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AMPUTATION IN CHILDREN

A follow-up of 74 children whose lower extremities were amputated

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The object of the present study was to obtain an impression of the incidence of complications in patients who had been exposed to amputation during childhood, and also to learn how these children later had adapted themselves to society.

MATERIAL

The series comprised 74 surviving patients to whom leg prostheses had been fitted prior to their 16th year; all patients had been seen in the Orthopaedic Hospital in Copenhagen in the period from 1899 to 1964.

Sixty-four of the patients were examined by the author; ten refused to co-operate at the follow-up and effects in the latter cases had therefore to be analysed exclusively on the basis of data included in the case records.

Amputation was bilateral in eight cases and hence, the examination included 82 extremities. Any difference between right and left sides was not demonstrable.

Table 1. Specification of terms of follow-ups of 74 children exposed to amputation, in eight cases to bilateral amputation of lower extremities.

Term of follow-ups	No. of amputations
6–10 years	6
11–20 years	18
21–30 years	22
31–40 years	14
41–50 years	9
51–60 years	10
61–70 years	2
71 years	1
	82

Table 2. Indications for 82 amputations of lower extremities in children, in relation to sex and age.

	In total	Boys	Girls	< 2 years	2–6 years	> 6 years
Trauma	46 (4)	36 (4)	10	2	21	23
Traffic	22					
Farming	14					
Sundry	10					
Congenital deformities	26 (4)	13	13 (4)	0	7	19
Infection	8	5	3	0	5	3
Tuberculosis	4					
Osteomyelitis	4					
Tumour	2	1	1	0	1	1
No. of amputations	82 (8)	55 (4)	27 (4)	2	34	46
No. of patients	74	51	23			

Figures in brackets denote bilateral amputations.

At the time of follow-up, ages of patients ranged from 20 years up to 74 years. Follow-up periods covered at least six years, at most 71 years. Lengths of follow-up periods are specified in Table 1.

Table 2 represents an analysis of indications for amputations together with the distribution according to age and sex of patients.

The level at which extremities were amputated is apparent from Table 3. In two cases, the hip joints were exarticulated on account of tumour growths.

RESULTS

Data on primary complications to the surgical measures were available in the case of eight patients (11 per cent). In five of these it had been a matter of infection, in three of delayed wound healing.

Data on secondary complications are recorded in Table 4. Among 74 children, 29 had been exposed to repeated surgery at later stages; in about half of these, surgery had been repeated even several times.

Table 5 illustrates the problem of overgrowth in relation to age of patients; this problem is particularly conspicuous if young amputees are concerned.

Types of prostheses applied are specified in Table 6.

Since 1933, all expenses in connection with the prostheses have been defrayed by the Government via the Board of Disablement Insurance.

Throughout childhood, patients must have their prostheses re-

Table 3. Level at which 82 extremities of children were amputated.

Amputation of the femur	21	
Exarticulation of the hip joint	2	
Exarticulation of the knee	4	27
Below-knee amputation	47	55
Syme's amputation and amputation of hind foot	8	

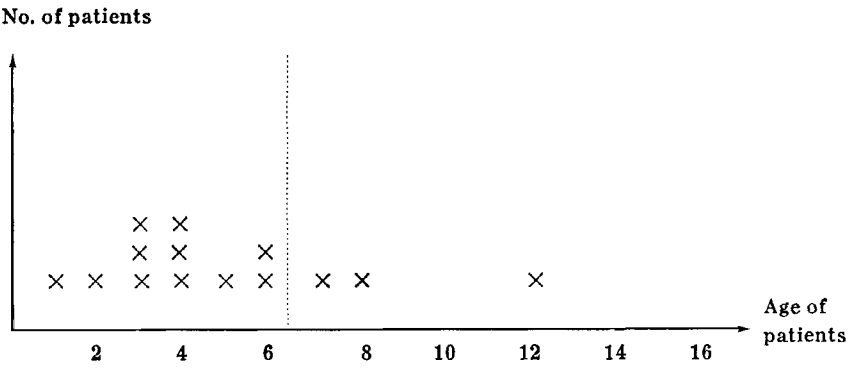
placed once a year because of their growth at this age; during adolescence, time intervals between replacements are prolonged, and adult patients need only have prostheses renewed at intervals of from two to six years, depending on their trade and walking activity.

The interval between amputation and fitting of prostheses varied greatly, namely from one to seven months; in one case, the prosthesis was not fitted until seven years after operation (osteomyelitis). On an average, children had their prostheses fitted three months and two weeks after amputation. Training was only of short duration, usually covering just a few weeks. Since it has been preferred in the present study to consider only follow-up periods of some length, for which reason patients operated upon after 1964 are not included, the series does not comprise any cases of "immediate postsurgical fitting".

Table 4. Secondary complications to amputations of lower extremities in children (82 extremities).

Prosthetic pressure on skin (ulceration, bursa formation, abscesses)	33
Keloid	1
Overgrowth (below-knee amputations)	14
Prominence of bone (no overgrowth)	3
Short stump	3
Neuroma formation	9
Fracture of the stump	3
Contractures	5
Pain in the back	8
Psychic problems	6
Adiposis	2
Arthrosis involving healthy legs	2
Epiphysiolysis involving the femoral head of the healthy leg after exarticulation of hip joint	1
Polio, developing after amputation	2
	92

Table 5. Age of children at the time of amputation of lower extremities followed by overgrowth of bone.



The author has personally examined the pattern of gait in 64 of the patients. Twenty patients limped to a certain degree, although their gait, subjectively and objectively, was rather satisfactory. Five patients walked poorly: limping was pronounced and their walking capacity ranged below 200 m. In the latter cases lesions had been of complicated nature: polio, marked scoliosis, arthrodesis involving the hip of the intact joint, pronounced, congenital shortening of the contralateral leg (bilaterally amputated); furthermore, one patient "sagged" to his too short prosthesis; having accustomed himself to it, however, he did not want it replaced.

In the course of study it was endeavoured to obtain an opinion of the patients' adaptation to society. Their marital status did not deviate from that among the population in general. The number of childless marriages did not either (10 per cent). Fourteen patients had received an education within the compass of the Public Rehabilitation Society. Eleven had received rehabilitation relief. Thus, one-third of all patients had been assisted, but two-thirds had been able to manage on their own (assisted by their relatives).

Among the 74 patients, nine received disablement pensions and two received disablement benefits.

Occupations of patients were collated with occupations of their supporters; the results appear from Table 7. The tendency is apparently that the children manage better than their supporters. During the period of time covered by the study, the proportion of the population to receive an education had reached a high level, as a

Table 6. Types of prostheses fitted to children. 82 amputations of lower extremities.

Canadian prosthesis, used in cases of exarticulation of hip joints	2
Femoral contact prosthesis	14
Femoral suction prosthesis	11
Conventional below-knee prosthesis	26
Patellar tendon bearing prosthesis (PTB)	21
Syme's and hind foot prosthesis	8
	82

result of sociological evolution. Thus, this feature need not be related to the handicaps of patients; it is rather an expression of the general change in the composition of Danish society.

DISCUSSION

Amputation in children is not common. In a series originating from a clinic supplying prostheses, Jansen (1960) observed that 16 per cent were children whose legs had been amputated; during a study of the population in Gothenburg, Hansson (1964) found that 2 per cent were children of this type among a total of 586 amputees.

With a view to obtaining a sufficiently large series of child amputees, two courses may be followed: either examination of patients treated in several, different centres (Clippinger et al. 1969), or selection of series that are representative of long periods of time. The latter course has been preferred in the present study.

The author has personally examined 64 patients out of 74 (87 per cent) at follow-ups; this percentage is considerably higher than that otherwise examined by investigators in other countries in their studies based on long periods of observation (Lambert et al. 1969).

Table 7. Occupations of patients collated with occupations of their supporters

	Untrained	Intermediate degree of training	Specially trained
Occupation of supporter	22	42	9
Occupation of amputee	10	49	15

Indications for amputations in children included primarily traumatic lesions, although congenital malformations also played a certain role; interventions indicated by infections or tumours were rather uncommon.

The series comprised twice as many boys as girls, the difference being particularly conspicuous when amputations due to traumata were concerned.

Intervention by tourniquet was not contra-indicated in any of the cases. Amputations due to infection were all performed more than 30 years ago.

The series comprised only two cases in which amputations were required on account of malignant tumour growths (sarcoma and fibrosarcoma). No patients other than those whose prostheses had been fitted during childhood and who were still alive in 1964 have been included; if all children to whom prostheses had been fitted during the period from 1899 to 1964 had been included, amputations due to tumour growths would have been more numerous. On the other hand, the number of patients to be examined by the author would have been much smaller because most of the children in whom amputations had been indicated by malignant growths would have been dead at the time of follow-up.

Below-knee amputations were twice as numerous as above-knee amputations. The reverse applied to the series of adult patients studied by Kolind-Sørensen (1970).

The present study confirmed that phantom-limb pains were immaterial if amputations dated back to childhood (Aitken & Frantz 1953), which is in contrast to findings obtained by Villars Lunn (1948) in his study of a series comprising children and adult patients among whom 20 per cent suffered constant or frequently occurring phantom-limb pain.

The author learned from some of the patients how they at first, after the prosthesis had been fitted, continued to dream that they were walking on their own legs, but after they had accepted their handicap completely, they were using their prostheses even in their dreams.

Among the old patients were quite a few who had experienced periods during which their prostheses had been made of cardboard; these had later been replaced by prostheses of the "pirate's leg" type, and the permanent prosthesis had not been fitted until they were about 14 years old. By now, this type of bandaging has been abandoned;

it is considered of value to provide prostheses which are immediately acceptable by the children as well as by their parents (Aitken & Frantz 1964).

In the case of above-knee amputations, Bomfim (1969) suggested having prostheses fitted while the children concerned were at ages between 18 months and two years; at least, they should not be more than four years old; below-knee prostheses should preferably be fitted while the children were at ages between nine and twelve months.

Immediate postsurgical fitting has not been of topical interest in the present study. This procedure, which was introduced by Weiss in 1963 at the IX World Congress of the International Society for Rehabilitation of the Disabled, has later been found to be relevant in cases of children (Hierton et al. 1967). Children are particularly suited for "intermediate fitting" owing to their excellent vascular supply. On the basis of psychological deliberations, this procedure has been generally adopted by now whenever children are concerned (Clippinger 1966).

Bones in children are immature and the programming of amputation should never disregard the problem of growth in length; furthermore, care should be taken to preserve as many as possible of the epiphyseal lines (Aitken 1963).

Even though children usually escape inconveniencing scar formation, neuroma, and phantom-limb pain during the healing process of the stump, one problem was seen to predominate in cases of children whose legs had been amputated, namely, overgrowth. In quite a few of the cases surgery had to be repeated because bones were found to grow at a rate higher than that of the soft tissues. In general, surgery had to be repeated within a few years, and occasionally repeated surgery was required even two or three times.

Owing to the problems involved in skin affection, two patients were unable to use prostheses for about six months. Bursa formation associated with an occurrence of abscesses required frequently repeated surgery; distribution of the latter according to time was uniform throughout the period of follow-up; surgery was repeated even as late as 42 years after the primary intervention.

A precise psychological and social analysis of the children's environments is required if late results are to be optimal (Steensma 1959). Intimate co-operation with the parents concerned is also of decisive value (Fishman 1958).

CONCLUSION

The study here submitted comprises 74 patients who prior to their 16th year had been provided with prostheses; the prostheses were fitted in the Orthopaedic Hospital in Copenhagen during the period from 1899 to 1964.

The series comprised 69 per cent boys; traumatic lesions exclusively accounted for this predominance of boys. Below-knee amputation was most common, which is in contrast to features otherwise observed among adult amputees in whom above-knee amputation is most generally encountered.

Secondary complications were numerous and repeated surgery was required in 29 of the cases (39 per cent). Overgrowth was seen mainly when amputation had been done early in life (children below the age of six years).

All of the patients used their prostheses and, in general, patterns of gait were satisfactory.

It was attempted to form an opinion of the social standing of the patients and their supporters and it appeared as though the social standard had advanced among amputees, whose level of education seemed to be higher than that of the older generation; since the study covers a rather long period of time, however, this feature may be attributable to the over-all advance in social standing which has occurred in Danish society.

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