Evaluating the Pressure-Reducing Capabilities of the Gel Pad in Supine

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OBJECTIVE. Gel pads are commonly used by occupational therapists in acute care settings to reduce pressure on the coccyx and sacrum in supine. The purpose of this study was to determine the pressure-reducing capabilities of gel pads used in supine and the resultant potential impact on pressure ulcer management.

METHOD. A pressure-mapping system was used to measure interface pressures between the participant’s buttocks and the mattress, with and without the gel pad.

RESULTS. The gel pad did not have a significant effect on interface pressure for most participants. No obvious clinical indicators were identified.

CONCLUSION. Use of the gel pad is not recommended to decrease pressure in supine. Because potential adverse effects may result from using the gel pad in supine and no clinical indicators were identified to direct practice, use of the gel pad in supine is not recommended as an intervention for decreasing interface pressure.


Pressure ulcers represent a significant health care cost as well as a significant risk of increased morbidity and mortality during and after a hospital admission. In the United States alone, >60,000 people die each year from pressure ulcers or sequelae thereof, and the cost in health care dollars exceeds $1 billion (all amounts in U.S. dollars) per year (Bansal, Scott, Stewart, & Cockerell, 2005). In Australia, pressure ulcer treatment is estimated to add $350 million annually to health care costs (Lewis, Pearson, & Ward, 2003). Interventions aimed at prevention are significantly lower in cost than treatment of pressure ulcers (Schectman, Hanson, Garrett, & Dunn, 2001). Pressure ulcers result from increased, sustained pressure on an area of the skin, the risk of which increases when concomitant conditions compromise skin integrity or blood flow. Skin care programs commonly involve a variety of interventions to prevent the development of pressure ulcers through the reduction or elimination of this pressure.

Occupational therapists are involved in many interventions such as the development of positioning schedules and mobilization of the person, as appropriate, to prevent the development or aggravation of pressure ulcers (Bansal et al., 2005). In many settings, it is the responsibility of the occupational therapist to recommend pressure reduction or relief surfaces both in seated and supine positions (Griesbrecht, 2006).

In an environment of managed health care resources, occupational therapists are often obligated to use available equipment in unconventional ways. One common practice in the acute care setting is to provide a square gel pad to reduce the pressure on the coccygeal region in supine. Thus, a cushion designed for use in seating is often used in supine. Data exist to support the use of gel surfaces in a...
Etiology and Prevalence of Pressure Ulcers

Pressure ulcers represent areas of superficial or deep damaged tissue associated with four causes: pressure, shear, friction, and moisture (Arnold, 2003). Pressure ulcers and tissue necrosis can be caused by sustained pressure of >32 mm Hg (accepted capillary filling pressure) for a period up to and exceeding 2 hr (Bansal et al., 2005). The degree of tissue damage can be exacerbated by intrinsic (chronic medical conditions, contractures) and extrinsic (pressure, friction, shear, or moisture) factors (Bansal et al., 2005). In fact, the presence of significant shear forces can further lower the threshold of pressure required to cause tissue damage by 50% (Bonomini, 2003).

Evidence has suggested that critically ill patients admitted to the hospital frequently are experiencing pressure ulcers or are at a high risk for developing them during hospitalization (Coats-Bennet, 2002). Moreover, incidence of pressure ulcers in hospitalized patients ranges from 2% to 29% (Arnold, 2003). This problem persists in long-term care facilities, where prevalence ranges from 3% to 35% (Abel et al., 2005). Data indicate that the most common areas where pressure ulcers develop are the sacrum/coccyx (36%), followed by the greater trochanters, ischial tuberosities, and heels and ankles (Geyer, Brienza, Karg, Treffer, & Kelsey, 2001).

Many factors contribute to the development of pressure ulcers in hospitalized patients, including immobility, incontinence, altered mental status, severity of disease, poor nutritional status, history of previous pressure ulcers, and increased age (Horn et al., 2004). Decreased mobility has been shown to be of significant importance (Bonomini, 2003). In addition, many chronic disease processes can decrease circulation and reduce blood oxygenation, rendering tissues more susceptible to injury at lower thresholds of pressure (Arnold, 2003; Griffiths & Gallimore, 2005).

Determining the risk level of developing a pressure ulcer is a crucial first step in prevention. The Braden Scale for Predicting Pressure Sore Risk (Bergstrom, Braden, Laguzza, & Holman, 1987) is one of many tools that have been developed to identify people at risk for developing pressure ulcers. It is frequently used and has been adopted by many acute care facilities (Griesbrecht, 2006; Thomas Hess, 2004) because it has shown the highest validity (Pancorbo-Hidalgo, Garcia-Fernandez, Lopez-Medina, & Alvarez-Nieto, 2006) of the tools available. The Braden Scale identifies risk using six subscales and provides a score out of 23. According to this scale, a score ranging from 15 to 18 indicates a low risk and a score of ≤12 indicates a very high risk (Ayello, Baranoski, Lyder, & Cuddigan, 2004). Courtney, Ruppman, and Cooper (2006) recommended the implementation of a skin care program for people with a score <16 on the Braden Scale.

Regular skin checks should be completed on clients with lower Braden Scale scores. Skin checks include a blanching test, which can detect a pressure ulcer in its initial stages. The blanching test detects the presence or absence of capillary refill by applying light pressure to the reddened area. A change in skin color indicates the presence of capillary refill but is suggestive of underlying tissue damage and is therefore identified as a Stage I ulcer (National Research Council Institute for Biodiagnostics, 2006).

Interventions Used to Reduce Pressure Ulcer Incidence

Many interventions are used in hospitals to reduce interface pressure (the pressure between a surface and a bony prominence) to prevent the development or aggravation of pressure sores (Coats-Bennet, 2002). According to Schoonhoven et al. (2006), 70% of Stage I ulcers did not progress when preventative measures were used, reinforcing the importance of early intervention (Nixon et al., 2006). The most common prevention method is a combination of manual repositioning of the client and the use of a therapeutic surface (Arnold, 2003). Therapeutic surfaces are used primarily to lower the interface pressure, thus limiting the risk of developing pressure ulcers (Kernozek & Lewin, 1998; Shechtman et al., 2001).

Interface pressure can be accurately measured with the use of a pressure-mapping system. Pressure mapping provides a quantitative measure of the efficacy of various therapeutic surfaces and can therefore guide clinical decisions (Schmeler & Buning, 1999). This system consists of a mat containing numerous sensors, which is placed between the individual and the surface. This mat measures the interface pressure and provides a computer-generated pictorial representation of pressure points between the surface and the body, as well as the relative degree of severity of such areas (Stinson, Porter-Armstrong, & Eakin, 2003). Pressure-mapping systems measure only uniaxial pressure (vertical) and do not measure shear forces (Schmeler & Buning, 1999).
Pressure mapping does allow for before-and-after comparison rather than product comparison and helps with validating clinical judgment. In one study, pressure maps demonstrated that 25% of participants were seated on inappropriate surfaces (Crawford, Strain, Gregg, Walsh, & Porter-Armstrong, 2005). Thirty-two mmHg is the theoretically identified capillary closing pressure; however, according to Bar (1998), no existing surface has been found to consistently maintain pressures <32 mmHg. Thus, Bar suggested that 60 mmHg is a more realistic and attainable target for pressure relief surfaces. Schmeler and Buning’s (1999) research recommended that pressure-mapping readings of 80 to 120 mmHg necessitate a change in surface and represent a significant risk for development of pressure ulcers in a seated position. They stress the potential for serious sequelae if pressure readings exceed 120 mmHg.

Role of Occupational Therapy in Pressure Ulcer Prevention

Occupational therapists make recommendations relating to positioning to relieve or reduce pressure; one such common suggestion is the positioning of the head of the bed at 30° to improve circulation over the sacrum and the ischial tuberosities (Lewis et al., 2003).

Occupational therapists also make recommendations regarding pressure-relief surfaces on the basis of skin status, the patient’s degree of mobility, and additional risk factors. Most therapeutic surfaces contain foam, gel, or air. Gel surfaces are commonly used for pressure relief because this allows for immersion in the viscous surface, thus limiting shear (Coats-Bennet, 2002). Cushions and other surfaces vary in their ability to reduce interface pressure on a case-by-case basis (Pellow, 1999). In principle, freely flowing gel evenly distributes the pressure throughout the supporting surface (Bar, 1991). In practice, however, Bar stipulated that the cover on gel surfaces may constrain the gel, which, in turn, limits the efficacy of pressure reduction by this surface. Therapists should take this constraint into consideration when making recommendations pertaining to selection of support surfaces.

The current study focused on the pressure-relieving capabilities of the gel pad in the supine position with the head of the bed at 30° elevation and attempted to validate this common occupational therapy intervention.

Method

We used a quantitative cross-over design in which each participant served as his or her own control for treatment comparison. The methodology and protocol were approved by the relevant institutional ethics review boards.

Sixty participants were recruited from the acute floors (medical and surgical) of a Canadian urban tertiary care teaching hospital. Participants were required to meet the following inclusion criteria:

• Age ≥18 years
• At low to moderate risk of skin breakdown (score of 10–18 on the Braden Scale)
• Able to tolerate the required test position in bed (30° angle for 20 min)
• Between 75 and 250 lb.

Potential participants were excluded if any of the following conditions were present:

• Agitation
• Incontinence of bowel or bladder (without Foley catheter)
• Need for palliative/comfort measures
• Diagnosis of cellulitis affecting buttocks, lower back, or upper thighs
• Existing non-pressure-related ulcers in pressure-prone areas (e.g., vascular, trauma)
• Dermatological condition interfering with pressure ulcer staging or visualization
• Need for restraints
• Inability to lie in supine (i.e., respiratory complications, hiatal hernia, bilevel positive airway pressure, inability to manage secretions, tracheotomy)
• Presence of chest tubes, nephrostomy tubes, or nasogastric tubes (continuous).

Participants were recruited by the primary occupational therapist during the initial assessment if the previously mentioned inclusion/exclusion criteria were met; names were forwarded to the research team with consent from potential participants. Research assistants, trained to follow the protocol and to use the clinical tests, performed all data collection.

Data Collection

Data were obtained from three sources. The medical chart provided medical history, demographic data, and a Braden Scale score. A skin integrity assessment consisting of a visual scan of skin and a blanching test provided qualitative information. Finally, the Force Sensitive Applications (FSA) pressure-mapping system distributed by Vista Medical (Andrew Frank, Medcare IT, Winnipeg, Manitoba) was used as the primary tool to collect quantitative data in this study. The pressure-mapping system measured the amount of pressure applied to the skin of an individual, thus identifying areas at risk for pressure ulcer development. Pressure-mapping equipment consisted of an 18 x 18-in. vinyl mat, of approximately 1/16 in. thickness and connected to a laptop.
computer. The 256 sensors within the mat could read pressure at discrete locations; resultant readings were interpreted by the computer system.

Once informed consent was obtained from the participant or guardian, the medical chart was reviewed by the research assistant. Participants were seen over two sessions lasting approximately 20 min each, with a minimum delay of 2 h between sessions. The first data collection session commenced with an assessment of skin integrity, in which existing pressure areas were documented if present. The FSA pressure-mapping mat was then placed under the buttocks of the supine participant with the head of the bed elevated to 30°. Pressure readings were taken at 5-min intervals commencing at time zero for 20 min and recorded for later statistical analysis. At the end of this period, the pressure-mapping mat was removed, skin integrity was reassessed, and participants were positioned in side lying. After a 2-hr rest period, the previously mentioned procedure was repeated with the addition of an 18- × 18- × 1-in. gel pad between the mattress surface and the pressure-mapping mat. The equipment was cleaned between each use.

Results

Sixty-eight eligible patients were recruited to participate in this study from acute care medical and surgical units; 60 patients completed both sessions of the study. Eight participants declined as a result of difficulty coordinating test sessions with medical appointments or a short hospitalization length. Of the 60 patients who completed the study, the majority were male (57%). The average age of the participants was 72.6 years. For subsequent demographic and data analysis, men and women were considered separately. The average height and weight of male participants were 69.12 in. (standard deviation [SD] = 4.10) and 173.38 lb (SD = 35.91), respectively, with an average body mass index (BMI) of 25.68 kg/m² (SD = 5.80). Similarly, the average height and weight of female participants were 64.03 in. (SD = 2.04) and 142.67 lb (SD = 33.01), with an average BMI of 24.52 kg/m² (SD = 5.81).

During the two study sessions, with and without the gel pad, the maximum pressure readings were recorded at 5-min intervals, beginning at time zero. The mean maximum pressure (Pmax) was calculated for each participant using the recorded maximum pressures for the final four intervals. The readings at time zero were excluded from the calculations to allow time for maximal submersion into the gel pad and stabilization of potential fluctuations in pressure. Mean maximum interface pressure with the gel pad (Pmaxg) was 51.64 mmHg, with a 95% confidence interval of 42.29 to 60.79. Mean maximum interface pressure without the gel pad (Pmaxng) was calculated as 54.03 mmHg with a lower and upper confidence interval of 45.57 and 62.49. Using these data, the difference between the mean maximum pressure with the gel (Pmaxg) and the mean maximum pressure without the gel (Pmaxng) was calculated for each participant (Pmaxg – Pmaxng). With this information, the overall average mean difference was calculated to be –2.39 mmHg (SD = 3.55). This indicates that, on average, among all participants, a slightly greater mean pressure was observed without the gel pad but also that the mean difference with and without the gel pad varied widely among participants.

The nonparametric Wilcoxon signed-rank test was used to calculate the difference between the medians of the two sets of observations. The two-tailed p value was calculated at .54. This finding indicates that there is no significant difference between the medians of Pmaxg and Pmax; therefore, the addition of a gel pad does not change interface pressure in a statistically significant way.

In a post hoc examination of the individual mean differences, three distinct groups emerged. In this analysis, a significant difference was defined as being 2 standard deviations from the average mean difference. For one group (n = 3), the addition of the gel pad provided a significant reduction in interface pressure; this corresponds to an individual mean difference larger than –73.55 mmHg. In a second group (n = 2), the addition of the gel pad significantly increased the interface pressure; an individual mean difference of more than 68.77 mmHg was measured. However, for the majority of participants (n = 55), the addition of the gel pad did not significantly increase or decrease interface pressure.

Individual results of the skin integrity assessment showed that there were no changes before and after each session, with or without the gel pad. For example, people with redness before the beginning of sessions had redness throughout without improvement or exacerbation; people with no signs of compromised skin integrity before commencing the sessions remained as such throughout. We should note that although changes were not observed during

<table>
<thead>
<tr>
<th>Table 1. Spearman’s Correlation Calculations</th>
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<tbody>
<tr>
<td>Pmaxg/Pmaxng</td>
</tr>
<tr>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>Female (n = 33)</td>
</tr>
<tr>
<td>Male (n = 26)</td>
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<tr>
<td>Combined (n = 59)</td>
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<tr>
<td>Note. Pmaxg = maximum interface pressure with gel pad; Pmaxng = maximum interface pressure without gel pad; BMI = body mass index.</td>
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the short sessions, skin integrity changes may occur with longer periods of time in supine.

Correlations were calculated in an attempt to elucidate the relationship between the mean individual difference in pressure (Pmaxg – Pmaxng) and height, weight, and BMI. For this nonparametric data, Spearman’s rank correlation test was used to calculate the correlations for men and women combined or separately (Table 1). Correlations were calculated for 59 participants; data were not available for 1 participant because the individual declined to provide this information to the research team. The mean individual difference in pressure was found to have a tendency to increase together with BMI and weight of men separately and also with BMI and weight of men and women combined. In other words, with the addition of the gel pad, interface pressure had a tendency to increase as an individual’s weight or BMI increased. The correlation relationships were considered of weak strength (ρ = 0.33) for weight with the combined male and female group and of medium strength (ρ = .34-.66) for BMI and weight with the male group separately. In addition, the correlation relationship between the individual difference in pressure and BMI for the combined group was considered of medium strength. Data were also analyzed for a relationship between the mean individual difference in pressure and admission diagnosis; none was found.

Discussion

The study results suggest that the pressure-relieving capabilities of the gel pad in supine are uncertain. For the majority of participants, the presence of the gel pad did not significantly affect interface pressure; therefore, there is no indication for its use. In fact, the gel pad significantly reduced the pressure for only 3 participants. More alarmingly, its presence considerably increased the pressure for 2 participants; for these participants, use of the gel pad is clearly contraindicated. These results may be explained in part by the fact that the gel pad was designed to be used in a sitting position.

Previous research using pressure mapping has helped to develop guidelines to facilitate selection of appropriate support surfaces. As previously mentioned, Schmeler and Buning’s (1999) research recommended that pressure-mapping readings of 80 to 120 mmHg necessitate a change in surface and represent a significant risk for development of pressure ulcers in a seated position. In a supine position, pressure is distributed over the entire posterior aspect of the body; as a result, one would anticipate lower acceptable interface pressures at the coccygeal region. Contrary to the previously stated expectation, for 9 participants, pressure exceeded 80 mmHg after the addition of the gel pad, indicating that the pressure-relief surface was not adequate. For 5 participants, interface pressure with the addition of the gel pad exceeded 120 mmHg, a value that indicates the potential for serious sequelae. Conversely, without the gel pad, only 7 participants recorded interface pressures >80 mmHg, with only 4 people in this group exceeding 120 mmHg. This finding further suggests that for some people the addition of the gel pad is potentially more detrimental than the use of the traditional hospital mattress alone.

Compared with the findings of Shechtman et al. (2001), we found a correlation between the pressure-reducing capabilities of the gel pad and the weight and BMI of male participants. Although statistically significant, these correlations are not strong enough to be used to establish reliable guidelines for use in a clinical setting. The difference in the strength of the relationship may be explained by participants’ position in the studies. The former study was conducted with participants in the seated position; in supine, pressure may be dispersed over a larger surface area rather than primarily over the coccygeal region. This study supports findings from Garber and Krouskop (1982): The provision of a therapeutic surface such as a cushion or a gel pad does not eliminate the risk of a pressure sore formation. Results also support previous studies that have concluded that no one pressure-relief surface is best suited for all people and that individual and ongoing assessment is essential to provide the best therapeutic surface (Pellow, 1999).

Given that no clear indicators were identified to support the use of the gel pad, that there exists potentially detrimental consequences of increased pressure with this intervention, and that for >80% of participants no significant change was noted, it is not advisable to use the 18- × 18-in. gel pad in supine.

Limitations

As in most quantitative research carried out in clinical settings, challenges existed. The equipment provided a quantitative computerized measure but could not account for transient changes in posture and appropriate positioning on the mat. Four research assistants collected data; however, the effect of this variation was mitigated by extensive training before data collection and the consistent use of the same pressure-mapping system. In the hospital setting, participants often presented in different types of attire and were included regardless of whether clothing or incontinence protection was worn. This may have affected pressure readings but should not have affected the final calculations (Pmaxg and Pmaxng). Because different attire is representative of this hospital population, it allowed investigators to draw realistic and relevant conclusions. Finally, because of documentation challenges within an acute care
setting, several estimations were made regarding height, weight, and resultant BMI.

Future Study

In future studies, it would be interesting to further investigate correlations between weight, BMI, and the role of morphology as correlated to gel pad efficacy. This information could be used to clarify potential indications for gel pad use in the clinical setting. Because the gel pad is intended to decrease pressure under the coccygeal region, the FSA system provided readings only in that area. Future investigations should reproduce the study using the full FSA mattress system to evaluate the effect of the gel pad on interface pressure at other pressure-prone areas.

Conclusions

This cross-over design study examined the efficacy of the gel pad when used to decrease interface pressure in a supine position for patients in an acute care setting. The 18 × 18-in. gel pad is routinely provided with the goal of decreasing interface pressures and thus reducing the risk of pressure ulcers. However, study results indicate that this is seldom the case; only a small subset of participants derived significant benefit from the gel pad. For the majority of participants, the effect of the gel pad was negligible (i.e., neither significantly increased nor decreased the interface pressure on the coccygeal region). Finally, and of greater clinical concern, are the participants for whom the interface pressure was increased to an alarming level with the addition of the gel pad. On further examination of the data, we found correlations between the efficacy of the gel pad and BMI and weight of men. These correlations, however, were not strong enough to establish clinical guidelines or to predict those participants who would have a negative outcome with gel pad use. Therefore, because no obvious indicators were determined, it is not recommended to use the 18 × 18-in. gel pad in supine to alleviate pressure or to decrease the risk of developing pressure sores. ▲

Acknowledgments

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References


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