A Case Report on the Collaboration of Health Care Professionals in Fitting and Training Seven Iraqi Clients With Right Wrist Disarticulations 9 Years Postamputation

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In 1995, seven men from Iraq had their right hands surgically amputated under the regime of Saddam Hussein. The men have lived with the shame, that is associated with missing a right hand in their culture, since that time. Recently, the media and a team of health care providers collaborated to bring these seven men to Houston, Texas, for surgical revisions, prosthetic hands, and occupational therapy services. The preprosthetic, interim-prosthetic, and postprosthetic interventions are discussed, as well as the typical time frames for each. This case report outlines the time restrictions that were placed on the health care team and demonstrates the continuous collaborative approach between occupational therapists, prosthetists, and other health care professionals, which contributed to the initial successful outcomes for these men.


Background Information

In 1995, seven Iraqi businessmen underwent crudely performed surgical amputations of their right hands under the regime of Saddam Hussein. The amputations were punishments for the crime of using American currency in Iraq, an act that Hussein blamed for the downfall of his country’s economy. The imprisonment of the men at Abu Ghraib and the sentences, which were ultimately carried out on them, were intended as a public warning and deterrent to other Iraqi citizens.

This particular type of punishment has very strong symbolism, as there is a very distinct function associated with each hand in Iraqi culture. In the early habits of the Arab world, the right hand was considered the dominant, clean, or spiritual hand; and all good and polite deeds were done with this hand. Even today, toileting activities are typically performed with the left hand and it is considered offensive to shake someone’s hand with the left hand (Crabtree, 2002). Because it is also considered rude to give or receive an item with the left hand, all business transactions are completed with the right hand. Amputation of the right hand for theft typically resulted in excommunication because the thief could not eat with other persons (Friedman, 1978). Although the men did not outright steal, Hussein viewed their acceptance of a currency different than their own as deceitful. After the amputations of their right hands, the men were forced to confront the daily shame of using left “unclean” hands for all activities. Nine years after the amputations, in April 2004, a humanitarian effort stretched across the globe to bring these men to the Texas Medical Center (TMC) in Houston to receive new “clean” hands.

Team Approach

The following case study involves two occupational therapists in Houston, Texas, who were provided an opportunity to help improve the quality of life of these Iraqi men. This opportunity was the result of a partnership of several health care providers. Area surgeons performed revisions of residual limbs. Local certified prosthetists and technicians donated the skill and services required to create the
prostheses. A rehabilitation hospital with a long-standing excellent reputation for treatment of persons with amputations donated occupational therapy services for preprosthetic and prosthetic training. An international manufacturer of prosthetic componentry donated the SensorHand® (Otto Bock® HealthCare, Two Carlson Pkwy. North, Ste. 100, Minneapolis, MN 55447-4467; SensorHand, n.d.) and requisite myoelectric componentry for each of the men, as well as the technical and clinical support necessary for problem solving during treatment sessions.

The goal was to revise each man’s amputation, cast and fit each with a myoelectric prosthetic hand, and provide each with the appropriate training to meet his individual functional goals. However, due to unforeseen external influences, the men had only 1 month in the TMC in which to accomplish this goal (see Figure 1). Upon learning of the imposed deadlines for completion of all treatments and the need to expedite all services, a meeting between surgeons, prosthetists, therapists, and the manufacturer’s clinical educator occurred prior to the patients’ surgical revisions. One of the purposes of this meeting was to establish revised time frames of preprosthetic, interim-prosthetic, and prosthetic training that would accommodate the limited amount of time the men would be able to stay in the United States.

Conventional Prosthetic Management

Therapeutic intervention is essential and can be divided into three phases: preprosthetic, interim-prosthetic, and postprosthetic rehabilitation (Miguelez, 2002). A search of the literature revealed no suggested time frames for the phases of prosthetic training in myoelectric prostheses. Based on our clinical experience following revision surgeries, the preprosthetic phase typically takes 7–14 days. Interim-prosthetic training for myoelectric prostheses may last from 2–3 weeks, depending on the pain levels of the patient, the amount of time required for the limb to mature, and the time required for all prosthetic adjustments and final fabrication of a definitive device. The functional training and patient education with the prosthesis typically range between 3 to 4 weeks, and will vary depending on level of amputation. Although it is not recommended that treatments be accelerated for pre-, interim-prosthetic, and prosthetic training, the continuous collaborative approach between the occupational therapists and prosthetists within the restricted time frame of this case allowed successful outcomes for these men.

During the pre- and interim-prosthetic training with myoelectrics, challenges for occupational therapists and prosthetists in rehabilitation for the amputee routinely include some or all of the following (Meier & Atkins, 2004):

- correct shaping of residual limb
- maintenance of skin integrity
- enhancement of the patient’s contact tolerance via limb desensitization
- presence and extent of phantom pain and/or sensation
- training of selected muscles according to each patient’s selected myoelectric control strategy
- obtaining an accurate casting impression
- establishment and maintenance of appropriate test socket fittings throughout the maturation process of the revised limb
- regular monitoring of adequate electrode contact
- maintenance of appropriate electrode gains and increasing the patient’s overall wearing tolerance

Cultural Considerations

Inherent to these cases were additional challenges. Due to inconsistent and often absent qualified interpreters, language barriers existed in the treatment of all the patients, whose use of the English language ranged from nonexistent to moderate. As mentioned earlier, loss of the right or “clean” hand was seen as something shameful in the Iraqi culture. Consequently, the men tried to hide their residual limbs by keeping them tucked into their pockets, causing deficits in shoulder external rotation, shoulder flexion/abduction, and forearm supination. Additionally, the 9 years of limited use of the right upper extremity made muscle fatigue a significant problem during preprosthetic, interim, and prosthetic
training. Finally, radial nerve, shoulder, and back pain were each reported by one or more of the patients treated.

Many prosthetic options are available for amputees, depending on their needs and preferences. The client and the rehabilitation team (Physical Medicine & Rehabilitation physician, prosthetists, occupational therapist, social worker, and case manager) discuss together how the prosthesis will be used—taking into consideration prior vocational, home activities, and environments. Possibilities include passive hands for cosmesis, harness/hook or “conventional” combinations, myoelectric technologies, and hybrid combinations of some or all of the preceding. The desired functionality, durability, relative importance of cosmesis, and available funding are all factors in determining which type of device is ultimately fabricated.

Based on aforementioned factors, myoelectric hands were determined to be the most appropriate prosthetic choice. Myoelectric prostheses use surface electrodes to detect the activation of residual muscles and use this muscle activity to drive the electrically powered components of the hand. Voluntary muscle action is necessary to activate and control the prosthesis, with the forearm extensors opening the hand and the flexors closing the hand (Uellendahl, 2000). Myoelectric hands (specifically the Otto Bock SensorHand) were chosen for the subjects of this study for several reasons. The significance of the right hand in their culture has already been emphasized, and any device provided would require an acceptable cosmesis. Additionally, all the men had vocational backgrounds in business enterprises, making a cosmetic prosthesis even more necessary. All of the subjects expressed interest in a prosthesis capable of active prehension to allow for bimanual function. During initial evaluation, all subjects were found capable of generating sufficient myoelectric signals to operate a terminal device. Finally, the medical team was assured that there were facilities available to the subjects where follow-up care and prosthetic maintenance could be obtained.

Preprosthetic Therapy Program

During the 1st week, the seven patients were initially seen for an occupational therapy evaluation and began preprosthetic training. Preprosthetic training included education on the importance of daily active assistive range of motion (ROM), with an emphasis on:

- shoulder flexion/abduction, external rotation, and supination
- scapular strengthening
- desensitization for hypersensitivity of residual limb as a prerequisite for tolerating compression of the prosthetic socket
- scar tissue manipulation

Interim-Prosthetic Therapy Program

Myo-site testing and training were also begun to determine the most appropriate electrode sites. Once the optimal sites were selected, muscle training began. The MyoBoyTM from Otto Bock HealthCare (Otto Bock HealthCare, n.d.) is a computerized software/hardware tool that allows the prosthetist and therapist to evaluate and train possible muscle sites for myoelectric use. The software also allows a clinician to document progress and increase in muscle strength and control. It measures patient muscle potentials with the same surface electrodes used in the definitive prosthesis and also allows immediate feedback in the training module to help patients train and prepare for myoelectric hands. The MyoBoy serves as a biofeedback tool for either positive or negative reinforcement of muscle activity, based on what the clinician is trying to achieve. In this particular case, where language was a barrier, the MyoBoy was a valuable visual tool when explaining to the patients what they were trying to accomplish. The patients could see the computer screen and understand which muscles to activate or relax to get the signals to increase or decrease. The MyoBoy software is also equipped with a game function and a virtual hand mode that allowed some of the patients to see and experience success before they ever received an actual prosthetic device.

All seven men were casted for prostheses during the 2nd week and received their test sockets the day after being casted. After test sockets were received, therapists and prosthetists continued to evaluate proper electrode placement for optimal function. Preprosthetic rehabilitation was continued with an emphasis on muscle isolation with each of the patients. During this 2nd week, all of the patients exhibited increased independence with self range of motion, strengthening, and desensitization techniques.
Prosthetic Therapy and Functional Training

At the beginning of the 3rd week, the patients received the test sockets with the myoelectric hands attached. The role of occupational therapists in the prosthetic phase included finalization of electrode placement and beginning basic functional training with the hands (i.e., opening and closing of the hand, donning and doffing the prosthesis, and prepositioning the wrist to complete functional tasks desired). Initially the men had limited wearing tolerance of 20–30 minutes due to muscle fatigue. Additionally, several men reported increased pain at the distal end of their residual limb due to the weight of the SensorHand on the residual limb that had just been surgically revised.

As would be reasonably anticipated, shrinkage of the revised residual limbs was rapid throughout training, affecting the contact of electrodes against target muscle sites and causing inconsistent signals. A valuable approach in this stage of intervention included daily site visits and conversations between the occupational therapists and prosthetists. During the castings and test socket fittings at the collaborating orthotics and prosthetic facility, the therapists were present to ensure and finalize electrode placement and gain settings, to increase the effectiveness of use of the electronic components by identifying and reducing cocontraction tendencies, and augment the proficiency of donning and doffing the protheses. Similarly, the prosthetists involved were present during occupational therapy treatment sessions to observe the fit of the prosthetic sockets during functional use, performing socket modifications as needed, and to ensure consistent and comfortable suspension. Some changes were made during the therapy sessions by the prosthetists, whereas others required the men to return to the prosthetists’ office after occupational therapy treatment sessions. The clinical education representative from the manufacturer of the donated prosthetic componentry was available during both therapy sessions and prosthetic fittings to problem solve any issues specific to her company's componentry.

The on-site approach by each discipline assisted with the consistent communication required in this case and allowed the occupational therapists and prosthetists to be involved in all aspects of training from initial contact to discharge. For the seven men, it also provided a seamless transition and continuity of care that reassured them of our commitment as a team to make every minute count and complete the desired outcomes.

During the 4th week the men received their final protheses and continued to work on functional training. Before their departure, each of the men demonstrated proficiency in the donning and doffing of his prosthesis. Additionally,
each experienced increases in muscle endurance, wearing tolerance of 4–6 hours consistently, and the ability to control the speed and direction of hand movement to complete specific fine or gross motor tasks.

### Functional Outcomes

Throughout the interim- and postprosthetic occupational therapy, each of the seven men had specific and unique functional goals that served as motivating factors during their training. Occupational therapists typically educate the amputees regarding adapted techniques and adapted equipment with the goal to maximize adaptation and function (Melendez & LeBlanc, 1988). Daily graded activities were set up to achieve these goals. For example, one man wanted to return to his occupation as a money changer. This particular gentleman focused on the task of picking up paper money, counting out money to an individual, and taking money from individuals. In another example, an educator wished to be able to write on the board again with his right hand. His main focus in daily treatment sessions was writing on a simulated chalkboard with a variety of writing utensils. Tailoring of each subject's training to his personal interests facilitated his motivation and attention.

Although each of the men had become proficient at performing all activities of daily living with their left upper extremity, each of the men also took great pride and enjoyment in writing again with his right hand. This man focused on the task of counting and handling money. Tailoring of each subject's training to his personal interests facilitated his motivation and attention.

Although each of the men had become proficient at performing all activities of daily living with their left upper extremity, each of the men also took great pride and enjoyment in writing again with his right hand. The men developed camaraderie and encouraged one another with the use of his new hand. All men received education and training regarding proper care and maintenance of the prostheses (i.e., charging the batteries, cleaning the glove). Some concerns the men expressed before leaving were the repair services available to them and follow-up with fittings, if necessary. The prosthetists agreed to make arrangements for repair if needed from a fitting standpoint, and the hands could be sent to the manufacturer base in Germany for any components or electrical repairs.

Although these men were 9 years postamputation, the therapists were able to assist the subjects in increasing both their ROM and their ability to perform the isolated muscle contractions necessary to effectively use the myoelectric prostheses. The ability of each subject to perform isolated muscle contractions is reflected in the sensitivity or "gain" setting of each subject's electrodes. Smaller gains indicate...
that the subject is capable of stronger, better-isolated contractions. Table 1 shows the changes that were made in ROM, sensitivity settings for the SensorHand, and pain.

Due to the prolonged immobility of subjects’ residual limbs, the initial endurance of wrist flexors and extensors was limited. Though data on muscle endurance was not collected, the treatment team additionally observed variable increases in stamina of the control muscle groups. Generally, in those subjects where residual limb pain induced by muscle contraction was mild or absent, muscle endurance increased quickly. In those patients where muscle contractions induced moderate to severe pain, endurance improved at a slower rate.

Malone et al. (1984) suggests that the first month after upper-extremity amputation is the “golden period” in which prosthetic fittings are recommended to maximize the level of acceptance. Another study found that acceptance and use of the prosthesis following traumatic upper-extremity amputation was more likely if prosthetic fitting and training were implemented as soon as the limb could tolerate the socket (Pinzur et al., 1994). Although this insight is generally accepted, it is interesting to note that all of the subjects in this case were 9 years postamputation before receiving their initial prosthesis. Although initial acceptance appears promising, long-term data are not yet available to support or refute Malone’s suggested time frame with respect to these patients. Factors that may allow the case subjects to achieve prosthetic success and acceptance despite the extended time period between amputation and prosthetic fittings may include the social stigma of right-handed amputation in their country and the psychological implications stemming from the initial causes of the amputations.

Table 1.

<table>
<thead>
<tr>
<th>Name</th>
<th>Pain Scale</th>
<th>Shoulder Flexion</th>
<th>Shoulder Abduction</th>
<th>Shoulder External Rotation</th>
<th>Forearm Supination</th>
<th>Forearm Pronation</th>
<th>4/29/04 Electrode Sensitivity Settings</th>
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<td>Trace</td>
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<td>WNL</td>
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<td>Trace</td>
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<td>0–60°</td>
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*Not tested secondary to pain, open surgical site, and inability to tolerate task.

<table>
<thead>
<tr>
<th>Name</th>
<th>Pain Scale</th>
<th>Shoulder Flexion</th>
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<th>Shoulder External Rotation</th>
<th>Forearm Supination</th>
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<td>WNL</td>
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<td>0–60°</td>
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<td>0–85°</td>
<td>0–80°</td>
<td>R-2; B-5</td>
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</table>

*Not tested secondary to pain, open surgical site, and inability to tolerate task.

Note. R = red sensitivity settings used for wrist extensors to open hand; B = blue sensitivity settings used for wrist flexors to close the hand; WNL = within normal limits. The levels of sensitivity on the electrodes range from 1–6. Larger numbers represent a more sensitive setting.
Beyond the successful fitting and training of the seven subjects, many additional positive outcomes emerged from this experience. The team members working with these men had the opportunity to learn about and experience a new culture and learn the different daily living priorities of each individual. Likewise, the men expressed their satisfaction in enjoying the opportunity to view and take part in the American way of life. The experience ultimately brought together cultures that each had only heard about or seen in the media at a time when both countries were receiving much attention.

Summary

The intense collaborative efforts between prosthetists and occupational therapists reached a new level during this experience. All clinicians involved recognized that the consistent and constant communication with one another made this experience a success. Ideally, occupational therapists would typically collaborate with prosthetists when dealing with upper-extremity prosthetics; but in reality, this is not always the case (Melendez & LeBlanc, 1988). This case report demonstrates the importance and effectiveness of a collaborative team approach in which the occupational therapists and prosthetists worked closely together to have each of these men complete preprosthetic, interim-prosthetic, and prosthetic training within a 4-week time frame. The intensity of this clinical case reinforced the values and influence we can have on our patients when the treating team works in a collaborative manner.

Finally, there was value in watching the seven men from Iraq take their initial experiences in occupational therapy and create additional learning opportunities. Initially, the occupational therapy treatment sessions were clinician-guided, as the patients were encouraged to meet the various goals set by the therapists to encourage functional use and operation of the prosthetic hands. As training progressed, there was an evident transition from these activities toward more individualized patient driven tasks that would integrate the men back into their respective societies and lifestyles. They benefited from the tools we provided them as therapists and began choosing relevant and meaningful tasks on their own—the very basis of occupational therapy.

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References


