YOGA RESEARCH

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A Sense of Balance

Research & Review

Yoga, as a practice and a way of life, is rooted in the development of balance on all levels. The discipline of yoga achieves balance through practice. When steadiness of body, emotion, and mind have been cultivated, the mind can be quieted.

Thus, it may be appropriate to initiate talks which encourage a constructive exchange of ideas between science and yoga with this study on balance.

Although we speak of a "sense of balance," balance is not attributable to a specific sense organ, like taste or smell. Rather, balance is a sensation of postural stability derived by the brain through proper integration of inputs from several sensory systems.

Balance and orientation are ancient functions, critical to survival, and are therefore integrated in the "primitive" hindbrain, mainly in the medulla and cerebellum. Thus the portions of the brain that integrate balance are referred to as the central vestibular system (abbreviated here as the CVS).

Most healthy adults take walking for granted, but every infant has learned through trial and error that bipedal locomotion is accurately described as a series of controlled falls.

The CVS maintains postural stability and orientation. Since muscles are flaccid unless stimulated, postural stability requires coordinated application of neural stimulation to the muscles of the body. Thus, bipedal stance requires constant muscle adjustment because of its inherent instability. Without constant adjustment of tension from a feedback loop, the body falls over.

The sense systems which are integrated by the CVS include the peripheral vestibular system of the inner ear, the visual system, and the proprioceptive sensors in joints and tendons. The peripheral system senses linear and rotary forces, the visual supplies head postion information, and the proprioceptors sense joint position.

The relative contribution of each sense system varies among the animal species. The most variable in vertebrates is the visual system. Integration of the sensory input optimizes motor control. Successful performance of many tasks, such as volleyball playing, requires integration of information on head and limb position with respect to the body, location of the head with respect to the visual environment, and location of the head with respect to gravity.

Postural stability is more dependable when information is integrated from several systems. This overlap of information provides an internal checking system for fine tuning. For any given posture the body assumes, the CVS must learn and remember the solution to a postural task through all its available sensory inputs.

Most healthy adults take walking for granted, but every infant has learned through trial and error that bipedal locomotion is accurately described as a series of controlled falls. In learning to solve a postural control problem like walking, the CVS assigns levels of importance to the various sensory inputs with respect to their influence on 73 various muscle groups (output). The interaction between muscles and sensory systems is constantly adjusted, which results in postural sway. The amount of body sway is thus used as a measure of postural stability.

In all primates, input from a highly developed visual system makes a significant contribution to postural balance. Sighted individuals rely strongly on visual input in most activities, and find it difficult to balance with eyes closed because of the loss of this important source of sensory input to the CVS. Low postural stability is distressing and is avoided.

However, the adaptive processes of the CVS will adjust the levels of the other input systems to overcome the loss of the visual sense. Vestibular adaptation can be accelerated by training on challenging tasks. This happens because they will provide the strongest sensory input and give strong error signals during training. Thus, balancing on one foot with eyes closed is an excellent way to see the adaptive process.

The purpose of the study (Buchele, Knaup & Brandt, 1984) was to measure the improvement in ability to balance on one foot during the course of training. There

continued

Yoga and the Healthy Heart

The most important organ of blood circulation is the heart, because it is the contraction and relaxation of the heart that circulates the blood throughout the human body. The heart is made of the strongest muscular stuff, but it can always be made healthier by means of proper Yogic exercises.

Uḍḍiyâna and Nauli raise the diaphragm so high (*Yoga Mîmâṁsâ*, vol. 3) that they give a very good massage from below to the perpetually working heart.

Again one of the ways of promoting the health of a muscle is to subject it to an alternate increase and decrease of pressure. The heart muscle is situated in the mediastinal cavity. Hence any increase or decrease of pressure in this cavity is shared by the heart.

Now in Uḍḍiyâna and Nauli the heart is alternately subjected to a decrease of pressure (*Yoga Mîmâṁsâ*, vol. 4) and thus gets an opportunity for building a healthier muscle.

Again Bhujañgâsana, Šalabhâsana and Dhanurâsana alternately exert an increased pressure on the heart and the same thing is done by the first stages of Sarvâñgâsana, Viparîta Karaṇî and Halâsana. This alternate increase and decrease of pressure brought about by the different Âsanas promote the health of the heart and thus add to the efficiency of the circulatory system.

ÂSANAS, pg. 118
by Swâmî Kuvalayânanda

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"Truth should not be suppressed merely out of sentiment for a particular person."

Swâmî Kuvalayânanda

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A Sense of Balance, *continued*

were 28 healthy subjects (8 male, 20 female), aged 17-33. Eight were gymnasts. Fore-aft and lateral body sway was measured while balancing on one foot. Daily training was scheduled in four 15 minute intervals with eyes open or closed, one half hour on each foot. Long term effects of training were studied over 5 days. Subjects were tested 40 days after the end of training to evaluate retention of balance skill.

Training improved ability to balance in two stages. There was a short-term training effect which occurred in the course of the first 15 minute training session, and a long-term training effect which occurred over the 5 days of training. Short-term improvement was most marked with eyes closed. On average, both fore-aft and lateral sway decreased by 25-30% in the course of a 15 minute training session when the eyes were closed. Short-term training with eyes open was not significant. This result might be expected, since there was more room for improvement with eyes closed. With eyes open, long-term training showed a 15-20% improvement in postural stability of normal subjects in 5 days. Long-term effects were smaller in the gymnasts, as expected, because of greater initial stability. Long-term training with eyes closed decreased postural sway by 45-50%. Balancing skills with eyes closed showed retention of training after 40 days with no additional training.

Improvement with training was dependent on initial instability. The greater the instability at the start of training, the greater the improvement. Men showed greater initial instabilty, and thus greater improvement. Women had better postural stability than men,whether normal subjects or gymnasts. Although subjects were matched for body weight, women may have better postural stability because of other factors, such as lower center of gravity and wider hips. However, gender differences in the CVS cannot be ruled out.

Physically, the benefits of practicing the balance postures are manifold. Steadiness in posture requires concentration, patience, and perseverance. In spite of initial differences in ability, measurable improvement of balance comes with practice. Improvement in balance skills promotes a positive attitude and sense of accomplishment. The results of this paper should encourage the practice of balance poses, especially with eyes closed. Even a short period of diligent training will result in long-term improvement in postural stability, possibly lasting months.

Buchele, W., Knaup, H., & Brandt, T. (1984) Time course of training effects on balancing on one foot. Acta Otolarynogologica (Stockh) (Suppl. 406, 140-142)

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