

Background

Pressure injuries are injuries to the skin and underlying tissue that occur when a region of the skin is subjected to pressure. The damaged tissue is unable to receive adequate oxygen because of the restricted blood flow due to the pressure. Consequently, the tissue begins to break down, resulting in the development of a pressure injury.^[1] This study aims to examine three support surfaces with potential for reducing the formation of pressure injuries by comparing the interface pressure in the sacrum, a bony prominence area. The investigated support surfaces are a standard foam surgical mattress, a gel pad overlay placed on top of the foam mattress, and an integrated alternating pressure (AP) support surface.

Methods

Interface Pressure Data Analysis

IRB approval was obtained. Raw pressure data was collected using the TekScan pressure map sensor 5250 for each support surface for 17 healthy participants. Data analysis was performed in MATLAB environment. Various parameters were evaluated to determine which mattress offers the best results in reducing pressure while lying supine on a mattress, similar to what patients may experience in a surgical setting.

Table 1: Analysis of Peak Pressure (PP), PP+ Four Corners, and Averages of Highest 9x9 and 25x25 Arrays in Foam, Gel, and AP.

	Foam	Gel	AP
Peak	126.02 ± 43.48	129.28 ± 36.44	151.36 ± 33.15
Peak + 4	73.62 ± 35.18	80.16 ± 21.97	88.22 ± 27.24
9x9	70.22 ± 25.12	71.1 ± 13.54	57.82 ± 13.68
25x25	52.7 ± 17.83	52.72 ± 7.79	38.43 ± 10.06

The Pressure Relief Index (PRI) represents the time ratio during which pressure remains below specific thresholds within one inflation/deflation cycle. Three thresholds were employed: 30 mmHg, 20 mmHg, and 10 mmHg. These values correspond to the average arteriolar, capillary, and venule operating pressures, respectively.^[2]

Table 2: Pressure Relief Index of the AP at 30 mmHg, 20 mmHg, and 10 mmHg.

	PRI <30 (%)	PRI <20 (%)	PRI <10 (%)
AP	43.14 ± 1.78	29.62 ± 2.16	15.31 ± 0.7

Experimental Set Up

Data Collection

Participants were directed to enter the data collection room and assumed a reclined position on the support surface. As part of a larger study, various parameters (temperature, blood flow, oxy/deoxy hemoglobin, movement) were recorded both before and after participants were instructed to remain immobile in the supine position for a period of 2 hours. Subsequently, a pressure sensor was strategically placed in the sacral region and a 5-minute measurement was conducted to enable a comparison of pressure distribution among the three support surfaces.

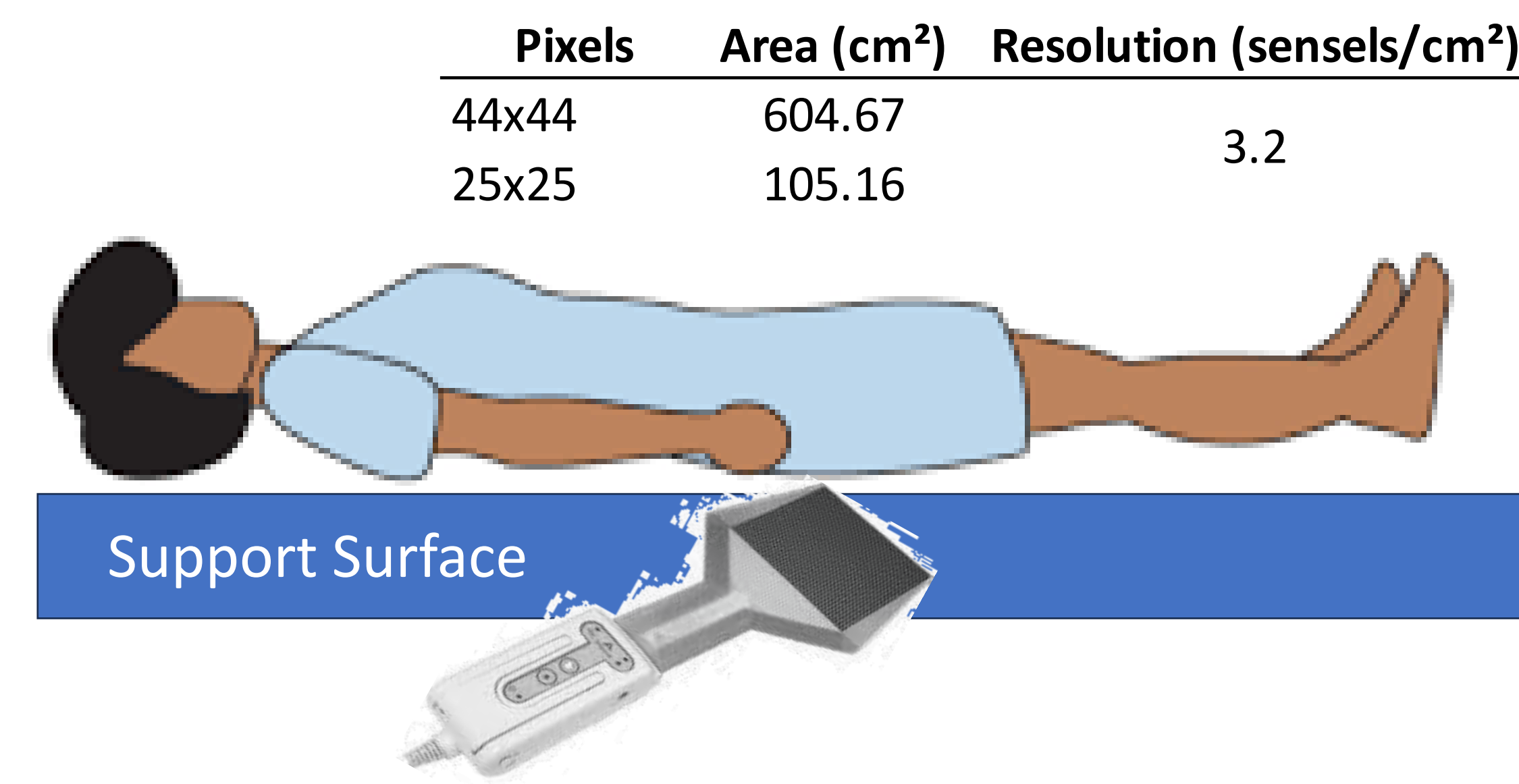


Figure 1: Placement of the TekScan pressure sensor in the sacral region for data recording.

Results

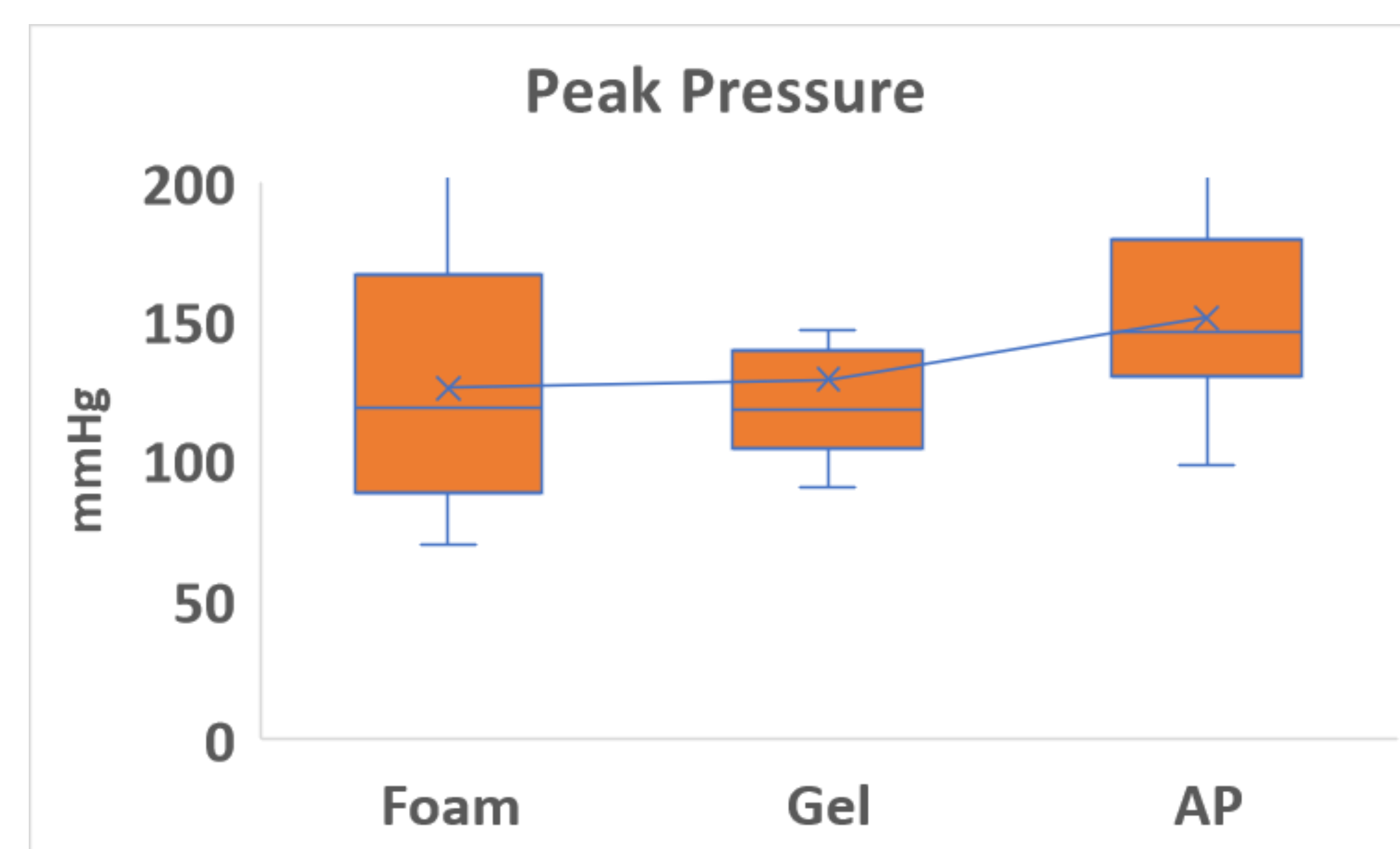


Figure 2: Average of the peak pressure value comparison of Foam, Gel, and the AP.

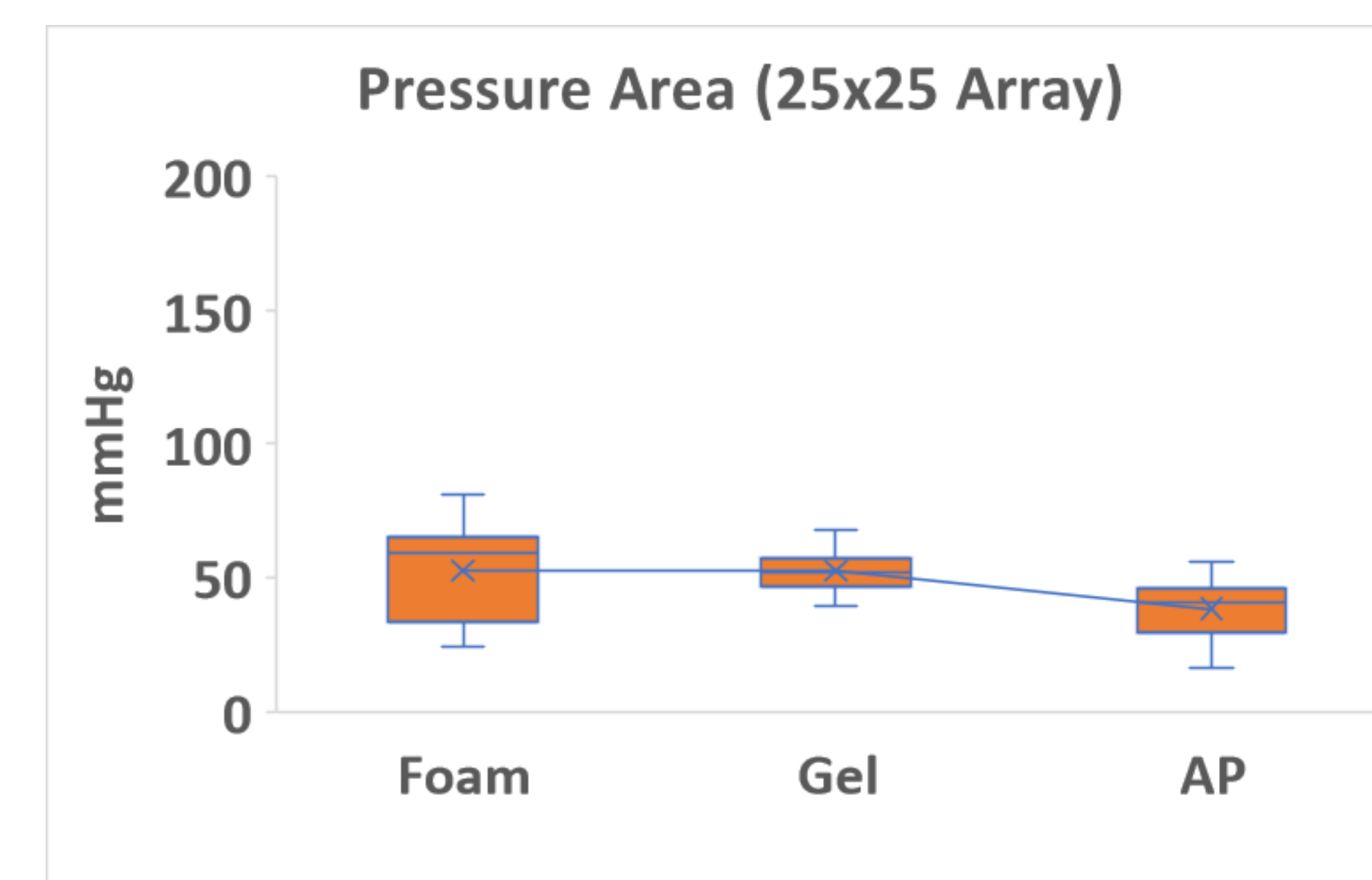


Figure 3: Average of the highest values in a 25x25 array for a comparative analysis of Foam, Gel, and the AP.

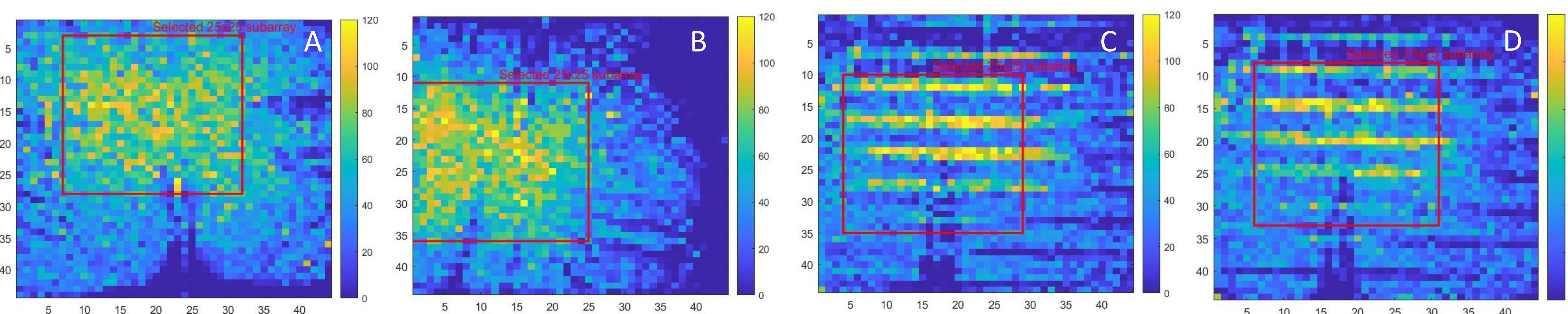


Figure 4: Comparison of pressure distribution for A) Foam, B) Gel, C) AP before pressure reversal, and D) AP after pressure reversal.

Future work

The correlation between pressure and blood flow will be further explored to unveil a deeper comprehension of the intricate relationship between these parameters, with potential implications for advancing clinical patient care.

The objective is to integrate this type of support surface into various applications in addition to its application in the operating room.

Conclusions

This study compared three support surfaces' pressure distribution and pressure relief index in 17 participants to enhance understanding of pressure injury development during surgery.

- The AP support surface demonstrated a significantly lower pressure in the 25x25 region compared to foam and gel, with a p-value of 0.0018.
- The AP support surface facilitated reperfusion in regions previously subjected to compression by showing a PRI of 43.1%, 29.6% and 15.3% under 30 mmHg (arteriolar), 20 mmHg (capillary) and 10mmHg (venule), respectively.

Acknowledgment

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References

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