

A SURVEY OF PROSTHETICS PRACTICE—1973-74

Sidney Fishman, Ph.D., Norman Berger, M.A.,
and Daniel Watkins, B.A.¹

Although members of prosthetics clinics are in contact with their colleagues at regional and national meetings and through professional journals, it is difficult for them to obtain precise information about the nature of the amputee population as well as the prescriptions, components, and techniques which prove successful and are in common usage in other clinics. Over the years several studies have been conducted to supply such data, notably: the Litt and Nattress report on prosthetic fabrication procedures and component choices, published in 1961 (3); the Davies, Friz, and Clippinger study of both amputee population and component prescription during the years 1965-67 (1); and Glattly's study, which investigated the composition of the amputee population in the years 1961-63 (2).

Because all of these studies are dated, the Prosthetics and Orthotics faculty at the NYU Post-Graduate Medical School initiated a survey to develop as accurate a picture of present practice as practical.

SURVEY METHOD

During the period January 1973 to June 1974 each student enrolled in short-term courses for prosthetists at NYU received a questionnaire² concerning the amputees treated at his facility, and the components, procedures, and materials used in fitting these patients. For each item on the 94 questionnaires completed, an average was calculated, and it is this figure that is cited throughout this report as an expression of the experience at the "average prosthetics facility." It should be understood that the raw data consist of estimates made by the prosthetists without the guidance of exact statistics gathered at their facilities. The students were requested to leave

unanswered any questions for which they lacked sufficient information. The homogeneity of the responses speaks well for the ability of this group to make accurate estimates.

Geographically, the sample is somewhat biased by the not-surprising fact that most of the prosthetists attending short-term courses at NYU are from states relatively close to New York City. An analysis of enrollment data shows that 50 percent of the students in the courses covered by the survey came from the Northeast, 30.5 percent were from the Southeast, and 19.5 percent from the West (Fig. 1). Although it would be presumptuous to interpret the findings of this survey as accurately depicting national practice, the fairly wide geographical distribution should be kept in mind.

RESULTS

Davies, Friz, and Clippinger (1), as well as Glattly (2), reported that the amputee population that receives artificial limbs consists of 14 percent upper-limb and 86 percent lower-limb patients, which is identical with our results. In the present survey more than half of the amputations (53%) of the upper-limb group, are below-elbow, 29 percent are above-elbow, with partial-hand and shoulder amputations each accounting for 9 percent (Table 1). It is interesting to note, however, that one-quarter of the prosthetists surveyed see no partial-hand patients and one-third see no shoulder amputees.

Just as below-elbow amputees comprise a majority of the upper-limb patients, so are below-knee amputees a majority of lower-limb patients (56%). Another third are above-knee amputees, with these two levels making up nearly 90 percent of the patients seen. The percentages of Syme's (7%) and hip-disarticulation or hemipelvectomy amputees (4%) reported in this survey are somewhat higher than in previous studies, which placed the size of these groups at about 3 and 2 percent, respectively. The larger percentages indicated by the prosthetists surveyed here may

¹School of Medicine and Post-Graduate Medical School, New York University

²Formulated by Joan Edelstein, B.S., A.M., School of Medicine and Post-Graduate Medical School, New York University.

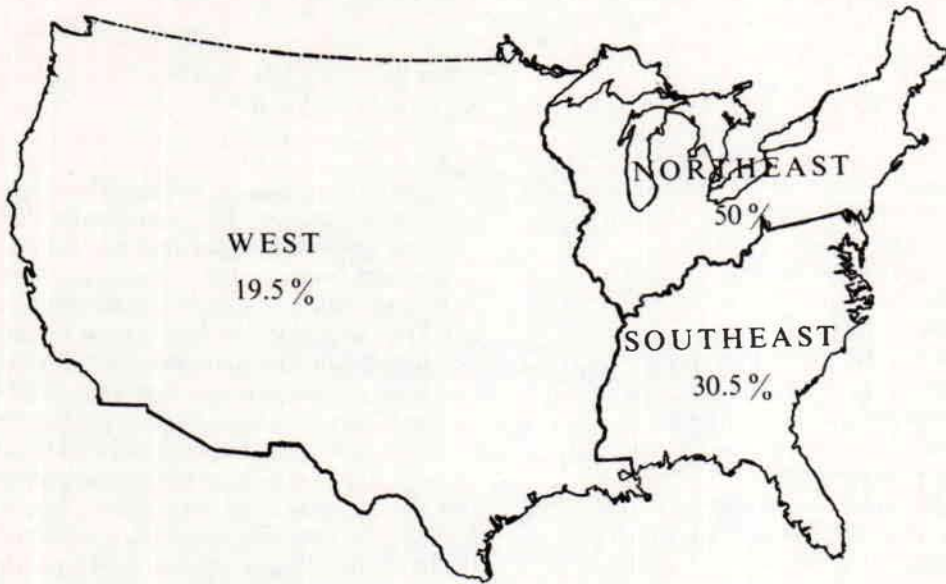


Fig. 1.

reflect some increase in the number of such amputations, or may be simply an inaccurate estimate.

The distribution of patients by age varies in one important and expected way between upper- and

lower-limb groups. The proportion of patients under 18 years is quite similar, but a greater number of individuals over 60 are found in the lower-limb group while more of the upper-limb patients are between 18 and 60. The causes of amputation

TABLE I. PATIENT POPULATION BY AMPUTATION LEVEL AND AGE

UPPER-LIMB AMPUTEES (14%)		LOWER-LIMB AMPUTEES (86%)	
	%		%
Partial hand	9	Syme's	7
Below elbow	53	Below knee	56
Above elbow	29	Above knee	33
Shoulder	9	Hip disarticulation and hemipelvectomy	4
TOTAL	100	TOTAL	100
Bilateral	3	Bilateral	5
Under 18 years	21	Under 18 years	18
19-60 years	71	19-60 years	60
Over 60 years	8	Over 60 years	22
TOTAL	100	TOTAL	100

explain this difference: most upper-limb amputations result from trauma to relatively young, active persons, while lower-limb amputations are more often caused by peripheral vascular disease in the elderly.

The patellar-tendon-bearing design of below-knee sockets is clearly the overwhelming prescription choice, accounting for 91 percent of all sockets (Table 2). The great majority of these utilize a soft insert, though a number of prosthetists regularly fit hard-socket PTB limbs: 16 of the respondents make them for 80 percent or more of their patients. The traditional carved wood socket is used in only 6 percent of the below-knee prostheses made today compared to 38 percent reported in the Litt and Nattress survey (3).

Cuff suspension is prescribed most frequently (58%) while supracondylar-suprapatellar (SC-SP) suspension is utilized in 16 percent of below-knee limbs. It is interesting to note, however, that one-quarter of the respondents feel that the SC-SP socket is preferable for the bulk of the amputee population rather than special cases and use this method for 50 percent or more of their patients. The supracondylar wedge suspension is used somewhat less extensively (9%), though several of the individuals who contributed to the "other" figure of 3 percent stated that they manufactured a soft insert which included a supracondylar wedge, and two prosthetists regularly use the removable medial-wall variation of this suspen-

sion system. To complete the suspension picture, side joints and thigh corsets are utilized for 14 percent of the patients. The SACH foot is prescribed for 81 percent of the below-knee amputees, which reflects greater use than the 73 percent reported by Davies, Friz, and Clippinger (1).

The plastic, total-contact, quadrilateral, above-knee socket was introduced approximately 12 years ago. It is clear that this socket design is now predominant and, in fact, used almost exclusively. As indicated in Table 3, 86 percent of all sockets are made of plastic, 80 percent are designed for total contact, and 97 percent are quadrilaterally shaped. The remaining small percentage of sockets that do not display these characteristics is generally found in the prostheses of long-time amputees who prefer not to change.

Apparently, many clinics recognize the advantages of suction techniques since this suspension method, used alone or in combination with a Silesian bandage or pelvic belt, accounts for 61 percent of the suspension prescriptions. Despite this excellent acceptance of the pressure-differential principle, the single, most widely used suspension method is still the pelvic belt (34%). This is not surprising in view of the significant numbers of elderly people in the lower-limb amputee population.

The simple single-axis knee with friction is clearly the most extensively used knee component (42%). Used less frequently are the friction-locking knees (23%) and hydraulic or pneumatic units (22%). However, each of these is used selectively by certain facilities, and the large number of patients fitted with one or the other speaks for the frequency with which specific clinics feel the need to provide patients with additional security and/or improved swing-phase characteristics, despite increases in weight and design complexity. The manual-locking knee, representing concern for stability even at the expense of a normal gait pattern, is used by an average of 8 percent of the limb-wearing population. Polycentric units account for only 2 percent of the knees prescribed, and no prosthetist reported that his facility used them for more than 20 percent of his above-knee patients. It is not clear if this sparse use of polycentric components is the result of dissatisfaction with their function, or lack of information, availability, and experience with these units.

The conventional and most common prosthesis for the hip-disarticulation or hemipelvectomy patient incorporates a socket and suspension of

TABLE 2. BELOW-KNEE PROSTHESES

SOCKET	%	SUSPENSION	%
PTB with insert	53	Cuff	58
PTB hard socket	37	SC-SP (PTS)	16
PTB air cushion	1	Corset	14
		Supracondylar wedge	9
Wood	6	Other	3
Other	3		
TOTAL	100	TOTAL	100
FOOT-ANKLE COMPONENT		%	
SACH		81	
Single axis		15	
Other		4	
TOTAL		100	

TABLE 3. ABOVE-KNEE PROSTHESES

KNEE UNITS	%	PROXIMAL SOCKET DESIGN	%
Single axis, no lock	42	Quadrilateral	97
Friction lock	23	Peripheral bearing	3
Hydraulic or pneumatic	22	TOTAL	100
Manual lock	8	DISTAL SOCKET DESIGN	
Polycentric	2	Total contact	80
Other	3	Open end	18
TOTAL	100	Other	2
SUSPENSION		TOTAL	100
Pelvic band	34	FOOT-ANKLE COMPONENT	
Suction only	32	SACH	74
Suction and Silesian bandage	20	Single axis	23
Suction and pelvic band	9	Other	3
Other	5	TOTAL	100
TOTAL	100		
		MATERIALS	%
		Plastic	86
		Wood	14
		TOTAL	100

the Canadian design (84%), a SACH foot (70%), and a single-axis knee unit (59%) (Table 4). In contrast with the above-knee prosthesis, a lesser proportion of friction-locking knees is used (23% A/K as compared with 9% of hip amputa-

tions) and a greater proportion of manual-locking knees are prescribed (8% A/K as compared with 12% hip). Though fewer hydraulic or pneumatic units are reported (22% A/K vs. 18% hip), it is worthy of note that five prosthetists used these

TABLE 4. HIP-DISARTICULATION AND HEMIPELVECTOMY PROSTHESES

KNEE UNITS	%	SOCKET DESIGN	%
Single axis, no lock	59	Canadian	84
Hydraulic or pneumatic	18	Tilt table	9
Manual lock	12	Other	7
Friction lock	9	TOTAL	100
Polycentric	1	FOOT-ANKLE COMPONENT	%
Other	1	SACH	70
TOTAL	100	Single axis	29
		Other	1
		TOTAL	100

components for virtually every hip-disarticulation or hemipelvectomy patient.

While the SACH foot is used extensively for all amputees, it is clear that the frequency of prescription decreases as the level of amputation moves proximally (Table 5). Correspondingly, the frequency of use of the single-axis ankle increases. Apparently, the ability of the single-axis ankle to provide faster plantar flexion after heel-strike, and thus enhance stability, leads to its more frequent prescription at higher amputation levels.

TABLE 5. FOOT-ANKLE COMPONENT BY LEVEL OF AMPUTATION

	Single			Total %
	SACH %	Axis %	Other %	
Below Knee	81	15	4	100
Above Knee	74	23	3	100
Hip Disarticulation and Hemipelvectomy	70	29	1	100

Modular prostheses are prescribed most frequently for hip-disarticulation and hemipelvectomy patients for whom the combination of light weight and superior cosmesis is of great advantage, with three prosthetists reporting use of modular components for 100 percent of their hip amputees (Table 6). The modular systems for above-knee patients were used least (7%) and only slightly more often for below-knee patients (9%). One may expect that these components will become increasingly popular as clinical experience brings further design improvements and wider availability with lower unit cost.

TABLE 6. MODULAR (ENDOSKELETAL) PROSTHESES

Below Knee	9
Above Knee	7
Hip Disarticulation and Hemipelvectomy	14

Though the principles and procedures of immediate and early postoperative management have been widely disseminated in the past five years, it is only after below-knee surgery that the technique is practiced with any frequency (19%) (Table 7). Only one prosthetist in ten reported that rigid dressings had been applied to 75 percent or more of their below-knee patients, and the procedure is used much less frequently for higher-level amputations. This is disappointing since, in the view of many experts, amputees at all amputation levels are greatly benefited by an aggressive rehabilitation program which includes rigid dressings and early physical and psychological mobilization of the patient.

TABLE 7. THE IMMEDIATE POST-OPERATIVE RIGID DRESSING

After Below-Knee Surgery	19
After Above-Knee Surgery	9
After Hip Disarticulation or Hemipelvectomy	3

SUMMARY AND CONCLUSIONS

Reviewing the data from this survey, one is immediately struck by the fact that for each of the three amputation levels (below-knee, above-knee, and hip-disarticulation), a relatively *small* number of components make up the prescriptions for a relatively *large* number of the patients in each category. As examples, the usual below-knee prosthesis consists of a PTB socket with a soft insert (53%), cuff suspension (58%), and a SACH foot (81%); the usual above-knee prosthesis incorporates a quadrilateral socket (97%) designed for total contact (80%), suction suspension either alone (32%) or in combination with other suspension means (29%), a single-axis knee with adjustable friction (42%), and a SACH foot (74%); for the hip disarticulation, the prosthesis includes a socket of Canadian design (84%), a single-axis knee with adjustable friction (59%), and a SACH foot (70%). The concept, then, of a "standard" prescription for each amputation level may be

proposed and the prescription problem stated as: "When and under what circumstances should the standard prescription be modified?" While this formulation is neither original nor startling, it may serve to clarify and expedite the decision-making process required for successful prescription.

Finally, in the absence of a more exhaustive, nationwide study, it is hoped that these data will provide clinic members with a useful indication of current lower-limb prosthetics practice, will encourage the exchange of information concerning various prosthetic components and techniques, and will be of value to the faculties of the prosthetics teaching centers as a guide to curriculum planning and emphasis.

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ADDITIONAL LITERATURE

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