Whiplash Prevention Campaign Initiative:

BC Provincial Results for an Observational Study Assessing Proper Head Restraint Use

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Why Focus on Whiplash?

• More than 65% of people injured in a crash report a soft tissue injury to their neck and/or back (ICBC 2012)

• In British Columbia alone, the economic costs exceed C$850 million/year (ICBC)

• Cost is in terms of
  • Lost work productivity
  • Disability        Sick leave
  • Litigation       Medical care
How can whiplash be prevented?

- The head restraint (HR) is positioned so that the head restraint is aligned with or above the head.

- The head restraint should be 2 - 5 centimeters from the back of your head.

- When positioned properly the head restraint can be very effective in preventing whiplash (i.e. 35% of serious injuries can be prevented)
What is the Problem?

- IBC (2002) study – in Canada on average, only 14% of occupants had their head restraints properly positioned!
Whiplash Prevention Campaign

GOAL:
• To reduce occupant injury in rear-end collisions

STRATEGY:
• To increase both awareness and proper HR use by educating public

ASSESSMENT:
• Up-to-date statistics on HR usage is needed: Observational Study
# Observational Study - Methodology

Compare vertical and horizontal distances to height and backset

<table>
<thead>
<tr>
<th></th>
<th>Vertical</th>
<th>Horizontal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poor</td>
<td>&gt;10 cm</td>
<td>&gt;12 cm</td>
</tr>
<tr>
<td>Marginal</td>
<td>8-10 cm</td>
<td>12-10 cm</td>
</tr>
<tr>
<td>Acceptable</td>
<td>6-8 cm</td>
<td>8-10 cm</td>
</tr>
<tr>
<td>Good</td>
<td>&lt; 6 cm</td>
<td>&lt; 8 cm</td>
</tr>
</tbody>
</table>
Sample Results

Verticle: 0.91cm (GOOD)  Horizontal: 1.6cm (GOOD)
Overall Rating: GOOD
Sample Results

Verticle: 19.46cm (POOR)  Horizontal: 16.05cm (POOR)
Overall Rating: POOR
The Reported Data Sample

- **Sampled areas:** Greater Vancouver, BC Interior (Kamloops, Kelowna), Northern BC (Prince George) and Vancouver Island (Nanaimo)

- **Data set:** 2770 occupants (i.e. 2572 drivers, 198 passengers)

- **Vehicle types:** Sub-compact to large pick-up & SUV
### Observational Study - Results

#### Greater Vancouver

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>46%</td>
</tr>
<tr>
<td>Acceptable</td>
<td>22%</td>
</tr>
<tr>
<td>Marginal</td>
<td>17%</td>
</tr>
<tr>
<td>Poor</td>
<td>14%</td>
</tr>
</tbody>
</table>

#### Vancouver Island

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good</td>
<td>39%</td>
</tr>
<tr>
<td>Acceptable</td>
<td>28%</td>
</tr>
<tr>
<td>Marginal</td>
<td>14%</td>
</tr>
<tr>
<td>Poor</td>
<td>14%</td>
</tr>
</tbody>
</table>
Observational Study - Results

Adequate Safety Percentage (Good + Acceptable)

- Mid-size Pickup Truck: 48%
- Sub-compact car: 56%
- Mid-size SUV: 70%
- Full size SUV: 53%
- Minivan: 49%
- Full-size Pickup Truck: 44%
- Mid-size Car: 60%
- Full-size Car: 62%
- Compact SUV: 72%
- Compact Car: 60%
Observational Study - Results

<table>
<thead>
<tr>
<th>Region</th>
<th>Car (%)</th>
<th>SUV (%)</th>
<th>Pickup Truck and MiniVan (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greater Vancouver</td>
<td>22%</td>
<td>37%</td>
<td>48%</td>
</tr>
<tr>
<td>BC Interior</td>
<td>37%</td>
<td>20%</td>
<td>43%</td>
</tr>
<tr>
<td>Vancouver Island</td>
<td>40%</td>
<td>15%</td>
<td>45%</td>
</tr>
<tr>
<td>Northern BC</td>
<td>40%</td>
<td>15%</td>
<td>45%</td>
</tr>
</tbody>
</table>

HR Rating:
- Poor (22%)
- Fair (37%)
- Good (48%)

Vehicle Types:
- Car
- SUV
- Pickup Truck and MiniVan

Region:
- Greater Vancouver
- BC Interior
- Vancouver Island
- Northern BC
Comparison with IBC Study (2002)

- 2002: 18%
- 2010-2012: 27%

Distance above/below average man's head (cm)

- Good
- Acceptable
- Marginal
- Poor
- Very Poor

Backset (cm)
Conclusions

- 44% “Good”, 17% “Acceptable”, 15% “Marginal”, and 24% “Poor”

- Less than half of the BC motorists have their HRs “properly” positioned

- Motorists in Greater Vancouver region were more likely to have their HRs adequately positioned

- Only 9% improvement since IBC study in 2002 in BC
Conclusions

- **Improvement in seat design:**
  - MiniVans and PU trucks – need improved designs for occupants

- **More awareness! Vehicle purchasers**
  - Long way to match seatbelt use! 44% vs. 95%
  - Public and fleet buyers – seek better designs!

Resources available:
www.whiplashprevention.org
Contributions

• The findings of this study provide baseline data for evaluating the efficacy of the “Whiplash Prevention Campaign”

• Protocol developed in this study is low-cost and can be easily implemented

• Valuable results to stakeholders involved with vehicle design, regulations and occupant safety
Closing: **Check your Head Restraint!**

Proper Head Restraint Adjustment

- Raise the head restraint (HR) so that top of HR is at top of head (which should place the center of HR slightly above the top of the ear).

- The head restraint should be 2 - 5 centimeters from the back of your head.

- **When adjusted properly the head restraint can be very effective in preventing injuries**
Acknowledgements

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• MEA Forensic Engineers and Scientists
Thank You for Your Attention

Questions?
Confounding Issues

- Reflections? Polarizer
- Too Bright for Laser? Ultra Sonic
- B-pillar? Shoot from passenger side instead
Custom Analysis Software

Target - Head & head restraint

Target Dimension (Unknown)

Target Distance (Known)

Reference Distance (Known)

Capturing Device

Head Restraint Analyzer

INSTRUCTIONS

1) Click "Browse image" to select desired image to analyze
2) View image using "open" (OPTIONAL)
3) Enter reference object dimension and distance in centimeters
4) Click "Select Reference Pixels" to select the end points of reference object on screen
   NOTE: Image automatically closes after selecting points
5) Enter target distance in centimeters
6) Select horizontal and vertical distance between head and head restraint (NOTE: Image automatically closes)
7) Click "ANALYZE" to find actual distance in centimeters
8) Click "ANONIMIZE" to edit target's face
9) Select two points that best bound the target's face. A black box will automatically be created to mask face
10) Select "RESET" to clear all values

Reference Dimensions (cm) 5.104
Reference Distance (cm)

Select Reference Pixels

Object Distance (cm)

Select Vertical Pixels
Select Horizontal Pixels

Select Car Size

Vertical Distance
Horizontal Distance

Overall Rating

Driver

Save Data As

Browse Image

ANALYZE
ANONIMIZE
RESET
### Sample Data Output

<table>
<thead>
<tr>
<th>Filename</th>
<th>V Distance</th>
<th>V Rate</th>
<th>H Distance</th>
<th>H Rate</th>
<th>Overall</th>
<th>Target</th>
<th>Car Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>IMG_7668.JPG</td>
<td>1.482</td>
<td>GOOD</td>
<td>3.324</td>
<td>GOOD</td>
<td>GOOD</td>
<td>Driver</td>
<td>Mid-size SUV Far</td>
</tr>
<tr>
<td>IMG_7670.JPG</td>
<td>3.93</td>
<td>GOOD</td>
<td>8.715</td>
<td>ACCEPTABLE</td>
<td>ACCEPTABLE</td>
<td>Driver</td>
<td>Compact Car Far</td>
</tr>
<tr>
<td>IMG_7683.JPG</td>
<td>6.671</td>
<td>ACCEPTABLE</td>
<td>9.443</td>
<td>ACCEPTABLE</td>
<td>ACCEPTABLE</td>
<td>Driver</td>
<td>Minivan Far</td>
</tr>
<tr>
<td>IMG_7690.JPG</td>
<td>7.939</td>
<td>ACCEPTABLE</td>
<td>7.955</td>
<td>GOOD</td>
<td>ACCEPTABLE</td>
<td>Passenger</td>
<td>Mid-size Pickup Truck Close</td>
</tr>
<tr>
<td>IMG_7691.JPG</td>
<td>1.316</td>
<td>GOOD</td>
<td>6.026</td>
<td>GOOD</td>
<td>GOOD</td>
<td>Driver</td>
<td>Compact Car Far</td>
</tr>
<tr>
<td>IMG_7692.JPG</td>
<td>0.831</td>
<td>GOOD</td>
<td>14.213</td>
<td>POOR</td>
<td>POOR</td>
<td>Driver</td>
<td>Mid-size SUV Far</td>
</tr>
<tr>
<td>IMG_7693.JPG</td>
<td>2.312</td>
<td>GOOD</td>
<td>5.031</td>
<td>GOOD</td>
<td>GOOD</td>
<td>Driver</td>
<td>Mid-size SUV Far</td>
</tr>
<tr>
<td>IMG_7696.JPG</td>
<td>0.414</td>
<td>GOOD</td>
<td>10.87</td>
<td>MARGINAL</td>
<td>MARGINAL</td>
<td>Driver</td>
<td>Mid-size Car Far</td>
</tr>
</tbody>
</table>
Why such a big difference?

- **Reason #3** (emphasizes the need for one standard)
  - Horizontal position “GOOD” rating
    - IIHS = distances less than 8 cm
    - IBC = “less or equal to ear width”
  - Typical male human ear is 5 cm
    - Difference of 3 cm
    - IIHS will have a 60% higher chance of “good”
    - IIHS based on measurements – yet less conservative?
The Process: Step 2

- Measure height & backset distances in image “pixel” units
The Process: Step 3

- Convert “pixel” data to real “physical” head-to-head restraint distances
The Process: Step 4

- The HR position data is compared to the IIHS guideline to assess whiplash protection rating

- Procedure:
  - Compare vertical and horizontal distances to height and backset

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<tr>
<td>Acceptable</td>
<td>6-8 cm</td>
<td>8-10 cm</td>
</tr>
<tr>
<td>Good</td>
<td>&lt; 6 cm</td>
<td>&lt; 8 cm</td>
</tr>
<tr>
<td>Vehicle Drivers</td>
<td>Vehicle Size Class</td>
<td>GOOD</td>
</tr>
<tr>
<td>-----------------</td>
<td>-----------------------</td>
<td>------</td>
</tr>
<tr>
<td>Car</td>
<td>Subcompact Car</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td>Compact Car</td>
<td>209</td>
</tr>
<tr>
<td></td>
<td>Mid-size Car</td>
<td>316</td>
</tr>
<tr>
<td></td>
<td>Full-size Car</td>
<td>147</td>
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<tr>
<td>SUV</td>
<td>Compact SUV</td>
<td>119</td>
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<tr>
<td></td>
<td>Mid-size SUV</td>
<td>152</td>
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<tr>
<td></td>
<td>Full-size SUV</td>
<td>57</td>
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<tr>
<td>Pickup Truck</td>
<td>Mid-size Pickup Truck</td>
<td>24</td>
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<tr>
<td></td>
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<td>25</td>
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<tr>
<td>Minivan</td>
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<tr>
<td></td>
<td>Subtotal</td>
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<tr>
<td></td>
<td>Percentage</td>
<td>44%</td>
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<tr>
<td>Vehicle Passenger</td>
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<td>GOOD</td>
</tr>
<tr>
<td>Car</td>
<td>Subcompact Car</td>
<td>4</td>
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<tr>
<td></td>
<td>Compact Car</td>
<td>31</td>
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<tr>
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<td>Mid-size Car</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td>Full-size Car</td>
<td>10</td>
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<tr>
<td>SUV</td>
<td>Compact SUV</td>
<td>7</td>
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<tr>
<td></td>
<td>Mid-size SUV</td>
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<tr>
<td></td>
<td>Full-size SUV</td>
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</tr>
<tr>
<td>Pickup Truck</td>
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<td>3</td>
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<td></td>
<td>Full-size Pickup Truck</td>
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<td>Minivan</td>
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<td>Subtotal</td>
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<td></td>
<td>Percentage</td>
<td>52%</td>
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