

# EFFECTS OF VISUAL, AUDIO AND TONGUE TACTILE SENSORY SUBSTITUTION SYSTEMS FOR THE CONTROL OF BUTTOCK PRESSURES IN SEATED POSTURE

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Pressure ulcers, resulting in a dramatic decreased quality of life [1] and high healthcare cost [2], are a critical problem in rehabilitation. A pressure ulcer is defined as an area of localized damage to the skin and underlying tissue caused by overpressure, shearing, friction or a combination of these factors [3]. Mostly located near bony prominences such as the ischium, sacrum and trochanter, pressure ulcers present a prevalence ranging from 23% to 39% in spinal cord injured (SCI) patients (e.g., [4]) and constitute the main cause of rehospitalization for persons with paraplegia [5]. Indeed, contrary to healthy persons, i.e. with intact somatosensory system, SCI patients (para- or tetraplegics) can not get reliable sensory feedback arising from their buttock area informing them of an excessive localized pressure at the skin/seat interface and the necessity to make adaptive postural correction to prevent pressure ulcer formation. Within this context, our group recently developed a biomedical device for preventing pressure ulcer formation in SCI patients. Based on the concept of “sensory substitution” [6], its general principle consists in supplying the patient with supplementary sensory information regarding the adequate seated posture to adopt to relieve or reduce the buttock pressures. This system comprises three distinct components. (1) The sensory input unit, consisting in a computerized pressure mapping system put on the wheelchair, allows the real-time acquisition of the seated buttock pressure distributions. (2) The processing unit allows the detection/localization of any excessive buttock pressure concentration and the determination of the postural change that would decrease the most the measured overpressures. (3) The sensory output unit allows conveying the information about seated buttock overpressures to the SCI patients via an intact and functional sensory modality. The present study was designed to assess the performance of three different substitutive modalities, namely visual, audio and tongue tactile. Height young healthy adults voluntarily participated to the experiment. Seated in front of a DVD movie, they were asked to reduce their buttock pressure, while benefiting from visual, audio and tactile sensory substitution systems or not. Visual, audio and tactile feedback consisted in visual alarms provided on the edges on TV screen, sound audio signals provided on earphones, and electrotactile stimulations of the dorsal part of the tongue provided by a dedicated device, namely the tongue display unit [7], respectively. Analyses of subjects’ trunk movements -recorded with a system for the analysis of movement- and the difference between the seated buttock pressure distributions - recorded using the pressure mapping system showed that young healthy adults were able to use available visual, audio and tongue tactile feedback to produce adapted postural behaviour to reduce excessive localized buttock pressure in a seated posture. Based on the encouraging results of this experimental proof-of concept study, these sensory substitution systems are currently being clinically evaluated in paraplegics.

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## **References**

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