This case report describes the preprosthetic evaluation and training for a patient with a shoulder disarticulation. In the United States, there are an estimated 90,000 people with upper extremity amputations, of whom 60% are between the ages of 21 and 64 years (Muilenburg & LeBlanc, 1989). Of the 50% who choose to wear prostheses, only 5% have an amputation at the shoulder level (Muilenburg & LeBlanc, 1989). Upper extremity amputees may be referred to occupational therapists for preprosthetic and prosthetic evaluation and training.

History

A 23-year-old single black man sustained a traumatic amputation when his shirt sleeve became caught in a cabling machine that he was operating. His right and dominant arm was avulsed. At an acute care hospital, the wound was surgically closed within hours after the accident. Occupational therapy was initiated the following day. The focus of the treatment, as indicated by the medical records, was on left hand fine motor training and activities of daily living, such as feeding and hygiene. The occupational therapy records indicated that a future prosthesis would be only cosmetic. He was discharged home 9 days after the accident.

Approximately 4 weeks after the accident, he was referred to the outpatient occupational therapy services at our hospital. The long time between acute care discharge and outpatient initiation of services was due to his case manager’s difficulty in identifying an appropriate outpatient rehabilitation service near the patient’s home. Upon their evaluation, the physician and prosthetist decided that the patient might be an appropriate candidate for a myoelectric prosthesis. The occupational therapy referral specified premyoelectric prosthetic training. As the patient’s injury was work-related, his treatment expenses were covered through workers’ compensation. A nurse served as his case manager to coordinate services and resources appropriate for his rehabilitation.

Initial Evaluation

During the initial occupational therapy evaluation, the patient was quiet and appeared introverted. He did not want to discuss his feelings regarding the amputation. He had completed eighth grade and had been working at the cabling company for 34 months. He lived with his significant other and her three children in a federal housing development. His social support included his significant other, her children, his parents, his six siblings, and his friends. Examination of the disarticulation site revealed it to be edematous, low in muscle tone, and hypersensitive to touch. He tolerated only minimal flat palpation throughout the right upper quadrant. The skin was soft with no signs of irritation. He experienced both phantom
sensation and phantom pain, which he reported as a “tingling sensation.”

Skeletal landmarks absent in the right upper extremity included the acromioclavicular articulation, acromion, coracoid process, and part of the superior, lateral aspect of the scapula (see Figure 1). The spine of the scapula was approximately two thirds intact from the medial border. The clinical picture was closer to a forequarter amputation than a shoulder disarticulation (see Figure 2). His surgical incision was 7 in. long.

Intact shoulder girdle muscles included the upper, middle, and lower fibers of the trapezius, the lower and part of the upper fibers of the serratus anterior, levator scapulae, and rhomboids. Testing of the right shoulder girdle muscles indicated trace strength in all of the scapula muscles: upper trapezius (scapula elevation), serratus anterior (scapular abduction and upward rotation), middle trapezius (scapular adduction), lower trapezius (scapular depression and adduction), and rhomboids (scapular adduction and downward rotation). His left upper extremity active range of motion was within normal limits in all planes of movement. His strength was normal in all major muscle groups. His mean left hand scores in grip strength, key pinch, tip pinch, palmar pinch, and finger dexterity for a nondominant hand were all below the mean scores reported in the normative studies conducted by Mathiowetz et al. (1985) and Mathiowetz, Weber, Kashman, and Volland (1985). Left-handed functional tasks were adversely affected by his decreased endurance and incoordination.

In activities of daily living, he required assistance in bed mobility, self-care, written communication skills, and home management. In self-care he required minimal to moderate assistance with feeding, bathing, grooming, and upper and lower extremity dressing because of a mild balance problem resulting from the shift to his center of gravity. In written communication skills, he expressed an interest in learning to write with his left hand. Although he needed assistance in home management activities, he felt that these were the primary responsibility of his significant other. He required a driving evaluation and an appropriate referral was made to another facility.

Therapeutic Goals
The patient’s stated goal for therapy was “I want to learn..."
to do with one hand." Through a collaborative effort, the following four therapeutic goals were established:

1. To decrease edema and hypersensitivity of the right upper quadrant.
2. To improve performance in isolating, recruiting, controlling, and strengthening scapular muscles in preparation for prosthesis control.
3. To improve unilateral performance in activities of daily living.
4. To assist patient with psychosocial adjustments to amputation.

**Treatment**

The problems identified in the initial assessment and the treatment methods selected are shown in Table 1. Craniosacral therapy techniques were used in conjunction with pressure wraps and retrograde massage to decrease the edema of the right upper quadrant and to release fascial restrictions resulting from the traumatic injury. Craniosacral therapy was used because it is a gentle, noninvasive method of treating the fascial restrictions assessed through palpation of the craniosacral system motion (Upledger, 1987; Upledger & Vredevoogd, 1983). The craniosacral system comprises the cranium and the spinal cord down to the sacrum (Upledger, 1987; Upledger & Vredevoogd, 1983). The craniosacral system motion is the rhythmic pulse of the cerebrospinal fluid as it enters and exits the ventricular system of the brain (Upledger, 1987; Upledger & Vredevoogd, 1983). Palpation of this motion determines its rate, amplitude, quality, and symmetry. The information obtained from this palpation allows identification of the restrictions within the craniosacral system, including fascial restrictions throughout the body. Treatment comprises application of light touch techniques that seldom exceed 5 g of pressure (Upledger, 1987; Upledger & Vredevoogd, 1983). These treatments minimized the patient's whole body guarding response while providing a foundation for later mobilization and desensitization techniques as a precursor to functional movement.

Biofeedback was used to identify muscle fibers that could be used to control a myoelectric prosthesis; the upper, middle, and lower fibers of the trapezius were identified. Biofeedback was then used to train the patient to isolate, recruit, control, and strengthen these fibers (see Figure 3). During the initial biofeedback session, functional electrical stimulation (FES) was required for approximately 10 min to assist the patient in accessing the trapezius fibers. Once he experienced the contraction, he was able to voluntarily contract the muscles in subsequent biofeedback sessions; thus FES facilitated access to muscles that the patient then developed for use in functional control of a myoelectric prosthesis. As the feedback was both visual and auditory (Basmajian, 1989), it allowed the patient to build his confidence in his ability to isolate, recruit, control, and strengthen the trapezius fibers and to see his progress during and between sessions.

A video by Heinze (1988) was used to address activities of daily living and psychosocial adjustment issues. The video shows an occupational therapist who has right above-elbow and left below-elbow amputations demonstrating adaptive activities of daily living methods and speaking about psychosocial issues. Although the patient had no specific comments regarding the video, it helped him visualize adaptive methods used in activities of daily living.

The therapeutic use of self (Mosey, 1981; Reed & Sanderson, 1983) was employed throughout the therapeutic process to foster an environment that maximized the patient's ability to successfully meet the therapeutic challenges in the physical and psychosocial areas. An example occurred during a brief disclosure of anger. During this disclosure, I nodded my head, maintained eye contact, provided noncommittal reinforcers such as "uh-huh"

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Initial Evaluation Summary and Treatment Methods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem</td>
<td>Treatment Methods</td>
</tr>
<tr>
<td>Stump edema</td>
<td>Craniosacral therapy, Pressure wraps/ace bandages, Retrograde massage</td>
</tr>
<tr>
<td>Stump hypersensitivity</td>
<td>Craniosacral therapy, Desensitization techniques</td>
</tr>
<tr>
<td>Range of motion/strength</td>
<td>Shoulder girdle mobilization, Biofeedback, Home exercise program</td>
</tr>
<tr>
<td>Activities of daily living</td>
<td>Heinze video, Home program, Adaptive aids for bathroom, dressing, feeding, kitchen, and driving</td>
</tr>
<tr>
<td>Psychosocial</td>
<td>Use of self, Heinze video, Verbal interventions</td>
</tr>
</tbody>
</table>

Figure 3. Posterior view of disarticulation site during biofeedback of the upper trapezius.
At discharge, the right shoulder disarticulation site was within functional limits. He tolerated maximal flat palpation and moderate pincer and snapping palpations throughout the right upper quadrant. The skin was firm, with no signs of irritation. Although he continued having phantom sensation and phantom pain, there was a decrease in its intensity.

He demonstrated improved right shoulder girdle muscle strength as summarized in Table 3. These muscle strengths were adequate to activate a myoelectric prosthesis (Spiegel, 1989). His final left hand measurements indicated his performance was slightly improved in grip strength and key pinch, unchanged in tip pinch, and slightly diminished in palmar pinch and finger dexterity. Although these scores did not reflect significant changes, improvement was observed in functional prehensile activities such as manipulating coins, handling utensils, printing, and writing in cursive.

At discharge, he was independent in bed mobility and other activities of daily living. In self-care, he used a combination of one-handed techniques and adaptive aids, including a scoop dish and a nonslip mat to stabilize his plate while eating, a long-handled brush for showering, elastic shoelaces, and a button hook for dressing. His writing was legible but slow; printing was more coordinated than cursive writing. He completed a driving evaluation program at another facility and he is now driving independently with the use of a spinner knob.

Although he was pleasant and cooperative, he had difficulty expressing his feelings regarding the arm loss. Counseling was suggested and approved by the case manager. However, he declined this option.

### Summary
This patient received 26 outpatient occupational therapy sessions for a total of 32.5 hr during an 18-week period. All treatment goals were achieved with the exception of psychosocial adjustment issues, which are ongoing. He made significant gains in right upper quadrant muscle isolation and demonstrated control and strength of the upper, middle, and lower trapezius fibers adequate for a myoelectric prosthesis. He also made improvement with left manual dexterity and unilateral coordination with regard to activities of daily living. He was discharged from outpatient occupational therapy services and referred to another medical center for prosthesis evaluation. Twenty weeks after discharge from our facility, he returned for a follow-up visit. He had been fitted with a shoulder cap.

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**Table 3: Comparison of Shoulder Girdle Muscle Strength**

<table>
<thead>
<tr>
<th>Muscle</th>
<th>Initial Muscle Strength</th>
<th>Final Muscle Strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upper trapezius</td>
<td>Trace</td>
<td>Good Minus</td>
</tr>
<tr>
<td>Serratus anterior</td>
<td>Trace</td>
<td>Poor</td>
</tr>
<tr>
<td>Middle trapezius</td>
<td>Trace</td>
<td>Fair</td>
</tr>
<tr>
<td>Lower trapezius</td>
<td>Trace</td>
<td>Fair</td>
</tr>
<tr>
<td>Rhomboids</td>
<td>Trace</td>
<td>Fair Minus</td>
</tr>
</tbody>
</table>

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**Table 2: Example of Verbal Dialogue During Vocational Role Status Discussion**

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Therapist:</th>
<th>Patient:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Questioning</td>
<td>What kinds of work do you think you would like?</td>
<td>I don’t know. Not what I was doing before.</td>
</tr>
<tr>
<td>Restating</td>
<td>I think I heard you say “I don’t know.”</td>
<td>Yeah, I’m not sure.</td>
</tr>
<tr>
<td>Clarifying</td>
<td>When you say you are not sure, it sounds like you really mean you don’t know what’s available for you at the company.</td>
<td>I’m not going back to my old job.</td>
</tr>
<tr>
<td>Suggesting</td>
<td>Perhaps, if a job site assessment was done at your company, a suitable job might be found for you there.</td>
<td>I’m waiting till I get my arm and finish therapy before I think about a job.</td>
</tr>
</tbody>
</table>
and his tolerance for wearing it was approximately 10 hr per day. Thirteen weeks after the follow-up visit he resumed outpatient occupational therapy. We are evaluating his tolerance to the placement of a passive arm to the shoulder cap.

**Acknowledgments**

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**References**


