Considerations for Functional Training in Adults After Head Injury

MARY ANNE RINEHART

Functional deficits in head-injured patients are a major concern to physical therapists involved in the rehabilitation process. Functional outcomes are affected by deficits in behavior, cognition, communication, and sensorimotor abilities. These deficits interact frequently and must be considered in planning and implementing treatment. The purpose of this paper is to describe the deficits affecting functional abilities, to discuss the rationale for functional assessment, and to provide treatment suggestions for functional retraining. The suggestions include retraining of protective and equilibrium responses and advanced locomotor skills and use of assistive devices or orthoses. Problems are identified in functional outcome reporting methods. Research endeavors are addressed for physical management during the recovery process and its relationship to functional outcomes.

Key Words: Cognition disorders, Head injuries, Movement disorders, Physical therapy.

The functional level of an individual with head injury is a major multidisciplinary concern because the outcome of rehabilitation is commonly measured by the level of functional independence a patient achieves. Justification for initiating, continuing, or ceasing a physical therapy program is often based on the patient's potential for attaining a higher level of functional independence. Therefore, the purpose of this paper is to present functional aspects for adults after a head injury with emphasis on 1) problems influencing function, 2) functional assessment considerations, 3) general treatment suggestions, and 4) functional outcome reporting.

PROBLEMS INFLUENCING FUNCTION

The four primary domains in which deficits may occur and affect outcomes after a head injury are behavior, cognition, communication, and sensorimotor functions. Problems in any of these areas may interact (Fig. 1). Most adults with a severe head injury have deficits in two or more of these areas. Each problem area can be at a different level of severity particularly at different stages of the recovery process.

Behavior Problems

Behavior problems may include changes in personality, such as increased agitation and anxiety; impulsiveness; and lack of sexual, temperamental, or other social inhibition responses. Attention to these problems must be considered when implementing the treatment program, and care must be taken not to await the resolution of such problems before starting a therapy program. Behavior modification may lead to an acceptable behavior, whereas not confronting the problem may lead to reinforcing the unacceptable behavior. A formal behavior modification program is indicated for individuals with a behavior problem that occurs repeatedly throughout the day. Behavior modification programs can be successful with patients who have at least immediate recall or short-term memory intact. The behavior to be altered is identified and a reward system established. All staff and family members involved with the patients should be included consistently in the behavior modification program to reinforce the desired behavior in all settings and to achieve results as rapidly as possible.

Agitation is a common affective disorder in the head-injured patient. This behavior is often regarded as a sign that the patient’s awareness level is improving. Deficits in cognition and communication, such as memory loss and aphasia, are some factors that may increase agitation. An understanding approach to the interacting problems, rather than time alone or medication, may help to alleviate the problem. Effective approaches for the agitated patient are largely...

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dependent on the events that trigger the agitation. Such triggering events could be a noisy environment surrounding the patient, moving a patient when he is not aware of what is occurring, and asking a patient to perform a task that exceeded the attention span or was too difficult. Identifying and alleviating events that trigger agitation should decrease the frequency of the agitation, and other treatment plans can then be accomplished.

Cognitive Problems

Behavior problems are frequently a ramification of the cognitive problems (see Malkmus in this issue). For example, a patient who is severely disoriented but who has good physical abilities may become agitated if left sitting for a long time. A walk or other physical activity could alleviate the agitation. Some of the cognitive deficits noted with brain damage are memory impairment, decreased attention span, altered state of awareness, and loss of the higher cortical function of abstract reasoning. A short attention span may impair function when the ability to attend to the task does not permit its completion. Patients with a short attention span require short simple instructions and tasks. If the desired task is to come from supine to sitting, the first request should be to roll to the side; second, to prop on the elbow; and third, to push and sit up. Additionally, the therapist may need to assist the desired movement pattern by providing tactile or proprioceptive input for sensorimotor deficits.

Communication Problems

Communication problems such as aphasia and dysarthria always influence the physical therapist's treatment approach. The therapist often needs to demonstrate the desired task for the patient with cortical deafness or receptive aphasia. Expressive aphasia and dysarthria are communication problems that may require using communication boards for the patient to express his needs. Frequently, the adult with a head injury has a mixture of cognitive and communication problems and not only a language deficit (eg, aphasia), or an oral-motor deficit (eg, dysarthria). The speech pathologist can instruct members of other disciplines about appropriate methods of communication for a particular patient. Further information can be obtained from the article by Groher. In addition, certain deficits such as the inability to produce the volume necessary for effective communication may be the result of an impaired breathing pattern and be amenable to direct treatment. Functional activities for an impaired breathing pattern can include use of incentive spirometers, balloons, and soap bubbles.

Sensorimotor Dysfunction

Sensorimotor dysfunction is a major problem limiting the functional ability for self-care and locomotor activities for those patients not in coma. For the purpose of clarity, sensory and perceptual problems are discussed separately from those of motor control although the systems involved function together. Effective assessment of and treatment planning for functional deficits are dependent on an understanding of the sensorimotor systems and the subsequent alterations of these systems after a head injury.

Sensory impairment. Sensation is considered the function of reception and transmission of sensory impulses to the CNS; perception is considered the result of the integration of the sensory impulses received. After a head injury, the patient may have problems in both transmitting sensory impulses and coding the information. Sensory impairment may result in visual disturbances such as diplopia, in taste disturbances such as hypogeusia, and in touch-pressure disturbances such as tactile hypersensitivity. Arousal may be attenuated by insufficient sensory stimuli reaching the reticular activating system. The CNS also serves to filter irrelevant sensory stimuli to allow selective processing of pertinent information. Impairment of this processing may be one cause of a decreased attention span, which then hinders the capacity for motor and other types of learning. Other disturbances affecting motor and functional behavior may occur with perceptual impairment.

Perception provides awareness of place in space and time, objects, events, and the environment in
general. Carr and Shepherd noted that perception and sensory integration are used synonymously by some authors; yet, others consider perception to be the result of sensory integration. Sarnat and Netsky considered neurologic association as gathering all relevant information, discriminating the importance of each input, comparing each aspect with each other and with past experience, and then determining the appropriate response. Such a definition obviously includes both sensory interpretation and perception. Some of our simple motoric decisions are probably based on association or integrative function occurring at the level of the diencephalon. The more complex associations are probably occurring in the telencephalon. Complex associations include the cognitive functions of sequencing for activities, abstraction, imagination, and conscience. If Sarnat and Netsky's definition of neurologic association is accepted, then memory of past experiences (perceptions) is an important factor in selecting motor responses. Furthermore, through perceptual processes in diencephalic regions, conditioned motor responses may occur without conscious awareness. The head-injured patient may retain and perform some simple motor acts at the subcortical level although those acts requiring higher cortical associations are impaired.

Damage to the posterior parietal area produces perceptual disturbances that affect motor behavior. Alterations occur in the perception of body image and its orientation in space through tactile and visual modalities. The resulting deficit of unilateral neglect affects functional performance in eating, dressing, or locomotor activities. Semmes found that tactually identifying objects was not dependent on somatosensory loss after brain damage. Although severe impairment of stereognosis occurred in patients with a sensory deficit, impairment also occurred in patients with intact sensation. Semmes concluded that stereognosis could result from an integration disorder to discriminate shapes as well as the loss of sensation. Other perceptual deficits than those occurring in body awareness and stereognosis influence function and need to be considered in treatment planning. These deficits include a loss of the ability to respond appropriately to tasks involving laterality, directionality, or bilateral tactile attention, and the existence of motor impersistence or perseveration.

**Motor impairment.** Motor control necessary for functional activities is often impaired after a severe head injury. Some clinically observed problems with motor behavior include muscle weakness and alterations in muscle recruitment and timing. Lesions of the motor cortices and their pathways have been noted to produce muscle weakness and alterations of tone. Although hypertonus has been thought to interfere with posture and phasic motor behavior, the loss of cortical command signals to the muscles that results in muscle weakness may have a more profound effect on motor behavior. Sage has defined the acquisition of a motor skill as the learning process for developing a set of motor responses into an integrated movement pattern. During the early development of a motor skill, more muscles are activated than necessary; in the final stages, inhibition of the unnecessary muscle activity leads to efficiency of goal-directed movements. Head-injured patients may demonstrate the loss of motor skills in functional abilities through alterations in timing and sequencing of muscle contractions. Moore emphasized the need for automatic postural stability, which is constantly being altered during even minimal functional activities. Adjustments in body alignment occur, whether observable or not, in anticipation of planned activities. Both postural set and ability to produce discrete movements are necessary for functional performance. Nashner and Cook found that during perturbation of standing balance, muscle activity was produced in specific groups of lower extremity muscles in healthy individuals. These functional synergies were altered in patients with brain lesions. The loss of patterned muscle responses for automatic postural adjustments and movement patterns also may occur after a head injury and contribute to poor equilibrium responses and motor behavior during standing and gait.

Another problem in motor control for functional skills is timing factors. Patients with cerebellar impairment display movement disorders such as dysmetria, adiadochokinesia, and intention tremor. Such disorders can be observed in movements throughout the body from the tongue to the ankle. Electromyographic studies have demonstrated prolonged firing of the agonist or antagonist muscles during rapid movements in persons with cerebellar lesions. This prolonged muscle contraction causes the movement to have an increased range, to stop abruptly, or both. When antagonist muscle activity does not cease at the appropriate time, which is before the agonist muscle begins, rapid alternating movements are affected. Movement disorders related to timing are also observed in patients with impaired basal ganglia and their pathways. Electrical muscle activity in patients with akinesia or bradykinesia demonstrated a prolonged reaction time to initiate or change a movement.

The head-injured patient may have to relearn functional locomotor skills in much the same manner as the skills were learned originally. Three broad stages of motor learning are 1) understanding of the task, 2) establishing sensory and motor associations, and 3) integrating movement patterns at an automatic level. During the first stage, the learner must be motivated and able to comprehend the task. Communicating the sequence of steps to the patient aids in clarifying the tasks, but care must be taken to give
1. Does not use wheelchair
2. Ambulates more than 2,000 ft* in functional time frame
3. Independent on ramps and all terrain
4. Independent on full flight of stairs
5. Independent to and from the floor and standing

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<th>INDEPENDENT COMMUNITY AMBULATOR</th>
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<td>1. Uses wheelchair for distance greater than 2,000 ft</td>
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<td>2. Ambulates 1,000 to 2,000 ft in a functional time frame with or without supervision for disorientation</td>
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<tr>
<td>3. Independent on level surfaces, ramps, curbs, and three or more steps</td>
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<td>4. Independent to and from the floor and standing</td>
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<th>LIMITED COMMUNITY AMBULATOR</th>
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<tr>
<td>1. Uses wheelchair outside the home</td>
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<td>2. Ambulates at least 25 ft in a functional time frame</td>
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<td>3. Independent on all indoor floor surfaces</td>
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<td>4. Independent to and from the floor and standing</td>
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<th>HOUSEHOLD AMBULATOR</th>
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<td>1. Unable to get to and from standing or ambulate with or without assistance</td>
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<td>2. Ambulatory time frame is not functional</td>
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<th>NONFUNCTIONAL AMBULATOR</th>
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<tr>
<td>1. Does not use wheelchair</td>
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<tr>
<td>2. Ambulates more than 2,000 ft* in functional time frame</td>
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<td>3. Independent on ramps and all terrain</td>
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<td>4. Independent on full flight of stairs</td>
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<td>4. Independent to and from the floor and standing</td>
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* One foot = .3048 m.

Fig. 2. Scale for denoting level of functional independence used at Santa Clara Valley Medical Center, showing criteria for different levels of ambulatory function.

short, simple step-by-step instructions if short-term memory is impaired.

Next, performing antigravity posture and movement patterns and inhibiting unnecessary muscle activity are learned. Active patient participation in the activity is required for learning to occur. Assistance may be given in the form of sensory stimuli or in guiding the motor behavior so that meaningful information is received by the CNS and a minimum of muscle energy is expended. Appropriate feedback to the CNS is essential to the learning process. Using biofeedback devices, inhibitive casting, weighting the trunk or extremities, and videotapes are all tools that help the patient receive appropriate feedback.

Finally, practicing the activity aids in neural integration and leads to automaticity of the motor behavior. How much practice is necessary is not known, but the amount will vary between individuals and between tasks of varying complexity. The amount of practice healthy individuals need to attain a basic skill in most activities provides a clue to the minimal amount of practice necessary for a head-injured patient to attain a basic skill. Because brain plasticity may allow the formation of new synapses during learning, practice may be required for months or years before new synapses develop and become functional.

The diffuse nature of brain damage can present many types of sensory and motor problems. Because the problems affecting functional motor skills after a head injury include deficits in behavior, cognition, communication, and sensorimotor behavior, which are all necessary for motor learning, these factors should be considered holistically during planning and implementing treatment.

FUNCTIONAL ASSESSMENT CONSIDERATIONS

The treatment designed for functional deficits in head-injured patients is formulated from assessing the patient. The functional assessment serves two primary purposes: 1) to provide a baseline for comparison with future functional status and 2) to identify goals and treatment plans based on functional impairment. Functional assessments are most often scored by either the level of independence for a function (Fig. 2) or the comparison of the functional ability with criteria based on "normal" individuals. A score for level of ambulatory independence may be "moderate assistance" to indicate the help of one person. Additionally, the score could reflect the use of assistive devices and a specified setting such as the home or community. Comparison of ambulatory score might be indicated by the percentage of a normal criterion met, such as "gait velocity is 20 percent of expected." The results of scoring functional status are important in providing guidelines for goal setting, program planning, and documenting progress. Because the efficacy of physical therapy for head-injured patients is judged on documented change in functional performance, the measures for the quality of the functional task also should be specified when reporting results of either scoring method. For example, a functional score of "independent for rolling" does not specifically define the quality of the movement. Descriptors defining the quality of rolling can also have a measurable score. These descriptors include the time taken to accom-
tient can be sitting out of bed and engaging in other activities. Resuming physical activity early is not only important for bodily functions and arousal but also provides the opportunity to stimulate movement in antigravity positions. Positioning the patient on a tilt table, prone on elbows, and prone over a large bolster are all more effective means than passive movements for preventing contractures. As the patient’s awareness increases, more demands can be placed on him to attain the desired postural and movement patterns.

**Beginning Functional Activities**

Beginning functional activities include components of the skills necessary for rolling, sitting, and upper extremity motor control for hygiene and dressing. Components of these beginning skills include the prone on elbows position to encourage neck extension and shoulder girdle stability and to inhibit any predominant tonic reflex responses.

**Rolling.** In the supine position, many head-injured patients have a predominance of hypertonicity in lower extremity extensor muscles and in upper extremity shoulder adductor and internal rotator and elbow, wrist, and finger flexor muscles. The prone on elbows position often decreases the tonic reflexes found in the supine position and allows the patient to flex and extend the knees spontaneously and to achieve shoulder range of motion in flexion, abduction, and external rotation. For the next component of the rolling activity, the patient could learn to go from prone on elbows to the side-lying position and to return with assistance from the therapist. When this skill can be accomplished with minimal assistance, rolling from supine to prone can be accomplished more easily. Patients who have the physical potential to roll but who have problems comprehending verbal requests will often automatically roll to their side by reaching for a pillow placed near their head.

Placing the patient in the crawling position over a large bolster facilitates elbow and wrist extension and hip and knee flexion. This position is useful for inhibiting tonic reflexes; it also provides kinesthetic input to activate weak, upper extremity elbow and wrist extensor muscles and encourages postural set in extremity muscles for sitting and reaching. Rocking the bolster back and forth encourages protective and equilibrium responses needed for sitting and standing.

**Sitting.** Sitting may require sensory facilitation, such as tapping or stroking to the extensor muscles of the back or to the abdomen, depending on whether extensor muscle weakness or hypertonicity is dominant. Passive scapular retraction by the therapist and passive or active elevation of the arms encourages a more erect posture if neck and trunk extensor muscles

**Stimulating Movement in the Comatose Patient**

The treatment of the comatose or semicomatose patient should include an emphasis on oral-motor and respiratory function and on positioning and passive movements to inhibit or facilitate automatic postural responses and spontaneous movements. Within two weeks postinjury, cerebral edema should have subsided and barring further complications, the patient can be sitting out of bed and engaging in other activities. Resuming physical activity early is not only important for bodily functions and arousal but also provides the opportunity to stimulate movement in antigravity positions. Positioning the patient on a tilt table, prone on elbows, and prone over a large bolster are all more effective means than passive movements for preventing contractures. As the patient’s awareness increases, more demands can be placed on him to attain the desired postural and movement patterns.

**GENERAL TREATMENT SUGGESTIONS**

Every head-injured patient displays a unique set of problems depending on the location and extent of the brain damage. Treatment programs must be designed on an individual basis according to the general problems of behavior, cognition, communication, and sensorimotor control. Treatment involves a blending of approaches to address the multiplicity of problems presented. Once problems interfering with functional abilities are identified, the treatment plan can be designed and implemented. Although physical therapy for the sensorimotor deficits is of primary concern, simultaneous consideration must be given to other general problems. Perhaps one of the most challenging aspects of the treatment plan is controlling behavior problems so that the optimal sensorimotor program can still be achieved. The following information provides general treatment suggestions for functional considerations in comatose patients and factors influencing functional training of locomotor skills.

**Plish rolling and the type of rolling pattern, such as total body or segmental. Addressing the quality of the functional task and, therefore, determines whether further functional training is justified despite an independent functional score.**

Functional abilities necessary for self-care include communication, personal hygiene, eating, dressing, and locomotion. Self-care activities need not be the only functional abilities considered when assessing function and rehabilitation outcomes. Other skills are also required for a fulfilling lifestyle. To a teenager, throwing a baseball may be all-important; to a musician, playing the piano may be the crucial skill. Specific goals and treatment plans could include posture and movement patterns that are components of these personal functional skills. Movement components of these personal skills may also be generalized to the other activities. The goal for the highest level of functional independence means the patient may work to achieve both the skills necessary for self-care and the skills for more individualized goals. Both types of functional skills should be a foremost consideration in designing a patient-care program.
are hypotonic. Patients who hyperextend the trunk when sitting may be able to maintain the sitting posture when the trunk is flexed forward on the hips, and their upper extremities are resting in front of them on an adjustable-height table. To prevent total extensor patterns of the back and lower extremities during sitting, the patient's hips may need to be flexed past 90 degrees by using a wedged cushion or raising the footpedals of the wheelchair.

**Weight shifting and standing.** Stimulation of protective and equilibrium reactions is frequently needed. These reactions are often missing or dominated by tonic neck and labyrinthine reflex responses. Because most activities are performed under the influence of gravity, equilibrium reactions and compensatory movements to maintain body alignment with respect to the center of support are essential aspects of treatment. Weight shifts and trunk rotation can start in the sitting position with auxiliary stimuli added by the therapist to achieve appropriate responses in the neck, trunk, and extremities. While he is sitting on a large ball or air pillow, the patient may perform weight shifts and other compensatory movements of the extremities.

Protective and equilibrium reactions in sitting or standing positions are facilitated by displacing the center of gravity through forward, backward, and sideward tapping to the trunk or by movement in these planes while the patient is on a tilt board. Standing on the tilt board with the feet parallel, the patient can shift his body weight from side to side; with one foot in front of the other, the patient can shift forward and backward. During the weight shifting, the therapist may need to guide the patient's pelvis to the appropriate side or into protraction or retraction movements. Another activity used as a precursor to ambulation is instructing the patient to shift his weight while he is standing on the floor. One lower extremity is placed forward in slight external rotation at the hip, and the other lower extremity is placed behind the body in slight internal rotation at the hip. The body weight is shifted diagonally forward and then backward over the extremities. During this activity, the therapist provides the desired guidance or resistance to the pelvis and the sensory stimuli needed to facilitate or inhibit muscles of the trunk and lower extremities for the desired motor behavior. For example, a biofeedback apparatus attached to the peroneal muscles of the forward lower extremity could be used to encourage facilitation of these muscles during the forward stance phase of the weight shift. Facilitating equilibrium reactions and body-weight shifts are two methods of providing appropriate total body kinesthetic and movement patterns before ambulation.

**Gait training.** After the patient has attained postural and movement patterns necessary for sitting and standing with minimal assistance, gait training can be initiated. If ambulation begins before this time, the likelihood exists that the undue stress will cause or increase undesirable motor behavior such as strong associated reactions, ataxia, and lack of trunk alignment.

**Assistive devices and orthoses.** Using assistive devices and orthoses are other factors to consider during gait training. The determinants for using such devices should include an analysis of the combined neurologic, orthopedic, and functional factors affecting the total body during ambulation. By using assistive devices or orthoses, the patient may be able to practice a better gait pattern and acquire a meaningful source of sensory feedback for relearning ambulation skills. Assistive devices or orthoses may provide more equal weight bearing during the stance phase of gait. Stabilizing the involved lower extremity during the stance phase may also lead to equal stride lengths and increase gait velocity. Using a forearm-trough walkerette with small wheels on the front enables the patient with poor trunk control (whether the cause is poor righting or equilibrium reactions, muscle imbalance, or tremor) to receive less aberrant feedback during gait. A foot biofeedback apparatus that buzzes on heel strike is useful in producing heel strike instead of toe contact at the end of the swing phase of gait. Using a Swedish knee cage* may prevent genu recurvatum and increased knee extensor muscle activity during the stance phase. A molded orthotic device fitted below the metatarsals can provide weight bearing to that area and decrease extreme toe flexion during standing and walking. Walking with crutches or a cane is not indicated for most head-injured patients because this type of ambulation is a high-level skill requiring coordination of arm movements with the gait pattern and good equilibrium reactions.

**Advanced Locomotor Skills**

For appropriate patients, functional training in advanced locomotor skills may be a pertinent part of their treatment. Advanced locomotor skills include activities such as hopping, skipping, jumping, and running. In addition to the need for advanced locomotor skills for recreational activities, a greater degree of movement pattern integration may be achieved that positively influences the quality of walking. Speed, balance, and coordination are stressed with advanced locomotor skills and are qualities that may be added to functional ambulatory skills. Advanced locomotor training may be indicated for patients with sufficient equilibrium reactions and motor control for ambulation but who lack the specific skills to perform

*US Manufacturing Co, 180 N San Gabriel Blvd, Pasadena, CA 91107.
these activities. The training process includes facilitating the various components of the skill. For example, jumping with both feet together requires less skill than jumping with one lower extremity ahead of the other one.

Motor control dysfunction can be improved by training the patient in advanced locomotor skills. Two factors of motor control appear to be frequently impaired in head-injured patients: rotation of the trunk and homolateral extremity movements during upright activities. These movements are especially difficult under physical stress. Running and skipping increase the excursion of trunk rotation and unilateral upper extremity movement. Homolateral extremity and rotatory patterns are not the only demands of advanced locomotor skills. Speed and equilibrium responses are also important components. Advanced locomotor activities might help the head-injured patient achieve a greater degree of velocity and equilibrium responses during gait to prepare for all aspects of community ambulation. Crossing the street before the light turns red may require increased velocity and going up and down stairs increased equilibrium responses that could be aided by running, hopping, and jumping skills.

FUNCTIONAL OUTCOME REPORTING

Numerous authors have advocated the need to predict the outcome in those individuals who sustain a head injury severe enough to produce coma and have designed various scales for reporting functional outcomes (see Heiden and Talmadge in this issue).\textsuperscript{1, 22, 28-29} Jennett and Teasdale stated that assessing outcome is important for establishing recovery curves that help 1) to compare the effect different medical techniques have in altering the recovery curve, 2) to determine practical duration of rehabilitation, and 3) to make future plans for those likely to remain disabled.\textsuperscript{2} These authors have conducted the most extensive studies involving the outcome of the severely head-injured population and have devised the Glasgow Outcome Scale.\textsuperscript{26} The specifics of the scale will not be discussed here, but one concern will be mentioned briefly.

Although the Glasgow Outcome Scale is useful in providing descriptions of outcome with universal application, its use in comparing functional outcomes with physical therapy intervention is questionable. On the Scale, the categories of Severe Disability, Moderate Disability, and Good Recovery are not well defined with respect to mental or physical deficits. For example, a physical therapist might be able to alter an individual's functional outcome based on physical ability from dependent for daily support (Severe Disability) to independent for daily life (Moderate Disability), and yet, the individual's mental ability may prevent this change to the higher category. The change in categories based on physical outcome alone justifies the need for therapeutic interventions if the change lessens the dependency of physical support from others.

SUGGESTIONS FOR RESEARCH

Criteria for assessing and measuring functional outcomes in head-injured patients need to be designed for universal applicability to substantiate the efficacy of physical therapy. Such criteria should address the quality of movement for locomotor skills, but such criteria are lacking in the literature on physical outcomes. Although Jennett and Teasdale reported the majority of severe head-injured survivors have made a Moderate to Good Recovery by one year postonset, they did not report the type or extent of physical therapy provided.\textsuperscript{26} These two outcomes, Moderate and Good Recovery, indicated that the individuals were independent in the physical functional skills necessary for daily life. Research is needed to determine if physical therapy intervention alters outcomes by increasing the outcome level, expediting the rate of recovery, or improving the quality of movement, and when in the recovery process, physical therapy is most effective.

Studies involving the effects of treatment for severe head-injured patients highlight the concern that each individual sustains a different impairment. This factor makes comparisons between individuals difficult. Although this concern is valid, research designs do exist that can be used to address many of the current questions. For example, longitudinal studies could indicate if a developmental pattern of recovery occurs or what factors are associated with recovery of a specific locomotor skill. Physical therapy could be conducted during such studies with documentation of the procedures used and the frequency and duration of treatment. By defining the recovery process of functional abilities in individuals with a severe head injury, the physical therapist may be able to understand when and how to intervene in retraining for functional deficits.

SUMMARY

Individuals with severe head injuries frequently have four primary domains that affect their physical functional capacity: behavior, cognition, communication, and sensorimotor. Physical therapy assessment of the individual's functional status is based on knowledge and analysis of sensory and motor behavior. Program planning and implementation should consider all four problematic areas because these problems frequently interact. Treatment considerations for functional training of locomotor skills have
been generally described. Because the diffuse nature of head injuries precludes specific treatment techniques applicable to all circumstances, the challenge remains to select appropriate individualized treatment procedures directed toward achieving the highest functional level. Research needs to be done to determine a functional outcome scale that includes the quality of the functional abilities, the recovery process of locomotor skills, the most effective point in the recovery process for physical therapy, and the effects of treatment on the recovery rate and level of functional skills.

REFERENCES


1982 PHYSICAL THERAPY