23 (46%)	25 (24.03%)
Malignancy	1 (1.8%)	4 (8%)	5 (7.8%)
Congenital	7 (12.9%)	0	7 (6.7%)
Others	84 (14.8%)	3 (6%)	11 (10.5%)

PVD = Peripheral Vascular Disease

DM = Diabetes Mellitus

Table 2. Details of prosthetic episodes on all patients and comparison between 15 to 60 years over 60 years of age groups

Prosthetic episodes	All age groups over 10 years (N=104)	Average for all ages per year (N=104)	Age group 15-60 over 10 years (N=50)	Age group 60 years and over over 10 years (N=54)	Value
New prosthesis	5.04	0.5	5.68	4.4	0.003*
Refits	6.25	0.6	7.41	5.09	0.012*
Major repairs	2.28	0.2	2.61	1.95	0.17*
Day repairs	17.04	1.7	19.8	14.2	0.01

\*=significant

out in these two groups of traumatic amputees ( $p=0.07$ ). Similar comparisons for patients with peripheral vascular disease between the two age groups could not be carried out as these were only 2 amputees with PVD in the younger age group.

Usually provision of a new prosthesis and the refit of socket need 3 visits to the centre by the patient, the first visit is to have cast and measurements taken, the second visit for a fitting and the third visit when the limb is completed and delivered to the patient following a check-out procedure. Major repairs to the prosthesis usually need 2 visits by the patients to the centre. The authors have extrapolated that over the 10 year period the patients on average needed 5.54 visits per year when all age groups were considered together, 6.42 visits per year for the 15-60 year age group and 4.8 visits per year for the 60+ age group.

### Discussion

Provision of a prosthesis and the ensuing maintenance programme is expensive and is important to monitor by continuous analysis of data. Narang and Jape (1982) and Hoaglund and Jergensen (1980) have confirmed this point.

As far as the authors are aware the pattern and frequency of provision of new prostheses and their maintenance in a group of trans-tibial amputees have not been previously reported. Narang and Jape (1982) concluded in their study in India that the average life of a prosthesis is about 5 years and also reported the number of prostheses issued over a 25 year period – but this patient group included all ages and all levels of upper and lower limb amputees.

The question is frequently asked, "How often will an amputee need to have a new prosthesis, how frequently do repairs need to be undertaken and how often will the amputee need to attend the

prosthetic centre?" Answers to these questions are important from both the patient's point of view and from the point of costing in compensation claims and to health service providers. Maintenance and the number of visits required for prosthetic maintenance are important for patients, and their employers to allow time off from work.

It is not possible to provide for the individual accurate answers to the above questions regarding frequency of need of new prosthesis and maintenance as there are likely to be considerable discrepancies due to different levels of amputation, level of prosthetic use, availability of services, type of prosthetic hardware used, etc.

The prosthetic provision in the United Kingdom under the National Health Service is very similar throughout the country with only minor variations. As the mobility level of the individual amputee was not examined and used in the patient selection in this study, the authors are confident that the study group is representative of unilateral trans-tibial amputees of a wide range of abilities. Therefore results of this study should be broadly applicable throughout the United Kingdom.

The aim of the study was to obtain information on the overall pattern of prosthetic requirements of a defined groups of amputees over a 10 year period. While general criteria for each of the four areas of prosthetic episodes have been described earlier specific criteria for socket change, day or major repairs were not identified.

Patients under the age of 16 years were not considered due to different prosthetic maintenance patterns due to the growth pattern. Only established patients who had reached a "steady state" and had been wearing prostheses for at least 10 years were considered. The

average number of years of wearing prostheses in the group was 13.9 years. This approach was taken in an attempt to eliminate "untypical" over use or under use of prosthetic services.

The finding of less requirement of new prosthesis, less number of refits and less number of minor repairs for the older age group was not surprising and it is assumed this is due to a more sedentary lifestyle for the older amputees. Significantly higher figures for minor repairs for the younger traumatic amputees compared to the older non-traumatic amputees probably reflects the more active and adventurous lifestyle younger traumatic amputees tend to lead. However this hypothesis has not been specifically tested.

Prosthetic hardware and prosthetic expertise are provided by an external contractor but during the study period of 10 years all individual prosthetists and technicians have remained virtually the same, through their employers changed once during this period. The expertise, principals and policies of prosthetics service provision has not altered during the study period.

### Conclusion

Overall, the amputees in the study on average needed about one new prosthesis and one new socket every 2 years, one major repair every 5 years and about 2 day repairs per year. It is however, accepted that the numbers would be

higher at the beginning of the prosthetic programme due to change in the stump condition and the patients' continuing progress with the rehabilitation programme until a plateau is reached. The results presented here are an overall average for a 10 year period.

This study has identified the pattern of prosthetic episodes in a defined group of trans-tibial amputees. As this study is limited to a relatively small number of amputees in one centre – its results cannot be accurately applied universally. However the results could be used as a base line predictor for estimating an amputee's prosthetic needs.

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### REFERENCES

- NARANG IC, JAFFE VS (1982). Retrospective study of 14,400 civilian disabled (new) treated over 25 years at an artificial limb centre. *Prosthet Orthot Int* **6**, 10-16, 1982.
- HOAGLUND ET, JERGERSEN HE (1983). Evaluation of problems and needs of veteran lower-limb amputees in San Francisco Bay Area during the period of 1977-1980. *J Rehabil Res Dev* **20**(1), 57-71.