ELECRlOTRANEOUS COGNITIVE FEEDBACK SYSTEM FOR ASSISTANCE OF PARAPLEGIC STANDING
Per Leth Jensen, Zlatko Matjacic, Ronald R. Riso, Thomas Sinkjaer and Tadej Bajd

Purpose: To develop a system for use with FES assisted paraplegic standing that provides the user with information about the dynamic pressure distribution under his/her feet.

Method: We developed an electrocutaneous cognitive feedback system which maps the somatosensory inputs from the subject's foot sole onto the subject's neurologically intact upper body. Arrays of electrode were placed on the paraplegic's left/right shoulder, and dynamic pressure distribution under the paraplegic's feet was measured using a Pedar insole system. The information included in the electrocutaneous cognitive feedback signal is the left/right Ground Reaction Force (GRF) and the sagittal position of left/right Center of Pressure (CoP). The GRF is related to a frequency modulation, and the CoP is related to spatial location of the stimulation.

Result: During FES assisted standing using electrocutaneous cognitive feedback, a position was displayed to a Th 7-9 paraplegic subject. The position is associated with a stimulation frequency and a spatial location of the stimulation. The subject was in position to track the stimulation frequency and a spatial location by adjusting his posture.

Conclusion: The results indicate that controlled postural adjustment in the frontal plane is possible. More experiments are, however, needed. If the subject can learn to use cognitive feedback to produce a well-controlled postural shift in the frontal plane (within the range that represents no risk of falling), then a closed-loop feedback system for the muscle stimulator could be developed to relax the appropriate muscle and reduce the fatigue. Thus, prolonged standing time could be obtained.