

# Effects of an Inclining Seat Support on Gluteal Pressure

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**Abstract.** [Purpose] The purpose of this study was to show the effect of an inclining seat support on gluteal pressure reduction. [Subjects] Ten males were recruited. [Methods] The inclining seat support was developed for repositioning. The Body Pressure Measurement Mat of the TekScan system was used to measure the location and magnitude of the peak pressures on the gluteal seat interface of the chair. The paired t-test of the SPSS statistical package was used to analyze the significance of differences between the general chair and the inclining seat support. [Results] The results show that the gluteal pressure was more significantly reduced in the inclining seat support than in the general chair. [Conclusion] We suggest that the inclining seat support contributes to repositioning and gluteal pressure reduction.

**Key words:** Body-pressure, Seat support, TekScan system

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## INTRODUCTION

Localized pressure on the skin surface is believed to cause blockage of capillary blood flow and subsequent ischemic damage, and is common in patients being nursed in wheelchairs or beds<sup>1)</sup>. Patient repositioning is a key component of skin care. Specialized pressure sores care can include, load reducing surfaces such as air beds or specialty seat supports<sup>2)</sup>. Many biomedical engineering research investigations into interventions designed to prevent pressure sores have measured contact areas, forces, and pressures<sup>3)</sup>. Research in this area has been aided by the recent introduction of digitized pressure-sensing devices<sup>4)</sup>. Localized stresses are generated even during contact with a deformable surface such as an air cushion, and they cause deformation of soft tissues and exacerbation of pressure sores<sup>5)</sup>. Koo et al.<sup>6)</sup> have demonstrated that the pressure-relieving characteristics of active cushions are worse than those of passive cushions, such as polyurethane foam and air-floatation cushions. Because patient repositioning by caregivers is a highly labor-intensive task<sup>7)</sup>, effective automated devices are needed. We developed an inclining seat support and in this study, we investigated its effect on gluteal pressure reduction.

## SUBJECTS AND METHODS

The study subjects were 10 males aged 21–29 years ( $25.0 \pm 4.8$  years, mean  $\pm$  SD) whose average height and weight were  $174.2 \pm 2.5$  cm and  $66.4 \pm 4.3$  kg, respectively. Subjects with conditions that might have affected trunk mobility, such as injury or neurologic deficits of the hip and

lower extremities during the previous year, were excluded from the study. All subjects provided their written informed consent to participation prior to the commencement of the study. The TekScan system was used to measure the location and magnitude of the peak pressures on the body–bed interface. A sampling rate of 60 Hz was used. The software supplied with the TekScan system was used to locate areas of interest, and display temporal forces and pressures on a monitor. We compared the mean peak pressures between the general chair and the general chair with the inclining seat support. The general chair consisted of a  $40 \times 40$  cm height-adjustable seat support with a 60 cm height backrest. We adjusted the distance from the seat surface to the floor using the height-adjustable seat support. The surface of the inclining seat support was covered with the same material as that of general chair. We only modified the structure below the seat support. The inclining seat support allow 20 degrees forward, backward, right and left inclination through adjustment of four air cushions. The tester performer controlled the inclination. The seat support was inclined for 1 minute in each of the directions: forward, backward, right and left. Subjects were instructed to look straight ahead during the test for 15 minutes. They sat on the chair which was covered with the Body Pressure Measurement Mat of the Tekscan system. The paired t-test of the SPSS statistical package (SPSS, Chicago, IL, U.S.A.) was used to analyze the significance of differences between the general chair and the chair with the inclining seat support. The level of statistical significance was chosen as 0.05.

## RESULTS

The result showed that the gluteal pressure was more significantly reduced in the chair with the inclining seat support than in the general chair ( $p < 0.05$ ). The mean peak contact pressure was  $23.6 \pm 9.7$  mmHg in the chair with inclining seat support and  $39.2 \pm 10.5$  mmHg in the general chair.

## DISCUSSION

Most pressure ulcers occur in the lower part of the body. The sacral and coccygeal areas, ischial tuberosities, and greater trochanteric areas account for the majority of pressure ulcer sites<sup>1)</sup>. Without dynamic pressure redistribution, these areas, when in contact with dense materials, eventually lose the ability to reduce the load and excessive load on soft tissue remains largely unrelieved<sup>8)</sup>. To relieve and distribute the pressure, special equipment is needed for confined patients. Repositioning devices can be defined as pressure relieving or pressure reducing<sup>9)</sup>. The majority of devices are pressure reducing. Pressure-reducing devices can be further classified as static or dynamic. Static surfaces are stationary and attempt to distribute local pressure over a larger body surface<sup>10)</sup>. Dynamic devices use a power source to produce air currents and promote uniform pressure distribution over body surfaces<sup>9)</sup>. This study investigated the effect of the inclining seat support on gluteal pressure reduction. The results show that the body-pressure of the lower extremity was more significantly reduced in the chair with the inclining seat support than in the general chair. The inclining seat support can be repositioned with forward, backward, right and left incline may develop as a patient becomes immobile and confined to wheelchair, due to the continuous application of pressure on the gluteal<sup>6)</sup>. Therefore, redistributing the pressure to different parts of the body surface should be considered as a preventive measure. This study had some limitations. We didn't segment and analyze the higher and lower pressure areas, nor did we calculate the mean peak contact pressure. Also, the measurement took place over a short period of time, so long-term effects could not be

investigated, and the sample size was small. This study investigated a new approach to skin ulcer prevention using an inclining seat support for repositioning of the gluteal area. Continuous repositioning is effective at reducing ulcers<sup>11)</sup>. We suggest that our inclining seat support can contribute to the repositioning and gluteal pressure reduction for confined to a wheelchair patients.

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