

The CAPP terminal device, size 2: a new alternative for adolescents and adults

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Abstract

CAPP Terminal Device, Size #2 for teenaged and adult amputees offers an alternative to hooks and hands available today. CAPP TD 2 is intended to be pleasing in appearance; it blends with the forearm in shape, colour and material to give a continuous flowing natural look. It was designed to provide secure grip through the combined action of a closing spring, a full frictional, resilient cover and an automatic lock. The lock operates as part of the voluntary opening control system and requires no conscious action by the amputee. CAPP TD 2 is a general purpose terminal device which especially serves unilateral amputees by performing functions usually carried out by the non-dominant hand. CAPP TD 2 comes with a built-in wrist connector which is available in two models; both offer quick disconnect. One wrist unit has adjustable friction and the other attaches to an existing friction wrist unit so CAPP TD 2 can be applied to an existing prosthesis. Ten patients have completed the evaluation programme with promising results. Prototypes of CAPP TD 2 are available for patients interested in evaluating it.

The CAPP Terminal Device, Size #2 offers unilateral teenaged or adult amputee patients a unique alternative. It is introduced here in hope of stimulating researchers to explore new mechanical solutions in their component designs. The CAPP research designer, Mr. Carl T. Sumida, CPO, introduced the idea of a non-hand, non-hook TD with the CAPP TD 1 for infants (Sumida and Setoguchi, 1967); that terminal device had more function than a passive hand and it had a softer appearance than a hook. CAPP TD 1 evolved from that

infant device and is now used by children up to ten years of age (Shaperman, 1975). Non-hand, non-hook terminal devices, such as the CAPP units, may be approached with caution by clinicians, but are often greeted with enthusiasm by patients who want a TD that is functional, not mechanical appearing, and which does not disguise the fact that they wear a prosthesis.

Design features of CAPP TD 2

The *appearance* suggests a continuity of line and colour with the forearm through the use of a built-in wrist connector and a full, replaceable soft cover. Patients over a wide age/size range can wear the same size TD due to this feature. Also, the same unit can be applied on the right or left side. Although the shape does not look

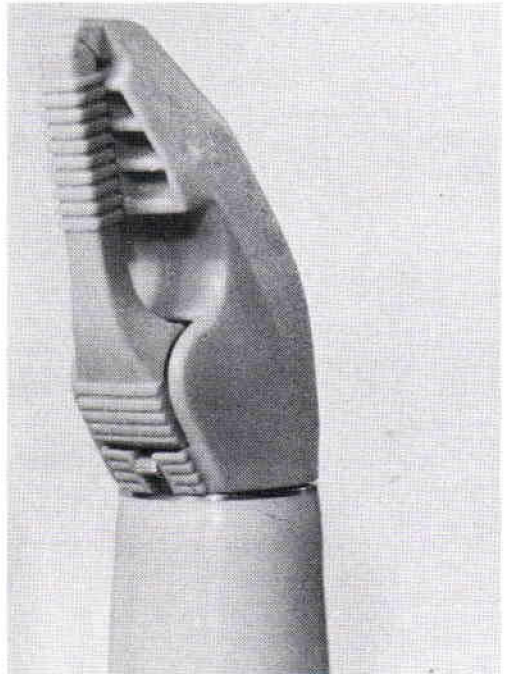


Fig. 1. The CAPP TD 2

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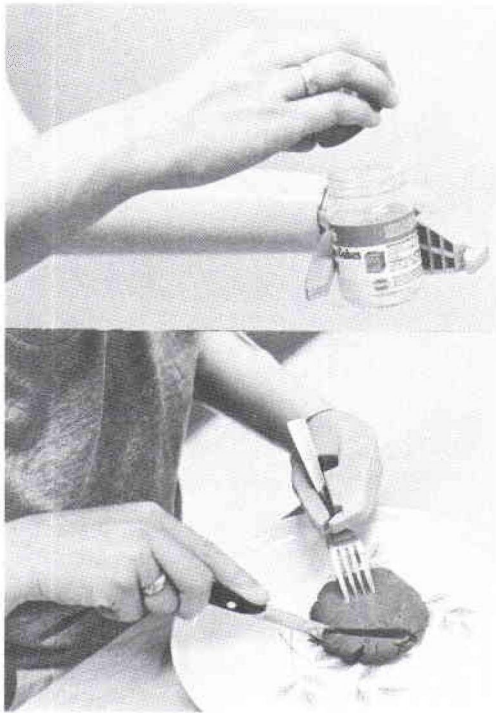


Fig. 2. Top, a variety of object shapes can be held. Bottom, cutting food is possible.

like a hand, its shape suggests a stylized hand in a grasping position (Fig. 1).

CAPP TD 2 functions as a general purpose terminal device substituting for the non-dominant hand; it primarily provides secure static grip but also has useful fine pinch (Figs 2 & 3). The friction cover is useful for passive stabilizing (Figs 3 & 4) and there is an area for "hooking" grasp. The functional design features were planned to provide secure grip without requiring high operating forces. In this voluntary opening, body powered terminal device, the grip feature includes three design elements. First, a frictional, resilient cover increases surface contact on objects and resists shear forces. Second, an automatic lock engages whenever tension is relaxed from the control line; the lock releases whenever the amputee places tension on the line¹ (Fig. 5). Third, a torsion spring closes the TD; since the spring and cover aid grip, a softer than usual spring may be used, but the measured pinch force is not an accurate indicator of the effectiveness of grip.

Mechanical features include a centre-pull control line; this precludes, at this time, fitting

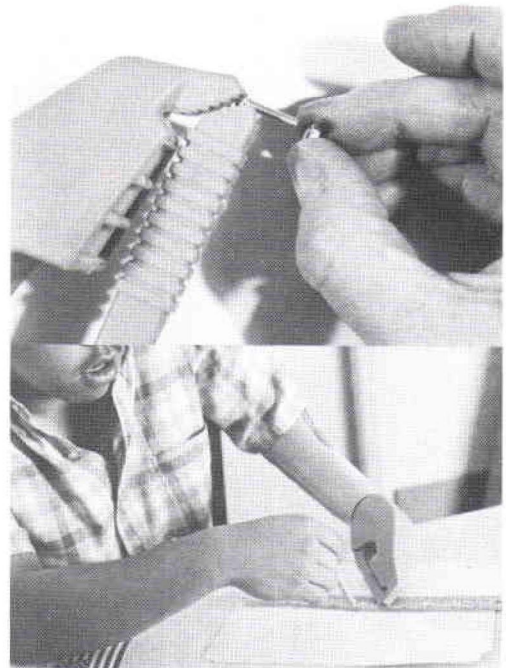


Fig. 3. Top, tiny objects can be held in the tips. Bottom, friction covering aids stabilization.

patients with very long stumps. There is a line inter-connector at the wrist; this eases line repairs for the prosthetist or patient and gives several fitting options. Also, the built-in wrist connector incorporates a quick-release feature and comes in two models; one allows retro-fit to an existing prosthesis. Additional information is available from the authors, and detailed illustrated fitting and maintenance procedures are provided with the terminal device.

Clinical evaluation of CAPP TD 2

Clinical trials have been organized to learn whether CAPP TD 2 meets its design objectives relative to function, acceptance and mechanical factors. Measurement variables are listed in Table 1. The protocol includes three evaluation sessions over a four-month period. Ten patients have completed the testing programme with

¹The automatic lock is essentially a one-way clutch that prevents the terminal device from opening further when outside forces act on the "thumb". This keeps objects from dropping out, but it does not increase the measured pinch force. The amputee has no fear of locking onto an object with this system. The lock operates without any conscious action by the amputee as part of the voluntary opening control motion.



Fig. 4. A notch provides hooking action.

promising results. They range in age from 10 to 31 years. Seven are males and three are females. All have unilateral limb absence and are previous prosthesis wearers; seven wore CAPP TD 1 and three wore hooks. Clinical trials are continuing, but a brief descriptive

Table 1. Dependent variables measured in the evaluation of CAPP TD 2

Factor	Dependent Variable
Function	Security of grip Versatility of object positioning Simplicity of operation Visibility of objects held
Acceptance	Acceptability of shape Cosmetic effect of continuity of line/colour
Durability	Reliability of structure and mechanism Convenience repair
Ease of fitting	Adaptability of installation to existing limbs Simplicity of assembly and line fitting

summary of the preliminary findings may be useful.

Appearance was acceptable to all of the patients; some teenagers were initially concerned about peer response, but reported positive comments such as, "It's like a space-age hand" or "It looks high tech". Size (same as adult hook) concerned some patients initially, but all of them adapted to this. Some patients said CAPP TD 2 was too heavy at first (240g or 8½ oz), and one patient objected to the limited choice of cover colours (only two standard colours are available). Nine of the ten patients chose to continue wearing CAPP TD 2 after the evaluation period.

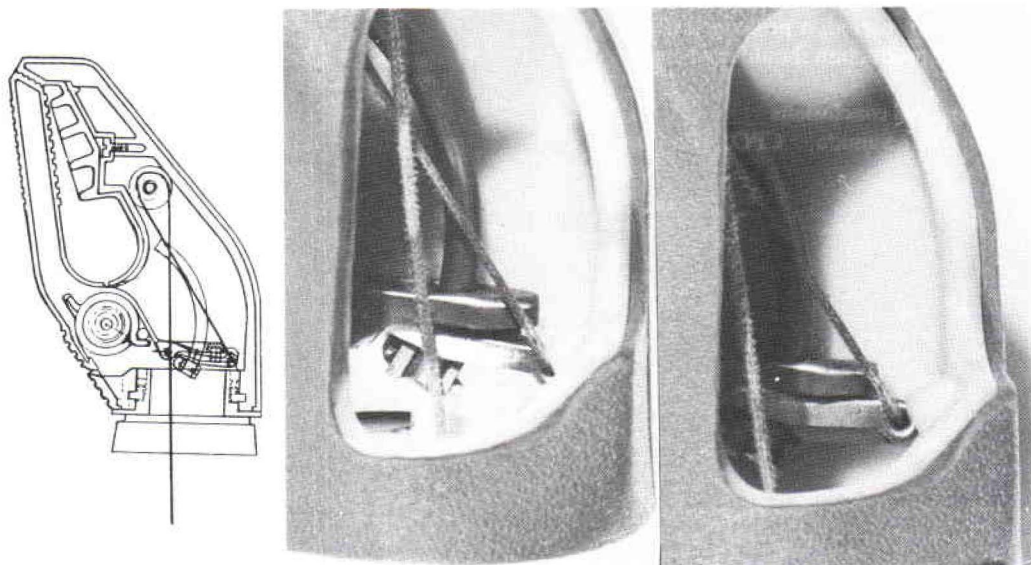


Fig. 5. The automatic lock. Left, lock and operating mechanism. Centre, lock is engaged when control line is slack. Right, lock is released when there is tension on the line.

Function was a positive factor for patients; all identified the lock as the most important benefit of the TD. Three patients needed to be reminded to relax cable tension during task performance or they would cancel out the locking feature. Patients could position and hold a wide variety of objects in the TD, but some needed instruction, or a period of trial and error, to become familiar with hold patterns of the new TD. Patients were able to perform work/office, dressing, homemaking, and recreational tasks. One patient reported difficulty seeing very tiny objects held in the TD.

Mechanical problems were rare. Incorrect line threading and accumulations of large amounts of dirt caused some problems and the wrist-lock release mechanism malfunctioned on two TDs. Urethane covers have worn well, clean easily, and are easily replaced when needed. Patients living a great distance from the testing centre are participating in the evaluation with remarkably little "down-time".

Future plans

Additional prototypes are available for patient evaluation; inquiries are invited.² Transfer to a manufacturer for production and marketing should occur within the coming year. Since many parts of CAPP TD 2 are made in moulds which were constructed during the development period, a prolonged development period for production should not be needed.

Summary and conclusions

Carl T. Sumida, CPO, designed and

developed CAPP TD 2 as an alternative for adolescent and adult amputees, and to demonstrate some new concepts in prosthesis design. CAPP TD 2 is intended to offer secure grip on objects, easy operation, pleasing appearance and reliable service for general purpose applications. Preliminary evaluation results suggest that appearance and function features will meet objectives and that very few mechanical changes will be needed in the transition from testing to production. Additional information and/or prototypes for patient evaluation are available from the authors.

Acknowledgements

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²Requests for information on the evaluation programme of CAPP TD 2 should be sent to CAPP, Shriners Hospital for Crippled Children, 3160 Geneva Street, Los Angeles, Ca. 90020-1199, USA.