

Some Experience in Harnessing Extreme Arm Cases

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recent developments in shoulder prostheses, including that for complete removal of the shoulder girdle, it is possible to fit all upper-extremity amputees with useful arm substitutes. But of course it does not follow that all patients with high amputations can obtain from the available harnessing resources a uniformly good level of prosthetic function. It is appropriate to review present experience with such cases in order to establish realistic guides for the fitter. Although there is only a limited number of upper-extremity amputees with multiple amputations or with amputations at very high levels, the UCLA Case Study (1) has accumulated a sufficient number to make tentative conclusions possible.

Limitation in the potentialities of shoulder harness begins with the unilateral shoulder case of the disarticulation type. Unilateral humeral-neck amputees with an intact shoulder girdle have, in every case known, been able to manage the shoulder dual control, and with any of several elbow-lock arrangements they have been able to carry out all of the operations of the prosthesis. Further unilateral shoulder losses, or losses of both shoulders at various levels, entail such impairment of harnessable shoulder mobility that it is impossible to attain the operating effectiveness ordinarily to be expected from the major prosthetic controls. A review of several types of fittings and the results obtained indicates the nature of these limitations.

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UNILATERAL SHOULDER AMPUTEES

In the unilateral shoulder amputee, limitation begins with the disarticulation because the leverage on the amputated side is then so reduced that biscapular shrug no longer gives the necessary excursion. With most men of average to large build, however, the results usually are satisfactory (Table 1). In the case of M.W., pelvic control was required. T.M., a large and broad-shouldered man, obtained good function despite large, but not complete, clavicle and scapula losses. With the fore-quarter case, P.H., the sound shoulder could not manage the full control, and the functional regain was decidedly marginal.

BILATERAL ABOVE-ELBOW/SHOULDER COMBINATIONS

No case of bilateral humeral-neck amputation has thus far come to notice, but the bilateral above-elbow/shoulder combination is comparatively frequent. Five cases of this type can be cited. All save one are at least moderately successful. The unsuccessful case, C.B., has a number of stump complications that have prevented a satisfactory result. Otherwise, good operation, one prosthesis at a time, is provided by harnessing modifications in which the elements of the shoulder-disarticulation harness from one side and of the figure-eight from the other are combined. It should be noted that in all these cases both shoulder girdles are intact, and there is in addition one humeral stump. Hence, shrug and arm-flexion controls can be managed normally.

The first case of this type, L.S., is a young man, age 29, with a right above-elbow stump of 10 in. and a humeral-neck amputation on the left side. The musculature and mobility

Table 1
EXPERIENCE WITH UNILATERAL SHOULDER AMPUTEES

Amputee	Sex	Site of Amputation	Type of Harness	Results
O.V.	M	Disarticulation	Basic shoulder disarticulation with waist control	Rated as an excellent wearer; prosthesis essential to job
P.W.	M	Disarticulation	Basic shoulder disarticulation with high axilla loop for control of elbow lock	Excellent wearer
M.W.	M	Disarticulation	Basic shoulder disarticulation with pelvic dual control and manual control of elbow lock	Good wearer; pelvic control required because of pain in axillary area and limited flexion of opposite shoulder
H.P.	M	Disarticulation	Basic shoulder disarticulation with waist control of elbow lock	Not well known; probably an indifferent wearer
T.M.	M	Partial scapula and clavicle	Basic shoulder disarticulation with waist control of elbow lock	Excellent wearer
P.H.	F	Forequarter	Basic shoulder disarticulation with manual control of elbow lock	Dual control limited to minimum function. Wears prosthesis principally for cosmetic purposes

of both shoulders and of the right stump are good. Amputee L.S. is tall and slender but of moderately broad-shouldered build. He is fitted on the right with an above-elbow dual control, on the left with a modified shoulder-disarticulation harness with nudge control for elbow lock. He is rated as a good wearer and is independent in nearly all activities.

The second case, C.B., is an elderly man, age 60. He has a right shoulder disarticulation and a left short humeral stump supplemented with a tibial graft. Neuromata in the shoulder area and tenderness about the tibial graft have made fitting difficult; trial fittings with numerous types of harness have not been successful. The age of the subject, recurrent shoulder pain, and habits of dependence have together prevented satisfactory results.

Another case, M.C., is a young woman, age 36, with a right short above-elbow and a left humeral-neck stump, the latter supplemented with a tibial graft not yet ready for fitting. Meanwhile, amputee M.C. is operating well with the right prosthesis only. She has acquired skill in eating, drives a car, does housework, and is rated a good wearer generally. Future addition of the left prosthesis is uncertain.

Amputee R.G. is a young man, age 31, with a right short above-elbow and a left humeral-

neck amputation. He is tall and rangy with broad shoulders. Bilateral pectoral muscle tunnels had been constructed, but they were eventually closed at the amputee's request. When last seen he was fitted with short above-elbow dual control on the right side and shoulder-disarticulation dual control on the left. For a while the left elbow lock was operated by the pectoral tunnel, but the method of elbow-lock operation after removal of the tunnel is unknown. Over several years of observation this amputee was rated as a moderately good wearer and was independent in most personal activities.

Finally, J.L. is a man, age 40, with a right above-elbow stump 9 in. long and a left amputation at the humeral neck. Of fairly tall and rangy body build with good shoulder and stump mobility, he was fitted with a right above-elbow dual control and a left basic shoulder-disarticulation harness, the left elbow lock being operated by a nudge control. After fitting and training he attained a good level of performance and as far as is known continues to be a good wearer.

BILATERAL SHOULDER DISARTICULATION

The reduced shoulder width associated with the bilateral shoulder-disarticulation case so impairs scapular abduction and shoulder

flexion that complete control of the prostheses is not possible. Full operation of the terminal device at elbow angles above 90 deg. cannot be managed with the dual control, and a lower level of operation must be accepted. The pelvic control remains a possibility, but this expedient has so many disadvantages of inconvenience, awkwardness, and discomfort that few if any amputees accept it for continuous use. Shoulder control can at best be unilateral only.

Nevertheless, an acceptable level of function may result. For example, J.G. is an elderly man, age 63, with bilateral shoulder disarticulations. Of medium build and with rounded chest, he has to date been completely dependent on help from others. Fitting and care have been sporadic because of infrequent visits to the laboratory. He last was fitted unilaterally with a right prosthesis and a reaction cap on the left shoulder. Thus far the fit has been promising. At the last visit he had managed eating and other activities.

With the congenital anomalies, amelia and phocomelia, control functions usually are considered as being the same as those for the shoulder-disarticulation case. Shoulder girdles are narrow because of the absence of humeral heads or owing to loose and nonarticulated rudimentary elements, so that basic shoulder control may not be adequate for bilateral function. In phocomelia, with both forearm and hand or only hand elements, additional help may often be obtained for secondary controls such as elbow-lock operation. In any event, these congenitals early develop "manipulation" with the feet, and these capabilities have not been matched, so far as is known, by any upper-extremity prosthesis.

LITERATURE CITED

1. Gottlieb, M. S., *Final report of the UCLA upper extremity amputee case study*, Department of Engineering, University of California (Los Angeles), in preparation 1955.