

# Assessment of injury probability based on crash tests using biofidelic dummies

Dummy-Crashtest Conference

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## On the safe side

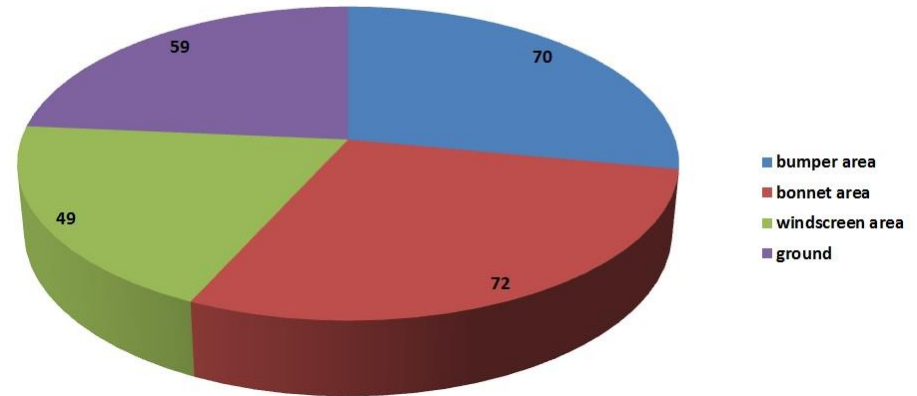
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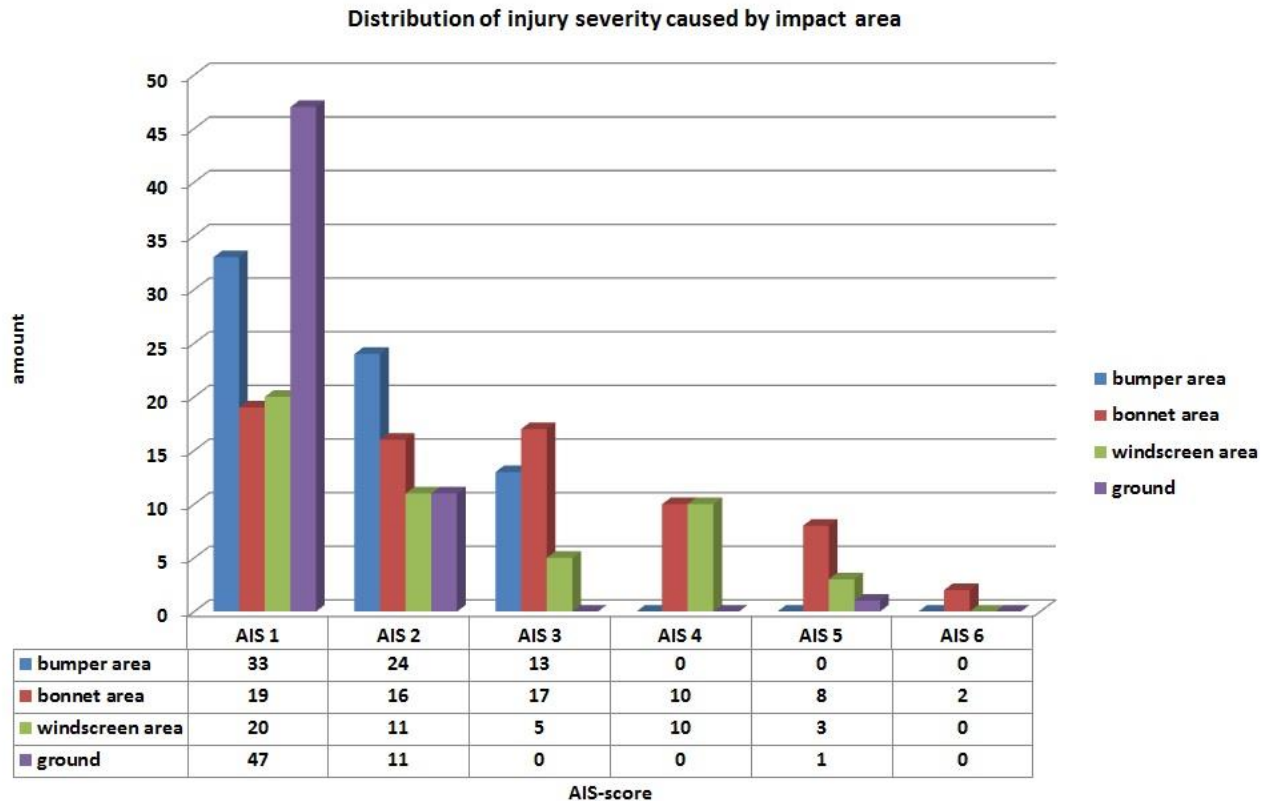
# Analysis of Pedestrian Accidents

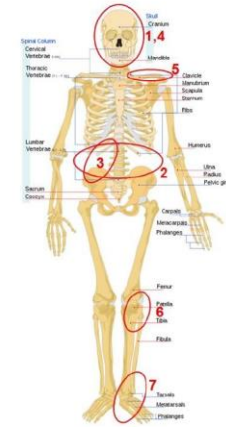
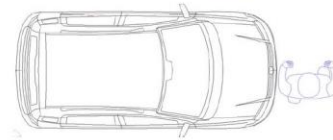
- 21 real-world accidents have been analysed
- 334 individual injuries
- 250 injuries have been assigned to a single injury-causing vehicle structure or the ground

Relationship between front-end area and injuries caused



# Analysis of Pedestrian Accidents





vehicle data	pedestrian data
Opel Astra Caravan F 1994	39 years
trapezium	male
1095 kg	182 cm
60 - 65 km/h	113 kg
pre-crash braking	survived
frontal	
complete	

no.	injury	injury caused by hit	injury caused by ...
1	1st degree craniocerebral injury with temporary unconsciousness	primary	roof leading edge
2	blunt abdominal trauma	primary	windscreen
3	liver haematoma	primary	windscreen
4	facial skin abrasion	primary	windscreen
5	fracture of left clavicle	primary	bonnet
6	maisonneuve fracture of left fibula with fracture of left lateral malleolus	primary	bumper
7	medial malleolus haematoma	primary	bumper

# Vehicle–Pedestrian Dummy–Crash Tests

crash test	vehicle	collision speed	braking	dummy
wh18.22	BMW 1 Series 2004	75 km/h	pre-crash	biofidelic
wh18.23	BMW 1 Series 2004	99 km/h	in-crash	biofidelic
wh18.24	VW Touareg 2003	75 km/h	pre-crash	biofidelic
wh18.25	VW Touareg 2003	99 km/h	in-crash	biofidelic
wh18.26	VW Passat Variant 2006	75 km/h	pre-crash	biofidelic
wh18.27	VW Passat Variant 2006	99 km/h	in-crash	biofidelic
wh18.28	Mercedes A-Class 2005	72 km/h	pre-crash	biofidelic
wh18.29	Mercedes A-Class 2005	96 km/h	in-crash	biofidelic
wh18.34	VW Touareg 2003	27 km/h	in-crash	biofidelic

# Injuries useful for Reconstruction Purposes

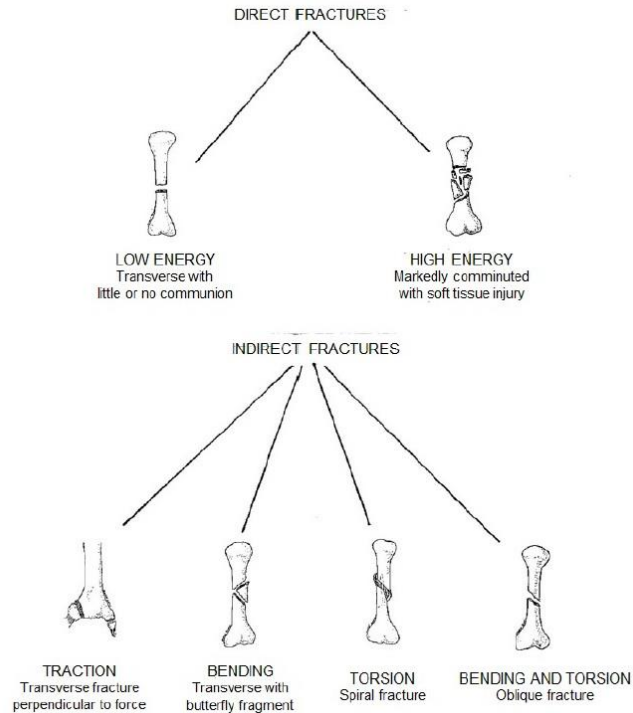
- Fracture patterns of the lower leg's long bones
- Knee joint injuries
- Pelvic injuries
- Ankle joint injuries
- Skull fractures

# Injuries useful for Reconstruction Purposes

- Fracture patterns of the lower leg's long bones
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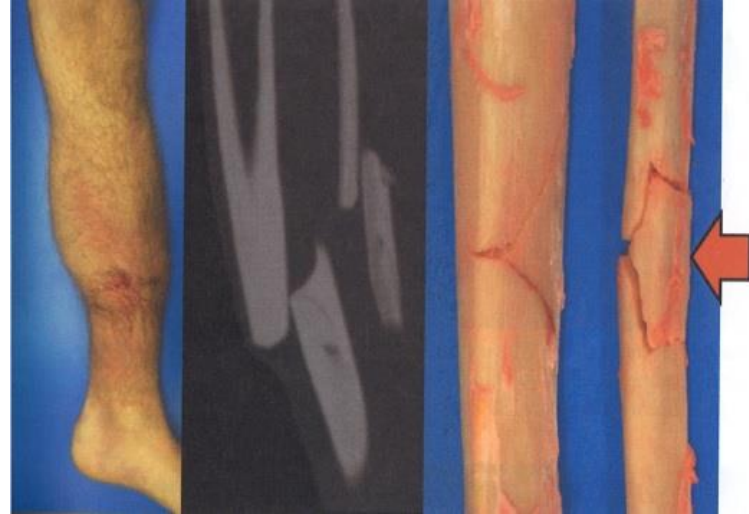
# Fracture Patterns of the Lower Leg's Long Bones



Schmitt, K.-U., Niederer, P., Muser, M. H., & Walz, F. (2010). *Trauma Biomechanics – Accidental injury in traffic and sports* (3<sup>rd</sup> ed.). Springer.

# Fracture Patterns of the Lower Leg's Long Bones

- Messerer's wedge fracture:
  - The apex points in the direction of the vehicle's velocity vector
  - The wedge fracture, however, must not be "used" on its own
  - The wedge fracture must be "corroborated" by relevant soft tissue injuries



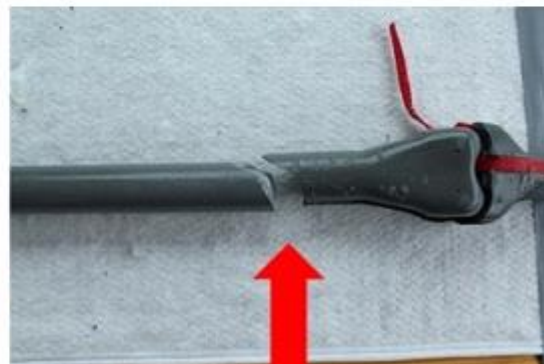
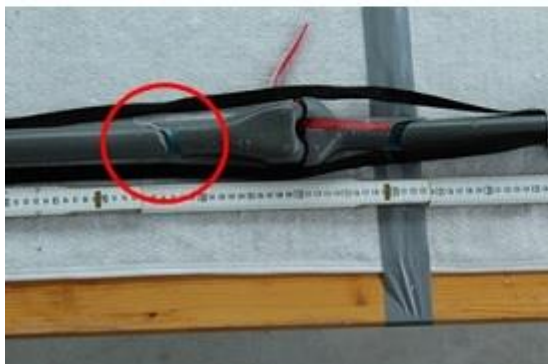
Hartwig, S. (2016). *Personenschäden im Straßenverkehr: Unfallanalyse, Medizin und Recht* (W. H. M. Castro, M. Becke, & M. Nugel, Eds.). C. H. Beck.

# Fracture Patterns of the Lower Leg's Long Bones

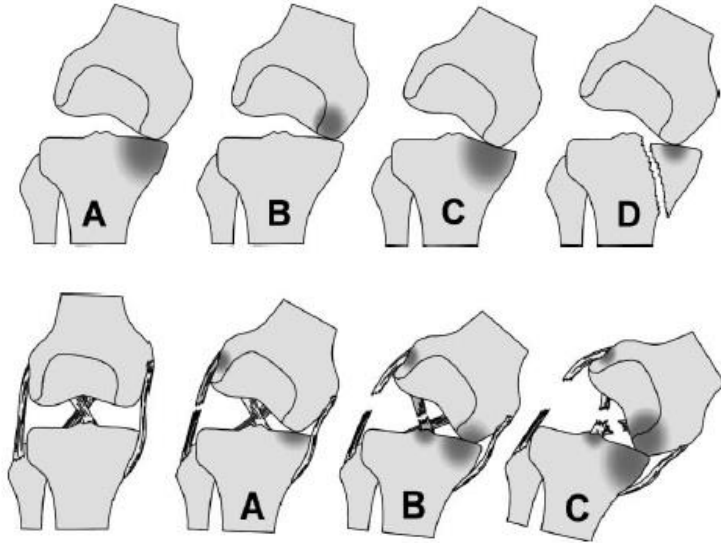
- Torsional fractures:
  - Occur when the pedestrian rotates over the concerning limb
- Low-energy impacts:
  - Transverse fractures with little or no communion
- High-energy impacts:
  - Comminuted fractures with soft tissue injuries

# Fracture Patterns of the Lower Leg's Long Bones

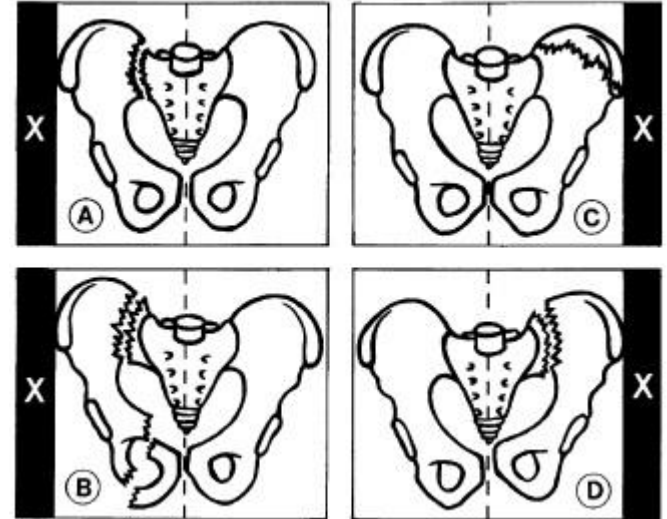
- Messerer's wedge fracture:
  - The protrusion indicates the impact direction



# Knee Joint Injuries / Pelvic Injuries

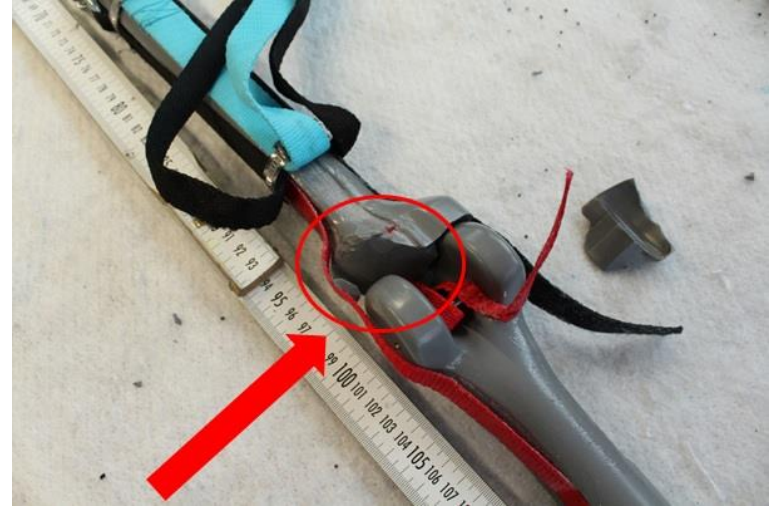
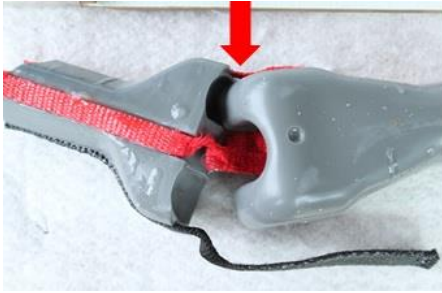


Teresinski, G., & Madro, R. (2001). Knee joint injuries as a reconstructive factors in car-to-pedestrian accidents. *Forensic Science International*, 124, 74-82.



Teresinski, G., & Madro, R. (2001). Pelvis and hip joint injuries as a reconstructive factors in car-to-pedestrian accidents. *Forensic Science International*, 124, 68-73.

# Knee Joint Injuries

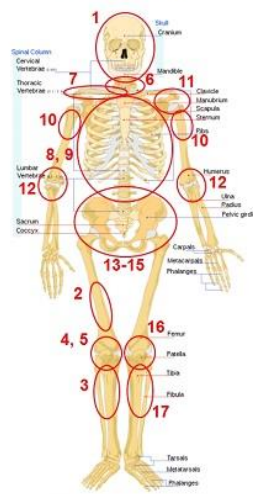
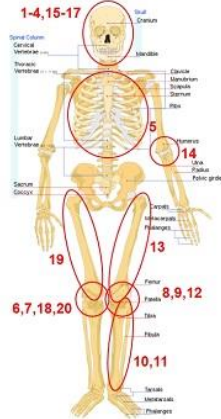


# Pelvic Injuries

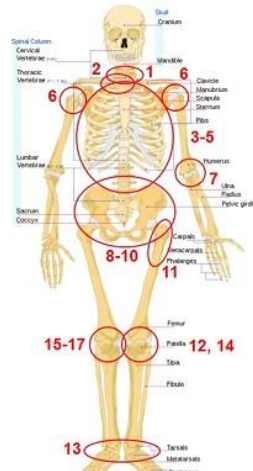




## Pedestrian 1



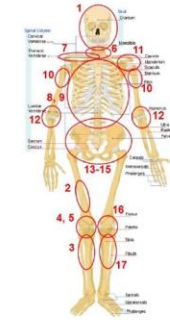
## Crash test wh18.26



pedestrian 2	
vehicle data	pedestrian data
BMW 320i 1996	51 years
1300 kg	male
173 cm	173 cm
53 - 63 km/h	83 kg
late or unbraked	deceased
frontal	
complete	



crash test wh18.22	
vehicle data	dummy data
BMW 1 Series 2004	D01
pontoon	166 cm
1282 kg	78 kg
75 km/h	
pre-crash braking	
frontal	
complete	



no.	injury
1	fracture of left scapula
2	fracture of right fibula
3	fraying of fibres of right knee joint's medial collateral ligament
4	rupture of left knee joint's lateral collateral ligament with opening of articular cavity and bony rupture of lateral collateral ligament
5	multiple rib fractures left: 1st to 6th rib at linea axillaries anterior and 3rd to 8th rib at medial linea scapula

no.	injury
1	laceration on os parietale right
2	fracture of lower femur right
3	wedge-shaped fracture of right upper lower leg
4	right knee torn out
5	rupture of posterior cruciate ligament right
6	fracture of spinal process of first cervical vertebra
7	fracture of right clavicle
8	fracture of the two lower ribs right next to spinal column
9	fracture of lowest rib left laterally



# Thank you very much for your Attention!



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