Clinical Study

Investigation of Peak Pressure Index Parameters for People with Spinal Cord Injury Using Wheelchair Tilt-in-Space and Recline: Methodology and Preliminary Report

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The purpose of this study was to determine the effect of the sensel window’s location and size when calculating the peak pressure index (PPI) of pressure mapping with varying degrees of wheelchair tilt-in-space (tilt) and recline in people with spinal cord injury (SCI). Thirteen power wheelchair users were recruited into this study. Six combinations of wheelchair tilt (15°, 25°, and 35°) and recline (10° and 30°) were used by the participants in random order. Displacements of peak pressure and center of pressure were extracted from the left side of the mapping system. Normalized PPI was computed for three sensel window dimensions (3 sensels × 3 sensels, 5 × 5, and 7 × 7). At least 3.33 cm of Euclidean displacement of peak pressures was observed in the tilt and recline. For every tilt angle, peak pressure displacement was not significantly different between 10° and 30° recline, while center of pressure displacement was significantly different (P < .05). For each recline angle, peak pressure displacement was not significantly different between pairs of 15°, 25°, and 35° tilt, while center of pressure displacement was significantly different between 15° versus 35° and 25° versus 35°. Our study showed that peak pressure displacement occurs in response to wheelchair tilt and recline, suggesting that the selected sensel window locations used to calculate PPI should be adjusted during changes in wheelchair configuration.

1. Introduction

Sitting-acquired pressure ulcers result from loading-induced soft tissue necrosis [1–3]. Pressure ulcers are both common (up to 85% lifetime incidence) and chronic (up to 70% recurrence) among people with spinal cord injury (SCI), largely due to the heightened pressure ulcer risk associated with diminished capacities to sense pain and to perform weight shifts [4, 5]. In the United States, treatment for pressure ulcers has been estimated to cost $1.2 billion annually, accounting for one-quarter of the total cost of SCI care [6].

Although pressure ulcer etiology is multifactorial, leading hypotheses are that tissue ischemia and tissue deformation are associated with the precursory tissue necrosis [1–3]. The former proposes the fact that mechanical loading prevents arterial vessels from resupplying tissues with oxygen and nutrients, leading to tissue ischemia and ultimately tissue necrosis. The latter proposes the fact that mechanical loading causes compressive and shearing deformation at the cellular level, leading to individual cell deaths and ultimately tissue necrosis. The apparent link between tissue necrosis and mechanical loading has prompted the development and evaluation of seating support surfaces in terms of optimizing seating interface pressure distributions [7–11]. Empirically, there is evidence linking increased mechanical loading with increased pressure ulcer incidence in elderly wheelchair