INTRODUCTION

- Lumbar supports can increase lordosis [1] and reduce discomfort [2] compared to non-supportive seating when driving (Fig. 1).
- During a rear impact collision, the effect of non-supportive seating on pain and injury potential is less understood.
- The objective of this study was to examine how lumbar support influences the seat-occupant interface during a simulated rear impact collision.

METHODS

11 men (26.4 ± 3.7 yrs; 81.0 ± 12.2 kg; 1.77 ± 0.04 m) and 11 women (25.0 ± 3.3 yrs; 71.1 ± 11.1 kg; 1.69 ± 0.04 m) participated. Two rear impact collisions (ΔV = 8 km/h) were simulated with a custom sled-track unit (Fig. 2): one without lumbar support and one with mechanical lumbar support (horizontal apex deflection = 4 cm). Seat back pressure was recorded together with pelvis kinematics. These data were used to quantify the Seatback Reaction Force, Force Concentration Area, and Deviation from the L1 Spinal Level. A posteriori analysis was conducted to examine how the total seatback reaction force was partitioned amongst the lumbar spine motion segments.

RESULTS

Table 1. Mean (SD) impact parameters.

<table>
<thead>
<tr>
<th></th>
<th>SUPPORT</th>
<th>NO SUPPORT</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Velocity</td>
<td>7.74 (0.35)</td>
<td>7.58 (0.25)</td>
<td>0.060</td>
</tr>
<tr>
<td>Peak Acceleration</td>
<td>4.76 (0.28)</td>
<td>4.74 (0.30)</td>
<td>0.826</td>
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</table>

Figure 6. Each plot represents the mean of the respective dependent variable during simulated rear impact collisions with and without lumbar support. Where applicable statistical significance is indicated (p < 0.05) and error bars represent one standard deviation.

DISCUSSION

Our findings suggest that lumbar supports can alter how and where the seatback force is applied to the lumbar spine (Fig. 6). As such, a measure of stress may more accurately characterize localized loading responses. Despite the lumbar spine bearing a larger load when support is applied, each motion segment is subjected to an external shear force of less than 200 N (Fig. 7). This is = 5 times less than the ultimate shear limit (1000 N) [3]. Therefore, the exact injury mechanisms of low-back pain resulting from low-speed rear impact collisions remain unclear and may require further analyses of the internal loading environment.

REFERENCES