Ejections and Fatalities in Single-Vehicle Rollover Crashes: A Question of Restraint

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Road Traffic Fatalities in Canada 1970-2012

- 1971: Motor vehicle safety regulations established
- 1970's: Roadway clear zone widening
- 1976: Mandatory seat belt use initiated
- 1980's: Breakaway luminaires and signs
- 1981: Economic recession
- 1989: National Occupant Restraint Programme (NORP)
- 1990: National Strategy to Reduce Impaired Driving (STRID)
- 1994: U.S. Airbag mandate
- 1998: Depowered airbags introduced


Bars represent different categories:
- Other/Not Stated
- Motorcycle
- MV Occs
Seat Belt Use in Canada 1975-2010

Seat Belt Use Rate on Urban Roads (%)
Percentage of Passenger Vehicle Occupant Fatalities Reported as Unrestrained
Single-Vehicle Rollover Collisions

- 57% of fatally-injured passenger vehicle occupants were not using seat belts

- 80% of unrestrained passenger vehicle occupants, fatally injured in single-vehicle rollovers, were ejected from their vehicle
Causes of Fatal Collisions Study

- In-depth collision investigation programme capturing human, vehicle and environmental factors related to fatal crashes
- Three phases of data collection between October, 2004 and December, 2009
  - Phase 1 – Pilot study, Ottawa, ON and Saskatoon, SK
  - Phase 2 – Added Fredericton, NB, Montreal, QC and London, ON
  - Phase 3 – Montreal, QC and London, ON only
Causes of Fatal Collisions Study

• 358 collisions were documented in the study
• Filtering criteria for the present paper:
  • Single-vehicle crash
  • Rollover as the harmful event
  • Light-duty vehicle
    (passenger car, light truck or van)
  • Unrestrained occupant
  • Ejected
  • Fatal injuries
• 26 criteria crashes
Frequent Occurrences

- Loss of directional control
- Run-off roadway onto soft shoulder, followed by a rollover
- High speed on loose gravel
- Abrupt lane-change manoeuvres
- Inadequate recovery/over-steering
- Yaw, tripping, rollover
- Impacts to poles or trees
Case Study - 2003 Nissan Xterra SUV

- Driver shoulder checking prior to lane change
- Traffic ahead slowed down
- Steered abruptly to the right to avoid impact
- Over-corrected, yaw, rollover
- 38-year-old female driver and 5 children (5-15 years) belted, minor or no injuries
- Two 13-year-old males, unbelted, rear cargo area
- Both completely ejected
- One – fatal head injuries
- Second – fractured leg, serious facial injuries
Case Study - 2001 Chevrolet Silverado

- 47-year-old male driver
- BAC 300 mg%
- Left bar, racing with nephew, 50 km/h zone
- 193 km/h (EDR)
- Lost directional control
- Ran off roadway, sheared off breakaway luminaire
- Ran over a snow bank and rolled over
- Driver completely ejected
- Fatally injured
Observations

- High speed
- Young, male drivers
- Impairment (alcohol, drugs)
- Light truck involvement
- Hard-steering manoeuvres
- Failure to use seat belts
Countermeasures

- Electronic stability control (ESC)
- Pre-safe systems (close windows, sunroof)
- Lane departure warning
- Ejection mitigation, rollover curtains
- Advanced seat belt reminder systems
- Passive alcohol sensing
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