CASE REPORT

A Task-Oriented Approach to the Treatment of a Client With Hemiplegia

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Key Words: hemiplegia • motor control • systems theory

This case report describes a task-oriented approach to the rehabilitation of a 34-year-old woman with left hemiplegia. The task-oriented approach is based on a systems model of motor control and contemporary motor learning theories. Systems models propose that occupational or functional performance emerges from the interaction and cooperation of many systems, and that no one system has a logical priority for controlling or organizing the system (Kamm, Thelen, & Jensen, 1990; Mathiowetz & Haugen, 1994). The idea behind this approach is that, at different times, various systems can control the behavior that emerges from the interaction of systems. The application of this model in rehabilitation emphasizes that effective therapeutic intervention depends on identification of the system that is critical to controlling the occupational performance at a specific time.

In the task-oriented approach, Mathiowetz and Haugen (1994) have used uniform terminology to propose that occupational performance emerges from the interaction of systems (see Figure 1). These systems are grouped into those relating to the person (sensorimotor, psychosocial, and cognitive systems) and those relating to the total environment (cultural, socioeconomic, and physical environment systems). Mathiowetz and Haugen proposed that intervention to alter occupational performance can occur through any or all of these systems. For example, for a person with a physical limitation, occupational performance could be enhanced either by altering the environment or altering the client's abilities by minimizing the physical limitation. The selection of one of these interventions would be determined collaboratively by the client and the therapist.

The treatment in this case report is based on the hypothesis that the sensorimotor system was the critical system limiting this client's occupational performance and that addressing this system with concepts from a task-oriented approach would result in improvement in the client's occupational performance. The sensorimotor system includes strength, endurance, range of motion, coordination, sensory awareness, postural control, and perceptual skills (Mathiowetz & Haugen, 1994). Although these components are familiar concerns in rehabilitation, the task-oriented approach focuses on the interactions between these components and uses the concepts of degrees of freedom and control parameters.

Degrees of Freedom

Bernstein (1967) first identified degrees of freedom as he explored how the central nervous system could efficiently control the many variables in movement, including the number of joints, motions within each joint, muscles that control each joint, and single motor units within each muscle, in order to achieve a single movement goal. The challenge of controlling this large number of variables, or
multiple degrees of freedom, is met in a variety of ways at different times. When a gymnast is attempting new maneuvers, he or she may limit the multiple degrees of freedom in the task by holding some joints rigid while focusing on other parts of the task such as hand or foot placement. Although the initial effect is a stiff appearance to the movement, as the gymnast becomes able to control more degrees of freedom, the stiffness disappears and a relaxed movement results. In fact, a relaxed appearance indicates that the gymnast has become more skilled at performing the maneuver.

The degrees-of-freedom concept may help to explain the incoordination and difficulty that clients with hemiplegia have in using their impaired upper extremities. For example, when asked to move a single joint in a specific plane of motion, a client with hemiplegia may have sufficient muscle strength to perform this movement without a major change in muscle tone or an abnormal movement pattern. However, when asked to perform a task with more than one joint or to combine the available movements into a functional task, the client may be unable to coordinate these isolated movements into a functional unit and may exhibit increased tone, or stiffness, in some muscle groups. From a systems perspective, this emergence of ineffective functional movement in the presence of adequate strength within component muscle groups may reflect the client’s attempts to control the multiple degrees of freedom in the limb (Horak, 1991). In an effort to achieve the functional goal, the client may attempt to increase the control of some joints by stabilizing them. Therefore, increased tone in clients with hemiplegia may actually be the result of their efforts at functional movement (Horak, 1991).

**Control Parameters**

A control parameter is a variable that shifts a person’s behavior from one form to another (Heriza, 1991). A component of a system, such as strength, could be a control parameter. If muscle strength is decreased due to a stroke or disuse, the result may be abnormal movement patterns or no movement at all. If muscle strength is increased through therapy, the result may be enhanced functional performance. Several control parameters may influence a person’s behavior. For example, in treating a client who has shoulder pain and weakness, a therapist may hypothesize that the client does not use the limb because of weakness. If strength is increased in the limb, but the client does not use the limb because it is painful, a shift in the client’s patterns of use will not occur because...
the critical control parameter (pain) was not addressed in treatment. The concept of a critical control parameter is particularly important because although a systems model identifies many opportunities for intervention, only changes in the critical control parameter will result in changes in behavior or performance. A control parameter is considered critical if changes to it result in changes to the client’s occupational performance.

The concept of control parameters can be seen in the hypothetical case of a male adolescent with a spinal cord injury who is returning to school. If the therapeutic interventions or adaptive equipment used in rehabilitation are not deemed acceptable to the client within his peer group, there will be little carryover of treatment to the school setting. In this case, the psychosocial system may be the critical control parameter; therefore, intervention would be appropriately focused on the client’s psychological adjustment to his disability. Although the client has other problems that need to be addressed, permanent change in his occupational performance will not occur without effective intervention in this critical control parameter.

Sensorimotor System

Ideas from systems theory, along with information regarding muscle function after central nervous system damage, have led to changing approaches to the sensorimotor system. Studies have confirmed that strength in clients with hemiplegia is decreased; clients are unable to generate adequate force in impaired muscles (Bourbonais & Noven, 1989; Duncan & Badke, 1987). Clients with hemiplegia also are slow to contract and relax muscles (Sahrmann & Norton, 1977). In other words, when the client attempts to initiate a movement, it takes much longer to generate force than it did before the cerebrovascular accident (CVA); once force is generated, the muscle is slower to return to its original state of relaxation. Thus, longer lengths of time must be allotted for the client to obtain muscle contractions in the hemiplegic limb. This delayed relaxation of the muscle may explain the increased tone that occurs after muscle contractions, particularly with repeated or reciprocal muscle contractions.

Recent literature on motor learning has offered new definitions of learning and performance. Schmidt (1988) has made a distinction between motor performance, the performance that is evident during practice or during a therapy session, and motor learning, the skill that is evident at some time after the practice has been discontinued. In fact, techniques that improve motor performance, such as constant feedback and blocked practice (practice in which there is repetition of a single task) may actually interfere with motor learning. Research has shown that motor learning is enhanced through intermittent feedback and random practice (practice in which a number of tasks are repeated in a variable fashion) for subjects without hemiplegia (Shea & Morgan, 1979; Weinstein & Schmidt, 1990).

The task-oriented approach described by Mathiowetz and Haugen (1994) comprises the systems model of motor control and its concepts of degrees of freedom and control parameters, information on muscle function in hemiplegic upper extremities, and use of techniques that maximize motor learning. This case report describes the use of this approach as applied to a client with hemiplegia.

Client History

The client is a 34-year-old woman who had a CVA 6 weeks earlier with resultant left-sided weakness. The CVA occurred in her right middle cerebral artery as a result of an emboli from an aneurysm defect. She began receiving inpatient rehabilitation services 4 days after her CVA and continued inpatient therapy for 2½ weeks. She then attended a day hospital program for another 3 weeks. At the time of this referral, she was making a transition from the day hospital program to outpatient services within the same facility for continued therapy to improve her activities of daily living and left upper extremity function.

Before her CVA, the client worked 4 days per week as a registered nurse on a high-risk antepartum unit. She had been married for 10 years and had two children, aged 3 years and 7 years. She engaged in a variety of handicrafts. She and her family enjoyed a variety of outdoor activities, such as camping and cross-country skiing. At the time of her CVA, she was 2 weeks pregnant with her third child and, at admission to outpatient therapy, the pregnancy was proceeding normally. After the client’s CVA, her husband and her mother managed the child care and homemaking responsibilities that she had previously performed.

The client continued to have limited skills in occupational performance at the time of her transition to outpatient therapy. She was independent in dressing and feeding and was able to prepare a light meal from her wheelchair if given ample time. With minimal assistance, she was able to walk 500 feet to 400 feet and was able to climb staircases that had railings. She needed supervision with transfers and required stand-by assistance for bathing when using a tub bench. Her tolerance for activities was diminished, due in part to difficulties with lightheadedness and nausea related to her pregnancy and fatigue related to her pregnancy and hemiplegia.

An evaluation was made of the client’s environment, including physical, socioeconomic, and cultural components. Her home was accessible to her in relation to her mobility status and did not require major adaptations. The client was not driving at this time and, because of both her inability to operate the car’s manual transmis-
Within the client’s culture there was a strong motivation to work and, from her first day in outpatient therapy, she talked of returning to work. She and her husband had a supportive network of family and friends who were able to help with child care and transportation for therapy.

Assessment of her personal characteristics, which included the cognitive, psychosocial, and sensorimotor areas, indicated strong interaction between her cognitive and psychosocial systems. While the client had been an inpatient, cognitive problems were identified, including impulsivity, decreased visual memory, and increased distractibility. However, after her discharge, these problems were no longer present. The client reported that she was “uncomfortable” being an inpatient in the hospital in which she worked and that anxiety decreased when she went home, which in turn resulted in her improved cognitive function. She also was relieved to be at home with her children for part of the day and to be able to supervise their care. When the client was seen in outpatient therapy, she was alert, motivated to make improvements, and outspoken about her intention to return to work as soon as possible. She was very interested in the therapy process and followed through on instructions for home activities and exercises. Initially, she had hoped to return to work within several months and work until the birth of her third child. As her rehabilitation continued, she decided to delay her return to work until after her maternity leave.

The client’s sensorimotor system was seriously impaired. Although sensation in her impaired (left upper) extremity was intact, the extremity was weak throughout, with mildly increased muscle tone evident with proximal motions (see Table 1). She did not spontaneously incorporate her impaired arm into functional activities, but was able to use it as a gross stabilizing assist when cued. She described use of her arm as “contrived.” She was unable to perform either the Jebsen-Taylor Test of Hand Function (Jebsen, Taylor, Trieschmann, Trotter & Howard, 1969) or grip strength tests (Mathiowetz et al., 1985).

Although the validity of manual muscle testing (MMT) (Daniels & Worthingham, 1980) in cases of central nervous system deficit has been questioned in the presence of abnormal tone (Bobath, 1990; Daniels & Worthingham, 1980; Davies, 1985), there is support for using MMT as one component of evaluation for clients with central nervous system dysfunction (Bohannon, 1989). MMT was used in this case because weakness was hypothesized to be the critical control parameter for this client’s function. Therefore, some measurement of that critical control parameter was essential.

In addition to MMT (Daniels & Worthingham, 1980), evaluation of the client included observation and report of use of the arm in functional activities, hand function testing, and grip strength evaluation. The presence of increased tone in the arm during testing was recorded along with the MMT score.

### Treatment Program

The client received 1-hr outpatient occupational therapy sessions over a 6-month period, with the frequency of the sessions decreasing over time from three treatments per week to one treatment per month. The client’s long-term goal was the resumption of her social and professional roles. The client selected the focus of treatment and was very anxious to resume her roles within her home. For this reason, treatment was initially directed toward child care and homemaking tasks and later toward specific anticipated work tasks. Her rehabilitation program was frequently revised, with the determining factor for change being progress or lack of progress in occupational performance. Various components of the systems model of motor control were reviewed periodically to determine their effects on the client’s function. However, the treatment program focused primarily on the sensorimotor system because the resumption of her work as a nurse was highly unlikely without improved use of her impaired hand.

### Table 1

<table>
<thead>
<tr>
<th>Upper Extremity Motions</th>
<th>1½ Months</th>
<th>3½ Months</th>
<th>5½ Months</th>
<th>7½ Months</th>
<th>11 Months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoulder flexion</td>
<td>2+ with mildly increased tone</td>
<td>3+</td>
<td>4+</td>
<td>4+</td>
<td>5</td>
</tr>
<tr>
<td>Shoulder abduction</td>
<td>2+ with mildly increased tone</td>
<td>3+</td>
<td>4+</td>
<td>4+</td>
<td>4+</td>
</tr>
<tr>
<td>Shoulder external rotation</td>
<td>2+ with mildly increased tone</td>
<td>3+</td>
<td>4</td>
<td>4</td>
<td>3+</td>
</tr>
<tr>
<td>Shoulder internal rotation</td>
<td>2+ with mildly increased tone</td>
<td>4</td>
<td>4+</td>
<td>5-</td>
<td>5-</td>
</tr>
<tr>
<td>Elbow flexion</td>
<td>2+ with mildly increased tone</td>
<td>3+</td>
<td>4</td>
<td>4+</td>
<td>5</td>
</tr>
<tr>
<td>Elbow extension</td>
<td>2+ with mildly increased tone</td>
<td>3+</td>
<td>4</td>
<td>4+</td>
<td>5</td>
</tr>
<tr>
<td>Supination</td>
<td>2-</td>
<td>3+</td>
<td>4+</td>
<td>4+</td>
<td>5</td>
</tr>
<tr>
<td>Pronation</td>
<td>2-</td>
<td>3+</td>
<td>4+</td>
<td>4+</td>
<td>5</td>
</tr>
<tr>
<td>Wrist extension</td>
<td>2-</td>
<td>3+</td>
<td>4+</td>
<td>4+</td>
<td>5</td>
</tr>
<tr>
<td>Wrist flexion</td>
<td>2-</td>
<td>3+</td>
<td>4+</td>
<td>4+</td>
<td>5</td>
</tr>
<tr>
<td>Finger flexion</td>
<td>2-</td>
<td>3+</td>
<td>4+</td>
<td>4+</td>
<td>4+</td>
</tr>
<tr>
<td>Finger extension</td>
<td>2-</td>
<td>3+</td>
<td>4+</td>
<td>4+</td>
<td>4+</td>
</tr>
<tr>
<td>Thumb muscles</td>
<td>2-</td>
<td>3+</td>
<td>4+</td>
<td>5</td>
<td></td>
</tr>
</tbody>
</table>


*Unable to test client due to her pain.*
arm. Although adaptation of the environment and compensatory techniques were possible interventions, the wide range of tasks required in her job made these strategies complex. In addition, these strategies were not the client's first choice of treatment.

Although a variety of assessment tools, including hand function testing, activities of daily living evaluations, grip strength, and MMT, were used during the course of treatment, treatment planning was based on the improvement that the client made in the functional use of her impaired arm, as measured by direct observation in the clinic and by the client's own report. These forms of evaluation were used to define critical control parameters. If an identified critical control parameter changed but functional performance did not, then the hypothesized critical parameter was not supported and a new critical control parameter was identified. On the basis of the new hypothesized critical control parameter, a revised treatment plan was designed. The process of selecting critical control parameters was challenging and required careful observation and evaluation.

Because the control parameters for upper extremity movement in clients with hemiplegia have not been identified, it was important to observe the client's performance of functional tasks from an open-minded perspective, disregarding previous therapeutic assumptions. For example, at one point in treatment, the client was having difficulty with hand grasp and release in many different types of tasks. She could grasp objects with some difficulty, but as she attempted to hold the object, her wrist would move into wrist flexion and she would lose her grip on the object. Although her grip strength was limited, it seemed that weakness in her finger flexors did not explain the problem. Practitioners of traditional neurodevelopmental approaches would identify the problem as increased tone in the finger flexors and recommend inhibition techniques in the arm to control the abnormal tone (Bobath, 1990). However, with the use of the information on hemiplegic muscle function included in the task-oriented model (Mathiowetz & Haugen, 1994), I suggested that the problem was a lack of wrist stability when using finger flexors.

As the client's wrist extensors fatigued, her wrist moved from wrist extension into wrist flexion because of the contractions of the long finger flexors that also flex the wrist. With her wrist in flexion, her long finger flexors were placed at a biomechanical disadvantage for grasping. An intervention that was used was to increase the strength and endurance in the wrist extensors, particularly through resisted isometric contractions during hand use. This approach was effective in improving the functional use of her hand. This need to observe movement in new ways was a challenge that required an awareness of previous assumptions about hemiplegic arm function and conscious efforts to consider alternative explanations when evaluating the client's performance.

**Treatment Months 1 and 2**

During the first 2 months of outpatient occupational therapy, the client was seen two to three times per week. Treatment focused on the weakness throughout her left arm and on maximizing the use of the arm in spite of this weakness. Her primary problem was an inability to control more than one muscle group at a time without experiencing increased tone in her arm. Her treatment plan was based on the hypothesis that the problems with her motor performance were caused by a combination of weakness and difficulty controlling the multiple degrees of freedom of her arm. On the basis of this hypothesis, a treatment program was initiated that included the strengthening of her arm and hand muscles along with the incorporation of her left arm into a variety of functional activities. Close attention was paid to limiting the degrees of freedom required for the tasks.

Early in the treatment program, the client was instructed to actively move her left upper extremity rather than passively move it with her right upper extremity. This active management of the arm, even if only to place her arm in her lap, was the initial stage of functional use. This early functional use was encouraged to minimize the disuse of the impaired arm and overuse of the sound arm that sometimes occurs after the loss of function in a hemiplegic upper extremity (Taub et al., 1993). To encourage successful integration of the impaired arm into function and to provide further opportunities to increase strength in the impaired arm, a variety of functional tasks were initiated in which the degrees of freedom were carefully controlled. The degrees of freedom required for a task were limited in a variety of ways, including decreasing the number of joints involved in the task by stabilizing or eliminating some joints, often by placing the elbow or forearm on a surface or by substituting flat hand stabilization for hand grasp. The degrees of freedom were also limited by decreasing the amount of movement of the limb against gravity, either by having the client stand rather than sit or by moving the task to a lower surface.

For example, the client used her impaired arm to lock her wheelchair brakes, dust tables, and provide stability and assist with balance while standing at counters, sinks, or tables. As with most clients with hemiplegia, performing functional activities such as laundry or kitchen work while sitting was awkward for the client, but she required her sound arm to steady herself when standing. Therefore, the client's ability to use her impaired arm to help stabilize herself in standing allowed her to perform many tasks more efficiently, including washing her face and brushing her teeth, preparing food in the kitchen, washing and putting away dishes, and putting away groceries. The use of her impaired arm to assist with trunk balance incorporated the arm into functional activities, and allowed her to perform tasks in her home more efficiently. As a result, the client realized that her im-
paired arm could help her resume her roles in the home even at its limited level of functioning.

The client’s strengthening program consisted of active assistive range-of-motion exercises in straight plane movements followed by isometric contractions at the end of the range. Her arm was supported as necessary during eccentric contractions as she lowered her arm. Care was taken to prevent muscle substitutions during these exercises, such as substitution of the middle deltoid for the anterior deltoid during shoulder flexion. As the client gained strength and active movement in concentric contractions, resistance was added through the addition of Thera-Band exercises graded to the maximum resistance at which the client could achieve full active range of motion without muscle substitutions. Within this exercise program, degrees of freedom were limited to those that could be controlled without evidence of abnormal tone.

During these exercises, the client’s trunk was positioned to activate her trunk muscles. The client was seated on an elevated surface with her sound foot on a footstool and her impaired foot on the floor. In activities involving large movements of the upper extremity in standing or sitting, initial muscle activity occurs in the lower extremities and then in the trunk as preparation for upper extremity movement (Belen’kii, Gurfinkel, & Pal’tsev, 1967; Horak, Esselman, Anderson, & Lynch, 1984); therefore, during the session, the client leaned forward so that her weight was over her feet and her trunk. For most clients with hemiplegia, activation of the impaired side of the trunk is more difficult; therefore, the client was positioned so that her entire trunk and impaired leg were activated to mimic the activity pattern that preceded upper extremity movement in an undamaged system and maximize the opportunity to elicit contractions in muscle groups of the upper extremity.

At the end of the second month of treatment (3½ months after her stroke), the client had made major improvements in occupational performance, resuming some specific tasks and activities that she had done previously. She consistently incorporated her impaired arm into specific functional tasks that she had practiced in therapy, such as assisting with balance when standing and managing the brakes on her wheelchair. She was able to carry light objects short distances by holding them against her body with her impaired arm, and although use of the arm continued to be very consciously planned, she did incorporate it into daily activities. At home, she assumed responsibility for cooking some meals and assisted with other home management tasks. At this time, her hand function was limited and she was unable to perform formal hand function testing or generate measurable grip strength (see Table 1 for changes in the client’s MMT scores).

At the end of this period, some changes had occurred in the client’s environmental systems. As the client began assuming more responsibility in the home, she required less outside assistance. Emotionally, she was dealing with her atrial septal defect and the required injections of heparin. A variety of drug delivery systems was tried with little success until she learned to stabilize the bottle with her left (impaired) hand, draw up the syringe with her right hand, and give herself the injection. The problems of pregnancy-related nausea continued to interfere with her ability to fully participate in activities at home and in therapy.

Treatment Months 3 and 4

During the third and fourth months of treatment, the frequency of her therapy sessions was decreased to two times per week. The client did her strengthening exercises independently at home, and her program was periodically reviewed and revised in therapy. Most of the therapy sessions focused on the client’s performance of functional tasks or on solving problems that the client had encountered at home. Tasks addressed during this period included turning light switches on and off, moving household items, stabilizing bottles while they were opened with the right hand, closing doors, and handling dishes. The client was given the assignment of incorporating her impaired arm into one new task per day, and this assignment created many opportunities to solve specific problems during therapy sessions. These problems were simulated in the clinic and solutions were suggested. The client then practiced these suggestions at home and returned to the next session with a report. The suggestions for improved function were usually related to decreasing the degrees of freedom involved in the task, and the client eventually generated these solutions herself. The client had increased strength and movement throughout the impaired arm and developed the ability to grasp, release, and manipulate objects, as long as neither repeated isolated movements of the thumb nor power grasp were required.

As the client’s ability to move her left arm improved, the degrees of freedom in her exercises and activities were increased by requiring her control of increasing numbers of joints simultaneously. For example, as the client’s impaired wrist and fingers became stronger, the Thera-Band exercises were altered to require static hand grasp and wrist positioning during elbow exercises, thereby increasing the number of joints that needed to be controlled. The degrees of freedom were further increased by the client’s early use of objects, initially through simply pushing items such as silverware from a counter into a drawer, and then by incorporating wrist position and hand grasp with this shoulder and elbow movement to grasp objects and place them on a variety of surfaces. The client’s development of minimal hand grasp

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was incorporated into her functional tasks, such as stacking the unbreakable glasses from the dish rack with her affected hand and holding her medication bottles with the left hand while opening them with the right.

During this period, problems in the client’s functional tasks also revolved around her difficulty with muscle strength in isometric, eccentric, and concentric contractions. The most problematic movements for the client were those that required a concentric or eccentric contraction of a prime mover (i.e., biceps) combined with an isometric contraction of an antagonist for a secondary function for that prime mover (i.e., pronators).

For example, when reaching forward to handle an object at shoulder height with the forearm in pronation, as in placing a plate on a shelf, the client had great difficulty keeping her shoulder in flexion rather than abduction. After several sessions of observation and some trial-and-error treatment, the source of the problem was determined to be in the forearm: The client was having difficulty maintaining isometric pronation during active elbow movement, either eccentric or concentric, presumably because of the biceps’ secondary function as a supinator. She was compensating for this inability to maintain pronation in the forearm by abducting her shoulder until the plate was in position to be placed on the shelf. This example demonstrates the difficulty involved in identifying a critical control parameter. To help counteract this problem, the client was instructed to pronate her forearm before activating her elbow flexors during functional activities in an effort to preposition her forearm and counteract the effect of the biceps. In addition, the client practiced Thera-Band exercises that required pronation during elbow flexion eccentric and concentric contractions as well as resisted isometric contractions at the extreme of pronation. After several days of practicing these movements and strengthening exercises, the client no longer had difficulty with tasks that incorporated this pattern of movement.

With this improved control in forearm rotation, the client’s arm use was more efficient because objects could now be approached in shoulder flexion without her use of shoulder abduction to compensate for improper position of the forearm. She was also able to perform rotational tasks such as turning doorknobs, placing and removing lids on jars (providing they were not sealed tightly), and turning on faucets. At this time, she made a major shift in her daily routine at home. This use of varying functional activities as modalities to improve function has been suggested in occupational therapy literature as an alternative to traditional drill tasks (Jarvis, 1994; Neistadt, 1994; Poole, 1991; Sabari, 1991).

At this point (5½ months after her stroke), the client had made gains both in muscle strength and grip strength (see Tables 1 and 2). She had a grip strength of 12 lb but fatigued quickly. She was using her impaired arm in most tasks at home and was able to perform limited grasp and release tasks, but she was unable to perform in-hand manipulation tasks. At this point, the client could have performed some of the subtests of the Jebsen-Taylor Test of Hand Function (manipulation of light objects, manipulation of heavy objects) (Jebsen et al., 1969), but because of her rapid fatigue in grasp and release tasks, her times would have been prolonged and of limited value in defining her functional level. Consequently, the tests were not administered.

Some slow but important changes were occurring within the client’s personal environment. Because she had resumed most of her responsibilities as mother and homemaker, she required less assistance from others. The assistance that she required was primarily for driving and for carrying bulky or heavy objects, such as laundry.

### Table 2
Client’s Outpatient Treatment and Follow-up Subtest Scores From the Jebsen-Taylor Test of Hand Function and Grip Strength Tests

<table>
<thead>
<tr>
<th>Hand Function Subtests</th>
<th>Time Since CVA</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>5½ Months</td>
</tr>
<tr>
<td><strong>Time (sec)</strong></td>
<td></td>
</tr>
<tr>
<td>Manipulation of light objects</td>
<td>Unable</td>
</tr>
<tr>
<td>SD</td>
<td></td>
</tr>
<tr>
<td>Manipulation of heavy objects</td>
<td>Unable</td>
</tr>
<tr>
<td>SD</td>
<td></td>
</tr>
<tr>
<td>Simulated feeding</td>
<td>Unable</td>
</tr>
<tr>
<td>SD</td>
<td></td>
</tr>
<tr>
<td>Card turning</td>
<td>Unable</td>
</tr>
<tr>
<td>SD</td>
<td></td>
</tr>
<tr>
<td><strong>Strength (lb)</strong></td>
<td></td>
</tr>
<tr>
<td>Grip strength</td>
<td></td>
</tr>
<tr>
<td>Left (impaired) hand</td>
<td>12</td>
</tr>
<tr>
<td>SD</td>
<td>-3.2</td>
</tr>
</tbody>
</table>

Note: CVA = cerebrovascular accident.

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**References**


She began to discuss resuming driving and was referred to a driving evaluation program at a local facility. Important changes also were occurring within the client's psychosocial area. She began reading biographies of persons who had met similar challenges, including those of persons who had spinal cord injury and stroke. She brought the books to therapy and read sections of the stories aloud, particularly enjoying the use of humor as a coping mechanism. She also reestablished contact with the nursing station on which she had worked, bringing treats to staff members and catching up on station news.

Treatment Months 5 and 6

During the fifth and sixth month of treatment, the client was seen in therapy sessions a total of five times. As the client began to anticipate returning to work, the treatment focus shifted to work-related tasks, such as breaking glass ampules of medication and drawing up syringes. With practice, the client was able to do these tasks without difficulty and within a reasonable period of time. The client continued to practice a home program of resistive strengthening exercises.

At the beginning of this period, the client had problems with functional tasks in which she needed to hold more than one object in her hand at a time or perform other in-hand manipulation tasks, such as isolating a key on a key ring or releasing one object from her hand while maintaining a grasp on another object. Upon further evaluation, it was noted that she was not able to isolate the intrinsic and extrinsic finger flexors, although she could use them together to make a full fist. Operating on my hypothesis that weakness in these individual muscle groups was preventing her from performing these tasks, the focus was shifted to strengthening intrinsic and extrinsic finger flexors. Initially, the client was asked to maintain a static position of either an intrinsic or an extrinsic finger flexor muscle contraction after her hand had been placed in that position. Later, she was asked to perform this motion actively, and then against resistance. After 2 weeks of work on these muscle groups, she was able to isolate them, and the quality and speed of her hand movements improved substantially. Again, this problem area was identified through its interference with occupational performance as she resumed her occupational roles.

Treatment also focused on her left thumb. Although she was able to isolate the muscles of the thumb during a functional task, with repeated motion or prolonged isometric contractions the thumb tended to flex into the palm, particularly when she was holding an object statically with her other fingers. This problem appeared to be one of controlling multiple degrees of freedom. To counteract this problem, the client was given a variety of home assignments that required static finger grasp along with thumb movement, such as pushing the lid off a medicine bottle held in her hand, unscrewing the bottle top with her index finger and thumb while holding the bottle with her other fingers, and removing a nut from a bolt held in her hand. In an effort to control the degrees of freedom, these tasks were initially performed with the client's arm supported on a surface so that only her forearm, wrist, and hand needed to be controlled. She was also instructed in manual resistance thumb exercises to build strength in thumb muscles. Over a period of several weeks, her ability to isolate thumb and finger movements improved, and she was able to isolate thumb function from the function of the other fingers.

At the end of 6 months (7½ months after her stroke), therapy was discontinued because the client had resumed her previous roles in her home and was able to independently modify activities when necessary. She continued upper extremity strengthening as a home program and was able to modify the program independently as she gained strength and endurance. She was followed periodically by a physiatrist and encouraged to contact her occupational therapist or physician if she began having difficulty with tasks she could currently do or if she developed any pain in her impaired arm. Tentative plans were made for her to participate in a work-hardening program after the birth of her child and before her return to work. Because she was interested in any suggestions about equipment and organization of the nursery that were related to energy conservation or work simplification, she was referred to a program at a nearby facility that focused on child care for persons with disabilities. The client thought that she would be able to physically handle and care for the baby without any difficulty, but she was concerned about her decreased endurance.

Results

After 6 months of outpatient therapy (33 sessions), the client had substantially improved her level of occupational performance. She was independent in all self-care and was able to care for her family, taking on cooking and housekeeping duties without outside help. She ambulated community distances independently without any assistive devices. She had resumed driving. She had not returned to work but was planning to do so after her maternity leave.

Her arm function had also improved substantially. Performance of some tasks had become automatic, with no conscious planning of arm or hand movement. She had no abnormal tone in her left arm, either during use or at rest. (Her manual muscle test scores after 6 months of treatment [7½ months after her stroke] are listed in Table 1.)

On four subtests selected from the Jebsen-Taylor Test of Hand Function (Jebsen et al, 1969), the client scored between 3.9 and 11.8 standard deviations below the mean, which although indicating significant deficit,
did allow her to perform functional tasks with her impaired hand (Jebesen et al., 1969). Her grip strength was 17 lb, 2.9 standard deviations below the mean (Mathiowetz et al., 1985). (Grip strength and hand function scores are listed in Table 2.) She continued to have some difficulty with rapid or repetitive fine motor tasks but was incorporating her arm into activities as a nondominant limb. She continued to require concentration on tasks that included in-hand manipulation or isolated finger movements.

Three and one-half months after therapy ended (11 months after her stroke), she returned for a brief evaluation. (Her MMT [Daniels & Worthingham, 1980] scores at that time are indicated in Table 1.) The client’s shoulder external rotation strength could not be evaluated because she experienced an increase in shoulder pain after immobilization of her shoulder because of placement of a cardiac pacemaker. She had a major decrease in passive shoulder external rotation and was referred to a physiatrist who diagnosed adhesive capsulitis in the shoulder. Grip strength (Mathiowetz et al., 1985) had improved to 25 lb, 2.4 standard deviations below the mean. On four subtests selected from the Jebesen-Taylor Test of Hand Function (Jebesen et al., 1969), she scored between 1.5 and 3 standard deviations below the mean (see Table 2). Although her scores for strength and hand function fell in a range from within normal limits to mild deficit, the client thought that she was able to perform tasks within reasonable periods of time and that she was able to plan ahead and modify activities to compensate for her decreased grip strength. She had upgraded her strengthening program to include exercise on weight lifting machines three to five times per week at a local exercise facility. After 6 weeks of physical therapy for adhesive capsulitis and resumption of strengthening exercises, her shoulder external rotation returned to an MMT score of 4+

Three months after the birth of her child, the client returned to work at her previous job. She decided that the work-hardening program was unnecessary, and she was successful in returning to work.

Conclusion

The use of the task-oriented approach in this case provided a valuable framework for treatment planning. The concepts of degrees of freedom and control parameters were integral in determining treatment. The hypothesis that weakness and inability to control excess degrees of freedom were critical control parameters for various tasks was valuable in identifying treatment foci. Treatment that addressed these areas was effective in improving this client’s function so that she could achieve her goal of returning to the family and work roles that she had held previously. Her outcome was excellent, particularly in view of her limited functional status at admission to outpatient occupational therapy.

Identification of critical control parameters remains a complex task that at this point relies on close observation and frequent reevaluation of function. Further research is needed to clarify methods and techniques to identify critical parameters so that therapeutic interventions will result more frequently in changes in functional performance. Until then, therapists can only generate hypotheses regarding critical parameters and then evaluate changes in occupational performance to determine the accuracy of their assumptions. Although the outcome for this particular client was excellent, the length of treatment was protracted. With practice in the identification of the critical control parameters, the treatment process could become more efficient.

Another area of concern is the use of the information regarding motor performance and motor learning. Research in this area has primarily involved subjects with intact central nervous systems (Shea & Morgan, 1979; Schmidt, 1988; Wintstein & Schmidt, 1990). Although some of the findings apply to populations with hemiplegia (Wintstein, Gardner, Mc Neal, Bartos, & Nicholson, 1989), there is currently little research on this population and such research needs to be carried out with subjects with hemiplegia.

The use of resistive exercise in treatment of clients who had CVA and increased tone indicates an important shift in practice from previous techniques that focused on controlling tone through inhibition techniques. In this client’s case, the resistive exercises were done with great care to avoid substitutions or abnormal patterns of movement. The client’s improvements in muscle strength were integrated with the incorporation of her impaired arm into functional tasks. The exact mechanisms of the increase in strength is not clear. There is also no information available regarding which specific clients would benefit from this treatment.

The effectiveness of the task-oriented approach needs to be evaluated in terms of the overall goal of therapy: improved occupational performance. Currently, exploration of this approach and these concepts is only beginning to be reported in occupational therapy literature (Haugen & Mathiowetz, 1995; Mathiowetz & Haugen, 1994), although many of these ideas have been discussed in physical therapy literature (Lister, 1991; Rothstein, 1991). As more exploration and discussion occurs, concepts such as control parameters and degrees of freedom will be more clearly defined within the context of occupational performance and occupational therapy. This case report provides beginning evidence in support of a task-oriented approach. However, outcome studies and controlled studies that use single-case or group experimental designs are needed to evaluate this approach.

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