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CONSIDER THE GRAVITY OF GRAVITY!

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Gravity. Who thinks about it? It is always there, yet when we are well, we don't consciously change our movement patterns to lessen it's influence. Subconsciously, we note the difference between going up or down a flight of stairs, but it would not prevent us from going up those stairs. This scenario can be radically different for individuals with severely weakened neuromuscular systems such as a spinal cord injury (SCI), Multiple Sclerosis(MS), Muscular Dystrophy (MD), Cerebral Palsy (CP) or Parkinson's Disease. For these individuals, gravity is a very strong and real force to contend with on a daily basis. It may very well be the limiting factor in their activities of daily living, their exercise program or even their breathing retraining. Breathing retraining will be the focus of this article.

Breathing is a three dimensional activity involving superior-inferior, anterior-posterior and transverse planes of movement at all times (See Illustration). This is significant because respiration will always simulataneously involve some resistance from gravity, as well as some assistance from gravity, during every breath we take. The other chest movements will be in a gravity eliminated plane of respiration. The person's posture determines which plane of respiration is experiencing which effect of gravity. For example, a person sitting in a chair will have gravity resisting his superior chest expansion, while inferior chest expansion will be gravity assisted. The anterior-posterior and transverse expansion will take place in a gravity eliminated plane. If that same person is sidelying, transverse movement or lateral costal movement, becomes gravity resisted, while anterior-posterior and superior-inferior movement become gravity eliminated movements. Transverse movement on the weight bearing side of the chest becomes posturally inhibited.

This same force of gravity can be utilized to assist the drainage of secretions from patient's lung segments through postural drainage positions. The "bad" lung is positioned in the upright position. For example, if the patient had a right lower lobe, lateral segment atelectasis, he would be positioned on the left side. He may also be aware that his breathing is improved in the left sidelying position. When the "good" lung is down blood flow is improved to the down lung. Consequently, the lung that is ventilating well is also being better perfused. This is an optimal respiratory unit. Unfortunately, just the opposite will occur if the right, atelectatic lung was in the down position. The patient would experience more difficulty breathing as the unventilated lung would have increased perfusion. This results in a shunt unit where perfusion is in excess of ventilation. The PO2 would dramatically decrease lying on the right side.

The therapist needs to consider these dynamics when treating the patient. If a sidelying position is to be used in therapeutic exercise, it should enhance the patient's breathing. The "good" lung should be down in cases of unilateral lung dysfunction

during exercise.

Gravitational influence can also be harnessed to make breathing mechanics easier or more difficult for the neurological patient. This glaring fact should be taken into consideration when teaching neurological patients compensatory or alternative breathing patterns to minimize their work of breathing. Each patient should have his breathing pattern evaluated in several different postures, watching for gravity's influence and how the patient changes his breathing pattern in response to the effect of gravity. Does he spontaneously choose a breathing pattern in gravity assisted or gravity eliminated planes? Does his pattern remain the same in all postures? Does he fight gravity's resistance when his muscle strength would indicate than an easier pattern is possible. Does his breathing appear more stressed in different postures? Does he express a feeling of shortness of breath in any posture? What changes do you notice in his voice quality or length of phrases with a change in position?

When the pattern or patterns of breathing are thoroughly evaluated, the therapist then determines a need to alter a breathing pattern in one or more postures. A therapeutic exercise program can be developed which considers gravity's constant influence on respiration using neuromuscular facilitation principles. Examples of these treatment techniques can be found in Frownfelter, Chest P.T.and Pulmonary Rehabilitation, an Interdisciplinary Approach, Yearbook Medical Publishers, C. 1987, Chapters 20,21 and 22. Teaching the patient to use the most efficient breathing pattern realizing that the patient is always breathing in a gravitational field should be a priority in the development of the patient's program.

Rather than deny that gravity exists, therapists should learn to use it to their patient's advantage. For example, a quadriplegic SCI patient could be taught to emphasize the superior-inferior plane of respiration when supine rather than fighting gravity's resistance in the anterior plane. The same patient could be taught to emphasize anterior chest expansion when sidelying and inferior expansion when sitting.

Obviously, the long term goal of a breathing retraining program would be to incorporate the principles of better breathing patterns into every day activities. By incorporating the best breathing pattern in all exercise activities, the therapist will help the patient integrate it into their subconscious motor plans.

Gravity is here to stay. If we as therapists help our patients use it wisely, they will increase their respiratory endurance and exercise tolerance. This will make it possible for them to maneuver their wheelchair a little farther, or to hold a longer conversation without becoming short of breath, or to transfer to the bed without significant fatigue. These are qualitative and quantitative objectives which need to be implemented. Considering the facts that we can not change, such as gravity's influ-

ence, we can learn to work more effectively to improve our patients' functional capabilities.

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