Special Equipment and Aids for the Young Bilateral Upper-Extremity Amputee

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Considerable information is available concerning the treatment philosophy, prosthetic prescription, and training of the child with a unilateral upper-limb deficiency (5). However, there are few published data on adapted equipment for the child with a bilateral upper-extremity deficit. To help remedy this lack, this article presents a brief discussion of the current treatment philosophy at the Institute of Physical Medicine and Rehabilitation in the New York University Medical Center and describes some of the adapted equipment and training procedures that have been found useful for children with congenital bilateral upper-limb deficiencies.

The presentation is essentially confined to children fitted with conventional prostheses. Experience with unilateral and a few bilateral amelic children at the Institute of Physical Medicine and Rehabilitation has led to the conclusion that these patients obtain inadequate benefit from conventional fitting and might do better with externally powered prostheses. However, these prostheses pose their own unique training problems which are not considered here.

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BILATERAL FITTING RECOMMENDED

The child is fitted as soon as he sits independently. If there are lower-limb deficiencies or other conditions which delay the achievement of sitting balance, assistive devices and training programs are used to facilitate this accomplishment.

It is believed that all children with bilateral upper-limb deficiencies should be fitted bilaterally at the outset for the following reasons:

1. To encourage the performance of bimanual activities and, hopefully, to assist in the development of an appropriate body concept by providing bilateral extremities of equal length.
2. To aid balance and prevent scoliosis.
3. To increase prosthetic tolerance.
4. To prepare for later bilateral prehensile function.
5. To promote eye-hand control of the prostheses.

The considerations listed above outweigh the disadvantages of lack of sensory input from the covered stumps. Since the prostheses are not worn full time by any of these children, ample sensory stimulation of the deficient limbs can be achieved.

TRAINING CONSIDERATIONS

In the training program, the longer stump is developed as the dominant member unless the child shows a strong preference for the shorter limb. If both sides are equal in length, the child's preference is determined by observation.

If the child has lower extremities which can assist in the performance of activities of daily living, use of the feet is encouraged, with loafer-type shoes recommended for easy removal *{4,6).* However, exclusive use of the feet should be discouraged. Pedal skills should be used to assist prosthetic function or in emergencies when the prostheses are not available. Thus,

the feet should be used primarily for activities that cannot be performed with prostheses, although strict rules cannot be applied. The degree to which the lower extremities are used must be a matter of judgment based on the individual case. It should be remembered, however, that if the child becomes too dependent on his lower extremities he will have to learn to reduce foot usage when he reaches the age of social consciousness.

FITTING MODIFICATIONS

In general, the same standard fitting procedures are used for the bilateral limb-deficient child as are used for the unilateral patient with the following modifications:

1. A 12P hook is fitted immediately but is not activated. Passive mitts are not used.
2. During the passive phase of training (inactive terminal device), a figure-eight harness is used, with a chest strap connecting the two axilla loops added for retention. To prevent the harness from riding up in the back, a vertical strap from the cross of the figure-eight is attached to a waist belt.
3. The usual developmental sequence in a child's perception of the prehensile function of a hook is well known (*6*). In bilateral amputees, the developmental sequence is the same, but is sometimes extended over a longer period. The therapist will usually be able to detect the child's readiness for cable attachment and active use by noting the typical signs of frustration arising from inability to function independently; for example, a sudden, sustained increase in crying, temper tantrums, refusal to wear the prostheses, and similar otherwise unexplainable manifestations. Occasionally, the child will verbalize the desire to do things independently without the prostheses. A reasonable attention span is an imperative requisite.
4. When the child reaches the age of four or five years, bilateral wrist-flexion units are provided.
5. For the very young above-elbow amputee, friction-lock elbow units, which have recently become available, are useful.

TRAINING PROCEDURES

Patients with bilateral limb deficiencies below the mid-humeral level present less of a fitting and training problem than bilateral amelic patients. Nevertheless, they still require specialized training. It is recommended that they be taught the use of one hook at a time and learn pre-positioning of the terminal device by use of the opposite hook, the knee, elbow, chin, or any available hard surface. Training in changing the position of wrist-flexion units by pushing against a hard surface or the opposite prosthesis needs to be given. These patients must also learn to don and remove their prostheses (5) and perform the activities of daily living.

ASSISTIVE DEVICES

The pattern of the training program in the New York University Medical Center follows the developmental scale of the normal child as far as possible *(6).* However, it must be remembered that the "child amputee" will eventually become a teen-ager and then an adult. Thus both the physical and psychological aspects of growth should be taken into account in special training programs.

Most of the special training devices used by adults for independence in activities of daily living can also be used by the young teen-ager. However, since training must start at a very early age if independence is to be obtained, devices specifically designed for the very young child must be used initially. The items described in this article are some that have been developed for the patients at the Institute of Physical Medicine and Rehabilitation.

SELF-FEEDING AIDS

The first level of activity training is self-feeding. A swivel spoon[3] possibly with a flat, built-up handle to prevent slipping (Fig. 1) is useful. Initially, the therapist places the

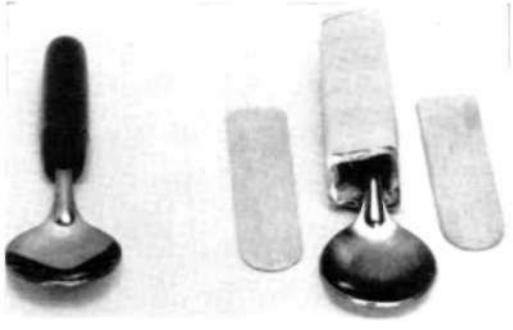

Fig. 1. Straight spoons. The one on the right illustrates a method of building up the handle to prevent slipping when grasped by a prosthesis.

[3] Sta-Level Baby Training Spoon ($1.00); Price Industries, Ltd., 815 East Talmadge Ave., Akron, Ohio.

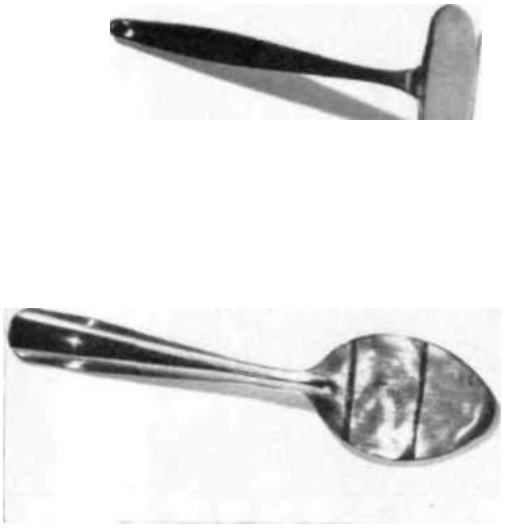

Fig. 2. *Top,* metal pusher formed from flattened spoon. *Bottom,* spoon flattened to make pusher.

spoon into the hook. Later, the child learns to pick up the spoon from the rim of the plate or from the table without assistance. Usually, the child can push the food against the rim of a bowl or against a plateguard. At about four years of age, the child is introduced to the use of a "pusher," a utensil (Fig. 2) commonly-used by normal children in Europe. The pusher has been found to be a good pre-knife-and-fork feeding aid. The pusher, which can be made from a flattened and re-shaped teaspoon, is placed behind the "thumb" of the hook on the nondominant side by the therapist. At this stage it is also likely that the child will be able to use a regular teaspoon with a flat handle, bent at an angle which is a compromise between that needed for scooping and the angle needed to get the food to the mouth without spilling.

At six to seven years of age, knife-and-fork usage can be started (Figs. 3 and 4). At first, both utensils are placed behind the "thumbs" by the therapist, but with practice the child learns to do this independently. Bilateral wrist-flexion units are very useful for proper positioning of the utensils as they are maneuvered for insertion into the terminal devices and then for cutting. To prevent plate movement, it is frequently" helpful at this stage to

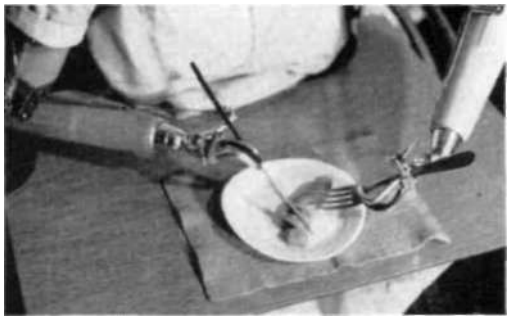

Fig. 3. Use of knife and fork for cutting.

Fig. 4. Use of knife and fork for peas.

use a damp, flat foam-rubber sponge, wet paper towel, or adhesive foam rubber attached to the bottom of the plate. Correct table height is important in reducing shoulder abduction during eating. With the prostheses in complete abduction, the elbows should barely touch the table.

When teaching drinking with a cup, a plastic, flat-handled cup[4] should be used initially. If necessary to prevent spilling when the cup is placed on the table, a lid (Fig. 5) may be provided. At this stage, the child can grasp and release actively but has not yet learned to pre-position the hook. This must be done by the therapist. When the child is able to pre-position the hook (three to four years of age), a regular plastic or paper cup can be introduced. Such cups must be held by the upper rim from above (Fig. 6).

In the public schools of New York City, children are provided soup and a sandwich for lunch. These items are most difficult to handle

[4] Baby Cup, KT5, with flat double handle and lock lid (50 cents); Kayware Corp., 2731 North Crawford Ave., Chicago, Ill.

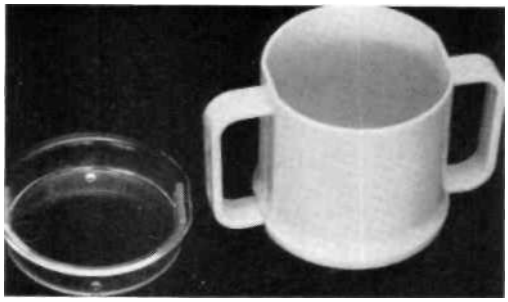

Fig. 5. Cup equipped with cover to avoid spilling.

Fig. 6. Plastic cup held at rim.

with a prosthesis. Soup should be sipped from the cup or through a straw, but the child cannot control his prosthesis well enough to prevent mutilation of a sandwich. At the Institute of Physical Medicine and Rehabilitation, a sandwich holder has been devised which is used successfully by some children. The teacher or a parent must insert the sandwich, but the child can then eat it from the holder (Fig. 7).

DRESSING AIDS AND ADAPTED CLOTHING

The amount and type of dressing activities performed by the bilateral upper-extremity

Fig. 7. Sandwich holder.

amputee vary greatly from one child to the next. For these patients the combined use of feet and teeth may be required.

To don his prostheses the child must first put on his stump socks and then maintain them in position as he maneuvers his stumps into the sockets. This feat is not very difficult for the bilateral below-elbow amputee, but if one or both of the limbs are deficient above the elbows, the socks tend to fall off. Others *(6)* have described a bilateral stump sock which is useful. At the Institute of Physical Medicine and Rehabilitation, a connecting piece has been added to this bilateral stump sock to protect the back and axillary skin from irritation (Fig. 8). There is no commercial source for this item at present.

Adolescent girls frequently find a front-opening brassiere useful. The standard item can be easily converted into a front-opening type by sewing up the back, opening the front

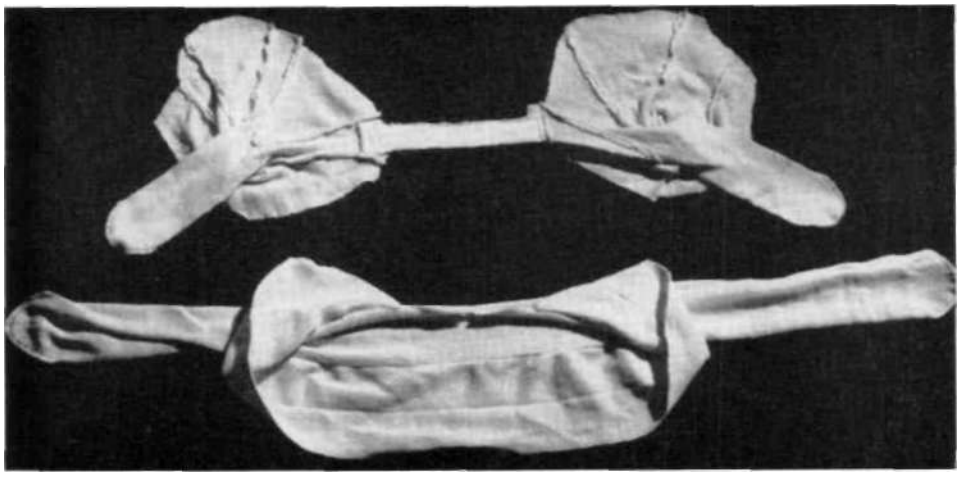

Fig. 8. Bilateral stump socks.

Fig. 9. Front-opening brassiere.

Fig. 10. Modified underpants.

and fastening it with a long Velcro strap and D-ring (Fig. 9). To close the top, a supplementary smaller strap with Velcro or a large hook on an elastic strap may be used. Sleeveless dresses split below the waist and with an open back are helpful.

The major training problem is toileting, which is particularly difficult for females. If a female child does not have normal lower extremities or at least toes able to function sufficiently in grasping clothing or toilet paper at the proper body level, life-long dependency in this function may have to be accepted. In using bilateral upper-extremity prostheses for assistance in toileting, it is a problem to get the prostheses close enough to the body to adjust the underpants while wearing a dress, even with elbow turntables and bilateral wrist-flexion units.

Some children have successfully used modified underpants which do not have to be removed. The crotch of the undergarment is split and refinished with binding (Fig. 10). The opening should close when the child is in the erect position. When the patient sits on the

toilet seat, with the trunk flexed on the thighs and the lower limbs abducted, the opening is sufficiently wide to prevent soiling of the garment. With practice, the use of toilet paper can usually be mastered without special devices. Sometimes, however, the solution of this problem requires the development of special reaching devices which are highly individualized. Female patients usually find tampons much superior to sanitary napkins.

SCHOOLWORK AIDS

For the bilateral amputee to function effectively in school, adaptation of equipment is required in many activities. For example, cutting with scissors is an impossible task with the standard item. Figure 11 illustrates a simple and very satisfactory adaptation in which one handle of the child's scissors is embedded in a small piece of wood (l-1/2 in. X 1 in. X 1/2 in.). The lower handle of the scissors is placed in a groove made with an X-acto knife and held in place with plastic wood. When the scissors are positioned in the wood block, the tip should touch the table. The axis of the two blades should not be tight and the blades should fall open with ease. The child holds the upper handle of the scissors with the hook tines pointing downward. As the handle of the scissors is pulled up and down, the block of wood rides flat on the table surface. In learning to use the adapted scissors, the child should start with straight lines on paper and then include gentle curves and corners and, finally, complex figures. Such scissors are effective only with paper; cloth cutting requires the use of electric scissors (Fig. 12). For cutting thread on a sewing project, a seam ripper is verv useful (Fig. 13).

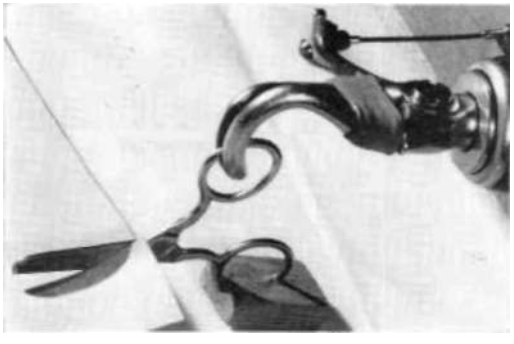

Fig. 11. Scissors with one handle embedded wood. Plastic wood holds the handle in place.

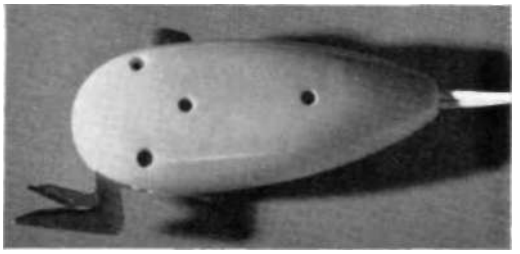

Fig. 12. Electric scissors,

Fig. 13. Seam ripper.

Writing can be facilitated by the use of a clipboard or attaching the paper to the table with masking tape, rather than letting the child struggle to hold the paper steady with his nondominant prosthesis. Chalk holders which prevent the chalk from breaking and improve blackboard writing efficiency are available commercially (6). A pencil holder has also been described (i). A simpler crayon-holding device has been used for very young patients at the Institute of Physical Medicine and Rehabilitation (Fig. 14). This holder consists of a wood block (6 in. X 2 in. X 2 in.) with a series of holes drilled at angles to enable the child to withdraw and reinsert the cravon without having to pre-position the crayon. Unless the child presses down very hard, the crayon will not slip from the hook. If a thin layer of foam rubber is glued to the bottom of the wood block, it will not slip on the table. Some older children cannot use their other hook to insert a pencil behind the "thumb" for stability. When clamped to the edge of the table, a simple block of wood with a single deep hole (Fig. 15) is effective in holding the pencil so that it may be properly grasped. In time, the

Fig. 14. Crayon holder fashioned from wooden block.

Fig. 15. Pencil holder clamped to edge of tray.

child learns to pick up and position the pencil without special devices.

SEWING AND KNITTING AIDS

It is possible for a bilateral upper-extremity amputee to learn knitting and sewing. One needle with the knitting on it can be inserted in a vise (Fig. 16), while the other needle is held behind the "thumb" in the dominant prosthesis. The wool is laced around the needle by

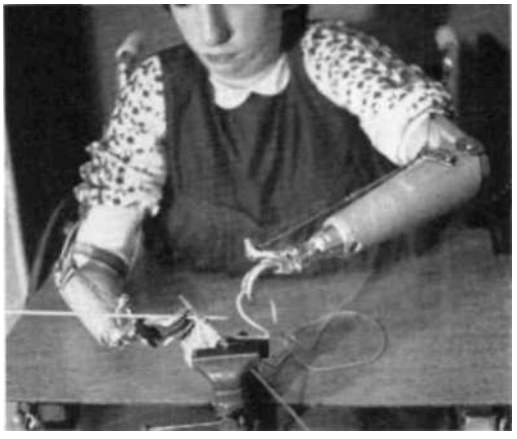

Fig. 16. Small vise used to hold knitting needle.

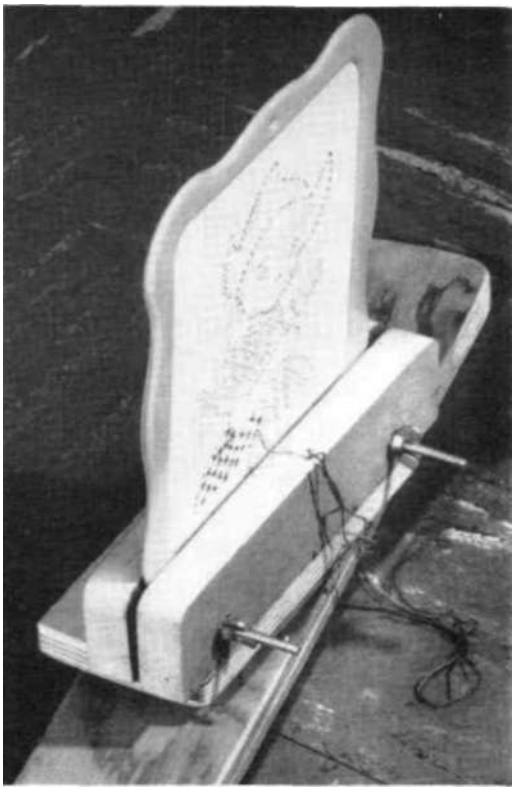

Fig. 17. Frame to hold sewing card, mounted on ball bearings to swing freely on pivot.

the nondominant hook. Thick needles and wool should be used. Sewing can be made easier by use of a frame mounted on a pivot with ball bearings (Fig. 17). Many four- and five-year-old children enjoy sewing cards or doing simple cross-stitch work. This is an excellent activity for training the child to achieve minimal opening of one hook at a time.

CONSTANT MODIFICATION NECESSARY

It is hoped that other therapists will find these suggestions useful and that they will report special devices that they have used successfully. Finally, it should be emphasized that, although a variety of assistive devices, including the feet, are used by young children with bilateral upper-extremity deficiencies in performing the activities of daily living, the problem changes as the child grows older. The physical growth and social consciousness characteristic of the teen-ager may preclude the use of techniques that were acceptable in the younger child. Constant alertness to the need for modification of techniques is required to meet the changing physical and psychosocial needs of the developing child.

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