

# Associations of Occupant Protection Devices with Maxillofacial Fractures in Frontal Collisions

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Maxillofacial fractures impose a substantial physical and functional burden on patients because of pain, swelling, and restricted mouth opening during treatment and recovery. Previous studies have shown that 60%–80% of patients presenting to emergency departments with maxillofacial fractures were injured in motor vehicle collisions.

This study examined the associations between restraint systems and the occurrence and contact sources of maxillofacial fractures in frontal motor vehicle collisions.

We analyzed data from the National Automotive Sampling System Crashworthiness Data System (NASS/CDS) and the Crash Investigation Sampling System (CISS). The study included drivers and front-seat passengers involved in frontal collisions and evaluated the associations of seat belt use, occupant height, seating position, airbag deployment, and vehicle model year with the distribution of injured body regions. We also characterized facial injury patterns and analyzed the frequency and contact sources of maxillofacial fractures among occupants with facial injuries.

Vehicles were grouped by model year as 2005 and earlier versus 2006 and later. Among the variables examined, seat belt use was most consistently associated with a lower prevalence of facial injury. Seat belt use was associated with a 58% lower prevalence of facial injuries among drivers and a 67% lower prevalence among front-seat passengers. Facial injuries were less prevalent in vehicles from model year 2006 and later. Among belted occupants, the prevalence of facial injuries was 23% lower in drivers and 36% lower in front-seat passengers in vehicles from model year 2006 and later than in those from model year 2005 and earlier (Fig. 1). In vehicles from model year 2005 and earlier, some maxillofacial fractures were classified as AIS 3; in contrast, no AIS 3 maxillofacial fractures were identified in vehicles from model year 2006 and later. Among belted front-seat passengers, airbag-related maxillofacial fractures were less frequent in vehicles from model year 2006 and later (Fig. 2).

One notable model-year difference was the apparent absence of airbag-related maxillofacial fractures in vehicles from model year 2006 onward. Although many maxillofacial fractures are classified as AIS 1, even these relatively minor injuries may have a substantial impact on quality of life. Airbags are designed to limit forward head excursion and reduce injury severity. However, under some deployment conditions, airbags may also contribute to facial loading and trauma.

To reduce facial loading without compromising occupant restraint performance, airbag systems have been refined through changes in bag geometry, folding patterns, tethering, internal gas-flow control, and dual-stage inflator technology.

These technological advances may have improved airbag safety and may partly explain the marked reduction in airbag-related maxillofacial fractures observed in vehicles from model year 2006 and later.

These findings suggest that continued improvements in restraint systems, including seat belts and airbags, may further reduce facial injuries in motor vehicle collisions.

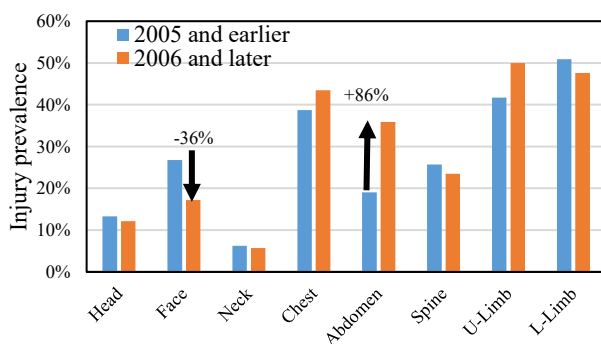


Fig.1 Injury prevalence by body region among belted front passengers  
(Vehicle model year 2005 and earlier vs. 2006 and later)

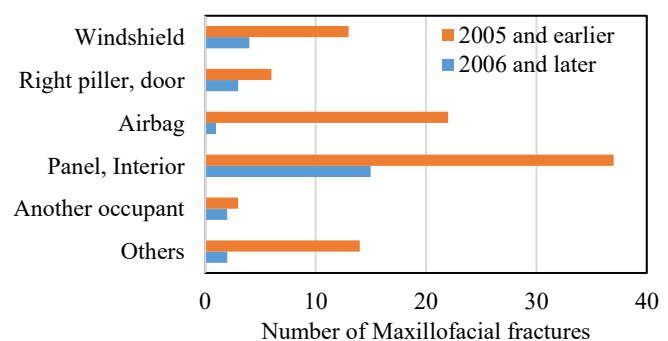


Fig.2 Causes of maxillofacial fractures in belted passengers  
(Vehicle model year 2005 and earlier vs. 2006 and later)