

## Patterns of Traumatic Injury In Drivers and Passengers Involved In Motorcycle Accidents

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**Introduction:** Motorcycle use in the U.S. carries disproportionately high injury and fatality rates, yet role-specific trauma patterns are underreported. Prior work emphasizes helmet use and global risk factors, but detailed orthopedic injury distributions for drivers vs passengers remain unclear. We aimed to compare demographics, toxicology, orthopedic injury patterns, and ED mortality between drivers and passengers injured in motorcycle collisions at a Level-1 trauma center over five years, and to test for role-based differences in injury frequency.

**Materials and Methods:** A retrospective review was conducted at a regional Level-1 trauma center over five years. Data on drivers and passengers who sustained motorcycle-related injuries were collected from trauma registries using e-codes (e812-e825). Patient demographics, sustained injuries, toxicology screening, Injury Severity Score (ISS), and mortality were recorded. Statistical analysis with chi-square analysis was performed to assess differences in injury frequency between drivers and passengers.

**Results:** The study identified 791 drivers and 48 passengers with motorcycle-related injuries. The average ISS was 11.9 for drivers and 10.3 for passengers, with 27% having an ISS >15. Significant differences were found in injury rates in drivers and passengers respectively of the thoracic facet joints (0.76% vs. 4.17%), thoracic spinous process (8.60% vs. 27.08%), thoracic transverse process (15.68% vs. 2.08%), lumbar spinous process (1.64% vs. 6.25%), lumbar pedicle (1.14% vs. 8.33%), open patella injuries (1.64% vs. 6.25%), lung contusions (20.61% vs. 4.17%), and subarachnoid hemorrhage (7.96% vs. 20.83%). Toxicology revealed a higher incidence of alcohol and substance use among drivers compared to passengers.

**Discussion:** Motorcycle collisions in our cohort were high-energy events with substantial morbidity (mean ISS 11.9 in drivers, 10.3 in passengers; 27% ISS > 15) and 2% ED mortality—consistent with national data. Role-specific patterns emerged: passengers showed higher rates of head injury and selected posterior-element spine and knee injuries (e.g., thoracic facet/spinous, lumbar pedicle; open patella), whereas drivers more often had thoracic transverse-process fractures and lung contusions; other fracture distributions were broadly similar. These findings align with prior epidemiology but provide one of the largest U.S. role-stratified orthopedic injury maps to date. The presented data highlights the need for targeted safety measures and injury prevention systems for motorcyclists. Limitations include retrospective single-center design, registry dependence, incomplete mechanism/helmet granularity, and lack of functional outcomes. Further research is warranted to explore differences in injury patterns in greater detail and their clinical relevance.

**SIGNIFICANCE/CLINICAL RELEVANCE:** Role-specific injury patterns can tighten ortho-trauma care: passengers warrant a lower threshold for T/L-spine CT reconstructions and knee evaluation for potential open injuries, while drivers merit heightened screening for thoracic transverse-process fractures and chest trauma that may influence fixation timing and perioperative planning. These data support rider-role-guided imaging and consult pathways to reduce missed injuries and streamline acute management.

**Table 1: Statistically Significant Injury Patterns**

Injuries	Drivers	Driver %	Passengers	Passenger %
Thoracic-Facet	6	0.76	2	4.17
Thoracic-Spinous Process	68	8.60	13	27.08
Thoracic-Transverse	124	15.68	1	2.08
Lumbar-Spinous Process	13	1.64	3	6.25
Lumbar-Pedicle	9	1.14	4	8.33
Patella - Open	13	1.64	3	6.25
Lung Contusion	163	20.61	2	4.17
Subarachnoid Hemorrhage	63	7.96	10	20.83