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Technical note

Evaluating the Contourhook—help or hindrance?

V. E. ANGLISS

Department of Veterans' Affairs, Central Development Unit, Melbourne

Abstract

A new Contourhook terminal device was introduced to the Central Development Unit (CDU) in Australia through the therapist attending the exhibit at the ISPO World Congress, London, September, 1983. Ten upper limb amputees, who were experienced prosthetic users were selected for the evaluation. The patients were asked to attend the CDU to perform selected activities; 7 activities were designed to simulate hand prehension and 17 were bimanual activities of daily living. The activities were performed using the conventional split hook terminal device. The same activities were repeated using the Contourhook terminal device. Performances and patients' comments were recorded. In general the Contourhook was found to compare unfavourably with conventional terminal devices, aspects of the brochure were misleading and all patients preferred their previously worn terminal device.

Introduction

From time to time in the three decades following the 1950's, a frequent query at prosthetic meetings or in patient discussions has been "have there been any changes in design or improvements to the split hook terminal device for an upper limb prosthesis?" The new Contourhook provided one answer.

It was therefore anticipated that the CDU would receive enquiries about the Contourhook from persons in Australia with upper limb prostheses and from professionals working in the field. Accordingly, a chart was designed to make a comparative overall evaluation of the Contourhook with a conventional Hosmer split hook terminal device (Table 1).

All correspondence to *be* addressed to Mrs. V. E. Angliss, Consultant Therapist. Department of Veterans' Affairs. Central Development Unit, 131 Stun Street, South Melbourne. Victoria 3205. Australia.

Ten subjects were selected who were experienced prosthetic users for the comparative evaluation. Six subjects were below-elbow (B-E) amputees, of these one had a traumatic amputation and five had a congenital limb deficiency. Four subjects had 'traumatic amputations above the elbow. All were unilateral and with the exception of two girls aged 13 and 16 respectively, all were active adults (Tables 2 and 3). A letter was sent to the subjects inviting them to attend and asking for their assistance in assessing a new terminal device. To avoid prejudice prior to attendance, neither a brochure nor a description of the Contourhook was supplied.

Table 2. Subject occupation

Occupation	Prosthesis
Bank clerk	B-E
Business executive	A-E
Business executive	B-E
Gardener	A-E
Lawyer	B-E
Office clerk (2)	A-E (2)
Storeman	B-E
School student (2)	B-E (2)

Table 3. Age and sex

Age		Sex M	F
–15 years	—		
15–20	2		2
20–30	3	2	1
30–40	4	4	
40–50	—		
50–60	1	1	
over 60	—		
Total	10	7	3

All 10 subjects wore a prosthesis for all their waking hours. Of the six with a B-E prosthesis, three wore Model 5x canted terminal device (t.d.) and a young woman and the three teenagers wore an 8x t.d. Of the four above-

Table 1. Comparison of split hook and Contourhook.

Key to performance:— 3. Activity accomplished without difficulty.
2. Performance adequate.
1. Activity possible but very slow or difficult.
0. Activity impossible.
X. Not tested.

Name of Patient_____ **No. of bands**_____ **conventional t.d.** _ **Contourhook.**

SIMULATING HAND PREHENSION

	t.d.'s conventional	Contourhook
1. Chuck grip—remove cap from tube.		
2. Plier grip—pick up 2" block.		
3. Pincer—pick up pin.		
Pincer—pick up 12 jellybeans (time taken)		
4. Clip—pick up envelope.		
5. Hook—carry bucket.		
6. Spherical—pick up tennis ball.		
7. Grasp—hold trolley.		

BI-MANUAL ACTIVITIES

1. Strike match.
2. Cut along line with scissors, t.d. holds paper.
3. Eat with knife and fork, knife in t.d.
4. Hold telephone while taking notes.
5. Pick up large heavy box.
6. Hold glass to drink.
7. Hold glass under tap, turn tap to fill.
8. Hold paper while writing.
9. Peel orange.
10. Sweep with broom.
11. Thread needle.
12. Draw line using ruler.
13. Use nail file.
14. Manage money from wallet.
15. Remove lid from screw top jar.
16. Sharpen pencil.
17. Pick up coin.

ASSESS—

1. Sitting with both correct table height ratio to chair while performing activities.
2. Standing — to perform activities.
3. Previous use of conventional t.d.:—

i) Numberof working hours conventional t.d. is worn.....

ii) Numberofworkinghoursconventional t.d. is not worn.....

iii) Activities for which t. d. is necessary or commonly used.....

iv) Activities with which there is some difficulty with conventional t.d.....

v) Current employment.....

vi) Current recreation/sport/hobbies regularly undertaken.....

Patient's comments on the two t.d.'s:—

Therapists' comments on patient's performance:—

Control system efficiency **conventional**_____ **xlOO=**_____

f.,.d **Contourhook**_____ **x 100=**_____

f.c. **xlOO**

elbow (A-E) amputees, three wore Model 555 and one wore Model 7 "heavy duty t.d. for his employment and a 5x at meal times. For the comparative evaluation the latter subject wore the heavy duty t.d. Tests on 'heavy' outdoor work for which he uses the heavy duty hook were not tried with the Contourhook.

Prior to assessment the Contourhook was fitted to the "training arm" prosthesis and worn by the therapist. It was noted that although the brochure states " . . . Contourhook is totally compatible with existing prosthetic arms. No changes or adaptions are necessary" it was found that it is not interchangeable unless approximately 55mm length of extra cable is fitted to the conventional split hook t.d. The subjects found they could not open the Contourhook to its maximum as they were limited by the cable housing and liner. The cable, housing and liner for the conventinal t.d. was not interchangeable with the Contourhook. Similarly, for a given amount of energy expended, the Contourhook required one less rubber band to give similar ease of operation to that of the split hook but efficiency was reduced (Fig. 1, top).

Maximum voluntary opening of the Contourhook is not possible due to its line of pull impinging on the cable flow at the wrist unit. In comparing the maximum opening of the t.d.'s, the attachment point on the lever arm or 'thumb' of the 5x split hook t.d., into which the ball terminal fits, is displaced 5cm (2"), giving a maximum opening of the terminal device of 9.5cm (3 3/4").

The Contourhook lever arm can be passively displaced 9cm *(3 1/2)* giving a maximum t.d. opening of 12cm (4 3/4"). However, maximum opening is impeded as the moving 'finger' approaches the wrist unit (Fig. 1, centre). The maximum practical opening of the Contourhook was 9.5cm, the same as for the 5x t.d. however the lever arm was displaced 7.5cm, hence greater exertion for the extra 2.5cm over that of the 5x t.d. The greater the distance between the two distal 'fingers' of the Contourhook, the wider the space between the two counter levers proximal to the axis. This leaves a vulnerable point for pinching objects or a person's finger (Fig. 1, bottom).

The subjects were originally advised that they would only need to attend the CDU for one half hour for the assessment. The subjects were busy,

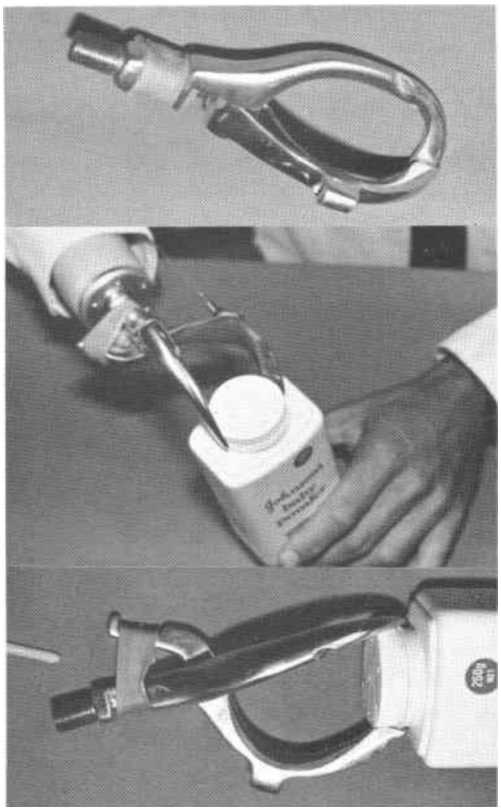

Fig. 1. Top, the Contourhook, left side (see text). Centre, maximum opening impeded by rubber bands on counter levers. Bottom, vulnerable area between counter levers (see text).

employed persons with the exception of the two teenagers who attended school. It was considered important that the time spent away from work/school for attendance and travel time should be kept to a minimum. However, attendance time approximated 1 1/*2* hours. Additional time being given to the adaption of cable length and determining the number of rubber bands required for effective use of the Contourhook to its maximum, which was limited by the cable housing and liner. The cable housing and liner for the conventional t.d. was not interchangeable with the Contourhook. The subjects' performance was recorded on videotape — this added to the attendance time.

Discussion

The subjects in the trial stated that they would not choose a Contourhook in preference to a conventional split hook t.d. with the exception of one subject with an above-elbow prosthesis

who mostly wears a heavy duty t.d. He considered that the Contourhook performed equally well to the heavy duty t.d. in the limited range of activities tested and, not surprisingly, preferred the appearance of the Contourhook to the heavy duty t.d.

Of the remaining A-E patients, one found the Contourhook required less pre-positioning, one found it required more pre-positioning and the other considered it would only have limited use for him in his place of work (as a business executive).

The three females with a B-E prosthesis wore a Model 8x t.d. and by comparison found the Contourhook large and heavy and did not like the appearance.

The three males with a B-E prosthesis found it less efficient than the conventional t.d. One found it no use for tying shoe laces or for dressing, one found it not sufficiently robust for his various activities in the house or garden and the third found it dangerous where the levers opened at the proximal end.

Additional comments on the Contourhook included:—

Advantages: when holding paper in the t.d. while cutting with scissors, the Contourhook 'tip' permits paper to slide through as scissors progress through the paper.

Disadvantages: after pre-positioning the Contourhook it is not possible to push it into the wrist unit with the other hand; the quality of the material in the Contourhook, together with the design do not stand up to the tasks required for gardening and other household duties; and it will not hold a knife for cutting food in the Western European style of eating.

Summary

The Contourhook was found to compare unfavourably with the conventional split hook terminal device; aspects of the brochure were misleading and all subjects preferred their previously worn terminal device for function, with the exception of the A-E subject who wore a heavy duty hook. Major criticisms were: it was not interchangeable with a conventional terminal device; an extra cable length was required; many objects were more difficult either to pick up or to grasp in the Contourhook t.d.; it was unsatisfactory for eating in the two handed Western European style, i.e. holding knife in prosthesis.

It was considered that with some modification to the Contourhook, e.g. if it were more robust and had a better grip for some objects and a larger gripping surface, it would be acceptable to those patients who did not require constant optimal functional use from the t.d. Similarly, for patients who have not previously been fitted with a split hook t.d., e.g. 5x, and are therefore not accustomed to its appearance, the Contourhook, largely because it does not have the connotations of 'Captain Hook', may well be preferred.

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