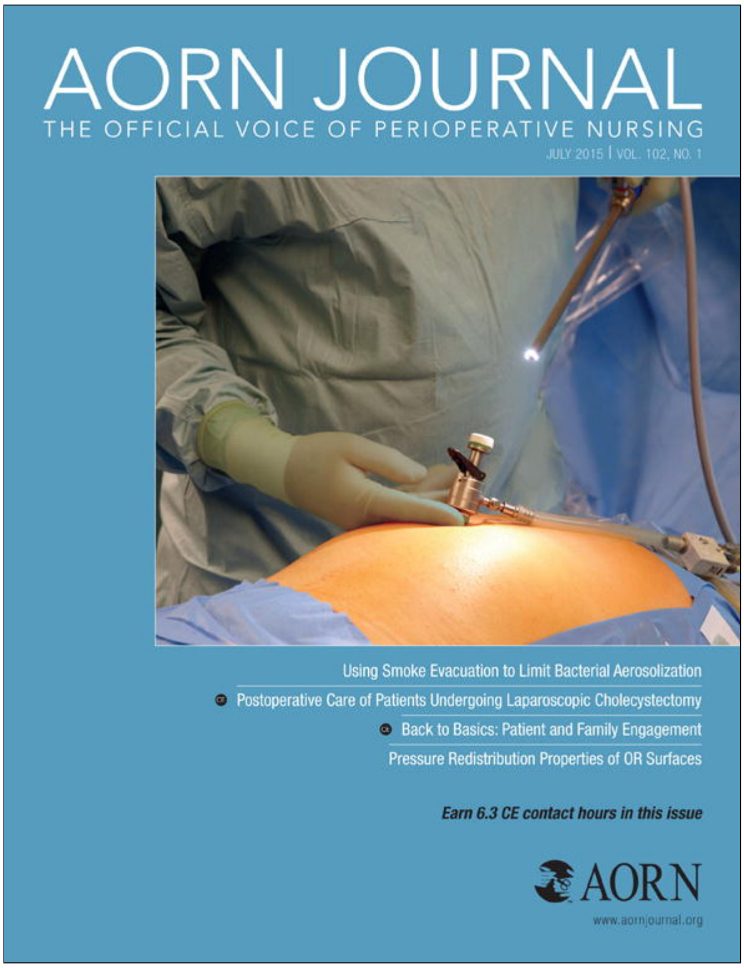
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Pressure Mapping Comparison of Four OR Surfaces

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ABSTRACT

Mortality and health care costs associated with hospital-acquired pressure ulcers (HAPUs) increase yearly. After four hours of surgery, the risk of developing a pressure ulcer increases by 33% for every 30 minutes of surgery. Prolonged immobility, lower blood pressures, and increased surface interface pressure may hinder the blood supply delivered to the skin, eventually leading to pressure ulcers. We measured and compared four different OR surfaces to identify the most effective pressure redistribution surface for prolonged OR procedures. The best surface attributes that provide efficient pressure redistribution should have the following properties: the lowest average interface pressure, the lowest peak interface pressure, and the highest skin contact area. Although all surfaces had similar average interface pressures, the air-inflated static seat cushion had the best pressure redistribution properties in the sacral region compared with the other surfaces tested. *AORN J 102 (July 2015) 61.e1–61.e9. © AORN, Inc, 2015. http://dx.doi.org/10.1016/j.aorn.2015.05.012*

Key words: *hospital acquired pressure ulcers, HAPU, pressure mapping, OR surfaces.*

Preventing hospital-acquired pressure ulcers (HAPUs) has become a major focus in many institutions. Results from the national Medicare Patient Safety Monitoring System study found that the nationwide incidence rate of HAPUs was 4.5%, with an 11.2% in-hospital mortality rate associated with HAPUs.[1] In addition, health care costs related to HAPUs increase yearly and are estimated to be between $44,000 and $128,000 per pressure ulcer.[2,3] Because of the disease burden, associated risks, and financial burden of HAPUs, implementing effective prevention interventions for all hospitalized patients with risk factors is imperative.

Studies suggest that 5% to 53.4% of all HAPUs are associated with prolonged or multiple surgical procedures.[4-7] The findings of one study suggested that after the first four hours of surgery, the risk of pressure ulcers increases by 33% for every 30 minutes of surgery.[5] Surgical patients have multiple factors that contribute to the development of pressure ulcers. Landmark studies indicated that prolonged immobility, lower blood pressures, and increased surface interface pressure may hinder the blood supply delivered to the skin, eventually leading to pressure ulcers.[6-10] Although multiple factors contribute to their development, pressure ulcers have been found to be more prevalent in patients with prolonged high surface interface pressures.[11]

STATEMENT OF PURPOSE

Many products are designed to redistribute pressure on the surgical patient during prolonged OR procedures. However, there is limited research on the efficacy of the pressure redistribution properties of OR surfaces. The aim of this study was to measure and compare four different OR surfaces and to identify the most effective pressure redistribution surface for prolonged OR procedures.

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RESEARCH QUESTION AND SIGNIFICANCE TO PERIOPERATIVE NURSING

Nurses are responsible for assessing, planning, implementing, communicating, and documenting the collaboration of care in the perioperative area. Standards of care for risk assessment in the development of pressure ulcers in the perioperative period do not exist. Yet, nurses have a responsibility to know and act according to standards of care in providing a safe patient environment.[12] The American Nurses Association revises the scope of practice for nurses to keep pace with technology.[13] However, there is scant research that examines the perioperative risk factors that contribute to the development of HAPUs in the perioperative area. To assist nurses in establishing appropriate standards of care, we asked how four OR surfaces compare in their pressure redistribution properties (decreasing interface pressure and increasing skin contact area).

LITERATURE REVIEW

Several types of surfaces have been developed to redistribute the interface pressure that occurs during prolonged OR procedures. The interface pressure can be redistributed statically by molding around the patient and spreading the pressure over a larger surface or mechanically by alternating the pressure beneath the patient. This redistributes body weight over a larger surface area.[14,15]

A literature search located only three studies that tested the pressure redistribution properties of OR surfaces. Keller et al, using the XSENSOR® system, analyzed the peak pressure and the skin contact area in two different positions of a standard OR mattress (3-cm pad filled with polyurethane fibers), a RIK® fluid mattress, a ROHO® inflatable mattress pad, and a 7-cm custom-made viscoelastic polyurethane foam mattress.[16] The investigators found that the fluid-filled surface provided the best pressure redistribution properties. King and Bridges, using an XSENSOR pressure mapping system, tested the peak pressure in a standard OR surface (3-layer pad: 2.25-inch-thick slow recovery foam, cushioning foam as a middle layer, and high-density foam as top layer), an EGGCRATE (high-density foam overlay), and a gel pad overlay.[17] The study measured an overlay foam pad and the standard gel pad on top of the standard surface and found significantly higher interface pressure when compared with the standard surface alone.[17] Defloor and De Schuijmer used the ERGO-CHECK pressure mapping system to evaluate the interface average pressures in four different positions on five surfaces: 1) a regular 4-cm foam surface, 2) a 6-cm foam surface, 3) a 1.5-cm gel surface, 4) a 6-cm polyether viscoelastic foam surface, and 5) a 7-cm polyurethane viscoelastic foam surface.[18] The results showed that the polyurethane and polyether surfaces had lower interface pressures compared with foam and gel surfaces.[18]

Synthesis of the evidence from the three studies suggests that only the results of Keller et al and King and Bridges can be compared because they used the same pressure mapping instrument and both reported peak interface pressure. Keller et al reported that a fluid-filled operating surface provided the lowest peak interface pressure compared with other surfaces.[16] In contrast to Keller et al, King and Bridges found that standard OR surfaces provided the lowest peak interface pressure when compared with gel or foam overlays.[17] The differences in the study results are due to the fact that the studies used different surfaces as a standard OR surface. Keller et al used a 3-cm-thick pad filled with polyurethane fibers, and King and Bridges used a 5.7-cm-thick pad that consisted of three different types of foam.[16,17] Most importantly, Keller et al are the only investigators who measured the skin contact area.[16]

Much of the literature available on pressure mapping of OR surfaces does not include newer technology surfaces such as the fluid immersion simulation surfaces or the air static overlay. To reduce the incidence of HAPUs that occur during prolonged OR procedures, ORs should be equipped with the most effective pressure redistribution surfaces and perioperative nurses should use the product that provides the greatest pressure ulcer prevention properties.

CONCEPTUAL FRAMEWORK

This study was based on a model derived from a classic study conducted by Kosiak[19] and a conceptual schema for the study of the etiology of pressure sores formulated by Braden and Bergstom.[20] Kosiak evaluated the interface pressure on skin over time. The model derived from Kosiak's study explained how external pressure in a specific area could lead to vaso-occlusion, resulting in decreased tissue perfusion and possible ischemic injury to both deep and superficial tissues. Kosiak conducted further studies investigating pressure over time and found that the greater the external pressure, the less time needed for ischemic injury to occur (Figure 1).

Kosiak described a cutoff of 32 mm Hg as a guideline for measuring surface interface pressure. Although this number does not always predict actual perfusion, an interface pressure of 32 mm Hg or less is regarded as a useful guideline in determining the efficacy of a product in redistributing the

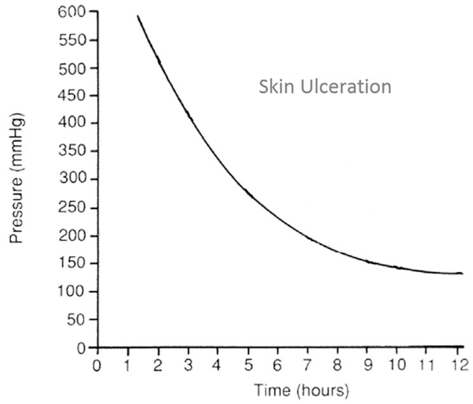

Figure 1. Kosiak's model of the relationship between applied pressure and time for pressure ulcer development.

interface pressure and thus lowering the risk of pressure ulcer development.[21,22]

Within the Braden and Bergstrom schema, exposure of the skin to high interface pressures for prolonged periods will indeed lead to tissue damage. At the same time, exposure of skin to low interface pressures for prolonged periods may also lead to tissue damage if the tissue tolerance is compromised.[20] Therefore, the tissue damage that occurs during prolonged OR procedures can be minimized by decreasing the interface pressure.

OPERATIONAL DEFINITIONS

- *Interface pressure* is the pressure load between the skin and the support surface.
- *Peak interface pressure* is the highest pressure load between the skin and the support surface.
- *Average interface pressure* is the average pressure load between the skin and the support surface of a full body or the specific area calculated by the XSENSOR pressure mapping device.
- *Skin contact area* is the total contact area between the skin and the support surface.
- *Pressure redistribution* is the pressure relief to a small concentrated area and the distribution of it over a larger area.

METHODS

This descriptive, comparative, quantitative study used a repeated-measures design in which the participants served as their own controls. A sample size calculation was conducted before recruiting volunteers and yielded a required sample size of 49. Sample size calculations were performed using the SAS® software procedure POWER and were based on the paired *t* test as an approximation of the repeated-measures analysis of variance (ANOVA). We used preliminary data from five subjects to estimate both the expected differences between mattress types and the standard deviations of the differences. We powered based on the highest standard deviation of 6.5 to ensure adequate power under the worst case scenario. Because of the high number of comparisons, we used the Bonferroni correction for multiple comparisons to correct the global type I error at 0.05. We powered at the 90% level.

A convenience sample of 11 and 40 women (N = 51) participated in the study. Study participants were recruited from hospital staff with various body mass indexes. Eligibility criteria included volunteers who 1) work at the hospital, 2) agreed to self-report height and weight, 3) had 30 minutes to participate, and 4) agreed to have the pressure mapping performed on four different surfaces while lying flat for more than seven minutes per surface. The study was approved by the hospital institutional review board.

We tested the following OR table surfaces: 1) a standard three-layer viscoelastic memory foam surgical table surface, 2) an air-inflated static seat cushion that was used under the sacral area placed over a standard surgical table surface, 3) a two-layer OR surface consisting of a top layer of nonpowered self-contouring copolymer gel and a bottom layer of high-density foam, and 4) a fluid immersion simulation surgical surface.

To evaluate the pressure redistribution properties of OR surfaces, we used full-body interface pressure testing. This method has been found to be valid and reliable in measuring interface pressure.[23] The instrument used for measuring the interface pressure for this study was the XSENSOR X3 PX100 system. Pressure mapping systems are composed of a pressure-sensing device that sends data to a computer program. The data are displayed as a color-coded map, a three-dimensional grid, and a numerical pressure value for each area. Numerical pressure values are typically expressed in millimeters of mercury (mm Hg) and reflect the pressure between the body and the surface used.[24] The XSENSOR X3 PX100 system consists of a thin, 99.06 cm × 220.98 cm full body pressure mapping pad with 1664 sensing points. The sensors in the pad have 3.175 spatial resolutions. The pad was placed between the volunteer and the support surface and connected to the XSENSOR X3 PX100 display for real-time pressure mapping recording.

Table 1. Surface Comparison Summary

	Surface Type Mean (Standard Deviation)				
Variable	Standard	Air-Inflated Static Seat Cushion	Self-Contouring Gel/Foam	Fluid Immersion Simulation	*P* Value
Sacral area average interface pressure (mm Hg)	23.6 (3.2)	23.9 (3.1)	23.4 (4.2)	22.1 (2.0)	0.0004*
Sacral area peak interface pressure (mm Hg)	43.4 (7.3)	35.8 (4.4)	40.6 (6.0)	35.9 (4.7)	<0.0001*
Sacral area skin contact area (in^2)	214.5 (52.9)	250.2 (47.8)	225.4 (50.1)	213.7 (47.9)	<0.0001*

A *P* value <0.05 is considered significant and is represented by an asterisk.

All participants were instructed to lie flat on the surface for five minutes before the XSENSOR measurements were collected. During the pilot study, no difference was found in the interface pressure readings that were recorded between three minutes and 30 minutes for acclimation. However, five minutes was used as an acclimation period as recommended in a previous study.[25] The data were displayed on the screen for a minimum of 1200 frames per participant and were recorded on each surface. The XSENSOR data collected were then downloaded to a computer using X3 medical v6.0 software. The peak pressures and surface contact areas recorded were then transcribed into Excel® spreadsheets by two investigators, and all measurements were validated by two investigators.

A repeated-measures ANOVA was fitted to test for differences in average sacral pressure, peak sacral pressure, and sacral surface area between the four surfaces using the SAS® software procedure GLM. Pairwise paired *t* tests were then performed to test for significant differences between each surface pair using the SAS® software procedure TTEST with the paired option. We used the Bonferroni correction for multiple comparisons. A *P* value of 0.05 was considered statistically significant for the omnibus tests. For the pairwise comparisons, the Bonferroni correction indicated that a *P* value of 0.008 should be used for each comparison to control the global type I error at 0.05. Distributional assumptions were validated using residual diagnostic plots to assess normality.

RESULTS

Residual diagnostic plots revealed no skew or irregularity in the distribution of the residuals, indicating that the normal assumption was validated. All ANOVAs were significant at the 0.05 level (sacral average pressure *P* value, 0.0004; sacral peak pressure and sacral area *P* value, <0.0001; and sacral area skin contact area *P* value, <0.0001). The ANOVA results are shown in Table 1.

The average difference in sacral interface pressure between the surfaces was significant, with the air-inflated static seat cushion having the highest measured average pressure (23.9 mm Hg) and the fluid immersion simulation surgical surface having the lowest average sacral pressure (22.1 mm Hg). The sacral peak interface differences were also found to be significant. The sacral peak pressure was lowest in the air-inflated static seat cushion (35.8 mm Hg). When comparing the skin contact area, it was found that the air-inflated static seat cushion was significantly greater (250.2 cm^2). These results suggest that the sacral interface pressure is better distributed with the use of the air-inflated static seat cushion than any of the other surface types used in this study.

The sacral average interface pressures were pairwise compared. As shown in Table 2, the air-inflated static seat cushion and the fluid immersion simulation surgical surface were significantly different. Table 3 shows the results for the sacral peak interface pressure pairwise comparisons, where a *P* value of <0.08 is regarded as significant. When compared, all surfaces were significantly different except for the fluid immersion simulation surgical surface and the air-inflated static seat cushion, which were not significantly different from each other with the measured difference of −0.09 mm Hg between the surfaces ($P = 0.9$). The test showed that there was no difference in sacral peak pressures between the fluid immersion simulation surgical surface and the air-inflated static seat cushion.

The results for the sacral skin contact area pairwise comparisons are summarized in Table 4. The sacral contact area

Table 2. Sacral Average Interface Pressure Pairwise Comparisons

Comparison	Difference (mm Hg)	*P* Value	95% Confidence Interval
Regular − Air-inflated static seat cushion	−0.3	0.4	(−0.9, 0.3)
Regular − Self-contouring gel/foam	0.2	0.5	(−0.3, 0.6)
Regular − Fluid immersion simulation	1.5	0.006	(0.4, 2.5)
Air-inflated static seat cushion − Self-contouring gel/foam	0.5	0.3	(−0.4, 1.4)
Air-inflated static seat cushion − Fluid immersion simulation	1.8	<0.0001*	(0.9, 2.6)
Self-contouring gel/foam − Fluid immersion simulation	1.3	0.05	(0.02, 2.6)

A *P* value <0.008 is considered significant and is represented by an asterisk.

pairwise comparisons showed that the difference between the surfaces was the greatest in the air-inflated static seat cushion and the fluid immersion simulation surgical surface with contact area at 36.6 (95% confidence interval: 25.9, 47.2).

The ANOVA results for the sacral average interface pressure indicate that the fluid immersion simulation surgical surface provided the lowest average pressure (22.1 mm Hg). Of the surfaces measured in this study, there was strong evidence to support that the air-inflated static seat cushion and the fluid immersion simulation surgical surface had the lowest sacral peak interface pressure (air-inflated static seat cushion, 35.8 mm Hg; fluid immersion simulation surgical surface, 35.9). The peak interface pressure pairwise comparison indicated no significance between the air-inflated static seat cushion and the fluid immersion simulation surgical surface measurements.

In relation to surface contact area, the ANOVA provided statistically significant results indicating the air-inflated static seat cushion as the surface that provides the largest skin contact area (250.21 in^2) over the sacrum. Moreover, the pairwise comparisons test showed that there is a significant difference between the air-inflated static seat cushion and all surfaces measured in this study. The air-inflated static seat cushion outperformed all surfaces in increasing the measured skin contact area of the sacral region (difference ranging from 24.8 to 36.6 in^2) as measured by the XSENSOR device.

DISCUSSION

Although many OR surfaces are available on the market, the best perioperative positioning techniques cannot protect the patient from tissue damage if the products do not provide pressure redistribution. When identifying the concept of pressure and how it contributes to the development of pressure ulcers, several measurements of pressure contribute to pressure redistribution: the average pressure, the peak pressure, and the skin contact area.[19,20] Therefore, the best surface attributes that provide efficient pressure redistribution should have the following properties: the lowest average interface pressure, the lowest peak interface pressure, and the highest skin contact area.

From previous studies of OR surfaces for pressure ulcer prevention properties, only Keller et al reported both peak interface pressure and surface contact area. The study by Keller et al indicated that a fluid-filled mattress had the lowest peak

Table 3. Sacral Peak Interface Pressure Pairwise Comparisons

Comparison	Difference (mm Hg)	*P* Value	95% Confidence Interval
Regular − air-inflated static seat cushion	7.56	<0.0001*	(5.7, 9.4)
Regular − self-contouring gel/foam	2.78	0.0011*	(1.2, 4.4)
Regular − fluid immersion simulation	7.46	<0.0001*	(5.3,9.7)
Air-inflated static seat cushion − self-contouring gel/foam	−4.77	<0.0001*	(−6.3, −3.2)
Air-inflated static seat cushion − Fluid immersion simulation	−0.09	0.9	(−1.3, 6.3)
Self-contouring gel/foam − fluid immersion simulation	4.68	<0.0001*	(3.0,6.3)

A *P* value <0.008 is considered significant and is represented by an asterisk.

Table 4. Sacral Skin Contact Area Pairwise Comparisons

Comparison	Difference (in∧2)	*P* Value	95% Confidence Interval
Regular − air-inflated static seat cushion	−35.7	<0.0001*	(−43.2, −28.2)
Regular − self-contouring gel/foam	−10.9	<0.0001*	(15.8, −5.9)
Regular − fluid immersion simulation	0.9	0.9	(−7.6, 9.3)
Air-inflated static seat cushion − self-contouring gel/foam	24.8	<0.0001*	(17.1, 32.6)
Air-inflated static seat cushion − fluid immersion simulation	36.6	<0.0001*	(25.9, 47.2)
Self-contouring gel/foam − fluid immersion simulation	11.7	0.003	(4.3, 19.2)

A *P* value <0.008 is considered significant and is represented by an asterisk.

interface pressure (68 mm Hg), an air-inflated mattress had the second lowest peak interface pressure (75 mm Hg), a polyurethane foam mattress had the third lowest peak interface pressure (112 mm Hg), and a standard foam mattress had the highest peak interface pressure (181 mm Hg). When skin contact area was measured, it was found that the fluid-filled mattress had the largest skin contact area (5226 cm^2), the polyurethane foam mattress had the second largest skin contact area (5067 cm^2), the air-inflated mattress had the third largest skin contact area (4391 cm^2), and the standard foam mattress had the lowest measured skin contact area (4249 cm^2).[16] However, in the study by Keller et al, air in the air-filled mattress was not adjusted for each participant as indicated by the manufacturer. Therefore, this result cannot be regarded as accurate.

The outcomes from our study show that the fluid immersion simulation surgical surface outperformed all tested surfaces in providing the lowest average interface pressure in the sacral area. However, these results are not clinically relevant because all surfaces had average interface pressures less than 32 mm Hg and the differences between all of the average interface pressures was less than 2 mm Hg. In addition, the results of the pairwise comparison show a statistical significance between only the air-inflated static seat cushion and the fluid immersion simulation surgical surface. Therefore, no surface can be identified as the best surface in providing lowest average interface pressures.

In relation to the peak interface pressure, we found that both the fluid immersion simulation surgical surface and the air-inflated static seat cushion provided lower measured peak interface pressures in the sacral area. The pairwise comparison test indicated no difference between the air-inflated static seat cushion and the fluid immersion simulation surgical surface in providing the lowest measured interface peak pressure. Consequently, the fluid immersion simulation surgical surface and the air-inflated static seat cushion are equally identified as the best surfaces for providing low peak interface pressures in the sacral area. However, the low peak interface pressure alone does not provide the full pressure redistribution properties. A surface with the properties of a lower measured peak interface pressure, while increasing the area of skin contact over a larger surface area, is required for minimizing the risk of pressure ulcer development.

The air-inflated static seat cushion provided the combined properties of lower peak interface pressure with redistributing the pressure by increasing the area of skin contact over a larger surface area, thus reducing the concentration of pressure over the sacrum area. The results from our study identified the air-inflated static seat cushion as having better pressure redistribution properties in the sacral region compared with the other surfaces tested. Although the manufacturer of the air-inflated static seat cushion produces a full-body OR air-inflated static overlay, the seat cushion was used under the sacrum for this study. The air-inflated products are not radiolucent and therefore not always practical for use in procedures that require x-rays or fluoroscopy of the pelvis. At the same time, the air-inflated static seat cushion can be easily removed for X-rays or fluoroscopy and is easy and economical for use in the OR for prevention of sacral pressure ulcers.

Limitations of the Study

One limitation of this study was that all of the participants were healthy volunteers. The average pressure, peak pressure, and skin contact area may be different when a person is fully sedated, has a history of low blood pressure, or is hemodynamically unstable. The full body pressure mapping device used in this study was used to measure pressures and contact areas; however, only the sacral area was evaluated for this study. In addition, all of the surfaces we tested were from

KEY TAKEAWAYS FOR CLINICAL PRACTICE

WHY DID WE DO THIS STUDY?

- Hospital-associated pressure ulcers are associated with patient morbidity and mortality and high costs. Appropriate pressure redistribution helps patients avoid pressure ulcers after surgery. We undertook this descriptive, comparative, quantitative study to measure and compare four different OR surfaces and to identify the most effective pressure redistribution surface for prolonged OR procedures.

WHAT DID WE FIND?

- The sacral interface pressure is better distributed with the use of the air-inflated static seat cushion than any of the other surface types used in this study.
- The air-inflated static seat cushion outperformed all surfaces in increasing the measured skin contact area of the sacral region.
- The fluid immersion simulation surgical surface and the air-inflated static seat cushion have the lowest sacral peak interface pressure.
- The fluid immersion simulation surgical surface outperformed all tested surfaces in providing the lowest average interface pressure in the sacral area. However, these results are not clinically relevant because all surfaces had average interface pressures less than 32 mm Hg and the difference between all the average interface pressures was less than 2 mm Hg.

HOW CAN HEALTH CARE PROFESSIONALS USE THESE RESULTS?

- **Clinician:** Perioperative nurses may help patients avoid pressure ulcers by using the air-inflated static seat cushion in combination with the recommended five-layered soft silicone bordered dressings to the buttocks and sacrum before prolonged OR procedures.
- **Manager**: Managers should be aware that air-inflated static seat cushions may reduce pressure ulcers and these cushions should be available for nurses to use when preparing patients for surgery.
- **Educator**: When training perioperative nurses, educators should emphasize the relative pressure distribution properties of OR surfaces when discussing the prevention of pressure ulcers.

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different manufacturers. Pressure redistribution properties of the same type of surface might vary from manufacturer to manufacturer.

Recommendation for Clinical Practice

Perioperative nurses are responsible for maintaining patient safety, selecting effective protective equipment, and minimizing HAPUs. The best perioperative positioning techniques cannot protect a patient from tissue damage if the products used to redistribute pressure in the surgical patient during prolonged OR procedures are inadequate. Pressure over time is a concept that nurses can understand and help to alleviate with the use of pressure redistribution surfaces.

Perioperative nurses should have a voice regarding the products that are needed and purchased for use in the OR to decrease HAPUs. Perioperative nurses already advocate for patients. This advocacy improves safety outcomes, minimizes the likelihood of litigation related to HAPUs, and optimizes Medicare and Medicaid reimbursement. After completion of this study, perioperative nurses working at our institution are promoting practice changes by using the air-inflated static seat cushion in combination with the recommended five-layered soft silicone bordered dressings to the buttocks and sacrum[26] before prolonged OR procedures.

Recommendation for Future Research

A wide range of body positions (lateral, supine, prone, jackknife, lithotomy) are used in the OR, and additional studies are needed to evaluate the best pressure redistribution products for each position. Additional research is needed in patients who have low blood pressure, are immobile, have low hemoglobin or serum albumin levels, are undergoing long surgeries, are hemodynamically unstable, and have known risk factors. Future studies should evaluate the same types of surfaces from different manufactures because pressure redistribution properties might vary from manufacturer to manufacturer. To develop a body of literature capable of sustaining evidence-based practice, it is important to build on existing research, use consistent methodologies for evaluating pressure redistribution surfaces, and continually compare and contrast newly developed products. Randomized trials are needed to ensure that the results are representative of a broad spectrum of patients who are cared for by perioperative nurses. Studies that include a cost-effectiveness analysis and studies that quantify the loss of reimbursement associated with HAPUs are also needed.

CONCLUSION

Identifying OR surfaces that provide the lowest peak pressure and the largest skin contact area is important to minimize the risk of developing pressure ulcers during prolonged OR procedures. All of the surfaces measured in this study had peak interface pressures greater than 32 mm Hg; therefore, skin contact area was used for further identification of the surface for pressure redistribution properties. Spreading the skin contact over a larger area reduces the concentrated pressure at the sacrum. Only one of the tested surfaces significantly increased skin contact area in the sacral area. Further studies should be conducted to identify the best OR surfaces available for pressure redistribution and preventing pressure ulcers that occur during prolonged OR procedures. ●

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