

Spine injuries in motor vehicle accidents – an analysis of 34188 injured front passengers with special consideration of injuries of the thoracolumbar spine in relation to injury mechanisms

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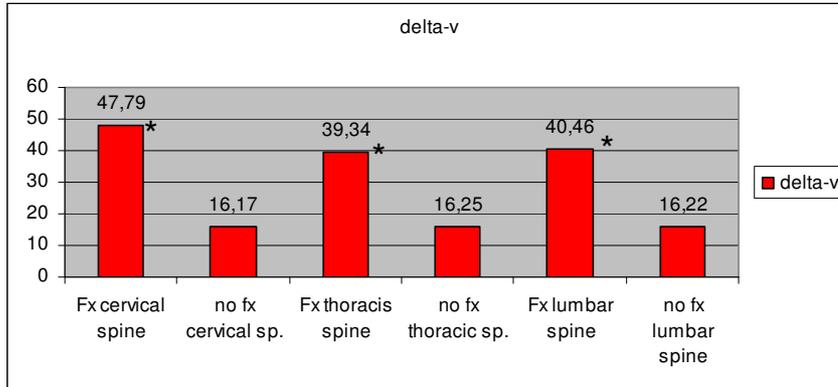
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Introduction: Spine injuries pose a considerable risk to life and quality of life. The total number of road deaths in developed countries has markedly decreased, e.g. in Germany from over 20000 in 1970 to less than 4000 in 2010⁷, but little is known how this is reflected in the burden of spine fractures of motor vehicle users. In this study, we aimed to show the actual incidence of spine injuries among drivers and front passengers and elucidate possible dependencies between crash mechanisms and types of injuries.

Methods: In an area representing a sample of the overall accident occurrence in Germany a local traffic accident research unit collected prospective data in regard to all reported traffic crashes. 300 vehicular collisions per year up to 1987 and 1000 accidents per year since then were documented. Specially trained documentation personnel are notified by police dispatchers and arrive on scene, often simultaneously with the rescue personnel. The circumstances of the crash are investigated by taking photographs and using a 3D-laser scanner. Slide and skid marks of involved objects, vehicles and persons are measured for later reconstruction of the crash and calculation of collision speeds. Furthermore technical features of involved vehicles, e. g. weight and size were obtained as well as on-scene clinical data from injured persons. Additional data was collected at the hospital which admits the injured occupants, with documentation of x-ray films, diagnoses after the first in-hospital examination and estimation of injury severity. The data comprised demographic data, type of road user (car/truck occupant, motorcyclist, cyclist, pedestrian), delta-v (km/h; change of velocity at the collision time as a basic force indicator) of motorized vehicle user; vehicle collision speed (km/h) of motorbikes, Abbreviated Injury Scale (AIS), Maximum AIS (MAIS), Injury Severity Score (ISS) and incidence of serious and/or severe multiple injuries (polytrauma, ISS \geq 16). The data base was analyzed in regard to collision details, preclinical and clinical data. Only drivers and front passengers were included. Hospital records were retrieved. Radiological imaging was evaluated. Fractures were classified according to the Magerl classification.

Results: During a 26 year period 19922 accidents with 34188 injured front passengers were included. We identified 131 front passengers (0.38%) with cervical spine injuries, 77 (0.26%) with thoracic and 101 (0.30%) with lumbar injuries. 68% and 57% of thoracic and lumbar fractures occurred in accidents with multiple impacts. Relative collision speed was 48, 39 and 40 kph in passengers with cervical, thoracic and lumbar spine, respectively, cf. fig.1.

Results: Collision speed (delta-v)

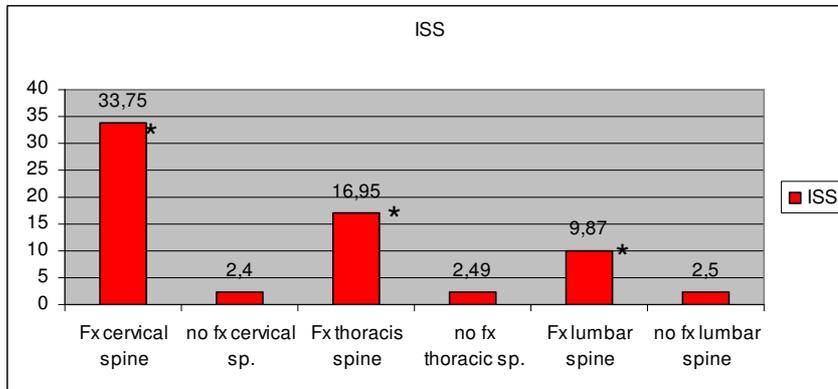


* $p < 0.001$ for all fracture vs. no fracture

Figure 1: Collision speed

ISS and MAIS were significantly higher in passengers with spinal injuries; cf. fig. 2 and 3.

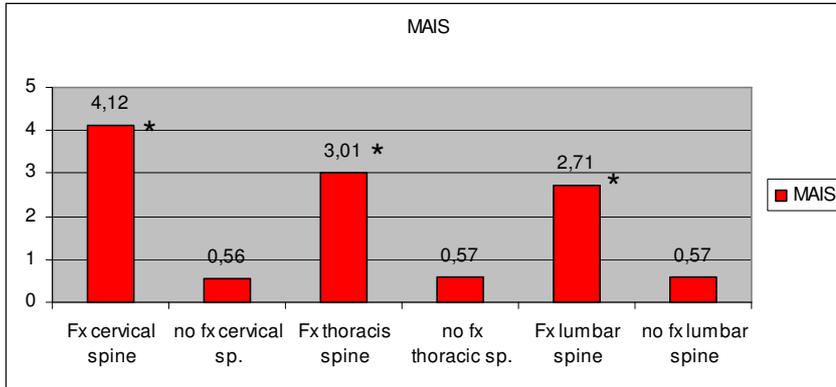
Results: Injury Severity Score



* $p < 0.001$ for all fracture vs. no fracture

Figure 2: ISS

Results: Maximum AIS



* $p < 0.001$ for all fracture vs. no fracture

Figure 3: MAIS

Passengers with spinal fractures frequently showed numerous concomitant injuries, e.g. additional vertebral fractures, cf. fig. 4.

Results: Injury severity (AIS)

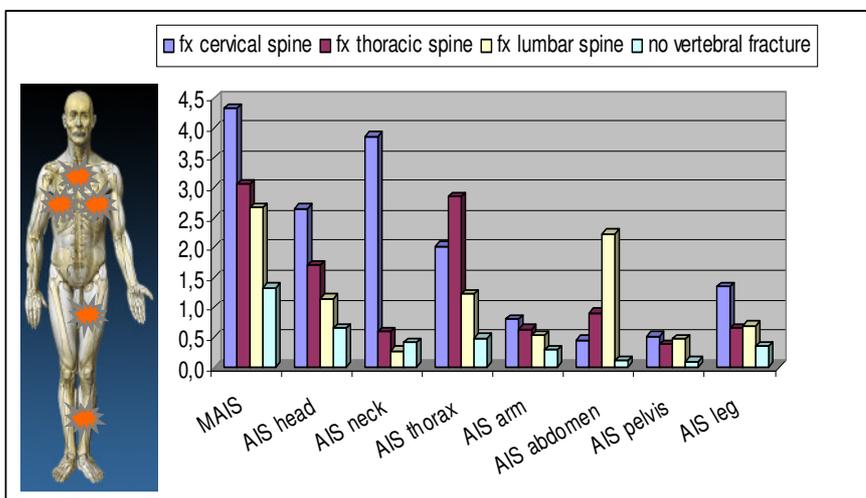
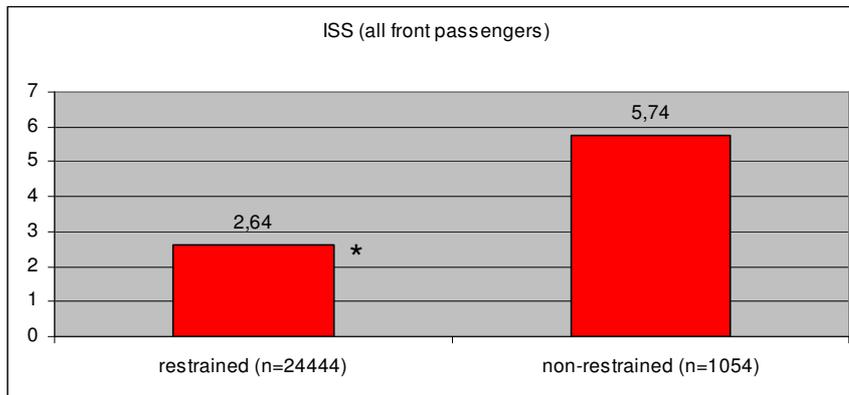


Figure 4: Concomitant injuries

Overall, the injury severity in patients not wearing safety belts was significantly higher than in those with usage of safety belts, although the collision speed did not differ, cf. fig. 5.

Results: Belt usage



* $p < 0.001$, missing values = unknown

Figure 5: Usage of safety belts

The most common collision mechanisms in these patients were multiple hits or roll-overs. The incidence of fractures did not change significantly over time.

In 80 patients the type of fracture could be determined by x-rays, detailed patients' records or report of autopsy. 44 thoracolumbar fractures were classifiable after Magerl. There were 30 compression type fractures (A1.1 to A1.3), 2 slice fractures (A2), 5 burst fractures (A3.1 to A3.3) and 6 complex spinal injuries (B and C). 22 were fractures of the lateral processus of the vertebral body, 2 fractures pertained to the sacrum, the remaining were fractures of the upper cervical spine. Five from six complex spinal injuries (B and C type) and four from five burst fractures (A3) were roll-overs or, mostly, multiple hits. There was no significant difference in delta-v. ISS and MAIS were higher in the more severe fractures. Seat belts had been used in all of these cases.

Conclusion: The overall risk of front passengers to sustain spine fractures in motor vehicle accidents is comparatively low. Yet, spinal injuries can be extremely harmful and are usually accompanied by significant additional injuries which might be more apparent. Prevention has to focus on complex collision mechanisms as they are most likely to cause spinal injuries.

References:

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