

SELECTED CASE REPORTS FROM THE CHILD AMPUTEE PROSTHETICS PROJECT, UNIVERSITY OF CALIFORNIA, LOS ANGELES

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Editor's Note: The Child Amputee Prosthetics Project was an outgrowth of the research program in upper extremities prosthetics which commenced in the Engineering Department at U.C.L.A. in 1946. The desirability of including children in the investigative program became evident several years later. In 1953, the Department of Prosthetics asked Dr. Robert Mazet to institute a research program in children's prostheses at the Marion Davies Clinic. This was done in cooperation with Dr. Craig Taylor from the Department of Engineering and Dr. Milo Brooks of the Department of Pediatrics. Soon after the inauguration of the program, it became evident that some financial support was necessary. A grant from the U.S. Childrens Bureau administered through the state's Crippled Childrens Services was secured in 1955 and has supported the organization since that time. This effort has always been a multidisciplinary activity. In addition to orthopedists, engineers and pediatricians, there are, on the staff, a psychologist, a social service worker, two prosthetists and three amputee trainers. Other consultants, such as plastic surgeons, dentists, cardiologists, etc. are called in when needed.

I

UPPER EXTREMITIES ABSENT; DEFORMED LOWER EXTREMITY

A 5 year and 3 months old child with a scoliosis, bilateral absence of upper extremities, and a deformed right lower extremity with short femur, absent fibula, malformed knee joint, and equinovarus deformity of the foot, was fitted with prostheses in January 1956. (Fig. 1) The club foot had been corrected.

The initial upper extremity prostheses consisted of a pair of shoulder caps, humeral ball and socket joints (placed facing forward rather than to the sides), and humeral pylons without terminal devices. Function with these devices was limited to pushing and poking. Activation was by shoulder girdle motion. Crayons, paint brush, etc. were strapped or taped to the humeral segments. Real independent function was not possible. A month later, therefore, he was fitted with prostheses which permitted a little more function. These consisted of the same type shoulder caps, ball and socket shoulder joints, and humeral pylon. Additions were elbow joints, forearm sections, friction wrist units, a 10x hook on the right, and an infant passive hand on the left. All components possessed passive motion only (Fig. 2).

Almost as soon as he was fitted, perspiration became a problem because of his decreased surface area. Multi-hole perforation of shoulder caps appreciably alleviated this.

The social situation was rather complicated. His I.Q. was 113, and he seemed quite well adjusted to his deformities. The father was overwhelmed by the catastrophe and unable to meet it objectively. The mother showed desire for help for him.

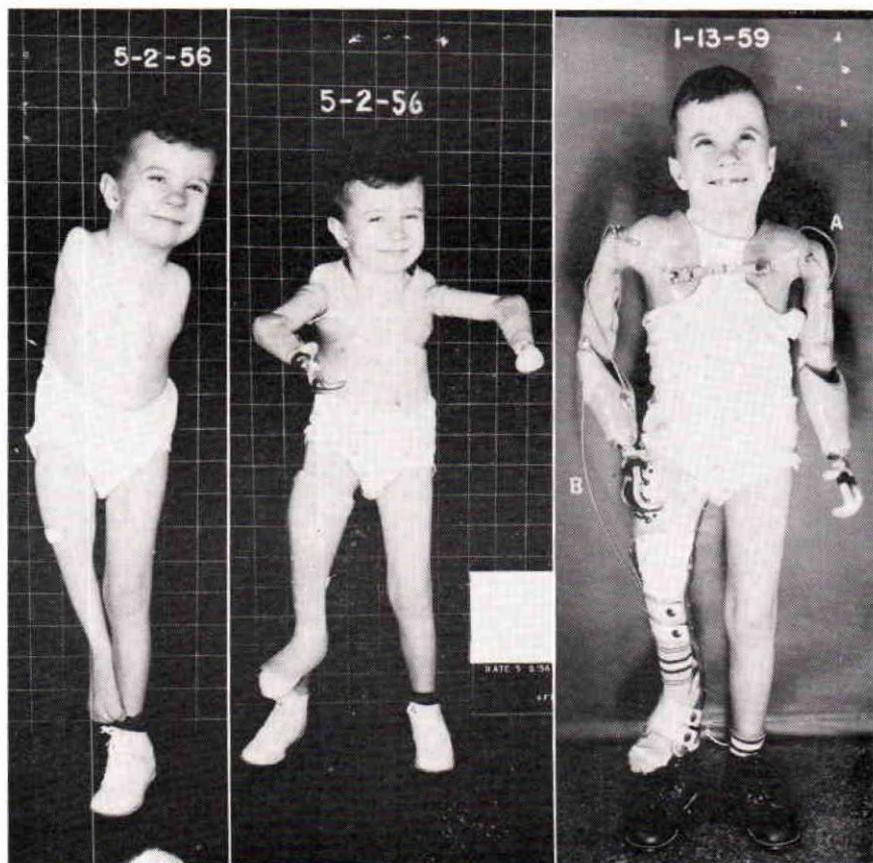


Fig. 1 (at left) Showing multiple congenital deformities. Fig. 2 (center) Showing ball and socket passive shoulder, and elbow joints, also plastic LE socket and foot. Fig. 3 (at right) Left shoulder loop A activates left elbow lock. It is mouth controlled. Cable B activated by planter flexion of right foot controls right elbow lock.

Approximately two months after the second pair of upper extremity devices were delivered, he received his lower extremity pylon. This consisted of a plastic socket and platform for the foot, with an extension and artificial foot beyond it (Fig. 2). Initially he was fearful of ambulating with the upper extremity prostheses, and would wear only upper extremity or lower extremity devices.

The school principal, nurse, local occupational therapist, local physical therapist, and his teacher were interested in his progress and visited the project during one of his training sessions. They had been much impressed by the boy's accomplishments with his feet. He could write, feed himself, and perform numerous tasks with them.

Progress was slow. He could, and did, perform creditably during training sessions. The upper extremity prostheses offered little or no active function; he was dependent on someone else for placement of objects in prostheses, and prostheses in space. This worked during training sessions at school, but there was no carry-over into the home. He did not use the

devices there. Because of limited scapular motion and inability to separate right from left action, there was frequent interference with one prosthesis by the other. He walked readily in his lower extremity pylon.

In an effort to provide more function and stimulus to use, the right artificial arm was modified. Active control of the 10x hook was instituted. It quickly became evident that a larger hook was desirable. Four months post initial fitting, a 99x hook was prescribed. Active use was still markedly inhibited by several factors: He was unable to rotate the T.D. TD opening was quite limited. No bilateral holding was possible. Positioning of forearm was difficult and awkward. There was interference in positioning of one component by another. The right shoulder cap tended to ride up and rotate. He was intrigued by his newly acquired ability to walk and bored by the lack of upper extremity function. He was easily fatigued. There was no carry-over or stimulus to upper extremity use outside training sessions. The upper extremity devices were left at home for a time; later they were taken to school and left there for some weeks. Both the boy and his mother felt that the necessity to have someone else passively adjust shoulders, position elbows, rotate forearms, etc. failed to provide sufficient function to justify wearing the prosthesis outside the training periods.

13 months after initial fittings, entirely new devices with improved functional potential were given him. Swivel, slightly canted, shoulder plates (2) were used, with positive alternating elbow locks. These were operated by lanyards which he pulled with his mouth. The infant passive hand was retained on the left, the active 99x hook on the right.

During his second year of therapy, he gained confidence in his walking ability, and showed some improvement in using the right active artificial arm. Active therapy at school continued; the school therapist had persuaded him to wear his arms 5½ hours daily, but he did not take them home.

The psychological problem here is complicated. There is a dominating father, who for many years rejected the son, while demanding that the mother protect and wait on him. The mother never forced him to do anything. He had no good friends of his age because he was not able to keep up with the other boys.

In the past year or so, the situation has improved. The boy attended summer day camp last year. He has made some friends among his contemporaries. His mother has adopted a firmer attitude, and does not permit him to impose and dictate to her as she formerly did. His father is facing reality. He is doing things with the boy, such as visits to Disneyland and overnight camping trips. 2½ years post original fitting, at age eight, he was fitted with UCLA canted shoulder plates and active controls as described below. Increased function is provided in them. He is particularly pleased by the foot control of the right elbow lock which makes the device more useful to him.

An interesting finding, which may or may not have any bearing on prosthetic use is the remarkable suppleness and utility of this boy's feet. He continues to perform many tasks, such as feeding himself with them. The right foot is as useful as the left. It is of equal length, but somewhat narrower. One can engage in considerable speculation as to the possible role his pedal ambidexterity plays in psychological acceptance and use of artificial limbs by this boy.

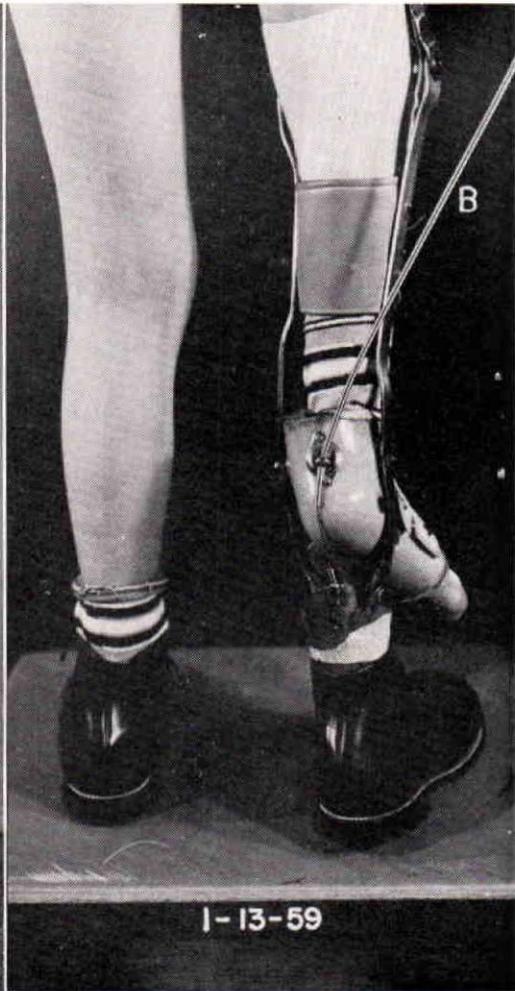
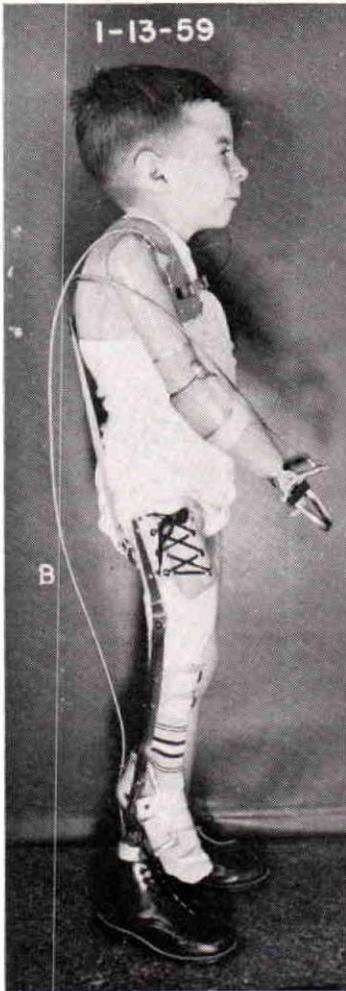


Fig. 4—Side view, showing cable B passing from plantar aspect of foot over shoulder and into arm shell.

Fig. 5—Showing cable B passing back of and under right heel.

Evaluation in this instance is difficult. The lower extremity prostheses have been useful and used constantly. The initial upper extremity devices did furnish limited function, and certainly partially conditioned him to prosthesis wearing. They did not provide enough function to convince him that they were worth the nuisance and discomfort of wearing. When he had attained the neuromuscular coordination necessary to understand and use the fully active devices presently worn, his function improved greatly. The unstable family situation and absence of active assistance and insistence in prosthetic use at home have militated against maximum facility with the apparatus, but are now somewhat improved.

The futility of prosthetic fitting alone is redemonstrated here. The devices must provide sufficient function to make their wearing worthwhile to the patient. His family and school associates must understand the problem,

and help him to extract maximum benefit from the devices. We anticipate increased acceptance and increasingly better use of his more functional artificial extremities. Special attachments such as a swivel spoon and a pencil holder are being used with some success. A wrist flexion unit might give better function. We believe the child and his equipment have now reached a place where there is a base on which to build better use.

Obtaining adequate function from prostheses by a bilateral shoulder disarticulation amputee is always difficult. In a child, it may be impossible because bicipital abduction is insufficient to provide the excursion necessary for TD opening, and forearm lift operation. Cross control interference is a frustrating complication, which has caused abandonment of routine bilateral fitting at UCLA in these cases.

The present UE prostheses for this boy have been designed to minimize the above enumerated troubles.

These are made with the canted shoulder joints, now standard at this clinic, which provide simultaneous shoulder flexion and abduction. They have passive elbow turntables. On the left, elbow motion, wrist rotation and TD opening are also passive. Only the elbow lock is actively controlled. This is attained by means of a loop over the left shoulder (Fig. 3) which is mouth operated. He is too little for the more conventional nudge control.

The right elbow lock is controlled by plantar flexion of the foot through a cable passing behind the extremity and back, over the shoulder, then in the conventional manner in the arm shell (Fig. 3, 4, 5). The TD opening is by scapular abduction in the usual manner.

The right bilateral long leg brace with artificial foot distal to his own foot departs from the conventional in two respects. One, activation of elbow lock mechanism has been noted. The other is incorporation of a plastic ischial weight bearing ring (he bears 80% of his weight here) modeled after the type described by Russek Eschen (3).

His second pair of upper extremity prostheses (Fig. 2) consisted of shoulder caps with attached fixed plastic three-quarter spheres in shoulder joint areas. Spring loaded sockets for humeral sections allowed passive motion of prosthesis in all planes. Fixed friction joints such as this enable the TD to be placed in an area of relative usefulness. They possess three inherent defects, however. The patient is dependent on outside aid in placement. If friction is not great enough, position is not maintained. If friction is too great, the shoulder caps slide around when any appreciable load is put on the prosthesis. An added disadvantage of this particular device was the location of the plastic spheres in front of the anatomical shoulder joints. They would have been better placed more laterally. In the passive friction elbow joints, the amount of friction proved quite critical and needed frequent adjustment. Details of construction are given in Reference I.

REFERENCES

1. "Passive Friction Prosthetic Shoulder." Published as Memo Report No. 38, Artificial Limb Program, Department of Engineering, University of California, Los Angeles, March 1957.
2. "Shoulder Plates"—See page 297 of "The Manual of Upper Extremity Prosthetics, Second Edition, published at Los Angeles by the Department of Engineering, University of California, Los Angeles, 1958.
3. Russek, Allan S., and Eschen, Fred. "Ischial Weight-Bearing Brace With Quadrilateral Wood Socket—Preliminary Report." "Orthopedic and Prosthetic Appliance Journal," September 1958, 31-35.

II

B.T.F.—BELOW ELBOW CONGENITAL AMPUTATIONS

A 23-month-old boy with very short right and short left below-elbow congenital amputations was first seen in October 1953 (Fig. 1). His development was normal in all other respects. Elbow and shoulder motions were normal. The left ulna was $2\frac{1}{4}$ " and the right $1\frac{1}{4}$ " in length. He was fitted with a double pivot hinge on the left, and a step-up hinge on the right, and #10 hooks (Fig. 2).



Figure 1 showing bilateral short below-elbow amputations.



Figure 2 showing the prostheses with step-up hinge on the right.

Several training sessions proved him able to operate either terminal device on command, but he developed no spontaneous use pattern. The left appeared to be the dominant side. Follow-up training in his home community was given regularly, but there was no follow thru in the home, and very little home use.

About a year after he received the initial artificial arm, new ones were fabricated, with 10x hooks. Post-fitting training sessions elicited no evi-

dence of motivation to use his arms. There were repeated requests for their removal. His mother confessed that she never insisted on his wearing the devices at home. Not until the boy entered nursery school at age five did he show any interest in prosthetic use. At this time, there was temporary interest in using the arm for school tasks and eating. With this increased activity, cross control interference became a problem. He could not readily use one device while the other remained passive. Inept performance was followed by relapse into disinterest in prosthetic use. To overcome this, it was decided to harness only the shorter right stump. It was hoped that improved unilateral function would be more beneficial than uncertain bilateral function. At this time he received a 99x hook. Some renewed interest and spontaneous use resulted but this was limited and transient. The mother's attitude remained entirely passive. His school teacher stated that there were no first grade activities which necessitated use of the arms. No use was made of them at home or in school. Intermittent training in his home community continued. The only time he used the arms outside the training periods was during the week of the local Easter Seal campaign, when he and another child amputee were displayed to encourage the public to loosen their purse strings. While in the limelight, he performed adequately.

By the end of 1958, when this boy reached his seventh birthday, it was quite apparent that results in this instance were not commensurate with the expended effort. Despite demonstrated ability to use the single device when he was stimulated to do so, there had been no progress for several years. He did not evince any concept of the basic controls or functional patterns which should long since have become inherent. This boy felt no need for artificial arms. His mother denied the existence of any great handicap. We had never been able to induce the father to enter the picture. Home and school environment provided no stimulus to independence and self-reliance. The mother was informed that we would be glad to see the boy again when he decided that he wanted and needed artificial arms.

In this instance the child did not feel a need of prostheses. This was largely due to the failure of his parents to admit his disability and stimulate him to overcome it, and to their complacency in his dependence on the mother.
