Comparison of Muscle and Skin Perfusion Over the Ischial Tuberosities in Response to Wheelchair Tilt-in-Space and Recline Angles in People With Spinal Cord Injury

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Abstract

Objective: To compare the efficacy of wheelchair tilt-in-space and recline on enhancing muscle and skin perfusion over the ischial tuberosities in people with spinal cord injury (SCI).

Design: Repeated-measures and before-after trial design.

Setting: University research laboratory.

Participants: Power wheelchair users with SCI (N = 20).

Interventions: Six combinations of wheelchair tilt-in-space and recline angles were presented to participants in a random order. The testing protocol consisted of a baseline 5 minutes sitting with no tilt/recline and 5 minutes positioned in a tilted and reclined position at each of 4 conditions, including: (1) 15° tilt-in-space and 100° recline, (2) 25° tilt-in-space and 100° recline, (3) 35° tilt-in-space and 100° recline, (4) 15° tilt-in-space and 120° recline, (5) 25° tilt-in-space and 120° recline, and (6) 35° tilt-in-space and 120° recline.

Main Outcome Measures: Muscle and skin perfusion were assessed by near-infrared spectroscopy and laser Doppler flowmetry, respectively.

Results: Muscle perfusion was significantly increased at 25° and 35° tilt-in-space when combined with 120° recline, and skin perfusion was significantly increased at 3 tilt-in-space angles (15°, 25°, 35°) when combined with 120° recline and at 35° tilt-in-space when combined with 100° recline (P < .05). Even in the positions of increased muscle perfusion and skin perfusion (25° and 35° of tilt-in-space combined with 120° of recline), the amount of muscle perfusion change was significantly lower than the amount of skin perfusion change (P < .05).

Conclusions: Our results indicate that a larger angle of tilt-in-space and recline is needed to improve muscle perfusion compared with skin perfusion. A position of 25° tilt-in-space combined with 120° recline is effective in enhancing muscle and skin perfusion of weight-bearing soft tissues at the ischial tuberosities.

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Pressure ulcers have remained a significant health care issue in the United States ever since Pârâ described one of the earliest pressure ulcers in the literature indicating that “the bed on the buttock has come from having been too long a time lying on it, without moving himself” in the 16th century.1,2 People with spinal cord injury (SCI) who lose mobility and sensation are particularly at risk of pressure ulcers on gluteal muscles.3,4 The National Pressure Ulcer Advisory Panel (NPUAP) states that most pressure ulcers are avoidable, thus prevention remains a mainstay of pressure ulcer treatment.3

Clinically, an essential component of a pressure ulcer prevention program is to periodically reduce the magnitude of pressure on weight-bearing soft tissues.2,3 During pressure relieving, ischemic soft tissues are able to improve blood flow to meet the metabolic needs of local cells. Such practice is based on the ischemia theory of pressure ulcer etiology.3,6,7 Wheelchair tilt-in-space and recline repositioning systems are commonly recommended for preventing sitting-induced pressure ulcers in