

Dundee revisited — 25 years of a total amputee service

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Abstract

The Dundee Limb Fitting Centre has provided an integrated rehabilitation programme for the amputee since 1965.

A review of 1846 primary amputees is discussed.

During this period a dramatic change in the above-knee/below-knee (AK/BK) ratio has been achieved with 71% BK and 26% AK occurring in 1989.

Over 80% of all amputees, the majority being elderly with peripheral vascular disease, were successfully fitted with a prosthesis.

Final discharge home or to a residential home for the elderly was achieved in 76.2% of cases with 3.6% dying in the Unit.

Bilateral amputation occurred in 18% of cases of whom 48% were BK-BK.

Overall 66% were successfully fitted with a prosthesis.

The results demonstrate the advantages of an integrated approach to the amputation and consequent rehabilitation.

Introduction

Dundee Limb Fitting Centre (DLFC) was established by Professor George Murdoch in 1965 as a specialised unit for the management of the amputee in Tayside, Scotland. Over the years the theme of total patient care by a multi-professional clinical team has evolved. The centre is now an unique institution where the total service for the amputee is provided by the Tayside Health Board for the population of the region. Over the years, because of its reputation and quality of service, the centre has attracted referrals nationally.

For the most, amputation is considered as the end of the road, but for the patient it is the beginning of a new life. Once a person becomes an amputee his or her life style changes dramatically. Accordingly, it behoves those concerned in the management of these patients to make life both comfortable and worth living. It must be emphasised that amputee management requires a holistic approach. The management process is complex and must cover all aspects provided by professional people from various disciplines.

Over the years it became apparent that numerous surgeons were performing amputations and that more above-knee (AK) amputations were carried out compared to below-knee (BK). In Dundee serious thought was given to improving this situation. Various important points were looked at and two significant factors were identified:

- 1) to concentrate the experience in the field of amputation surgery;
- 2) to provide accurate level selection to save as many knee joints as possible.

The following phases of patient management were identified:

- 1) vascular assessment and level selection;
- 2) pre-operative management;
- 3) surgical management;
- 4) post-operative management;
- 5) prosthetic management and rehabilitation.

In these areas experience was concentrated to gain more expertise to achieve a high quality service. This expertise was then integrated to provide total patient care. Once a patient is identified by a clinician as a possible candidate for amputation, he or she is referred to the Tayside Amputation Service. The service from thereon takes over the management and provides the assessment, surgery, pre and post-operative care and rehabilitation.

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Assessment of the patient is carried out in the vascular Laboratory at Ninewells Hospital and the surgery is performed in a specialised unit, where nursing and theatre facilities are available, by one of two teams of orthopaedic surgeons. Following surgery the patient is transferred to the DLFC, usually within a week, for post-operative management, rehabilitation and prosthetic fitting.

Bi-weekly multi-disciplinary ward rounds are carried out with detailed case conferences with full discussion and appropriate goal setting. Close co-operation with family members is encouraged and interdisciplinary discussions are full and frank. Visiting social workers and district nurses ensure that discharge is smooth and stress-free. Clerical staff ensure that out-patient follow-up appointments occur regularly.

On average a BK amputee is discharged from the centre, with a definitive prosthesis, within 49 days of surgery. Patient contact and care is maintained through the Out-Patient Clinic for the rest of the patient's life.

Information relating to amputation surgery and rehabilitation has been collected over the years and is described below. The results show that with a careful, integrated, organised and methodical approach to the care of the amputee, high rates of BK amputation can be achieved with over 76% returning to their home, independent and mobile with a prosthesis.

Method

Some 1805 primary amputees have been studied from 1965 to 1989, the data on level of amputation, revision rate, prosthetic fitting, age, sex, pathology, discharge placement and date of death have been recorded over the years and now are stored on an Olivetti M24 PC with dBase III+ software.

In 1981 a comprehensive review of the stored data was undertaken and the new expanded data sheet implemented. Further, although not reported here, physiotherapy and prosthetic data have been routinely stored for analysis.

Analysis was carried out using dBase III+ and Reflex a database manager package.

Results

- 1) The average age at the time of first amputation of the amputee has remained remarkably stable at 69.1 years (range 66.6 yr–71.46 yr).
- 2) The sex ratio was 59.7% male, 40.3% female.
- 3) Figure 1 is a graph of AK to BK as a percentage of lower limb amputations. The change from a high rate of AK amputation in 1966 to a high rate of BK from 1972 to 1989 is clearly shown.
- 4) Table 1 shows the levels of amputation in Scotland and in the Tayside region in identified periods. The DLFC admitted 98% of all the amputations performed in

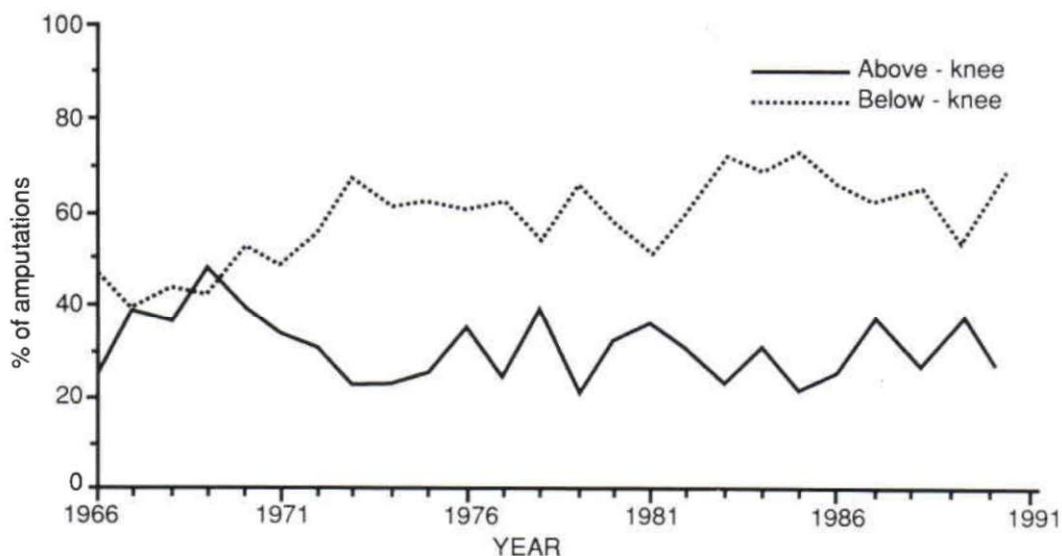


Fig. 1. Above-knee vs below-knee amputations (1966–1990).

Tayside but a few were discharged directly from the hospital where the amputation was carried out and were not admitted to the Centre.

- 5) Table 2 lists the overall causal condition of the amputation, the predominance of vascular cases is clear.
- 6) Table 3 lists the incidence of those amputees in the period 1981–89 who have had vascular surgery prior to the amputation. The overall incidence of those having vascular surgery was 33.8% and these patients were more likely to have an AK amputation.
- 7) Table 4 indicates that prosthetic fitting was achieved in 81% of all the cases with primary amputation. The supply profile is shown in this figure.
- 8) Table 5 shows the supply of wheelchairs for the period 1981–1989 during which 25% of all cases received a wheelchair. The 1989 figures show the steady increase in the numbers receiving a chair.
- 9) Table 6 lists the place of discharge in the period 1981–89. Over 76% managed to go either to their own home or to a residential home for the elderly.
- 10) Table 7 shows for the 25 year period the details of the double amputees who represented 18% of all the patients studied.

Discussion

This study reviews the amputees admitted to DLFC over 25 years and reports the results achieved by a comprehensive National Health Service Amputation Service. The most dramatic change which has occurred has been

the complete reversal of the AK:BK ratio (Fig. 1). There were 26% AK amputations in 1989 and 71% BK which in this respect was one of the most satisfactory results of the 25 years (Table 1). In 1965–66 there were 46% AK amputations and only 25% BK, demonstrating the dramatic change in these ratios. This high BK rate is in keeping with that reported by Malone *et al.* (1979) who achieved a ratio of 3.3 BK to 1 AK.

These high rates of BK amputation achieved are due to the integration of expertise with comprehensive multi-disciplinary team approach in patient management. The amputation service starts with use of a fully equipped vascular laboratory providing advice on level selection as reported by McCollum *et al.* (1984).

Recent literature has reported an apparent improvement in the BK:AK ratios (Pohjolainen *et al.*, 1990). Reviewing 175 amputees in Finland he reported 35% AK and 53% BK. Fyfe (1990) in the United Kingdom reported similar figures of 38% AK and 54% BK. Both these papers however, report patients referred specifically for prosthetic fitting and do not truly represent the total amputation rate in their respective countries. Pohjolainen *et al.* (1989) reviewed 16 operation units in Finland and found an overall rate of 33.9% BK and 62.6% AK. This demonstrated a remarkable difference between the amputation rate from the surgical team and those referred for prosthetic fitting. A study from Scotland (Knight and Urquhart, 1989), again displays data collected from Limb Fitting Centres and reports 43% AK and 55% BK.

Table 1. Levels of amputations for Scotland, Tayside and DLFC.

Level	Scotland (1982–1983)	Tayside (all years)	DLFC	
			(all years)	1989
Through Hip/Hindquarter Above-knee	43%	0.9% (16) 31.4% (579)	1.5% 32.9%	26%
Through-knee		0.5% (10)	5.0%	
Below-knee Symes	55%	62.7% (1158) 4.5% (83)	56.6% 4.0%	71%
		100% (1846)	100% (1805)	

Notes

1. In addition to the above there were 1,003 toes amputated in this period.
2. At DLFC there was an 18% failure rate at first level of amputation, local surgery achieved healing in 12%, higher amputation was required for 6%.
3. DLFC figures include some patients from outwith Tayside. Mainly from N. Fife.

Table 2. The overall pathology of lower limb amputations.

Pathology	DLFC (1966–1990)	Scotland (1982–83)
Peripheral vascular disease	59.7%	65%
Diabetes mellitus	26.0%	22%
Trauma	5.3%	6%
Tumour	1%	3%
Others	8%	4%

Note

1. Others include vasculitis, varicose ulceration.

In keeping with published literature there was an overall predominance in the Dundee figures of peripheral vascular disease (85.7% with 59.7% having arthrosclerosis without diabetes and 26% with diabetes mellitus (Table 2). The Scottish figures (Knight and Urquhart, 1989) revealed 87% peripheral vascular disease with 65% arthrosclerosis and 22% diabetes related. Pohjolainen *et al.* (1990) reported 81.2% with vascular disease in those referred for prosthetic fitting. Pohjolainen *et al.* (1989) reported that 88.8% of those on whom an amputation had been performed had vascular disease with almost equal arthrosclerosis and diabetic levels of 46.4% and 42.4% respectively.

In a Swedish study by Renstrom (1981) the incidence of diabetes mellitus was found to be 49.5% (193 cases) with Fleurant and Alexander (1980) from the United States reporting 74% having diabetes mellitus.

Over the period, 1981–1989, it was recorded that 53.8% of amputee cases in Dundee had previously had a vascular surgical procedure before amputation (Table 3), (either sympathectomy, femoral popliteal by-pass, thrombectomy or endarterectomy). Men were statistically more likely to have had surgery prior to amputation ($p < 0.01$). It was established that the vascular procedure did affect the overall outcome of amputation surgery in respect of level; 64.1% had a BK amputation if no surgery was performed, whereas only 60.3% achieved this level after vascular procedure. This was a significant difference ($0.01 < p < 0.05$). This reduction in BK level is in keeping with other studies. Sethia and Berry (1986) drew attention to the fact that failed vascular reconstruction might adversely affect the ultimate level of lower limb

amputation. Larsson and Risberg (1988) found no such effect. However Falstic-Jensen and Christensen (1990) reviewed 83 lower limb amputations by way of a logistical regression analysis of 18 variables and found that amputation failure occurred where previous vascular surgery had been performed. In addition they also indicated that the older the patient the more likely was a stump failure leading to a higher level of amputation.

In the years of study there was an overall revision rate of 18%. Of these 6% required a revision to another level and the others only required local surgery for example a ‘Wedge Resection’ (Haddon *et al.*, 1987).

An overall prosthetic fitting rate of 81% was achieved (Table 4). There was no significant difference in the fitting rate of AK or BK amputees. These proportions of fitting are in keeping with those of Moffat *et al.* (1981) who achieved 72.7% fitting and Cummings (1974) at 79.7%, but less than Malone *et al.* (1979 and 1981) who reported 100% fitting. Recent figures from Finland report only 26.9% of 577 patients being fitted with a prosthesis (Pohjolainen *et al.*, 1989). Knight and Urquhart (1989) reported that of those fitted in Scotland with a prosthesis only 62% actually used their limb all the time, whereas 9% never used it at all. Some evidence was found that in those with high levels of amputation less use of the limb was made. In the single BK amputee 87% wore

Table 3. Lower limb amputation surgery for vascular cases (1981–1989).

Level	Had vascular surgery	Had no vascular surgery
Hindquarter	0.2% (1)	0.3% (1)
Through hip	1.8% (7)	0.9% (3)
Above-knee	34.5% (133)	25.9% (85)
Gritti-Stokes	0.6% (2)	0.6% (2)
Through-knee	1.6% (6)	3.0% (10)
Below-knee	60.3% (233)	64.1% (210)
Syme	1.0% (4)	5.2% (17)
	100% (386)	100% (328)

Notes

- 54.1% (386/714) of all cases (1981–1989) had a vascular procedure.
- Of this group it was found that those who had had vascular procedures were slightly more likely to have an above-knee amputation than those who had not had any vascular surgical intervention ($0.01 < p < 0.05$).

Table 4. Prosthetic supply over the 25 years.

	All	(1803)	AK	(588)	BK	(1017)
Supplied	75%	(1354)	68%	(400)	78%	(797)
Not supplied	12%	(218)	14%	(84)	11%	(113)
Wheelchair only	4%	(77)	8%	(45)	3%	(31)
Wheelchair and prosthesis	6%	(106)	8%	(46)	5%	(55)
Not recorded	3%	(48)	2%	(13)	2%	(21)

Note 81% fitted with prosthesis.

Table 5. The supply of wheelchairs (1981-1989).

		1981-89	1989
AK	Total Number	226	32
	Wheelchair only	42	5
	Wheelchair + prosthesis	43	9
		85(38%)	14(44%)
BK	Total Number	452	51
	Wheelchair only	31	3
	Wheelchair + prosthesis	53	16
		84(19%)	19(37%)

Notes

1. Overall 25% received a wheelchair
 38% above-knee } $p < 0.01$
 19% below-knee }

For those *only* supplied with a wheelchair above-knees were more likely to receive a wheelchair than below-knee ($p < 0.01$).

2. In 1989 40% received a wheelchair
 44% above-knee } Not significant
 37% below-knee }

the limb at least half a day every day whereas in a single AK amputee only 70% used the limb for half a day.

In the years 1981-1989, during which time the provision of a wheelchair was recorded on the DLFC data base, it was found that 25% of cases were supplied with a wheelchair (Tables 4 and 5). However, it was interesting to note that although the level of supply was consistent until 1985 the request for wheelchairs for amputees had risen sharply to 40% in 1989. This is thought to be due to the increase in frailty of the patients despite the fact that the age at first amputation has remained remarkably consistent over the period of study at 69.1 years. This last figure of wheelchair supply is in keeping with the 48% reported by Knight and Urquhart (1989) for Scotland.

During the whole period of the study it was found that significantly more AK amputees received a wheelchair than BK amputees ($p < 0.01$). By 1989 the last year of the study, this difference was not so significant.

The amputees are discharged from DLFC or

average 49 days post-operatively with a definitive prosthesis, no temporary devices being used. The period between delivery of the first definitive device and the need for replacement was about 9 months. During the period 1981-1989, 76.2% were discharged home either to their own home or to a residential/nursing home (Table 6). Only 8.4% were placed in long term hospital care.

Bilateral lower limb amputees represented 18% of all amputees (Table 7). These again were mainly in the peripheral vascular disease group 94%. The second amputation at BK level

Table 6. Discharge placement (1981-1989).

Home	72.8% (527)	} 76.2%
Residential home	3.6% (26)	
Long term care	8.4% (61)	
Dead (in unit)	3.6% (26)	
Others	11.6% (84)	
Total	100% (724)	

Note

Others include acute hospital transfer, and other hospital for long term rehabilitation.

Table 7. Bilateral amputee levels.

Level	Number
BK — BK	48% (157)
BK — AK	19% (61)
AK — AK	20% (66)
Others	13% (43)
Total	100% (327)

Notes

1. 327 (18%) of all amputees have had a bilateral amputation.
2. 66% of bilateral amputees have prosthetic fitting.
3. 31% of bilateral amputees supplied with wheelchair.
4. 74% of bilateral amputees were discharged home or went to a residential home.
5. 94% of bilateral amputees had vascular disease.

was achieved in 61% (189 cases), resulting in an overall bilateral BK amputation rate (BK-BK), of 48% (157 cases). BK-AK bilaterals were found in 19% (61 cases), and 20% (66 cases) had bilateral AK level. Prosthetic fitting was achieved in 66% (215 cases), the majority being bilateral BK level (131 cases), 83% of the bilateral BK amputees. It was found that in those fitted with a BK and AK prosthesis it was immaterial which was the initial level of amputation. Overall only 31% (101 cases) were supplied with wheelchairs, although more recently all bilateral amputees have had a wheelchair supplied. This contrasts fairly markedly to the report by Van de Ven (1973) reviewing elderly lower limb amputees who indicated all (100%) were supplied with a wheelchair. Discharge to home or welfare accommodation was achieved in 74% of the double lower limb amputees.

Conclusion

The 25 years experience of lower limb primary amputees has been analysed using data collected over this period.

In the 25 years studied, the average age of the amputees at the time of first amputation has remained remarkably steady at 69.1 years in keeping with other studies. The predominance of peripheral vascular disease cases is in keeping with other Western studies. The sex ratio was 57.9% male to 40.3% female.

A comprehensive amputee service based on the total, integrated care of the amputee has resulted in a dramatic yet sustained change in the AK:BK amputation ratio. This has also resulted in high ratios of prosthetic fitting

although 25% of the cases required a wheelchair.

It has also been shown that previous vascular surgery does adversely affect the final level of amputation. Those who had previous vascular surgery carried out, displayed a lower below-knee to above-knee ratio than those who had no vascular surgery. Final discharge was achieved in an average of 49 days, with a definitive prosthesis in 82% of cases, either to their own home or a residential home (77.5% of cases).

The results clearly show the value of an integrated amputation and limb fitting service with a high BK level of amputation and high prosthetic fitting rate. The high discharge rate to either the patient's home or to a residential home adds to the advantages of such a scheme with social integration of the majority of amputees back into the community.

In summary the main advantage of an integrated programme are:

- 1) a high ratio of below-knee to above-knee amputation;
- 2) a high level of prosthetic fitting;
- 3) a high level of social integration.

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