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An audit of the quality of the stump and its relation to rehabilitation in lower limb amputees

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Abstract

An audit was undertaken amongst the lower limb (adult) amputees, 60 unilateral trans-femoral (TF) and 72 unilateral trans-tibial (TT), who attended a Disablement Services Centre (DSC) during a one year period, to determine whether amputees with better quality stumps (as assessed by a scoring system used at the Centre) achieve better outcome from prosthetic rehabilitation and whether there is any relation between the construction of the stumps and the grade of surgeons. At eighteen months (minimum follow up of six months) there were 31 (52%) TF and 54 (75%) TT amputees wearing prostheses. Some 44 amputees with Grade A stumps (score of 60 and over, out of a possible 100) needed 154 days to achieve the predicted mobility grade, 15 (34%) of them needed alteration of prosthesis, attended the Centre every 42 days and achieved the activity score of -25.7; 41 amputees with Grade B stumps (scores less than 60) needed 206 days to achieve the predicted mobility grade, 24 (58.5%) of them needed alteration of prosthesis, attended the Centre every 29 days and achieved the activity score of -39.1 (less active than Grade A).

The trainee surgeons (registrars, staff grade surgeons and SHOs) produced 26 Grade A stumps out of 67 amputations (40%) and the Consultants and the Senior Registrars (senior team) produced 37 Grade A stumps out of 65 amputations (57%).

However, only 36% of amputees were prescribed prostheses at their first attendance (60% Grade A, and 40% Grade B).

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Introduction

Despite various attempts to improve the overall mobility and independence of the lower limb amputee, the result has been rather depressing (Dormandy and Ray, 1995; Collin and Collin, 1995). The majority of amputees belong to the dysvascular group and are aged. They suffer from additional medical and/or physical conditions which can influence the process of rehabilitation. As the longevity of this group is short (Stewart *et al.*, 1992: Finch *et al.*, 1980) it is desirable that the rehabilitation process is not unduly prolonged.

Quality of the stump is one of the many factors influencing the rehabilitation of an amputee (Fig. 1). The level and length of stump influence the energy requirement of the amputee (Gailey and Wenger, 1994: Waters *et al.*, 1976: Gonzalez *et al.*, 1974) and the shape dictates the fit of the prosthesis, as does fluctuation of the stump volume. The shape, length and relative bulk of soft tissue significantly influence the interface pressure distribution (Silver-Thorn and Childress, 1996). In general, the longer the stump the less the energy requirement but one has to take account of the prosthetic constraints and cosmesis, as well as the underlying pathology. Too long a stump, especially in a dysvascular patient, invites wound breakdown, stump revision, stump claudication or greater stump shrinkage (Persson and Liedberg, 1983). Even with tremendous advances in prosthetics, the energy requirement of mobility with a prosthesis has not been reduced to any appreciable extent. In an earlier observation (Chakrabarty, 1995), it was noted that amputees with better quality stumps fared well with regard to their rehabilitation.

The aim of this prospective study was to

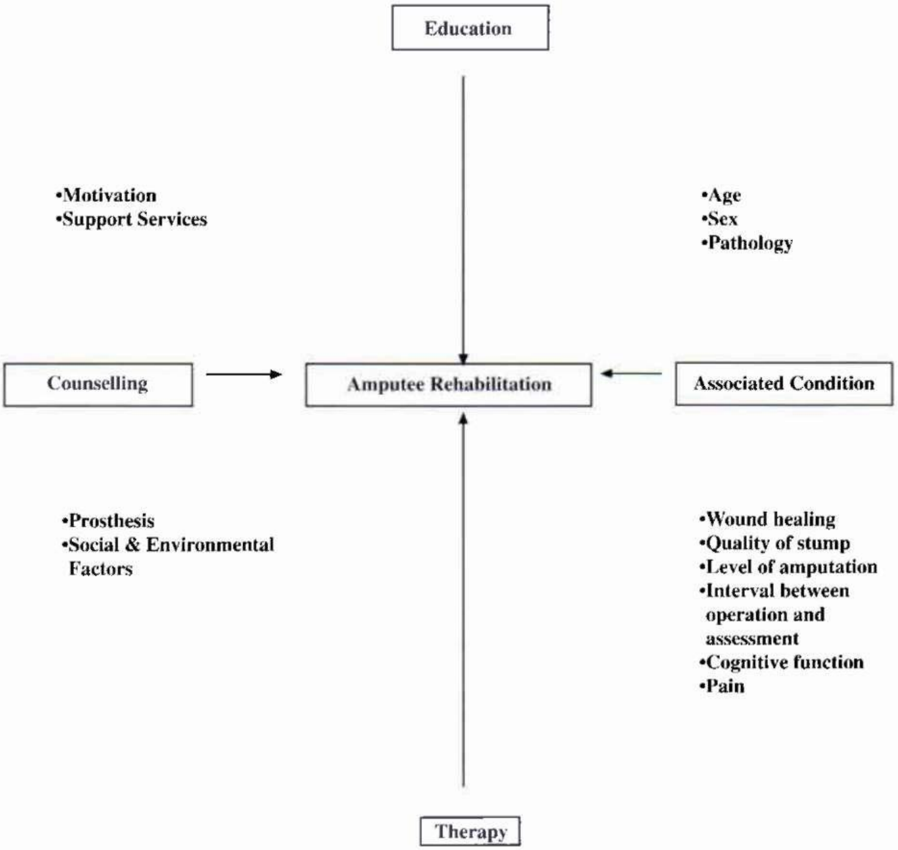

Fig. 1. Factors influencing amputee rehabilitation

determine whether this was true and whether construction of the stumps was influenced by the level of training of the surgeons.

Patient and methods

In 1994 (1 January to 31 December) 60 unilateral trans-femoral (TF) and 72 unilateral trans-tibial (TT) amputees attended the DSC for their assessments for prosthetic rehabilitation. Individual hospitals sent a referral form with particulars of the patient and with the name and designation of the operating surgeon. When the form was incomplete the hospital concerned was contacted for the missing details.

The stumps of the amputees were with consent, photographed, and were graded according to the format shown in Figure 2. This is slightly different than that used in 1993 (Chakrabarty, 1995). Stumps scoring +60 and over out of a possible +100, were considered to be of better quality (Grade A) and stumps scoring less than +60 were considered to be of poorer quality (Grade B). A mobility grade (Harold Wood and Stanmore Mobility grade (Hanspal *et al.*, 1991)) was predicted after a multidisciplinary team assessment and with the help of the pulse-oximeter reading and peak expiratory flow estimation. The team consisted of: consultant in rehabilitation, nurse, physiotherapist, occupational therapist and prosthetist. There was also a counsellor who exercised a supportive role towards the patient. In the mobility assessment, Grade I was used for an amputee who was likely to use the prosthesis for cosmetic purposes only (cosmetic user), Grade II was used for someone who was likely to use the prosthesis for transfers (therapeutic user), Grade III for someone who was going to be limited to indoor mobility (indoor user), Grade IV for someone who would use the prosthesis for outdoor (and indoor) mobility, Grade V for an independent user and Grade VI for normal mobiliser. Handgrip strengths were also

Name .... **DoB** .... **Ref.No** ....

Operator .... **Hospital** ....

Date of Amp .... **Amp.Site R/L Level** ....

Date of Assessment ....

Wound

Healed	+10	
Unhealed	-5	
Infected	-10	

Tenderness

None	+10	
Moderate	+5	
Severe	-10	

Oedema

None	+10	
Minimal	+5	
Significant	-5	

Proximal Joint Contracture

None	+10	
<20°	+5	
>20°	-20	

Scar

Fully Mobile	+10	
<1/4 Adherent	-5	
>1/4 <1/2 Adherent	-6	
>1/2 Adherent	-10	

Bone End Sculpted (& Covered)

Satisfactory	+10	
Acceptable	+5	
Unsatisfactory	-10	
Bone End Exposed	-20	

Skin

Sensate	+6	
Insensate	-6	
Insufficient	-6	

Dog-ears

None	+6	
Minimal	0	
Significant	-6	

Length

Suitable*	+10	
Acceptable	+5	
Unsuitable	-10	

Redundant Tissue

None	+6	
Minimal	3	
Significant	-6	

Shape

Conical/Cylindrical	+6	
Bulbous	-6	

Additional Scars or Other Factors†

No	+6	
Yes	-6	

(†To affect prosthetic fitting)

*For trans-femoral stump, at least 10 cm of space available above the knee joint line. 14-16 cm distal to the knee joint line or 30 cm above the ground level, whichever is longer for trans-tibial stump.

Maximum Points = 100

Photo Yes/No

Fig. 2. Stump grading

measured.

Those amputees who were provided with prostheses were seen at four weeks and subsequently assessed by the team at three, six and twelve months. A modified questionnaire regarding the amputee's activities was completed at six and twelve months by direct questioning by the team and scored afterwards (Day, 1981).

The activity score depends on the amputee's ability to don and doff the prosthesis, use of aids and wheelchair, hours of use indoor/outdoor, various household chores, spare-time activities and if at work (full or part time) the nature of the work involved. According to Day (1981) those who score +30 (no one in this study) are considered to be very highly active, +10 to +29 are highly active, -9 to +9 are of average activity, -40 to -10 have restricted activities and less than -40 are inactive. However, the author considered amputees scoring -50 to -30 were less active and those scoring less than -50 were inactive.

No attempts were made to evaluate the frequency of therapy and the quality of training, nor the influence of other variables. The environmental status and the factors supposed to influence re-integration into the community were not considered, although the occupational therapist and the counsellor assessed all amputees.

Those who became bilateral amputees before the six monthly assessments were excluded from the study. However, those amputees who became bilateral amputees after six or twelve monthly assessments were included.

Table 1. Wound classification used in the study

Wound:	
• When integrity of the skin is intact healing ridge palpable	Healed
• When integrity of the skin is broken	Unhealed
• When there is sero-purulent discharge and/or obvious clinical infection	Infected
• With scab, if adherent	Unhealed
if loose	Healed
• With necrotic skin margins	Unhealed
• With stitches *in situ*, if dry	Healed
if moist	Unhealed

The wounds were classified according to the format shown on Table 1. Prostheses were provided in five working days after prescription in 99.5% of cases. Amputees from sixteen health districts attended the centre (population 3 million).

Results

Activity scores (AS) at six monthly assessments were used in the study. AS improved in two TF amputees (Grade A) but deteriorated in five at twelve months (A1, B4) whereas AS improved in eight (A5, B3) and deteriorated in eight (A2, B6) TT amputees at twelve months.

Table 2. Amputees excluded from the study

(a) Trans-femoral amputees	(29)	(b) Trans-tibial amputees	(18)
	14 grade A 15 grade B		5 grade A 13 grade B
• Prosthesis not prescribed	9(A4,B5)	• Prosthesis not prescribed	7(B)
• Deceased (within 6 months)	3(A2,B1)	• Deceased	3(A2,B1)
• Abandoned limb wearing	6(A3,B3)	• Abandoned limb wearing	3(B)
• Lost to follow up	5(A3,B2)	• Lost to follow up	1(A)
• Became bilateral amputees	3(A1,B2)	• Became bilateral amputees	2(A1,B1)
• Refashioning of stump	1(B)	• Fell out of weelchair and factured femur	1(A)
• Cosmetic prosthesis user	1(B)		
• Did not collect prosthesis	1(A)	• Did not collect prosthesis	1(B)

The results are presented here according to the type of amputees.

The trans-femoral (TF) group (n=60)

Some 29 amputees (14 Grade A, 15 Grade B) were excluded from the study, details are shown in Table 2a.

The operating surgeon and the state of the wounds of the total (60) and the study group (31) are shown in Table 3a. There were 31 (52%) amputees with Grade A and 29 (48%) with Grade B stumps.

The senior team produced 16 (60%) Grade A stumps out of 27 amputations. The trainee surgeons produced 15 (46%) Grade A stumps out of 33 amputations. Total number of healed wounds was 37 (62%). In the study group, only 14 operated by the senior team were included with 10 Grade A stumps. Some 17 amputees operated by the trainee surgeons were included with 7 Grade A stumps. The number of healed wounds was 20 (65%).

The stump score, interval between operation and assessment at the DSC, prescription of prostheses, attendance interval and requirement for refits are shown in Table 4a. Mobility grade predicted (MGP) and achieved (MGA), with total time taken (from the date of operation) to achieve the grades, activity scores and age in each group are shown in Table 5.

Assessment was earlier by almost 13 days, prostheses were prescribed earlier by 26 days, interval between attendances to the DSC were longer by almost 9 days and the need for refits was in 41% of amputees with Grade A stumps as opposed to 71% in amputees with Grade B stumps. Average time to achieve the correctly predicted mobility grade in 16 (94%) was 135 days and the mean activity score was -29.3 (range -65 to +15) in the Grade A group. In the Grade B group, average time required to achieve the correctly predicted mobility grade in 8 (57%) amputees was 178 days and the mean activity of these amputees was -41.4 (range -72 to -7). Five amputees in this group failed to achieve the predicted mobility grade.

Table 3. Operating surgeons and state of wounds

(a) TF Group (*n*=60)					**The Study Group (*n*=31)**			
	Grade A (31)		**Grade B (29)**		**Grade A (17)**		**Grade B (14)**	
	H	**UH**	**H**	**UH**	**H**	**UH**	**H**	**UH**
Cons	10	2	3	4	7		2	1
SR	3	1	3	1	3			1
Reg	7	3	4	10	4	2	1	5
SG	1			1	1			1
SHO	4		2	1			2	1
	25 (81%)		12(41%)		15(88%)		5(36%)	

(b) TT Group (*n*=72)					**The Study Group (*n*=54)**			
	Grade A (32)		**Grade B (40)**		**Grade A (27)**		**Grade B (27)**	
	H	**UH**	**H**	**UH**	**H**	**UH**	**H**	**UH**
Cons	7	7	2	14	3	7	2	10
SR	6	1		1	5	1		
Reg	4	3	5	17	4	3	4	10
SG	1				1			
SHO	2	1		1	2	1		1
	20(63%)		7(18%)		15(56%)		6(22%)	

Key:

H	=	Healed
UH	=	Unhealed
Cons	=	Consultant
Reg	=	Registrar
SHO	=	Senior House Officer
SR	=	Senior Registrar
SG	=	Staff Grade Surgeon

Table 4. Stump score, assessment, prosthetic prescription and refits of TF and TT study group

(a)	TF Group (31)		(b) TT Group (54)	
	Grade A (17)	Grade B (14)	Grade A (27)	Grade B (27)
Stump score	Mean + 75.4 (range + 61 to + 87)	Mean + 49.9 (+40 to + 57)	Mean + 67.7 (+60 to + 87)	Mean + 47.1 (+28 to +58)
Assessment (interval from operation)	Mean 36.3 days (18 to 114)	Mean 49 days (11 to 129)	Mean 92.2 days (17 to 247)	Mean 46 days (18 to 153)
Prosthesis (prescribed after operation)	Mean 43.2 days (22 to 118)	Mean 69 days (29 to 118)	Mean 60.2 days (21 to 247)	Mean 85.8 days (30 to 244)
Attendance interval	Mean 39.8 days (25 to 74)	Mean 31.2 days (16 to 47)	Mean 38.8 days (19 to 70)	Mean 26.6 days (14 to 48)
Refits (socket alteration of prosthesis)	Mean 0.7* 7 (41%) needed refits	Mean 1.2 10 (71%) needed refits	Mean 0.41 8 (30%) needed refits	Mean 0.7 14 (52%) needed refits

*One needed two refits due to change of prescription.
One needed to attend more and needed 2 refits due to trial of a new knee unit.

A total of 64% of amputees with Grade A stumps were prescribed prostheses at the first attendance (average 40 days, range 27 to 114 days) whereas 28% of amputees with the Grade B stumps were prescribed prostheses at the first attendance (average 48 days, range 32 to 129 days).

Age of amputees was 69 median (range 32-85) in the Grade A and 68 median (range 51-82) in the Grade B group.

The trans-tibial group (n=72)

A total of 18 amputees (5 Grade A, 13 Grade B) were excluded from the study and the details are shown in Table 2b.

The operating surgeons and the state of wounds of the total (72) and the study group (54) are shown in Table 3b. There were 32 amputees (44%) with Grade A and 40 (56%) amputees with Grade B stumps of which 27 amputees with Grade A stumps and 27 amputees with Grade B stumps were included in the study.

The senior team produced 21 (53%) Grade A stumps out of 38 amputations of which 16 were included in the study. The trainee surgeons produced 11 (32%) Grade A stumps out of 34 amputations and all were included in the study. The total number of healed wounds was 27 (38%) and in the study group it was 21 (39%).

The stump scores, interval between the operation and assessment, prescription of prostheses, attendance interval and requirement for refits are shown in Table 4b. Mobility grade predicted (MGP) and achieved (MGA) with total time taken to achieve the grades, activity scores and age in each group are shown in Table 6.

Although assessment of amputees with Grade B stumps was earlier by 46 days, prostheses were prescribed later than for amputees with Grade A stumps (25 days). Interval between attendances was longer (12 days) for the group with Grade A stumps. Alteration of prosthesis was needed for 52% of amputees with Grade B stumps but only for 30% of amputees with Grade A stumps.

Three amputees with Grade B stumps achieved normal mobility (Grade VI) but their ages were 36, 43 and 59 and the time required was quite long (376 days).

Mobility grade was correctly predicted in 96% and 81.5% respectively of amputees with Grade A stumps and with Grade B stumps. Four amputees (15%) in the latter group failed to achieve the predicted mobility grade. Average time required for the amputees who achieved the predicted mobility grade was 159 days for the amputees with Grade A stumps and 220 days for the amputees with Grade B stumps.

Some 55% of amputees with the Grade A stumps were prescribed a prosthesis at the first

Table 5. Mobility grade predicted/achieved, time taken, activity level, age (trans-femoral group)

Grade A (17) MGP/ MGA	Time (days)	Activity Score	Age
V/V -5 Independent walker	Mean 124.8 (112 to 138)	Mean -5.2 (-18 to +15)	Median 44 (32 to 53)
IV/IV -2 Outdoor/ Indoor walker	Mean 163.5 (117 to 205)	Mean -18 (-22 to -14)	Median 59 (54 to 63)
III/III -9 Indoor walker	Mean 135.3 (115 to 208)	Mean -41.2 (-65 to -10)	Median 74 (68 to 85)
Values for the 16 achieving predicted mobility grades	**Mean 135.2 (112 to 208)**	**Mean -29.3 (-65 to +15)**	**Median 69 (32 to 85)**
III/IV -1	134	-14	69
Values for all 17	**135.1 (112 to 208)**	**-26.6 (-65 to +15)**	**69 (32 to 85)**

Grade B (14) MGP/ MGA	Time (days)	Activity Score	Age
V/V -1	139	-7	58
IV/IV -3	Mean 202 (187 to 212)	Mean -26.7 (-36 to -21)	Median 68 (67 to 72)
III/III -3	Mean 156 (138 to 187)	Mean -50.7 (-60 to -40)	Median 71 (60 to 75)
II/II -1	210	-72	76
Values for the 8 achieving predicted mobility grades	**178.0 (138 to 212)**	**-41.4 (-72 to -7)**	**69.5 (58 to -76)**
V/IV -1	119	-28	51
III/II -4	Mean 161 (147 to 187)	Mean -69.7 (-79 to -60)	Median 74 (68 to 82)
III/IV -1	129	-29	67
Values for all 14	**Mean 165.5 (119 to 212)**	**Mean -46.2 (-79 to -7)**	**Median 70 (51 to 82)**

attendance (average 55 days, range 17 - 247) whereas only 1 amputee (3.5%) with a Grade B stump was prescribed a prosthesis at the first attendance (34 days).

Age of amputees was 65 median in both the groups (Grade A - range 30-84, Grade B - range 31-83).

Discussion

There is no dispute about the expected and desirable outcome after an amputation of the lower limb (Pinzur *et al.*, 1993; Fyfe, 1992; Campbell *et al.*, 1994; Collin *et al.*, 1992; Narang *et al.*, 1994). Apart from regaining some lost function of mobility in pursuit of daily activities, integration into the community, socially and psychologically, will improve the quality of life of the amputee. There is also growing evidence that multidisciplinary involvement in rehabilitation of amputees is beneficial (Pinzur *et al.*, 1993; Malone *et al.*, 1979; Houghton *et al.*, 1992) and that trans-tibial amputees rehabilitate better (Castronuovo *et al.*, 1980; Steinburg *et al.*, 1985: Kegel *et al.*, 1978; Pohjolainen *et al.*, 1990) as the energy requirement is less (Gailey and Wenger, 1994;

Table 6. Mobility grade predicted/achieved, time taken, activity level, age (trans-tibial group)

Grade A (27) MGP/MGA	Time (days)	Activity Score	Age
V/V -3	Mean -126.3 (107 to 158)	Mean +1 (-9 to +10)	Median 36 (30 to 60)
IV/IV -12	Mean 160.3 (111 to 250)	Mean 19 (-45 to -3)	Median 64 (55 to 78)
III/III -11	Mean 165.2 (117 to 337)	Mean 44.5 (-67 to -21)	Median 77 (62 to 87)
Values for the 26 achieving predicted mobility grades	**Mean 158.7 (107 to 337)**	**Mean -27.8 (-67 to +10)**	**Median 64.5 (30 to 87)**
III/IV -1	128	-14	75
Values for all 27	**157.6 (107 to 337)**	**-27.3 (-67 to +15)**	**65 (30 to 87)**

Grade B (27) MGP/MGA	Time (days)	Activity Score	Age
VI/VI -3 Normal	Mean 376 (310 to 413)	Mean +5 (-2 to +15)	Median 43 (36 to 59)
V/V -2	Mean 154 (153 and 155)	Mean -14 (-45 and +17)	Median 43 (31 and 55)
IV/IV -6	Mean 157 (120 to 224)	Mean -30.7 (-49 to -13)	Median 64 (47 to 71)
III/III -11	Mean 224 (134 to 348)	Mean -42.6 (-67 to -22)	Median 70 (64 to 83)
Values for the 22 achieving predicted mobility grade	**220.2 (120 to 413)**	**Mean -30.3 (-67 to +17)**	**Median 65 (31 to 83)**
V/IV -1	410	-42	63
IV/III -2	Mean 186 (152 and 220)	Mean -49 (-53 and 45)	Median 62 (58 and 67)
III/II -1	239	-53	65
III/IV -1	139	-17	58
Values for all 27	**Mean 222.4 (120 to 413)**	**Mean -32-44 (-67 to +17)**	**Median 65 (31 to 83)**

Waters *et al.*, 1976; Gonzalez *et al.*, 1974). The working party of the Amputee Medical Society of UK (Amputation Rehabilitation: recommended standards and guidelines, 1992) endorsed all these in their report.

The author believes that wound healing plays an important part in the rehabilitation process. Apart from delaying the rehabilitation process non-healing may also represent technical inadequacies and/or underlying pathology. The classification of wounds used may appear rigid but this format was arrived at after a postal survey amongst 34 consultants involved in the rehabilitation of amputees and 32 practising surgeons including 17 professors and directors in England and Wales, and after studying the world literature.

Sometimes it is difficult to determine how much of the scar would become adherent when an open wound is healed; the assessments at three, six and twelve months help to clarify the situation. Only 62% of TF and 38% of the TT group had healed wounds when seen at the DSC.

Although the International Society for Prosthetics and Orthotics devised a clinical standard for measurement and classification of stumps in 1982, the author found it difficult to use in a day to day clinic setting (Persson and Liedberg, 1983). However, after a trial period of two years, the present format was found easy to use.

With the use of the pulse-oximeter reading and peak expiratory flow estimation, the author's prediction for mobility grade has improved from 57% to approximately 80%. These predictions have been especially useful for the assessments of bilateral amputees.

This study asked two questions: (1) does the quality of stump influence the outcome of rehabilitation of a lower limb amputee and (2) does the operating surgeon have a role to play?

Mobility: 17 out of 17 (100%) TF amputees with Grade A stumps achieved their mobility grade (one with improved grading) in three months whereas 8 out of 14 (57%) amputees with grade B stumps achieved the predicted grade in the same time. A total of 27 out of 27 (100%) TT amputees with Grade A stumps achieved their mobility grades (one with improved grading) in three months but 17 out of 27 (63%) amputees with Grade B stumps achieved their mobility grades in the same time.

It was found to be extremely difficult to assess the exact time when an individual did achieve the mobility grades and as such it cannot be considered a precise measure. However, the total time required by the amputees with Grade B stumps was longer in both TF and TT groups. Greater number of amputees with Grade A stumps were mobile in a shorter time.

Interval between attendances: The interval was longer for amputees with Grade A stumps at both TF level, (approximately 9 days, $P<.05$, t value = 1.92 against a critical value of 1.699 at the 5% level) and TT level, (12 days, $P<.002$, t value = 3.30 against a critical value of 1.683 at the 5% level and 2.42 at the 1% level).

Need for alteration of prosthesis: some 34% of amputees with Grade A stumps of the combined TF and TT Groups needed refits whereas 59% of amputees with Grade B stumps needed refits.

Activity: Mean activity score of TF amputees with Grade A stumps was -27 as opposed to -46 for those with Grade B stumps and in the TT group it was -27 for those with Grade A stumps and -32 for those with Grade B stumps. Amputees with Grade A stumps were more active than amputees with Grade B stumps.

The activity scoring system for the amputees devised by Day (1981) favours a person at work but it has been used in this study as a measure of activities for amputees with both Grade A and Grade B stumps.

Although the TT amputees with Grade B stumps were seen earlier than those with Grade A stumps, they were prescribed prostheses much later. It is possible that the amputees with Grade A stumps were not referred until the wounds were healed.

Role of operating surgeons: It is arguable whether staff grade surgeons should be considered as trainee surgeons. However, the number of operations they performed were few in numbers. Trainee surgeons performed 33 (55%) TF amputations with wounds healed in 55% and with 15 (48%) Grade A stumps. In the TT group, they performed 34 (47%) amputations with wounds healed in 35% and with 11 (32%) Grade A stumps. The trainee surgeons produced 40% of Grade A stumps out of 67 amputations.

The senior team performed 45% TF amputations with 60% Grade A stumps and wounds were healed in 70% of cases. In the TT group, they performed 53% amputations with 55% Grade A stumps. Wounds were healed only in 39%. On the whole the senior team produced 58% of Grade A stumps out of 65 amputations.

Contrary to previous findings (Pohjolainen and Alaranta, 1991), age did not seem to influence the outcome, except perhaps in the TF group with Grade B stumps, as 5 out of 14 (36%) could not achieve the expected mobility grade.

In the present climate of economic considerations and especially if there is the ultimate desire to improve the quality of life for lower limb amputees, the quality of stump is an important factor. Amputees should arrive at the DSC as early after operation as possible with a stump for which a prosthesis can safely be prescribed.

Long periods of stay in hospital for the wound to heal and subsequent delayed prosthetic prescriptions, frequent attendances at the DSC, often by ambulances, and frequent alterations of prostheses, all incur increased expenses and exaggerate frustrations of amputees (Narang *et al.*, 1984). It also reduces the period of effective use of the prostheses for a great number of amputees because of their short span of life (Stewart *et al.*, 1992; Finch *et al.*, 1980). One cannot expect a good result with a poor quality stump. The lower activity levels displayed by amputees with Grade B stumps suggests that their quality of life could have been better with a better stump.

Limitations and conclusions

The results of this study reflect the difficulty of conducting field studies using complex sets of variables as unit analysis. In this study the influence of associated conditions has not been considered. At this centre, 59% of amputees with peripheral vascular disease and 54% of amputees with diabetes have three or more (up to five) concurrent medical conditions.

Practical and perhaps ethical constraints prevented the isolation and controlled manipulation of various components of the rehabilitation process. As the multidisciplinary assessments were carried out at three, six and twelve monthly intervals, the exact time any amputee achieved the mobility grade in between the assessments was not recognised. However, the procedure was applied to all the groups. The possibility of variable treatment interaction and multiple treatment interference could not be eliminated in this investigation.

It should be accepted that outcome measurement in rehabilitation should be every provider's responsibility, (Malone *et al.*, 1979). The goal of rehabilitation is not to cure a specific organ or body system pathology but to enhance individual function e.g. mobility in lower limb amputees (Keith, 1984).

If the challenge is to be accepted of achieving the goal in amputee rehabilitation, surgical practice needs re-examination and training of trainee surgeons needs reappraisal (DeJong, 1987; Reed, 1993) even if it proves time consuming and expensive (Pietroni, 1993). We may have been getting away with sub-optimal service regarding stump construction, perhaps because of a mistaken philosophy about amputees being a 'lost cause' but the time has come for rectification with proper supervision of the trainee surgeons and adherence to good surgical practice by all.

This study represents an attempt to address the quality of stump and its relation to rehabilitation. Future outcome research should be designed to evaluate the nature and type of support services and the importance of concurrent conditions in greater numbers of amputees, probably in a multi-centre study for proper evaluation and implementation of any procedures (Williams *et al.*, 1995).

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