CASE REPORT

Evaluating the Potential for Powered Mobility

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Chris has lived in a state school for persons with mental retardation for approximately 21 years. In 1983, she was selected as a possible candidate for a powered wheelchair. The following case report describes the 5-year process involved in her learning to use the chair and the clinical reasoning used by therapists to assist her in achieving her goal.

Client Information

Chris is a 38-year-old woman who at birth experienced encephalopathy secondary to anoxia, resulting in spastic quadriplegia with athetosis and scoliosis and mild mental retardation. She has been seen at an outpatient clinic since the age of 3 years, had numerous surgical procedures throughout childhood to assist with her muscle spasticity, and was admitted to a state school for persons with mental retardation at 17 years of age.

Chris has received all of the major therapies during her stay in the institution. Over the years, staff members have worked with her on numerous programs designed to increase her independence and control over her environment. These programs, including toilet training and drinking independently with a straw, have been largely unsuccessful. She has also participated in various training groups, including prevocational and activities of daily living groups, and has received custom-made positioning equipment (i.e., a wheelchair insert) and communication devices. Functionally, she is dependent on others for transfers, feeding, and manual wheelchair mobility. She can use her right hand with great difficulty to pick up and release small objects.

Chris has increased muscle tone, a slight startle reflex, and an asymmetrical tonic neck reflex. She is nonverbal as a result of dysarthria, but she is very sociable and can communicate her preferences with an eye-gaze communication board. Using this device, Chris demonstrates basic spelling and reading skills.

Currently, Chris is attending a day activity program 5 days a week for 4½ hr a day, where she participates in music, adapted physical education, recreation, mobility, and communication training. She enjoys watching sports on television and visiting with friends on her unit for coffee, and she greatly appreciates receiving special attention. She has an extended family who visits her regularly and who is actively involved in her care and treatment program.

Reasons for the Use of a Powered Wheelchair

In 1983, Chris was referred to occupational therapy to see if she would be a candidate for a powered wheelchair. The occupational therapist viewed the use of such a wheelchair as a long-term goal requiring a thorough evaluation to determine the type of wheelchair that would be most appropriate for her needs.
controls Chris could use followed by extensive training. Toward this end, an occupational therapist, a physical therapist, and technicians from the Therapeutic Equipment Center of the Walter E. Fernald State School in Waltham, Massachusetts, have been working with Chris for several years.

Although Chris is now motivated to achieve independence in mobility using a powered wheelchair, she did not express this desire initially, probably because she was unaware of the possibility. The original goal of mobility, therefore, was decided by occupational and physical therapists who knew Chris well. They considered her a good candidate because she has good cognitive abilities, extremely limited physical abilities that would prohibit her from ever using a manual wheelchair independently, and excellent social skills that could be used more fully were she able to move about independently to visit her friends. Because Chris does enjoy feeling special and few of her peers have powered wheelchairs, the staff felt that she would be motivated to work hard on wheelchair mobility training.

**Initial Evaluation and Training Process**

Although independent mobility in a powered wheelchair was the ultimate goal, the team of staff determined that some interim training devices would be necessary for Chris to achieve this goal. Because of the high price of powered wheelchairs and because it was not certain that Chris would be able to control one, it was deemed important for her to learn to use interim electronic devices that would give an indication of her abilities. Additionally, the method of control (e.g., joystick or other device) that would be appropriate and manageable for her was unknown. Her special positioning needs made it difficult for her to use someone else's wheelchair for a trial.

As a first step in the evaluation of Chris's potential to use a powered wheelchair, a Solo Unit was attached to her manual wheelchair. The Solo Unit permits a manual wheelchair to be battery powered and consists of two 12-volt batteries, a controller with friction drive wheels, and a control box. The controller is secured to the back of the manual wheelchair so that its two drive wheels contact the rear wheels of the wheelchair.

Chris was evaluated on her use of her right hand to manipulate an adapted joystick (T-handle) with the control box mounted on the right armrest. She had great difficulty releasing the joystick, fair ability to move the joystick to the left and right, and poor ability in the forward and backward directions. It soon became obvious that Chris's ability to control her right upper extremity was greatly affected by her head position.

As an alternative to the traditional joystick, a chin control was temporarily mounted on Chris's wheelchair and hooked to the Solo Unit. This option was chosen because, like a joystick, it offers the advantage of direct, proportional control. Although in some ways the chin control seemed better suited to Chris's needs than the traditional joystick, it too had its problems. Because of athetoid movements during her efforts to support her body in the upright position, Chris's chin was frequently not in a good position in relation to the control box. Also, her muscle tone and reflex involvement made control of her head and jaw movements difficult.

Both the training with the joystick and the chin control evaluation were accomplished in an uncluttered, fairly wide area in Chris's building. After being positioned correctly in her wheelchair, Chris's occupational therapist and physical therapist helped her passively make the movements necessary to move the joystick or chin control. Although the Solo Unit was mounted on her wheelchair throughout this time period, it broke so often that Chris only experienced powered mobility for 3 weeks during a 5-month period.

When the Solo Unit was working, the occupational therapist stood in the hall approximately 15 ft from Chris and instructed Chris to come to her. Additional verbal instructions were given when needed. Chris was allowed to run into walls or other obstacles as part of the learning process and was encouraged to try to right her course herself. Because on some occasions she was able to do so (e.g., by backing the wheelchair and turning it in the right direction), her therapists felt fairly certain that she had the perceptual spatial skills necessary to drive a powered wheelchair. It was the motor control component that needed work. Chris's therapists also decided that she was more likely to be successful using her right hand than using the chin control, and they had Chris continue to practice using the joystick for 5 months.

This practice period yielded some important information about Chris's abilities and difficulties and resulted in a number of adaptations, both major and minor. An elastic strap was added to the T-handle of the joystick to help keep Chris's hand in place. We found that the excessive force was damaging the control box of the Solo Unit, so in 1984, a device was designed to allow movement in only two directions. This device, an arm trough mounted on ball-bearing racers, was fabricated and mounted on top of Chris's right armrest. The goal of this device was to allow Chris to use shoulder and elbow movements (rather

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1 This particular unit is no longer available, but similar units are available from Fortress Scientific, 61 Miami Street, Buffalo, NY 14204.
than the usual wrist and hand movements) in only two directions and to limit the range of movement. These motions would be used to move the wheelchair forward and backward.

Chris used the arm trough device for approximately 6 months and, for a short time while the Solo Unit was working, actually experienced powered mobility. Training sessions occurred three to five times per week for about a half hour each and were similar to the sessions with the standard joystick and chin control. Progress over this period, however, was not entirely smooth. Chris's ability to use the device seemed to be affected by many things, including her mood, the degree of muscle spasticity, the people present, and the condition of the ball-bearing device. The ball-bearing racers that allowed the arm trough to move did not work smoothly, especially after being subjected to spilled food and drink. Additionally, Chris had difficulty isolating the forward and backward movements necessary to use the device.

Reassessment and Further Training

After a year, a meeting was held with Chris's occupational therapist and physical therapist together with staff from the Therapeutic Equipment Center to determine the next step. It was evident that the Solo Unit had not been useful, but that allowing Chris to practice with the various training devices had yielded some interesting results. The problem was that Chris had inadequate control of her shoulder and elbow movements and was unable to eliminate side-to-side movements. The lateral movements caused the ball-bearing mechanism to catch, thus preventing a smooth forward and backward movement. The ball-bearing arm trough, therefore, was discarded.

Beginning in 1986, a new occupational therapist began evaluating Chris to determine if she had sufficient control over any four movements to enable her to move a wheelchair forward, backward, to the left, and to the right using discrete microswitches for each direction. Movement of Chris's head, right arm, and right foot were selected for in-depth evaluation, because this was where she appeared to have the most control.

Meanwhile, Chris's therapists had been evaluating her ability to use her right arm in other positions. They had found that by supporting her forearm on several books placed on her lap, she had fairly good control of two motions—a pushing-away motion at an angle of approximately 45° to her body and a pulling-back motion at the same angle (see Figure 1). It was decided that the Therapeutic Equipment Center would build a lap tray to support Chris's right arm at an appropriate height and would mount an inexpensive game-type joystick below the surface of the tray, so that only the joystick would show above the tray.

The occupational therapist made a splint to position Chris's hand and wrist. This splint was attached to the joystick and prevented Chris from releasing the joystick (see Figure 2). Therapeutic Equipment Center therapists and fabricators also designed a direction indicator box with lights that indicated whether the joystick was in the forward, backward, left, right, or neutral position.

The device was used on Chris's manual wheelchair to simulate powered mobility. Training sessions consisted of having Chris drive down a wide hallway. When Chris pushed the joystick forward, the forward indicator light would light and the therapist would push the wheelchair forward. If the left light was lit, the therapist would turn the wheelchair to the left, and so on. It was soon obvious that the lights were not sufficient to give Chris feedback on the joystick position (she was supposed to be watching where she was going), so a buzzer was added that sounded whenever the joystick was positioned in any of the four directions.

Over a period of many months, the following conditions for success were found necessary to compensate for Chris's poor motor control:

1. The forearm needed to be supported on a horizontal surface to improve control.
2. The right hand and wrist needed to be stabilized in a splint attached to the joystick to maintain grasp on the joystick.

3. The joystick needed to be pushed forward and backward at an angle of about 45° to the body, rather than straight forward or backward at a 90° angle.

Although lateral movement of the joystick allowing right and left turns was possible, Chris often got stuck in one of these positions. Therefore, neck rotation was substituted for arm movements for the left and right directions through the mounting of two switches on a headrest. The headrest was transparent, so as not to block Chris’s peripheral vision (see Figure 3). Chris practiced using the joystick and head switches attached to her manual wheelchair for about 5 months in training sessions that lasted approximately 45 min, at least three times per week. In these sessions, powered mobility was simulated with the methods described earlier.

Use of the Powered Wheelchair

Trial Powered Wheelchair

In mid-1987, it was decided that Chris was progressing well enough to try a new powered wheelchair borrowed for 1 week from a vendor. A Fortress Scientific wheelchair was chosen because of its compact base, adjustable level of sensitivity, and environmental control options. Much technical and fabrication effort was required to allow Chris’s seating insert to mount onto the Fortress base, but the effort proved to be worthwhile, giving both Chris and her therapists encouragement to continue. The new seating insert was designed to give her more trunk and leg support. A special lap tray was built to support her arms and to allow her to use her right hand on the joystick.

After 1 month of practice, Chris was able to drive 50 ft down the hall with an average of two to three bumps into the walls. After such errors, she was able to correct her direction and continue down the hall. Problems remained, however. Chris apparently became discouraged with the amount of effort required to control the wheelchair and was often distracted during training sessions. As a result, her performance declined and she became even more discouraged. Her therapists altered her training program so that she was in her powered wheelchair only 1 hr per day, 5 days per week. She was also reinforced with coffee and stickers for time spent practicing.

Final Powered Wheelchair

Eight months later, in April 1988, Chris’s wheelchair arrived: a Fortress Scientific power base with two head switches for left and right, a joystick for forward and reverse, and the option for a kill switch, which would stop the chair when engaged (see Figure 4).

After their initial jubilation, the therapists and technical staff at the Therapeutic Equipment Center recognized a serious problem. Chris had spent all but 2 weeks of her recent training period using an inexpensive, game-type joystick. She would now be using the slim, fragile joystick common on powered wheelchairs. Furthermore, she would have to have her splint attached to it. Any number of physical adaptations were considered to limit the force and range of her movements in order to protect the joystick and...
control box from damage. Finally, an electrical engineer was consulted and an inexpensive joystick, similar to the one Chris had been using in training, was wired to the wheelchair controller for the forward and reverse directions.

Summary

It has been 5 years since Chris was evaluated for a powered wheelchair, and she has had two occupational therapists and three physical therapists since the evaluation and training process began. It has been a long and arduous process, full of triumphs and setbacks. Chris’s level of functional mobility, self-confidence, and ability to socialize, however, have increased dramatically as a result of her perseverance. The powered wheelchair, which she can control herself, has increased her ability to explore her environment and to master the increased activities made available through an expanded environment.

Editor’s Note. To continue the Case Report department, we need and welcome reports that document the practice of occupational therapy for specific clinical situations. Guidelines for writing case reports are available from the Editor.