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EXPERIMENTAL STUDY

Manipulation of the body schema – Unilateral manual stimulation of lower extremity influences weight distribution in standing position

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Summary Clinical experience advocates sensory stimulation to increase the body sensation and adjust the body schema, which may be disturbed in some patients. Unilateral massage may affect the body midline orientation, but little evidence is available to support the effect of this practice.

Twenty-one healthy young people participated in this experimental study. Two force plates measured weight distribution between the legs in standing position before and after unilateral manual stimulation of the lower extremities.

Stimulation of the leg with initial least weight-bearing increased the load on this leg significantly from 48.2% to 49.0% and a similar but reverse effect was seen when stimulating the contra-lateral leg. When analysing the data with respect to stimulation of the non-dominant leg, the stimulation increased the weight-bearing on this leg from 49.6% to 51.3%.

These findings indicate that external afferent stimuli may enhance the body perception and influence the body schema and midline orientation.

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Introduction

The concept of bodily awareness is widely used in the clinical approach to patients with disturbed perception of their body, but the concept and the word is often not precisely defined and may be used in many different ways (de Vignemont, 2016). The concept of bodily awareness may be subdivided into body image and body schema. Shaun Gallagher proposes the following definitions: "A body image consists of a system of perceptions, attitudes and beliefs pertaining to one's own body. In contrast, a body schema is a system of sensory-motor capacities that function without awareness or the necessity of perceptional monitoring" (Gallagher, 2005). This paper is focussing on body schema as a system sensory-motor functions dependent upon bodily sensations, sensory integration and perception, that operate below the level of self-referential intentionality.

The body schema may be disturbed in some individuals due to immobilization, a traumatic incident in the central or peripheral neurological system or due to psychological factors (de Vignemont, 2016). In the clinic, a disturbed body schema of the patient is potentially a barrier to rehabilitation. When there is a potential lack of sensory integration of afferent stimuli from a neglected body part of the patient, the therapist may try to stimulate the sensory receptors in this area of the body as part of the treatment (Andrade and Clifford, 2008). Interventions based on increased sensory stimulation have been tried with some success within post-stroke rehabilitation (Goliwas et al., 2015), and clinical experience advocates manual stimulation in order to increase the sensation of the body and to adjust the body schema (Lederman, 2005). Little evidence is available, however, to support these interventions.

Healthy individuals may experience that the stimulated side feels more alert following one-sided manual stimulation, and patients may feel more aware of a neglected body part after manual therapy treatment (Lederman, 2005). Observations like this have led to the belief that such a stimulation affects the body schema and the body midline orientation (Harris et al., 2015). The body midline orientation may be defined as the perceived body midline and a sensation of symmetry with respect to the midsagittal plane (Ceyte et al., 2007).

In order to evaluate the clinical practice and the impact of sensory stimulation on mid-line sensation, objective measures of weight distribution between the feet may be evaluated in an experimental setup. These objective measures will address the research question, whether the subjective sensation of difference between the two sides of the body after one-sided sensory stimulation, has an impact on the standing posture. The posture of an individual in standing position may be measured with respect to the weight distribution in the frontal plane by two force plates.

The aim of the present study was to evaluate whether one-sided manual stimulation of one leg influences the weight distribution between the legs during standing. It was hypothesized that this intervention would increase weight-bearing on the stimulated leg.

Methods

This experimental study was performed in a laboratory setup with healthy volunteers.

A convenience sample of twenty-one healthy young people was included in the study, 12 female, mean age 24.5 years (SD 2.9), BMI 23.6 (SD 2.3). Exclusion criteria were: current injuries, or injuries within the last month in the lower extremities, pelvis or back, previous injuries that may have affected body symmetry or any neurological conditions. The regional research ethics committee of Northern Denmark approved the study and informed consent was obtained from all participants in accordance with the Declaration of Helsinki.

Intervention

The intervention consisted of unilateral manual stimulation of the lower extremities for five minutes carried out by one of two well-trained physical therapy students. The participant lay supine on a massage plinth wearing shorts with the knee of one leg bent to an angle of 90° and the hip bent to 45°. The participants were not distracted by conversation or by other things during the intervention.

The intervention consisted of the following three manual techniques (McKechnie et al., 2007) performed for 100 s: 1) Tapotement (percussive strokes) — a percussive massage stroke, such as hacking, performed to stimulate the skin and superficial muscles. This technique was performed at a rate of approximately 4 Hz over the surface of both sides of the lower extremity including the foot. 2) Vigorous petrissage — carried out as vigorous kneading with the "duck bill" hand position. This technique was performed on both sides of the lower extremity including the foot. 3) Joint approximations — applied to the ankle, knee and hip joint with 33 compressions applied to each joint — one compression per second — in order to stimulate mechanoreceptors such as those in the ligaments and joint capsule of the knee and ankle.

The order in which the three techniques were performed was randomized for each participant.

Outcome measures and procedures

In total eight tests were performed to monitor the effect of the interventions. In each test the weight distribution between the two feet was evaluated in the standing position. The participants were instructed to stand with bare feet and closed eyes on a double force plate (Smart Equitest, Neurocom, Natus Medical Inc.). In order to eliminate the influence from visual input and the external reference system the participants were asked to close their eyes. Vertical ground reaction forces were recorded for each leg separately and four recordings were made with three seconds interval. The average of these four recordings was used for the analysis. During the tests the participants were asked to stand with equal weight on both legs during the recordings. The participants were aware of the elements in the protocol but were blinded to the outcome measures.