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Biomechanical Models for Stroke Rehab

Of all the visions of a physical therapist, the one that excites us most is the therapist with hand on chin staring intently at the aberrant movement pattern of the earnest patient. We can almost see the gears grinding as all of our past knowledge goes into play to describe, analyze, modify and fix the movement pattern.

This biomechanical approach will be the focus of the evidence-based treatments we will explore in this article. Pollack in 2007 studied outcomes of therapist who used singular approaches (such as neurophysiological or motor learning) versus a therapists who used a variety of approaches. He found that the mixed approach was far superior in outcomes to using one single approach.[1] Hence this article will use a variety of biomechanical approaches.

Exercise Task-Specific Training

The first biomechanical evidence-based approach to stroke rehabilitation that will be discussed is that of Carr and Shepard.[2,3] These Australian physical therapists emphasize active exercise and task-specific training while preserving muscle extensibility and continually working on cognitive engagement, strength, control, endurance, skill, fitness and social readjustment. They have biomechanical models for action, ranging from bed mobility to sit-to-stand to walking. They have developed protocols and guidelines for testing and training along this mobility spectrum. An example of this is the task of a patient getting up out of bed from sidelying. The essential components for this activity are lateralization of the head and trunkand bringing the legs over the side of the bed.

Keeping these components in mind, the therapist asks the patient to try to get out of the bed. The patient who has had the stroke attempts this. The therapist watches and notes no lateralization of the head. This is called the missing component. The therapist then works on lateralization of the head, and the patient and therapist practice just that piece. An example of how this can be done is simply to get the patient comfortable on one side with a pillow under the head. Then the therapist works with the patient on gently lifting the head off the pillow. Once the patient masters this task, it is put into the entire task.

Getting Technical

A more evidence-based "tech" approach for balanced sitting, a progression along the mobility spectrum, is using a laser pointer.[4] In this study, patients with stroke, balance and neglect issues sat with a laser pointer on their head and using their head and trunk muscles to point at objects. They had to control their trunk as they looked and pointed up, down and side to side.

Nuzik, Lamb, VanSant and Hirt developed the first sit-to-stand model.[5] In this model it was clear that sitting to standing required a flexion moment in the first 35 percent of the task and an extension moment in the last 65 percent. That means that in the first part of the movement task of getting out of a chair, everything flexes—ankles, knees, hips, trunk, head and pelvis. Then there is a momentum shift and those same joints extend as the buttocks lift from the chair.

Older adults tended to minimize the forward body displacement when sitting down. This strategy could be seen as an adaptive mechanism to decrease the risk of anterior disequilibrium.[6]

In patients with stroke, Carr and Shepard found center of body mass (CBM) should be within the perimeter of the new base of support at thighs-off. Extension of the lower limbs with the CBM behind the heel would propel the person backward, not forward. Therefore, an excellent way to get the better movement pattern is to have patients clasping hands in front and reaching forward to bring the center of mass over the bass of support.[7]

Monger developed an evidence-based home exercise program to improve the sit-to-stand movement pattern in patients with stroke.[8] The program was conducted on patients who were at least one year status post-stroke and six months out of rehabilitation. The program was performed three times a week for three weeks for a 20-minute program supervised by a physical therapist. Patients were also expected to do their home exercises 20 minutes every day.

These treatment ideas can get our gears started as we look more at the biomechanical approach to treating patients with stroke. ■

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