Changing Patterns of Facial Fractures among Seat-Belted Motor Vehicle Collisions: A National Trauma Database Study

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BACKGROUND

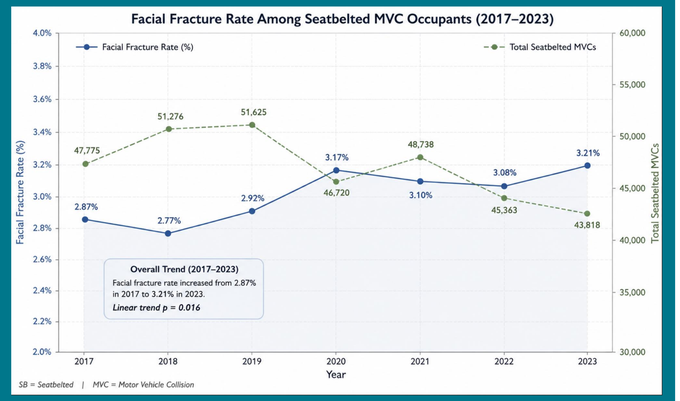
- Facial fractures are common in Motor Vehicle Collisions (MVCs) and frequently require trauma and reconstructive surgical care. Previous NTDB studies (2000–2012) **showed stable overall facial fracture rates**, with nasal, midface, orbital, and mandibular fractures being the most common.
- Risk factors for facial fractures include **young age, male sex, and alcohol involvement**.
- Modern seatbelt technologies including pretensioners, load limiters, and adaptive/multi-stage systems, are now **standard in most vehicles produced since 2015**, designed to improve head and facial protection.
- Our objective is to analyze NTDB data from 2017–2023 to:
  - Determine facial fracture rates in seat-belted occupants.
  - Identify fracture types and associated mortality.
  - Examine trends over recent years and the influence of modern restraint systems.

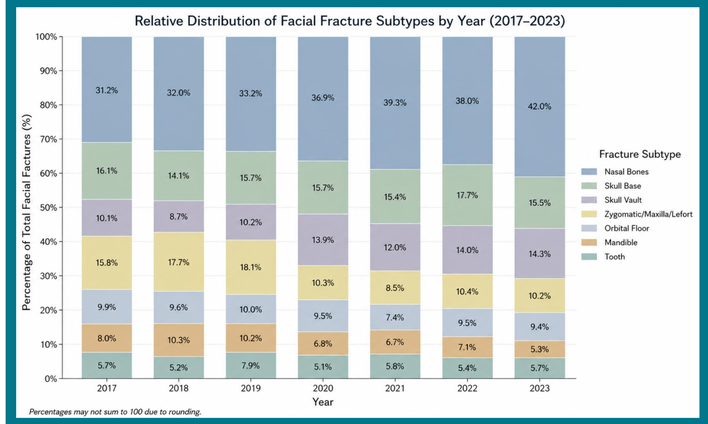
METHODS

- **Study design:** This was a retrospective cohort study using data from the National Trauma Data Bank (NTDB) between the years 2017-2023.
- **Population:** Patients who were drivers or passengers in car, van, and pick-up truck MCVs and were documented to be wearing seatbelts were filtered and included in the study statistics. Motorcyclists and pedestrians were excluded.
- **Measuring Outcomes:** ICD codes for all classifications of head/facial fractures (S02.0-S02.9) were found and attached to the incident reports. Reports of mortality were also found and attached to the incident reports.
- **Statistical Analysis:** Temporal trends were assessed using linear regression and Chi-square testing which was performed using python and Microsoft excel.

Results

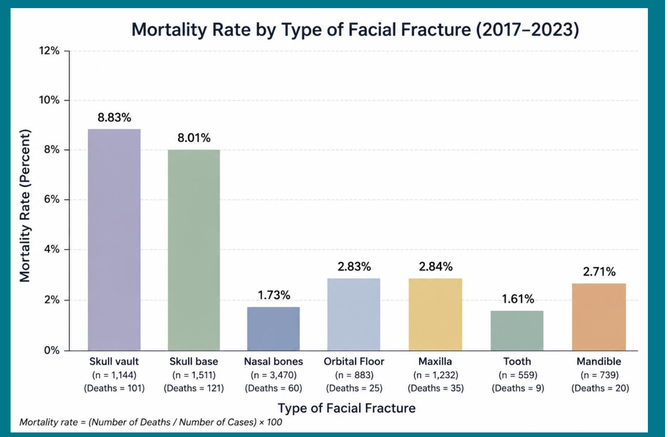
- Figure 1 – Percentage trend of all restrained MVC facial fractures between the years 2017-2023 found in the NTDB.
- Facial fracture incidence increased significantly from 2.87% to 3.21% despite a non-significant decline in total restrained MVC encounters. (p = 0.016)





- Figure 2 - Facial fracture subtype distribution by year.
- Nasal fractures remained the most common subtype. Skull vault and nasal bone fractures increased, and maxillary/mandibular fractures decreased over time.
- The fracture distribution change was shown to be significant over the years. (p < 0.001)

- Figure 3 - Mortality rate of each type of facial fracture studied.
- Skull vault and skull base fractures carried the highest mortality rates, whereas nasal fractures and broken teeth demonstrated the lowest mortality rates.
- Mortality rates by fracture subtype remained stable over the 7-year period.



Conclusions

- **Clinical burden is increasing:** Facial fractures remain an important cause of morbidity among seat-belted MVC occupants. Despite advancement in vehicle safety features, incidence of facial fracture increases over recent years.
- **Risk is pattern dependent:** Mortality differs significantly by fracture pattern, supporting early, fracture-pattern–informed escalation of evaluation and management for high-risk patients.
- **Systems implications:** These observed trends have implications for trauma system preparedness, including resource allocation (e.g. imaging and operation prioritization) and operative planning for MVC-related facial trauma.

DISCUSSION

- Airbag deployment, improved seat-belt compliance, and early braking systems may reduce fatal thoracic and abdominal injuries but **expose the face and craniofacial skeleton to deceleration forces**.
- The predominance of **nasal bone fractures likely reflects survivable injury** patterns; however, the association of **skull base and vault fractures with high mortality** underscores the importance of early surgical involvement and aggressive multidisciplinary management.
- These findings highlight the continued relevance of **facial trauma expertise within trauma systems**, particularly as automotive safety advances alter injury biomechanics rather than eliminate craniofacial injury.
- Recognition of these trends may also **guide future vehicle safety innovations** aimed at mitigating facial injury while preserving the survival benefits of current restraint technologies.

Acknowledgments

Data derived from the American College of Surgeons National Trauma Data Bank with permission and in conjunction with Dr. Andrew McCague, DO