

## **B. Exercise with the Active Passive Trainer**

### **A Professional Background**

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A model describing the disabling process has recently been published, as a modification of the World Health Organization's International classification of impairment, disability and handicap (1980).

This model was produced jointly by the National Center for Medical Rehabilitation and National Institutes of Health in 1993, and offers 5 dimensions of the disabling process, pathophysiology, impairments, functional limitations, disabilities and societal limitations.

1. **Pathophysiology:** Underling medical or injury processes at cellular and tissue levels.
2. **Impairment:** Organic and systemic disorders which may potentially impair function of the organism or person. Impairment may not be recognized at the site of lesion, but result from it. It must be remembered that impairments can lead to further (secondary) impairments.
3. **Functional limitations:** A combination of impairments in one or more systems may lead to functional limitations. They involve whole body function.
4. **Disabilities:** Failure to fulfill normal life roles and quality of life.
5. **Societal limitations:** Referred to as "handicap" by the WHO - resulting when societal barriers prevent the individual from functioning at the highest level he or she is capable of achieving.

The daily functions of man demand movement. Control of movement demands co-operation between the nervous, muscular, connective tissue and skeletal systems. For normal function, besides control of the nervous system, a person needs muscle power and endurance, full range of movement of the joints, muscles, ligaments, connective tissue and the nervous system.

Moving synovial joints prevents biomechanical and histological changes in the soft tissues around the joint, and decreases elasticity of the capsule and ligaments (Akeson et al 1980). This allows free movement and, in other words, can decrease impairments and delay or avoid secondary impairments.

A muscle kept in a shortened position for a long period shows:

- a) Changes in its composition - loss tissue protein (William & Goldspink 1978) loss of sarcomere (component of muscle fiber) and increased amounts of connective tissue;
- b) Increased passive-elastic stiffness (William & Goldspink 1978, 1984), causing remodeling of connective tissue to match the new, shortened muscle length. This restriction of movement (Light et al 1984) causes impairment which, if prevented, would not lead to secondary impairment.

Muscle contraction causes normal tension on bone to which it is connected, affecting bone density (Bassett 1977) and preventing osteoporosis. Osteoporosis often appears following long periods of immobility. In order to develop muscle strength, it is necessary to exercise enables tired muscle to revive and, together with improved muscle strength, endurance increases.

Connective tissues and skin. Non-mobile connective tissue has a tendency to shorten (Kisner & Colby 1987), as does the skin, e.g. scar tissue following burns or other tissue damage (trauma or surgery). This also may lead to contractures - in other words - impairment.

**The nervous system:** The entire nervous system is a continuous tissue tract. It forms an (Butler 1991), which means that a restriction appearing in one part of the body may cause limitation in another part of the body. Movement also influences the interaction between the nervous system and other tissues in the body. Nerve cells send messages to target tissues in various ways (electrical and chemically). One method of transport is via the axoplasm (the substance within the axon) from the nerve cell to target tissue. These messages are responsible, amongst other things, for the well being of the target tissue. The target tissue itself also sends messages to the nerve cell via the axoplasm, regarding its condition. The axoplasm is a viscous substance, which, amongst other characteristics, can change its viscosity - is lower when the nerve is moving, enabling the messages to transfer normally. If man does not move the viscosity of the axoplasm increases and the speed of transport is greatly reduced, slowing down the messages sent in both directions, and ultimately causing trophic changes in the target tissue.

There are various factors influencing balance, which are very important to consider in order to prevent falls (especially in the frail person). Besides the sensory systems (vestibular, visual, somato-sensory), many other systems affect balance e.g. the effects of range of movement of joints and soft tissues and muscle strength (Shumway-Cook 1994).

**General Physical Fitness:** To develop or improve general physical fitness (cardio-vascular system) it is necessary to activate large groups of muscles for between 15-45 minutes or more (Fox & Matthews 1987, Kisner & Colby 1987). Thus it can be concluded that, fulfilling functional demands requires passive and active elements. Passive movement (at varying speeds) should be available, while maintaining safety of moving joints. Active movement should be graded and use different muscle groups. To attain this, a suitable mechanical device may be used.

Many people over the age of 65 display symptomatic, degenerative changes in different joints. For example - osteoarthritic changes in the knee cause pain, reduction in movement and function leading to contractures and muscle wasting (secondary impairment) (Coni et al 1988).

Increasing age (often accompanied by less active life style) causes loss of nerve cells, loss of muscle mass, muscle wasting, and reduction of elasticity of lung tissue (which in turn causes reduction of lung capacity and function). In other words, there is impairment, which, if not attended to, will develop into secondary impairment.

In conclusion, it may be said that, appropriate exercise in mobility, strength and endurance may help to improve, or maintain the functional ability of the older or frail person or people with various pathologies.

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