## Iatrogenic Positional Pressure Injury During Posterior Spine Surgery: A Pressure Mapping Study for Risk Mitigation

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INTRODUCTION:

Patients undergoing surgery are at increased risk for developing iatrogenic pressure ulcers and soft tissue injury. In spine surgery, the prolonged operative times, prone positioning (posterior approach), dynamic table movement, limited area of contact between the patient and operative table, and requirement for muscular paralysis further increases the risk for pressure injury. Within the past year at the study institution, three cases of rhabdomyolysis have occurred in the early postoperative setting after posterior spine surgery, presenting in a muscular distribution consistent with the location of the operative table pads. These cases motivated investigation into the pressures experienced in the chest and thigh during spine surgery. This study aimed to elucidate the effects of operative table pad number, pad positioning, and dynamic movements on chest and thigh maximum pressure and pressure distribution during spine surgery prone positioning.

METHODS:

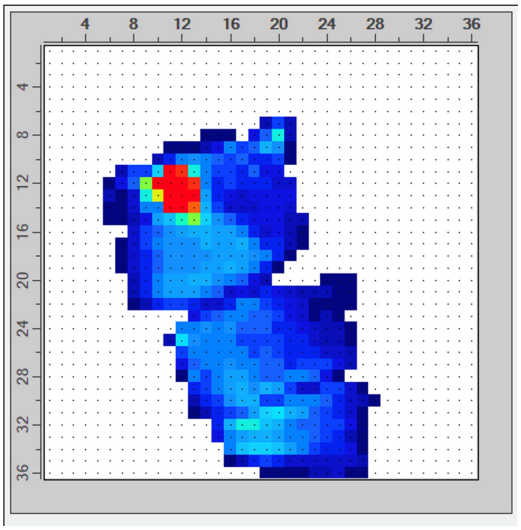
Individuals of representative body habitues were consented to participation in simulated spine surgery prone positioning on the Axis (hinged) and Jackson (non-hinged) operative tables. The XSENSOR PRO V8 pressure sensing mat was utilized to quantify and visualize pressure levels between the chest/ thigh pad and individual in real-time (Figure 1). The independent effects of lower chest and thigh pad positioning, separate hip and thigh pads, increased knee flexion angle, and two chest pads (female only) were assessed in comparison to standard (manufacture recommended) patient positioning with a single chest pad and bilateral thigh pads. In all positioning scenarios, patients underwent an identical series of operative table dynamic movements (flexion, extension, and airplanning) in intervals of 10 degrees until the maximum position was achieved. Univariate analysis compared average and peak pressures between positioning groups at the individual and full cohort level. Paired univariate analysis assessed the for significant changes in average and peak pressures with dynamic table movement compared to the neutral/ flat state.

RESULTS:

Five individuals (standard female, large breasted female, standard male, muscular male, obese male) were enrolled in and completed the study. In the overall cohort, in comparison to the standard thigh pad, separate hip and thigh pads increased peak pressures (separate: 107mmHg, combination:150mmHg, $p=0.007$), whereas lower thigh pad position decreased peak pressures (low: 100mmHg, standard: 139mmHg, $p<0.001$). At the individual level, two chest pads (two: 79.4mmHg, one:112mHg, $p<0.001$) resulted in reduced peak pressures in the large breasted female. Lower single chest pad position resulted in decreased peak pressures in the muscular male (low: 128mmHg, standard: 190mmHg, $p<0.001$) and standard female (low: 75.3mmHg, standard: 87.4mmHg, $p=0.001$) and decreased average pressure in the standard male (low: 29.7mmHg, standard: 31.8mmHg, $p<0.001$). Relative to the neutral state, airplanning 10 and 20 degrees resulted in significant increases in peak and average ipsilateral thigh pressures (all $p<0.05$). There were no significant changes in thigh pressures with flexion/ extension or chest pressures with any dynamic table movement.

DISCUSSION AND CONCLUSION:

In order to mitigate the chance of iatrogenic intraoperative pressure injury during posterior spine surgery, surgeons may choose to utilize a lower thigh pad position, avoid the use of separate hip and thigh pads, and minimize the time in airplanned positions.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