

Temporary above-knee prostheses and training programme during chemotherapy

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Abstract

A temporary prosthesis has been developed for above-knee amputees who receive long-term post-amputation chemotherapy. The temporary prosthesis has an adjustable laminated quadrilateral socket, the size of which is adjusted by metal screws.

Fifteen patients were fitted with the temporary prosthesis. Initial fittings were carried out after a period averaging 46 days from amputation. All of the patients were able to walk with one crutch after about one month from initial fitting. Although patients often had to discontinue their prosthetic training owing to chemotherapy, they could resume wearing their prostheses simply by adjusting the socket.

One patient, who was fitted with a cosmetic ultra-light prosthesis initially due to her poor general condition, was later fitted with the temporary prosthesis. She regained the ability to walk 60 days later and still wears it.

Early fitting of temporary prostheses for these patients is not only of practical convenience but also improves their mental state.

Introduction

Though chemotherapy used for malignant bone tumours has significantly prolonged the amputee's life span, it has also caused new difficulties in the prosthetic programme such as poor general condition and fluctuation in the size of the stump with each course of chemotherapy. These conditions require special consideration in regard to their prostheses and training. The authors have developed a temporary above-knee prosthesis for these

patients. This paper reports details of the temporary prosthesis and the training programme for above-knee amputees who receive post-amputation chemotherapy.

Temporary prosthesis

The temporary above-knee prosthesis is constructed with components used for the permanent prosthesis except for the adjustable socket (Fig. 1). The adjustability of the socket is provided by two tear drop cutouts at the lateral wall and metal hose clamps, used as adjusting screws. Two clamps are installed at each tear drop cutout for medium length stumps, and three or more clamps for long stumps. The cutout is covered from the inside with a tongue made of polypropylene sheet. The socket used is basically a laminated quadrilateral socket which is individually fabricated over a cast and suspended both by suction and an auxiliary Silesian belt. No stump sock is used. At the initial fitting, the prosthesis is provided with an adjustable coupling between the socket and the knee joint, but the adjustable coupling is removed and a cosmetic cover is attached after approximately one month (Fig. 2). The physical therapist adjusts the size of the socket by altering the metal screws according to the change in the size of the stump. There is no need to call the prosthetist for this adjustment.

Patients

Sixteen patients received above-knee amputation for malignant bone tumours at the Osaka University Hospital between 1976 and 1982. There were nine men and seven women with a mean age of 14 years (ranging from four to 34 years), of which 14 had osteogenic sarcoma and two had Ewing sarcoma. They received

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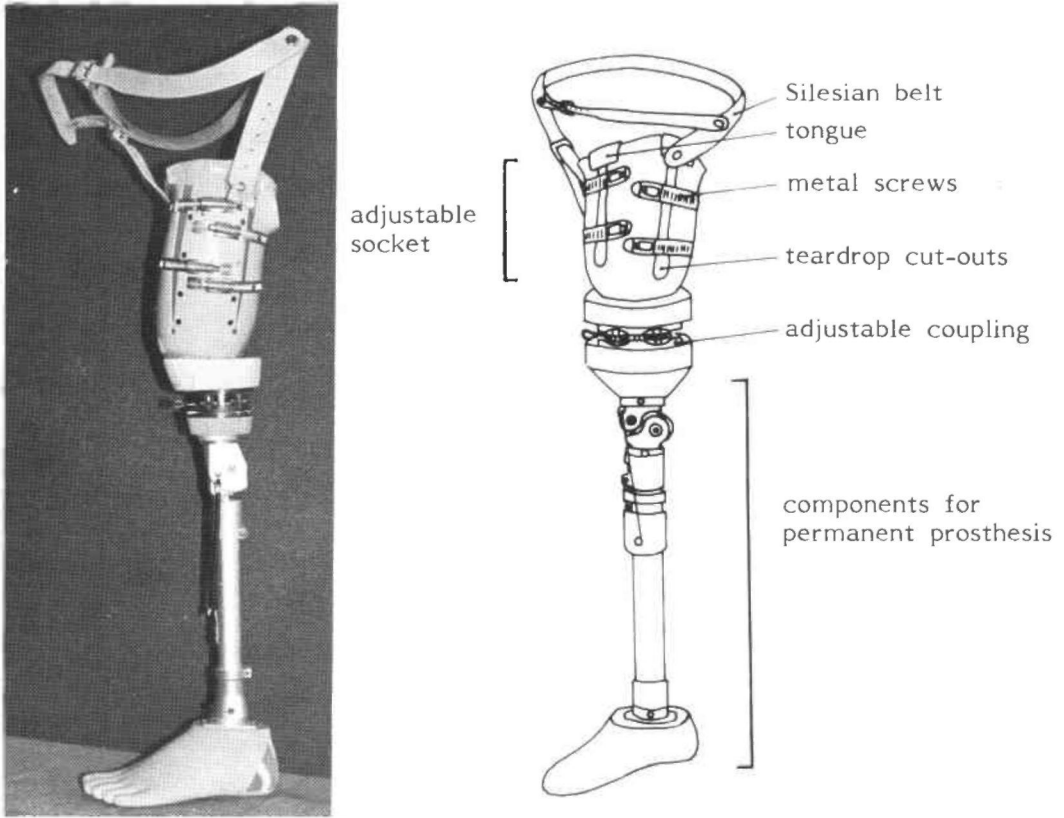


Fig. 1. Initial temporary prosthesis fitted with adjustable coupling between socket and knee joint.

chemotherapy of adriamycin, high-dose methotrexate, etc. for a period ranging from four to 24 months, averaging 11 months (Table 1).

Training programme

When the stump is healed, usually about three weeks after amputation, casts and measurements are taken for the temporary prosthesis. The temporary prosthesis is usually fitted about a week after casting and measurement and gait training is started. Acquiring some practical walking ability using one crutch is set as the main objective of this training. Patients are not forced to walk with proper posture while learning to go up stairs and kerbs. During the period of poor general condition caused by chemotherapy, training is suspended temporarily. When training is resumed, the physical therapist adjusts the size of the socket according to the change in stump

volume. Use of the temporary prosthesis is continued until chemotherapy is completed, after which a definitive prosthesis is fitted.

Results

Fifteen patients were fitted with the temporary prosthesis as the initial prosthesis after amputation. One patient who was initially fitted with a cosmetic ultra-light prosthesis was later fitted with the temporary prosthesis (Table 2).

1. Results for 15 patients who were fitted with the temporary prosthesis from the initial stage

The time of initial fitting was between 24 and 78 days after amputation, averaging 46 days. During each course of chemotherapy and for several days following it, patients usually could not carry out gait training. In resuming training after this temporary suspension, the physical therapist adjusted the size of the socket according to the fluctuation in the size of the



Fig. 2 Temporary prosthesis with cosmetic cover.

stump. The adjustment of the socket was useful not only to accommodate fluctuations in the size of stump due to each course of chemotherapy, but also to accommodate stump shrinkage which would occur even without chemotherapy during the first few months after amputation. All of the patients could walk with one crutch after a

period of 10 to 50 days, averaging 31 days. In spite of the prolonged and unpleasant chemotherapy and the uncertain prognosis, patients accepted the use of the prostheses and were always cheerful during training.

However, the general condition of these patients was poor both during each course of chemotherapy and in the intervals. Their physical condition seemed like that of aged amputees. None of the patients could stop using one crutch till after the completion of chemotherapy.

To date, five patients out of the 15 died from metastases during the period between six months and three years after amputation, averaging 19 months. Three patients received surgery for pulmonary metastases and two of them are continuing to wear the temporary prostheses. One patient lost his ability to walk with the prosthesis about four months later due to severe stump pain caused by ring necrosis of the femoral end. Seven patients are now free from disease, with four of them wearing permanent prostheses and three continuing to wear the temporary prosthesis.

2. Results for one patient who was fitted with the prosthesis secondarily.

One patient was initially fitted with a cosmetic ultra-light prosthesis since she already had multiple pulmonary metastases and it was thought that she could hardly walk with a prosthesis. Nine months later, she regained better general condition following chemotherapy and surgery for pulmonary

Table 1. Characteristics of patients provided with temporary prostheses

No.	Cases	Age	Sex	Cause of amputation	Duration of chemotherapy (months)
1	MN	4	F	osteogenic sarcoma	5
2	SK	24	M	Ewing's sarcoma	4
3	TH	34	M	osteogenic sarcoma	5
4	OT	16	M	osteogenic sarcoma	6
5	OH	13	M	osteogenic sarcoma	6
6	KH	19	M	osteogenic sarcoma	4
7	YK	16	M	osteogenic sarcoma	4
8	NM	12	F	osteogenic sarcoma	8
9	KT	10	F	osteogenic sarcoma	9
10	NH	9	M	osteogenic sarcoma	12
11	YF	12	F	osteogenic sarcoma	12
12	IT	10	F	osteogenic sarcoma	7
13	KS	7	M	osteogenic sarcoma	24
14	HH	7	F	Ewing's sarcoma	24
15	IN	10	F	osteogenic sarcoma	22
16	SH	17	M	osteogenic sarcoma	19

Table 2. Results.

No.	Period from amputation to fitting (days)	Period from fitting to walking (days)	Prognosis	Present type of prosthesis
1	51	46	free	permanent
2	67	36	free	permanent
3	78	11	free	permanent
4	40	37	died	
5	43	30	died	
6	43	10	free	permanent
7	24	30	died	
8	64	35	metastases	temporary
9	74	40	free	temporary
10	48	28	died	
11	39	50	metastases	temporary
12	27	22	died	
13	32	32	metastases	cosmetic*
14	327**	60	metastases	temporary
15	24	32	free	temporary
16	41	30	free	temporary

* cosmetic ultra-light prosthesis.

**fitted with the temporary prosthesis secondarily.

metastases, and she was fitted with the temporary prosthesis. She regained her ability to walk with one crutch 60 days later. She is still wearing the temporary prosthesis.

Discussion

Immediate post-surgical prosthetic fitting is not appropriate for patients who are receiving chemotherapy, because of their poor general and local condition.

Despite the interest in post-amputation chemotherapy for malignant bone tumours, there have been few reports relating to the provision of temporary prostheses and training programmes for these patients. Watts (1979; 1981) used a variable volume socket which was designed to accommodate changes in stump volume using Velcro tapes. Cole et al, (1982) used a preformed adjustable polypropylene quadrilateral socket developed by Irons et al, (1977) during the first few months after amputation. At the beginning of this study, Hayashi et al, (1979) used an adjustable socket which is similar to the socket developed by Watts except that it is suspended by both suction and an auxiliary Silesian belt. After clinical application of the socket to several patients, the socket was found to give insufficient grip on the stump, to be apt to hurt the stump at regions corresponding to cutouts and to have poor adjustability at the distal portion of the stump

where stump shrinkage occurred most markedly. That is why the authors adopted an adjusting mechanism using metal hose clamps. The socket is durable and remains usable throughout the entire course of chemotherapy.

The patients were provided with the temporary prosthesis when the wound was healed. Gait training carried out during the intervals between chemotherapy, enabled them to walk with one crutch and also improved their psychological state. Use of the temporary prosthesis should be continued until the completion of chemotherapy because stump fluctuation occurs whenever patients undergo a course of chemotherapy.

Conclusion

The fitting of a temporary prosthesis, provided with an adjustable socket to above-knee amputees who are receiving chemotherapy not only reduces their disability but also improves their mental state.

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REFERENCES

- COLE, W. G., KLEIN, R. W., VAN LITH, M., JARVIS, R. (1982). Prosthetic programme after above-knee amputation in children with sarcomata. *J. Bone Joint Surg*, **64B**, 586-589.
- HAYASHI, Y., KAWAMURA, J., MIZUSHIMA, T. (1979). Prosthetic management during regimen of chemotherapy. *Sogo Rihabiriteshon*, **7**, 375-379.
- IRONS, G., MOONEY, V., PUTNAM, S., QUIGLEY, M , (1977). A lightweight above-knee prosthesis with an adjustable socket. *Orthot. Prosthet.* **31(1)**, 3-15
- WATTS, H. G. (1979). Surgical management of malignant bone tumours in children. In: Jaffe, N. (ed.) *Bone tumors in children*, Massachusetts: PSG Publishing Company, p. 131-142.
- WATTS, H. G. (1981). Special considerations in amputations for malignancies. In: American Academy of Orthopaedic Surgeons. *Atlas of limb prosthetics*, St. Louis, Mo.: C. V. Mosby, p. 459-463.