Finding a Stable Base

Re-training Balance Reactions in Adults Post-CVA

By Steve Anderson, PT

For patients who've experienced a cerebral vascular accident (CVA) that results in hemiplegia, finding a stable upright posture can be very challenging. Trying to superimpose a functional activity on this fragile upright posture can topple the whole works. This article will address treatment ideas in two areas that therapists treating adults with hemiplegia may consider when trying to provide a stable upright posture for their patients and, at the same time, allow them to complete an activity. The two main ideas revolve around developing a stable base of support and developing effective trunk reactions to changes in body position over the base of support.

In the early stage of recovery following CVA, patients often have significant difficulty not only finding midline in upright sitting, but in being able to hold themselves up at all. In this stage, gravity is the primary force acting on the body. When the patient is assisted in coming into sitting at the side of the bed, he is unable to activate postural musculature to counter the effects of gravity. Head position can be difficult to maintain; a hemiplegic upper extremity (UE) that is unable to generate sufficient force to counter the effect of gravity may pull on the trunk, resulting in a posture flexed forward and toward the hemiplegic side. The lower extremity (LE) on the affected side may also lack sufficient force generation to provide a reaction against the surface, thus preventing the patient from establishing an effective base of support.

In addition sensory systems may provide input that is not accurate, making it even more difficult for the patient to position himself relative to the environment. At this stage, a careful examination must be made not only of systems affecting movement patterns in the extremities but in the trunk as well.

In sitting, the trunk often assumes a position that is off center with respect to all three planes of movement. In the sagittal plane, the trunk usually falls into gravity, resulting in flexion of the spine with an associated posterior pelvic tilt. In the frontal plane, one may observe lateral flexion of the trunk toward the hemiplegic side caused by the weight of the arm on that side. In the transverse plane, the trunk is usually rotated anteriorly on the hemiplegic side, again due to the influence of the arm. The therapist who aims to have the patient achieve a better postural set for functional activity in sitting must evaluate the position of the trunk with respect to all three planes of movement and develop treatment strategies that assist the patient to activate the trunk against the force of gravity.

Finding a stable base in the environment

The first step in achieving better alignment is to provide a stable base of support from which to work. In NDTA's book, *Theoretical Foundations and Principles of Clinical Practice*, Systems Theory is advanced as the current model for understanding the complexity of motor control. According to this theory, motor behavior emerges from the interactions of three factors: 1) multiple bodily systems and subsystems called upon to complete a given task, 2) the environment in which that task takes place, and 3) the demands of the task itself.

That is to say that, in order for the patient to develop the motor control necessary to maintain balance and complete a given task, attention must be given to three areas: 1) the systems that the patient can easily access as well as those that are impaired, 2) the physical space in which we ask the patient to work, and 3) the demands the task makes of the patient.

Therefore, in the early stages of recovery, in order to provide an optimal opportunity for the patient to develop better postural control, the therapist must consider the environment. Most hospital beds today are equipped with air overlay mattresses to protect the skin of patients who

are immobile. These mattresses may be effective at protecting skin, but they do not make good sitting surfaces. Often, however, such beds have a setting that allows for maximal inflation, usually for the purposes of cardiopulmonary resuscitation (CPR). With the bed in this mode, a better sitting surface can be achieved.

In addition to the firmness of the sitting support, the therapist must also consider the height of the bed. To provide the optimal base of support for functional tasks, the LEs must be engaged against the surface. This includes the feet against the floor and the thigh against the seating surface. If the patient's feet cannot reach the floor, then the contribution the LEs make to the base of support is diminished. Anyone who has worked in an intensive care unit (ICU) knows how many of these beds do not lower very much even at the lowest setting. It is often necessary to find something to place under the patient's feet to give the LEs, particularly the hemiplegic LE, the opportunity to activate against a surface and to contribute to the base of support.

It is not necessary to position the patient at 90˚ of hip and knee flexion; in fact, a wider angle at the hip may help the patient to become more active. However at hip angles of more than 100-110˚, care must be taken to prevent the patient from sliding off of the bed. Active hip extension and loading of the hemiplegic leg in sitting are precursors to good UE control.

Finding alignment for movement

Once the environment has been adapted to optimize the ability of the patient to participate, movements into a symmetrical sitting posture should be practiced. Assistance to help the patient find optimal alignment begins at the base with a neutral position of the pelvis and lumbar lordosis. Once the pelvis and lumbar spine are well positioned, the thoracic spine can be guided into more extension. Finally, cervical spine and head position can be properly aligned. This in itself, however, is not enough. Static sitting postures are not of much use if function is the goal. The patient must be trained to move over the base of support, finding its edges, and moving back once again into an optimal symmetrical sitting posture.

The position the trunk adopts as it moves over the base is dependent upon the task requirements. Trunk positions should include a variety of postures that combine movement components of all three planes—flexion and extension with lateral flexion and rotation. For instance, in reaching toward the floor to retrieve a shoe during dressing, a combination of lateral flexion with forward flexion is required. Other tasks demand that the trunk move into a posture of trunk extension with rotation over hip flexion, as when reaching forward and to the side to retrieve a bottle of hand lotion from the table. Initially, components of the posture can be practiced separately, but they must eventually be combined and in different patterns to provide the patient with a wide repertoire of movement options to allow for greater function.

As motor control develops, the patient often moves into the next stage of recovery where gravity is not the primary force acting on the trunk and head. The patient begins to develop some skill at moving against gravity, but these movements are also frequently atypical. Muscle imbalances between the hemiplegic side and the less involved side result in postures that are characterized by weight that is borne consistently on one side, rotation in the trunk, and lateral flexion on one side or the other. It is difficult to describe a common pattern used by most patients because patients find postures that are available to them due to the interaction of systems that they can access. For example, the patient with an impairment in discerning vertical orientation will typically position himself over the *hemiplegic* side of the base of support. Another patient with a dense sensory loss on the hemiplegic side may exhibit motor behavior that is favorable to placing the center of mass over the *less* involved side of the base of support.

In each of these examples trunk positioning will vary depending upon which side is bearing the patient's weight. Our first patient with midline orientation problems may present with lateral flexion

on the less involved side, whereas the second patient may present with a trunk posture that is reversed. Now this in and of itself is not atypical. All people sit at times with their weight distributed over one side or the other. However postures for the patients described here are atypical because these are the *only* positions chosen. Each patient feels insecure in any other sitting position due to limited movement possibilities and sensory loss. This obligatory posture is atypical. For function to occur, a variety of patterns must be available to the patient. In treatment planning, assessments must be made of the patient's preferred postures, then strategies implemented that stimulate the trunk to adopt new postures that include flexion with rotation, extension with rotation, and straight plane movements.

Changing the environment

The complexity of the task, and thus the demands placed on the trunk, can be modified by changing the environment. Two parameters that add difficulty to a task are time and space. By placing items required by the task further away from the patient—in other words, by extending the reach needed by the patient to complete the task—greater demand is placed on the trunk to change postures, hold the new posture as needed, and return finally to a more stable one. Introducing tasks that are completed in standing adds complexity as well. Increasing the speed in which the task must be completed also adds complexity and can be used as a measure of increased skill. On the other hand, if a task proves to be too difficult for the patient to complete, these parameters may be manipulated in the other direction to decrease complexity.

The role of the LE in contributing to the base of support has been discussed. But what of the role of the UE? Some tasks require bimanual manipulation of objects for successful completion, but in the early stage of recovery this may be too difficult for a patient to accomplish. At this stage, the role of the hemiplegic UE is one of support; it becomes part of the base. If the trunk and UE segments are initially too difficult to control, some work may be done in forearm weight bearing on a table rather than extended arm weight bearing. Keep in mind, however, that at this stage the table should be stable when introducing it as part of the base of support. Forearm weight bearing provides a wider base for the trunk while at the same time increases sensory stimulation and demand on the hemiplegic UE.

Exploring new trunk movement experiences

Reactions between the trunk and UE can be explored by having the patient practice small amplitude weight shifts anteriorly and posteriorly at first. In this closed chain position, as the trunk moves anteriorly over the hips, the spine extends while the scapulae move into positions of depression, adduction, and downward rotation. The glenohumeral joint moves further into extension and external rotation. With a posterior weight shift over the hips, the opposite occurs. The trunk moves into flexion, the scapulae elevate, abduct, and upwardly rotate. The glenohumeral joint moves into flexion and internal rotation.

Lateral weight shifts provide trunk elongation on the weight bearing side with scapular elevation and upward rotation. The glenohumeral joint moves into adduction and external rotation. On the non-weightbearing side, shortening of the trunk occurs with scapular depression and downward rotation. The glenohumeral joint abducts and internally rotates. In the early stages of recovery, working in this position can be effective in developing these typical trunk and UE movement patterns. After observing the trunk posture most often assumed by the patient, decisions can be made as to which of the above patterns the patient lacks. By providing new movement experiences the patient begins developing skill in the desired patterns.

As recovery progresses and the trunk gains stability, one can continue to work at the table by reducing the part of the base of support provided by the less involved UE. By moving that arm against the surface or in reaching tasks, more demand is placed on the hemiplegic UE and trunk. As with all of these activities alignment of the scapula, trunk and glenohumeral joint is critical. The goal is to assist the patient to become more active, not to hang on the body segments.

Finally reaching tasks must be practiced with the hemiplegic UE. Initially the hand can be placed on a mobile surface, the back of a chair or the top of a cane. In this position, forward reach may be guided by the therapist with facilitation of appropriate changes in the trunk position over the base. Activity in the abdominals can be initiated by having the patient push against an object with either one or both hands. Engaging both hands against the object in the sagittal plane will limit rotation initially and may be easier to control. However, rotation should be introduced at some point to activate more of the abdominal muscles. Beginning with an immobile object, such as a heavy table or the wall, will teach the patient to set the abdominals in an isometric contraction. Using a movable object, but one with some heft to it, will teach the patient to grade the activity of the abdominals in a concentric contraction. Activation of the abdominals is critical for stability of the trunk and should be addressed early in recovery.

The ideas presented here for retraining the trunk list just a few possibilities of the many activities in which the patient may be engaged. The key is observation. The therapist must know which trunk and limb patterns the patient prefers and introduce those that are optimal for task completion. By providing a variety of movement patterns, the patient is given the best chances for success in stabilizing the trunk during movement in every day tasks.

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References:

Howle, J. with the NDTA Theory Committee. 2002. Theoretical Foundations and Principles of Clinical Practice. NDTA: Laguna Beach.
Ryerson, S., Levit, K., 1997. Functional Movement Reeducation, Churchill Livingstone, Inc., pp 183-189.