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Clinical study

The effectiveness of small changes for pressure redistribution; using the air mattress for small changes

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Abstract Observing small changes (SCs) at specific sites is a new form of managing changes in position. We investigated SCs at specific sites considering interface pressure, contact area, body alignment and physical sensation in nine healthy female adults and evaluated SCs using the air mattress that was divided into six cells (A—F). Thirty-three SC combinations at one or several sites were evaluated. Pressure in the sacral region significantly decreased in 28 SC combinations compared with the supine position ($p < 0.05$), and the effect of pressure redistribution was greater when SCs were applied at several instead of a single site. The contact area at 17 of the 28 SC combinations significantly increased ($p < 0.05$). Among sites ranked based on interface pressure, body alignment and physical sensation, SCs at sites BCE, AE and BD were the most favorable. The common feature among these

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three combinations was that they involved tilting the buttock region and one other site. The findings suggested that SCs at the buttock region could reduce disruptions in alignment as well as the impact on physical sensation caused by the body sinking into the mattress and improve interface pressure redistribution via increased contact area with the mattress.

1. Introduction

Changing the position of the body every 2 h has been recommended to prevent pressure ulcers [1,2]. However, this is a burden not only for caregivers [3], but also for patients, as it can disrupt sleep [4]. Moreover, friction forces are closely associated with superficial skin lesions [5]. Therefore, avoiding such issues when changing body positions becomes crucial. A consensus panel that developed the Virginia Commonwealth University (VCU) guidelines, recommend providing mini-turns [6]. Exton-Smith et al. also reported that the incidence of pressure ulcers increases among elderly inpatients when the frequency of body movements decreases at night [7]. Movements with small amplitudes were measured in that study as a representation of small changes in body weight, since large body movements are artificially produced. Their results were the first to indicate the importance of small changes body weight to preventing pressure ulcers, and this generated the notion of incorporating such changes for patients who are unable to move independently.

Small, as opposed to large physical movements to change body position such as changing from the supine to the lateral position, are called "small changes" (SCs), and Lunde [8] stated that natural body movements can be mimicked by tilting the body by inserting a small pillow under the mattress.

Oertwich et al. [9] investigated the relationship between SCs and interface pressure as well as blood flow in the sacral region and found that SCs decreased pressure in the sacral region and increased blood flow. Because SCs could decrease the burden on caregivers, an air mattress for SCs is required at automatically changes body position.

Small changes have been generated at a single site, but generating SCs at multiple sites should elicit a further pressure redistribution effect on the sacral region. However, whether or not that is true remains unknown, and whether or not the body axis of patients becomes disrupted, or the patients experience discomfort after applying SCs has not been investigated as far as we can ascertain.

Therefore, we investigated these issues in healthy adult females using an Air mattress for SCs that was custom-designed to study SCs at several sites instead of a small pillow.

2. Materials and methods

2.1. Study design

This study was quasi-experimental.

2.2. Participants

The subjects were healthy adult females.

2.3. Air mattress for SCs

Cells A (left shoulder), B (left buttock), C (left calf), D (right calf), E (right buttock), and F (right shoulder) comprising two compartments each were placed under a high-performance, multifunction NEXUS air mattress (CAPE Co., Ltd., Yokosuka, Japan) that was modified to stationary mode (Fig. 1). All six areas could be independently and/or simultaneously inflated and deflated. Of the 63 conceivable combinations of individual or several SC sites, those that were symmetrical and those involving SCs only in Cells C or D were excluded. The remaining 33 combinations were measured. The internal pressure of the cells after inflation with air was 30 ± 3 mmHg.

2.4. Outcome measurements

2.4.1. Interface pressure

Changes in maximum pressure before and after SC were determined using a three-point interface pressure sensor (Pressure Scanning Aid Cello; CAPE Co. Ltd.), in which three sensor pads were positioned along an arc and the maximum value was automatically detected by one pad. The sensor could measure a range of pressure from 0 to 199 mmHg with a precision of ±4.0 mmHg.