This case report demonstrates the role of occupational therapy in the rehabilitation of a patient with a rare upper extremity (Krukenberg) amputation, who was fitted bilaterally with prostheses.

Ideally, prosthetic fitting and training eliminates the need for environmental modifications and enables the person to function more normally within his or her environment. In this particular case, the patient had been functioning without prostheses or home modifications for two decades with little difficulty. He was provided with prostheses to (a) further improve his upper extremity function for the performance of self-care, homemaking, and housekeeping activities; (b) improve his perception of body image; and (c) accommodate his social and spiritual needs.

Case Description

K.V.P. is a 52-year-old Laotian man who sustained traumatic bilateral below-elbow amputations during the Vietnam War. His limbs had been surgically revised with the Krukenberg procedure, in which the radius and ulna are separated and covered with skin to form a clawlike pincer, or forceps (Sinaki, Dobyns, & Kinnunen, 1982). The Krukenberg procedure's main advantage is that it preserves tactile sensation, stereognosis, and prehension. According to Harrison and Mayou (1977), its main disadvantage is that "1 in 4 adults [feel] 'inconvenienced' by the appearance of their hand" (p. 173), which is the primary reason why this procedure is rarely performed in developed countries. Sinaki et al. reported that the Krukenberg procedure was popular for patients living in areas where prostheses were unavailable, which presumably was the situation for K.V.P.

A person with a Krukenberg revision is not routinely a candidate for a prosthetic fitting because of the resultant loss of sensation and function in the residual limb. Most persons with Krukenberg amputations are independent in activities of daily living and find that their residual limb functions usefully. However, therapists can still consider fitting such a patient with a prosthesis, especially a patient with a bilateral amputation, because the prosthesis may provide that patient with increased function over the residual pincer by enabling him or her to simulate the fine prehension necessary to perform the palmer pinch (Tubiana, 1981). In addition, for a patient with a bilateral amputation, a Krukenberg revision combined with a prosthesis on the opposite extremity provides more effective functioning (American Academy of Orthopaedic Surgeons, 1981). The Krukenberg extremity provides sensory feedback and enables the patient to preposition objects for prosthetic grasp.

K.V.P. wanted to obtain prostheses for spiritual and social purposes only. In his religion, it is believed that when a person loses an organ or a limb due to
disease, injury, or mutilation, he or she will pass into the "next stage" as an incomplete person (B. Vilaysane, personal communication, April 15, 1988). This belief affected not only K.V.P.'s body image but also his social functioning; he rarely interacted with people outside his immediate family.

Evaluation
An occupational therapy evaluation of K.V.P. revealed his range of motion in shoulders, elbows, and the remaining musculature to be within normal limits. Muscle strength was in the normal range bilaterally at the shoulders, elbows, and forearms. Strength of the 8-cm right forceps and 6-cm left forceps, when abducted, was also in the normal range. Deficits were noted in the areas of sensation (interior left forceps, lower pincer) and fine motor coordination, as demonstrated by the patient's inability to manipulate clothing fasteners. K.V.P. was otherwise independent in all areas of daily living and self-care.

K.V.P. functions primarily with his left arm because his right residual limb is several centimeters shorter and the forceps have limited opening capability, which negates functional capacity. It was therefore decided to fit the patient initially with a right, below-elbow prosthesis.

Prosthetic Fitting and Training
An electrically powered prosthetic hand with proportional control was chosen as the most functional prosthesis for this patient (see Figure 1). By contracting his muscles and using the tips of his forceps, K.V.P. could operate an electric wrist rotator, which provides pronation and supination of the hand; these motions had been lost bilaterally as a result of the Krukenberg procedure. The wrist rotator is operated via a rocker switch mounted distally in the socket and can be activated by moving the radius. The prosthesis is self-suspending and self-contained.

The initial prosthetic training goals for K.V.P. were

1. To don and remove the prosthesis independently
2. To monitor skin condition after removing the prosthesis
3. To increase prosthetic tolerance
4. To demonstrate control of finger abduction and adduction
5. To master wrist supination and pronation
6. To successfully perform finger abduction separate from wrist supination and pronation
7. To consistently grade the pressure used in picking up objects
8. To demonstrate how to recharge the prosthetic battery and how to insert and remove the battery from the prosthesis and the charger

K.V.P. learned to control the wrist rotator component as well as finger abduction and adduction by manipulating various sized pegboards, stacking cones, and placing small washers on thin dowel rods. To learn to grade pressure when picking up objects, he initially pinched graded resistive putty until he was able to leave a shallow (versus a deep) impression. Next, after much practice, K.V.P. mastered picking up empty paper and styrofoam cups; cartons filled with liquid; and various food items, such as a piece of bread, a cracker, and an egg.
Training for Activities of Daily Living

K.V.P.'s main activities included taking care of his grandchildren while other family members worked, preparing simple meals, and performing light housekeeping duties.

The goals met in the second stage of K.V.P.'s rehabilitation were:

1. To feed himself independently using adaptive equipment
2. To prepare simple, hot meals independently
3. To dress independently using adaptive equipment
4. To independently perform housekeeping duties

K.V.P. became self-sufficient in all areas of daily living by using adaptive equipment such as a button aide (see Figure 2) and curved eating utensils. While wearing his prosthesis, K.V.P. can also prepare scrambled eggs, mop the floors, wash clothes in the washing machine—activities that he could not accomplish previously.

The final stage of rehabilitation involved fitting the patient's left residual limb with a self-suspending prosthesis and passive hand (see Figure 3). This type of prosthesis was chosen to meet the patient's social and psychological needs. The patient easily dons and removes the left prosthesis to use his forceps functionally. It was felt that a removable prosthesis would allow the patient freedom of motion, function, and sensation, whereas a mechanical hand would limit the use of his forceps.

Conclusion

The therapist's goal in prosthetic fitting and training for a person with an upper extremity amputation is to improve the patient's quality of life by providing adaptive equipment and teaching the skills necessary for independence in daily activities. In the occupational therapy clinic, this patient learned complete self-reliance 2 decades after sustaining his traumatic injury. The patient's compliance in wearing his prosthesis to function in his home and community confirms that he has adopted his prosthesis as his second pair of hands and has accepted his new body image. The patient also has developed more confidence in venturing outside the protective confines of his small Laotian community.

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References


