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Scapula Fractures and Other Shoulder Injuries: Occupant, Vehicle, and Impact Differences

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San Diego CIREN

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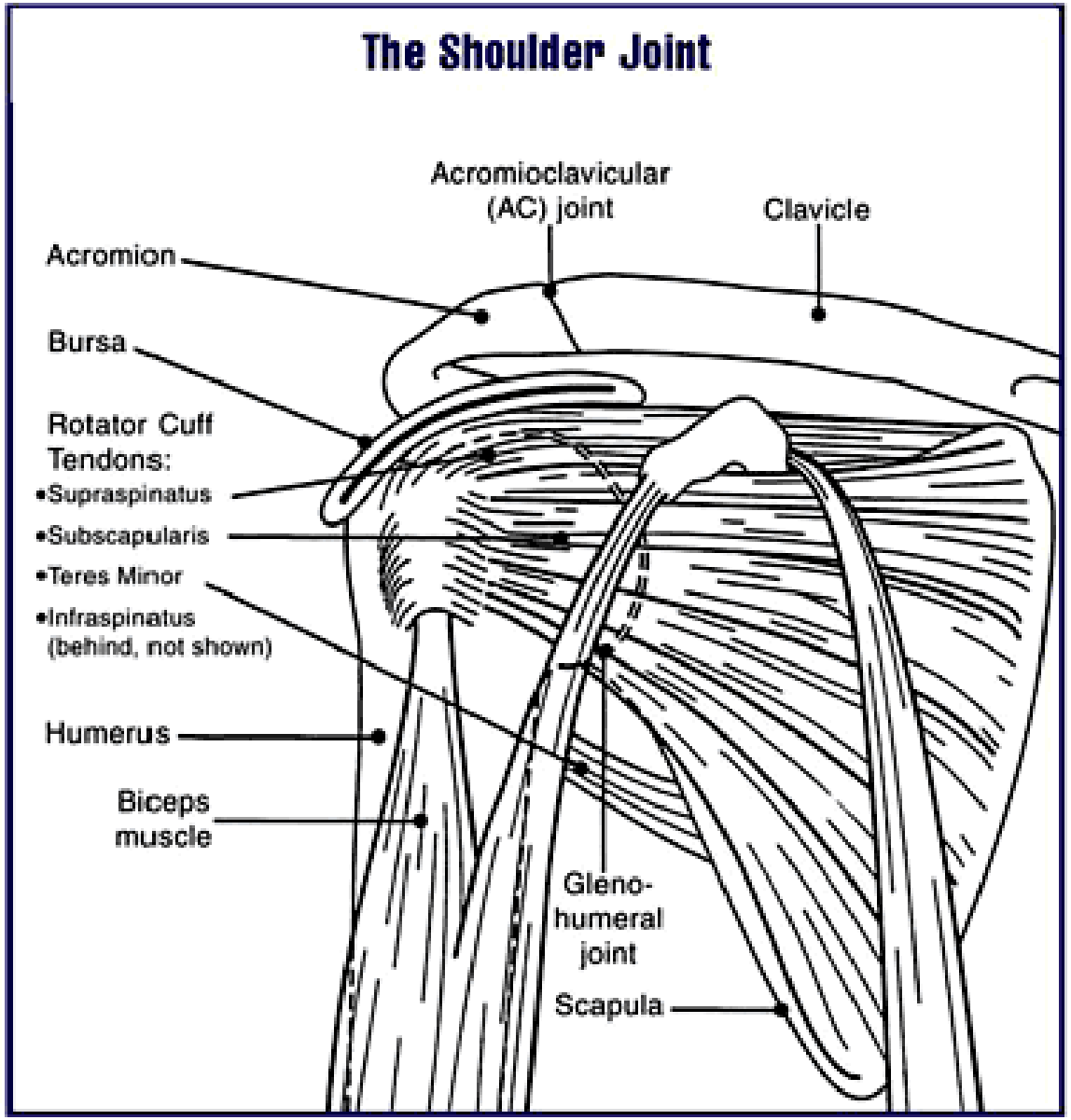
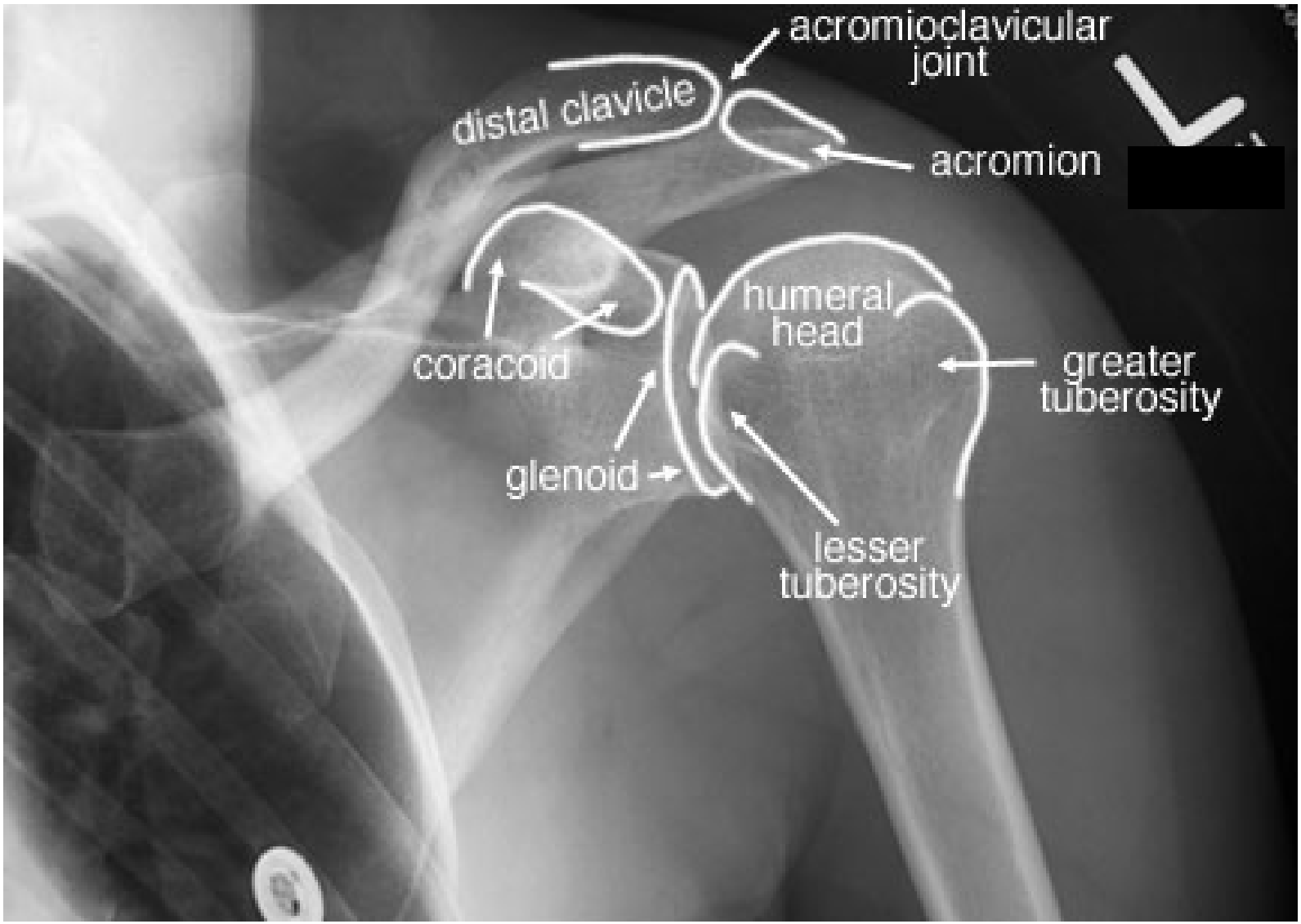
Background

- Bio-mechanically the shoulder is a separate body region but anatomically it is within the AIS upper extremity body region
- Shoulder consists of clavicle, scapula, proximal humerus and associated muscles, tendons, ligaments allowing for wide range of motion of arms
- Previous research using CIREN data found 35% of upper extremity injuries involved the shoulder in drivers and 46% in passengers
- Medical literature notes scapula fractures account for <3% of all fractures even in patients with multiple trauma
- Our research question: Are there differences between scapula fractures and other shoulder injuries occurring during motor vehicle crashes?

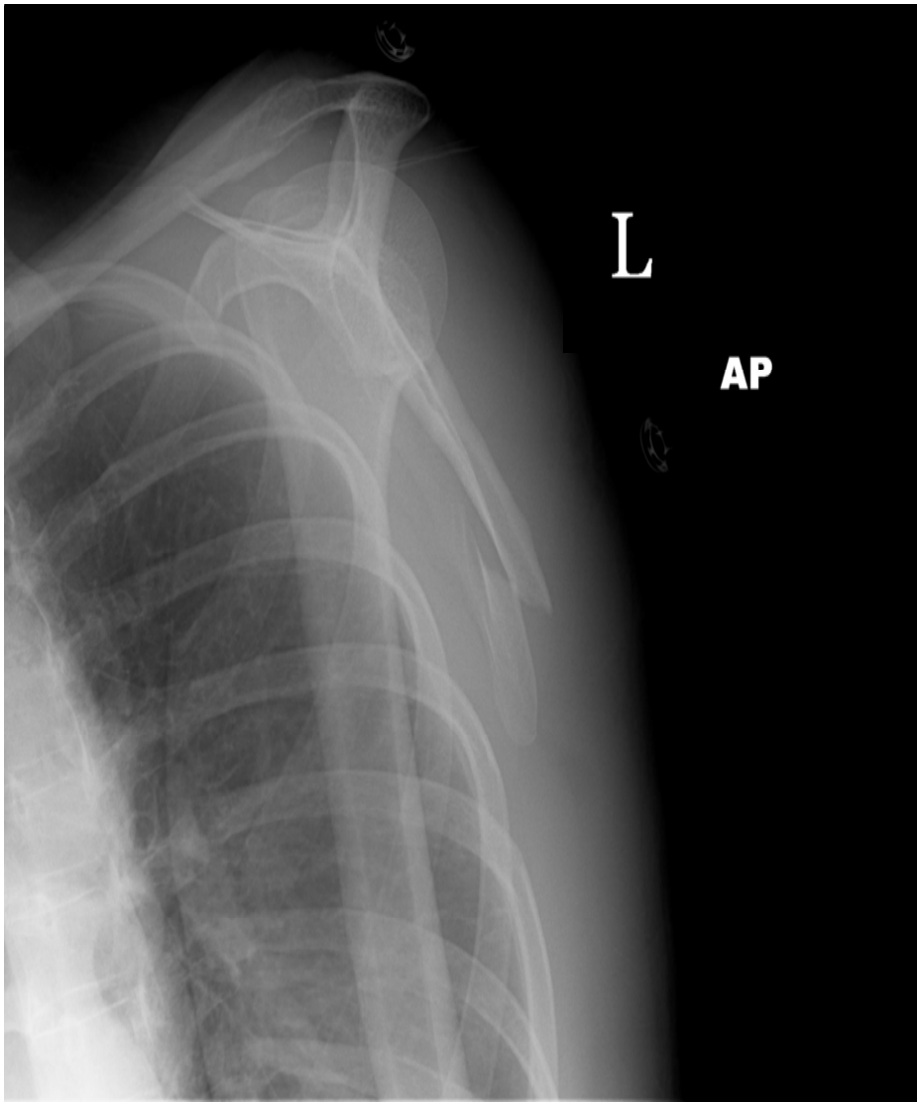

Shoulder
Clavicle
Humerus
Scapula


The Shoulder Joint
Acromioclavicular
(AC) joint
Clavicle
Acromion
Bursa
Rotator Cuff
Tendons:
•Supraspinatus
•Subscapularis
•Teres Minor
•Infraspinatus
(behind, not shown)
Humerus
Biceps
muscle
Gleno-
humeral
joint
Scapula


acromioclavicular joint
distal clavicle
acromion
humeral head
coracoid
greater tuberosity
glenoid
lesser tuberosity

San Diego CIREN Case Examples

- 39 year old female driver
- Restrained 3-pt lap/shoulder belt with frontal airbag deployment
- CDC: 12FYEW4 (off-set frontal impact) with 20 mph delta V
- 2007 Chevrolet 1500 Silverado vs. Honda Civic
- Major Injuries: Bilateral distal tibia fractures, Left scapula wing fracture



- 82 year old female driver
- Restrained 3-pt lap/shoulder belt with side torso airbag deployment
- Left side leading 6 quarter-turn trip-over with moderate delta V based on external residual crush
- 2003 Honda Odyssey
- Major Injuries: Bilateral rib fractures (L 1-6, R 2,3), pulmonary contusion, left scapula fracture, left radial stylus fracture

- 20 year old female front seat passenger
- Unrestrained with no airbag deployment
- CDC: 02RYAW03 (near-side impact)
- 2003 Ford Mustang
- Major Injuries: subdural hematoma, basal skull fracture, bilateral rib fractures, pneumothorax and pulmonary contusion, multiple pelvic fractures, bilateral clavicle fractures, scapula fracture

Methods

- Data Source: CIREN database (1997-2008)

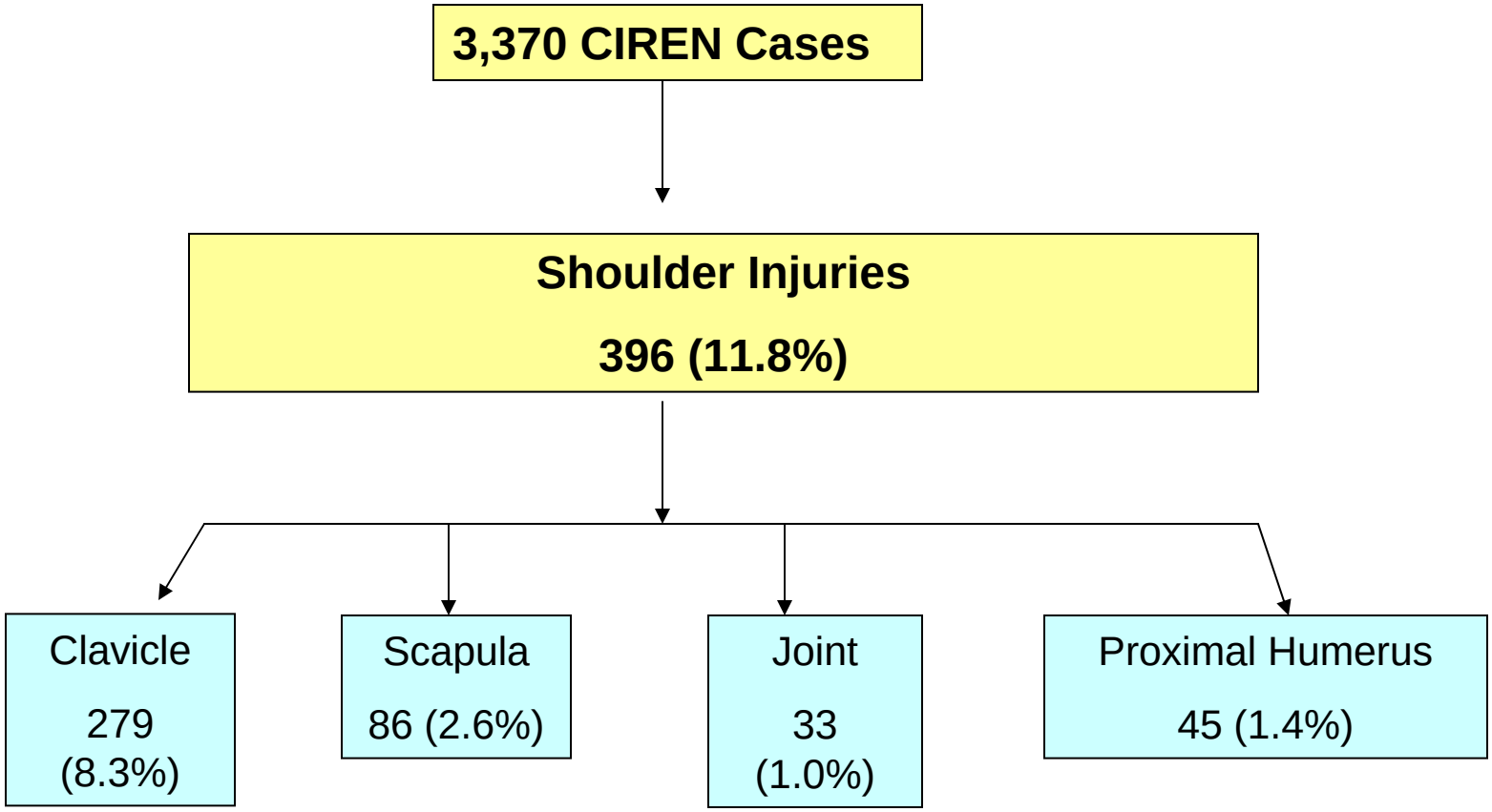
- Identified all occupants with shoulder injuries
- Compared occupants with scapula fractures only in the shoulder region (n=54) to occupants with other shoulder injuries (but no scapula fracture) (n=342)
  - Occupant, vehicle, crash characteristics
  - Source of injury
- Assessed statistical differences at 0.05 significance level using t-tests, Odds Ratios, Fisher Exact tests

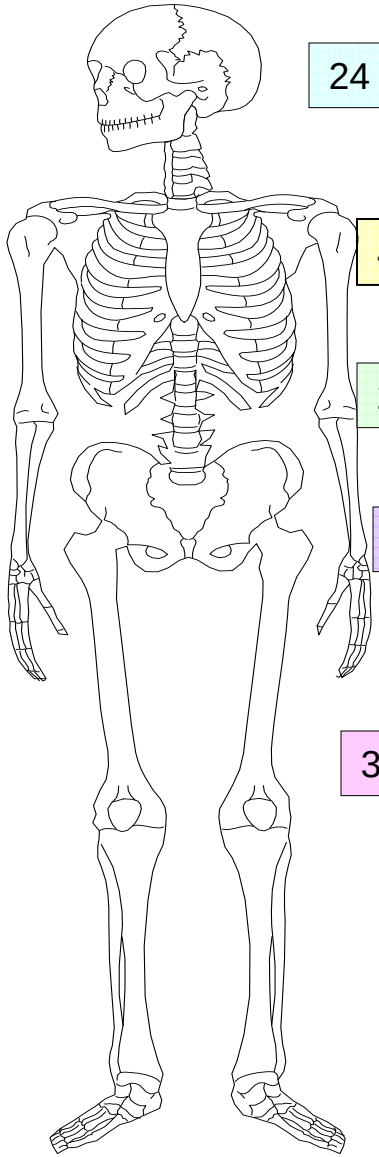
Shoulder Injuries in CIREN

Scapula Fracture	AIS 753000.2	Moderate
Clavicle Fracture	AIS 752200.2	Moderate
Glenohumeral Joint dislocation	AIS 751030.2	Moderate
Sternoclavicular Joint dislocation	AIS 751230.2	Moderate
Acromioclavicular Joint separation	AIS 750230.2	Moderate
Closed humerus Fracture	AIS 752602.2 (if ICD-9-CM 812.0)	Moderate
Open/displaced/comminuted humerus fracture	AIS 752606.3 (if ICD-9-CM 812.1)	Serious

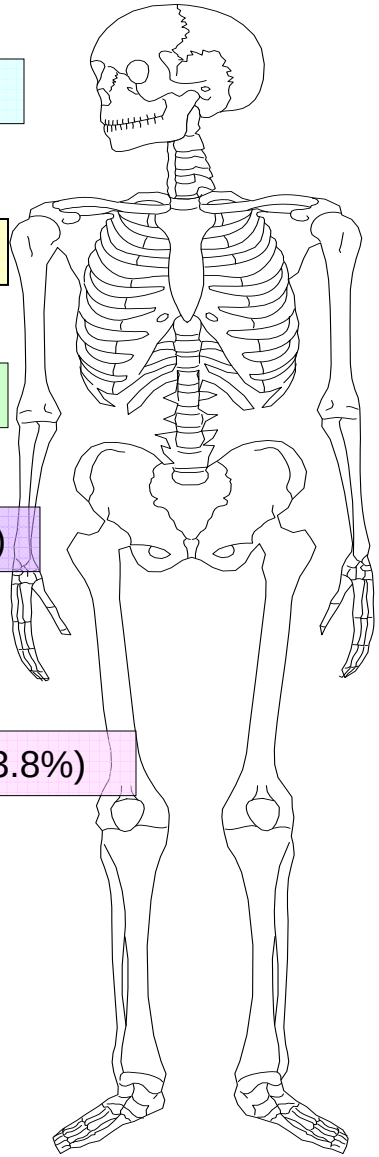
- **Occupant variables**
  - Age
  - Gender
  - Height
  - Weight
  - Body Mass Index
  - Safety belt use
  - Seat position (driver or passenger)

- **Crash and Vehicle Variables**
  - Principal Direction of Force
  - delta V (or Barrier Equivalent Speed)
  - Height
  - Residual Intrusion at occupant seat position
  - Airbag deployment
  - Impact type (based on Collision Deformation Classification)
  - Vehicle curb weight


3,370 CIREN Cases
Shoulder Injuries
396 (11.8%)
Clavicle
279
(8.3%)
Scapula
86 (2.6%)
Joint
33
(1.0%)
Proximal Humerus
45 (1.4%)



	Scapula Fractures	Other Shoulder Injuries	
Head	24 (44.4%)	173 (50.6%)	
Thorax	46 (85.2%)	224 (65.3%)	OR=3.06
Spine	23 (42.6%)	83 (24.3%)	OR=2.31
Abdomen	23 (42.6%)	140 (40.9%)	
Lower extremity	30 (55.6%)	184 (53.8%)	



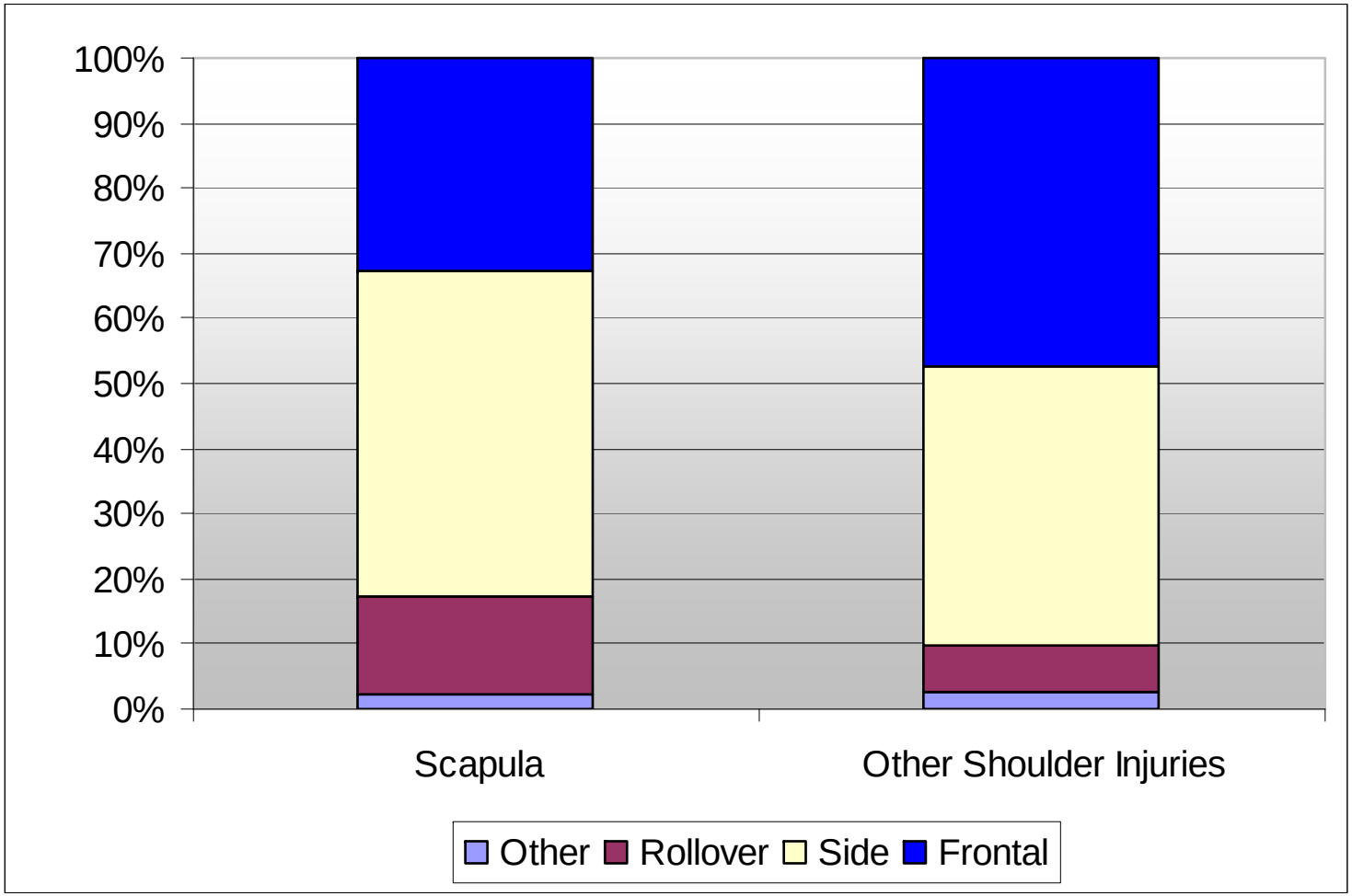
Significant Differences

- Male gender (OR=3.30), taller stature, greater weight was associated with scapula fractures

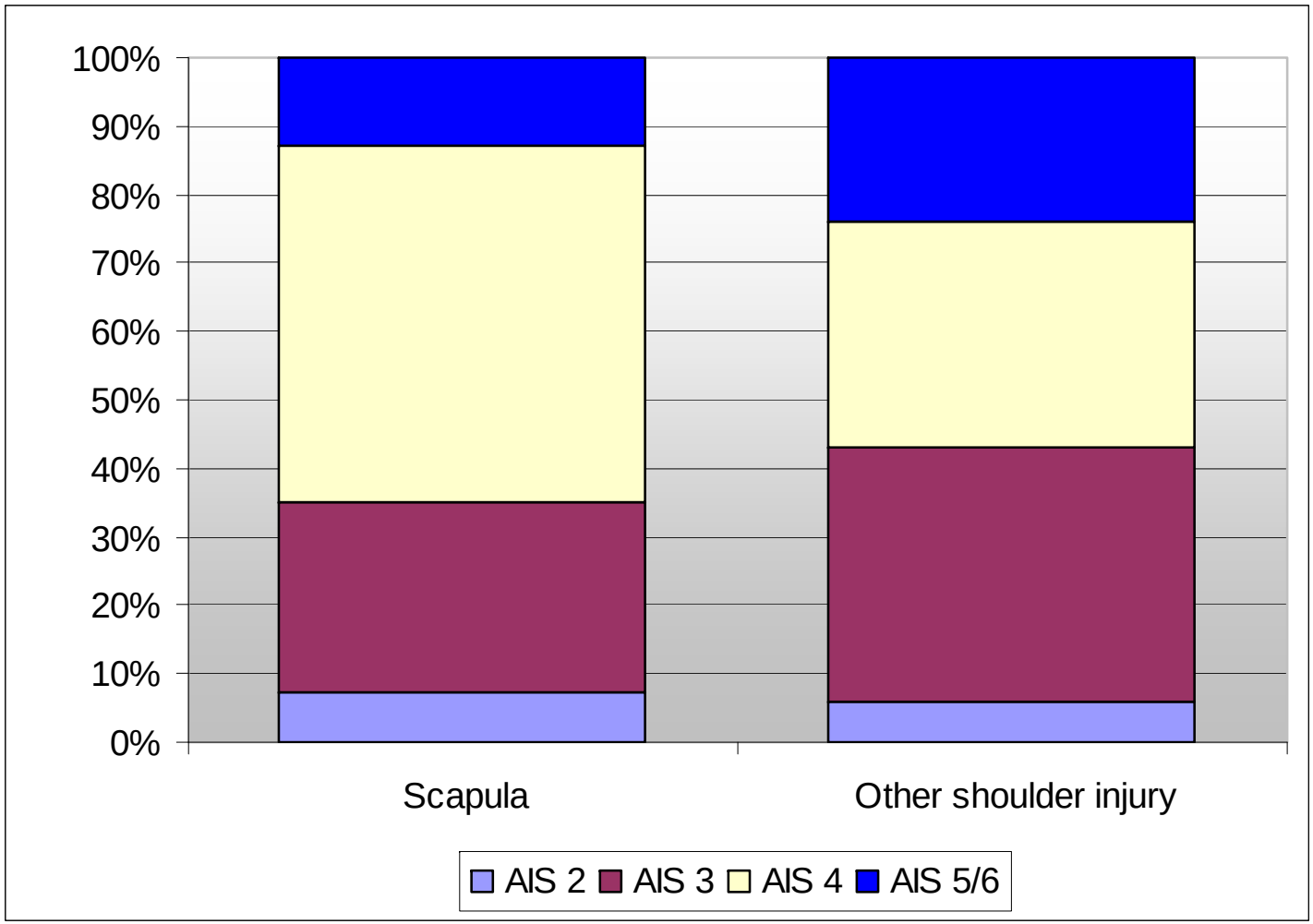
- Occupants with scapula fracture had a less severe maximum AIS injury
  - MAIS: 13% were AIS 5 or 6 compared to 24% for other shoulder injuries

- Occupants with scapular fracture only were less likely to die compared to those with other shoulder injuries
  - 5.6% vs. 18.8%
  - No difference in Injury Severity Score

Impact Type for Occupants with Scapula Fractures compared to Other Shoulder Injuries



Injury Severity (MAIS) of Scapula Fractures Compared to Other Shoulder Injuries



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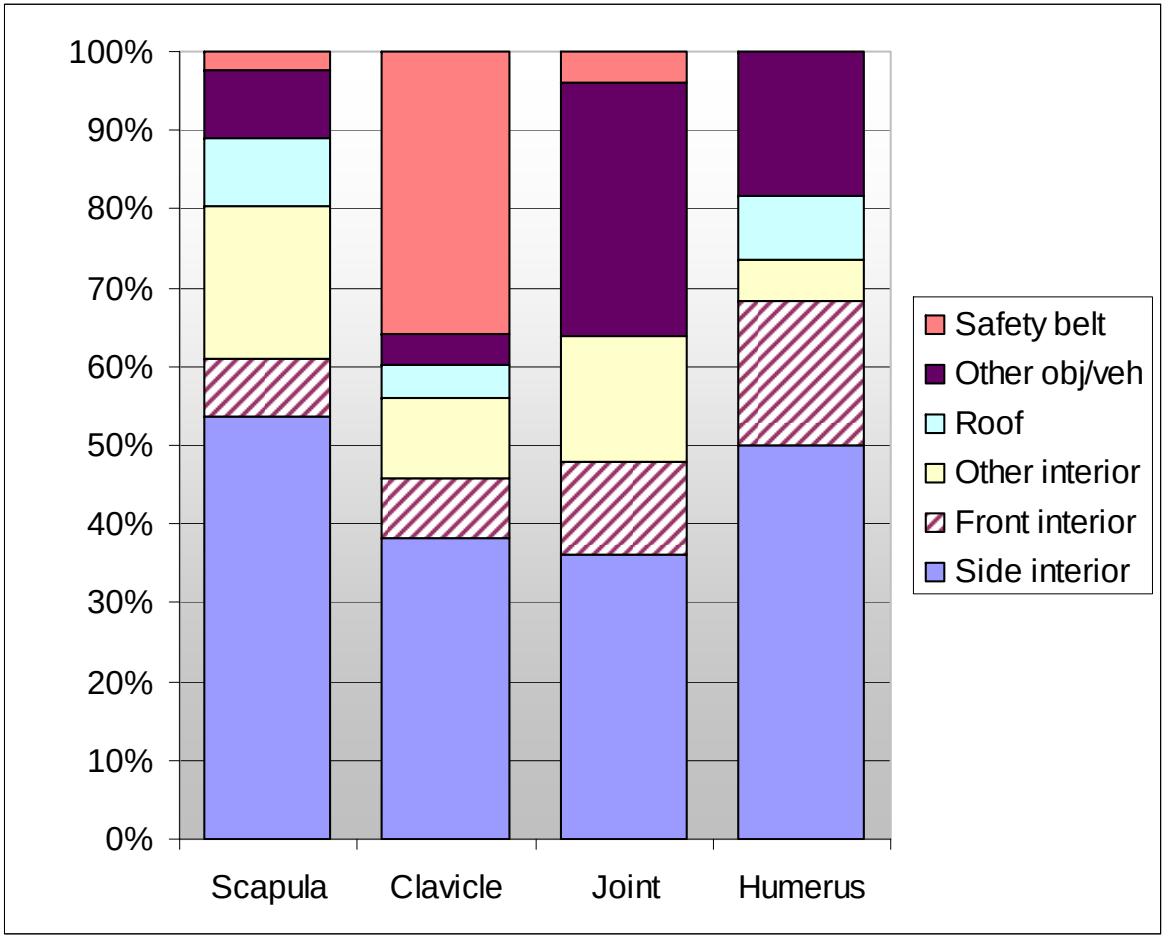
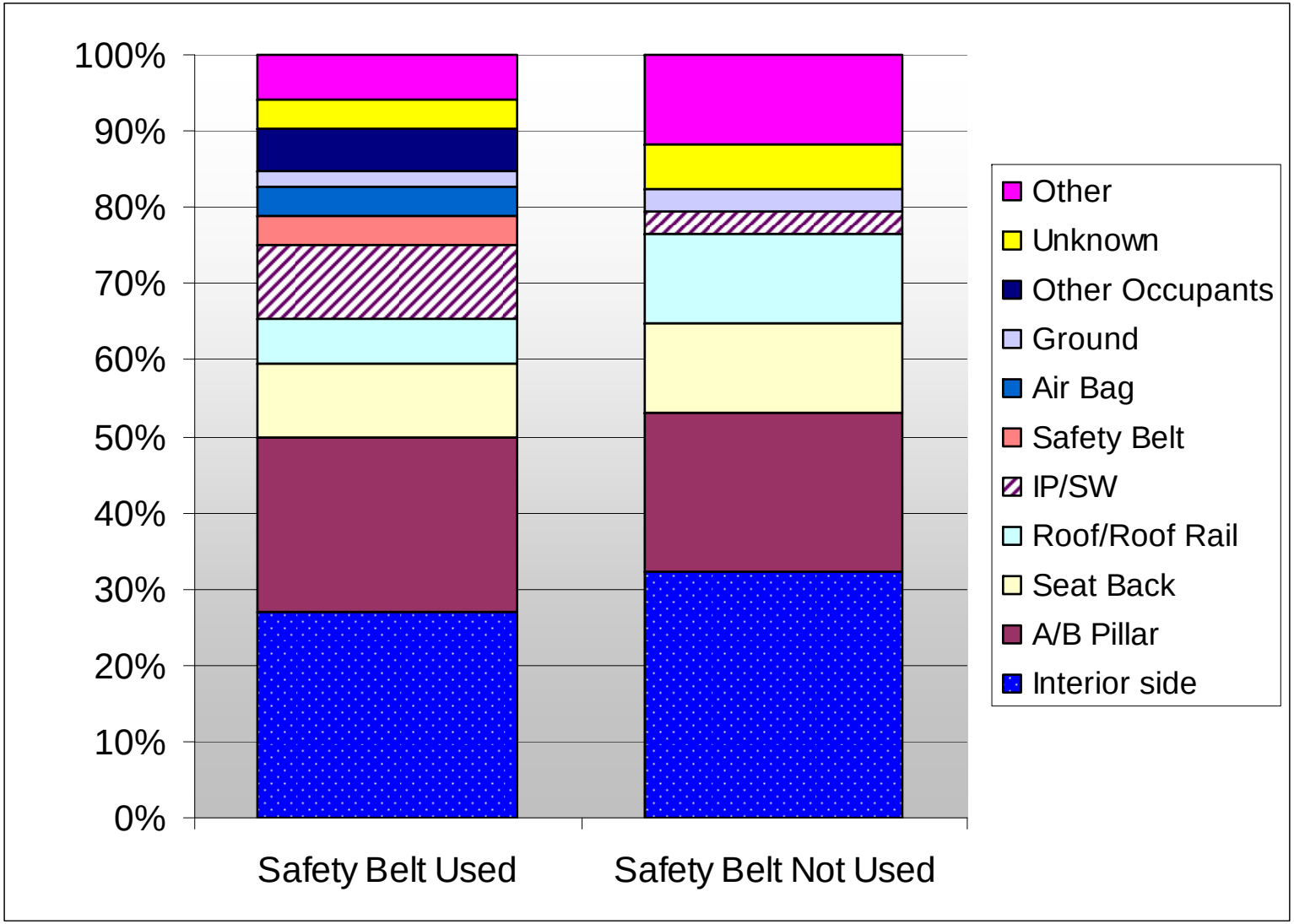
Vehicle Component causing Injury for Shoulder Injuries



Causes of Scapula Fracture by Safety Belt Use Status



Conclusions

- Thoracic and spinal injuries are associated with scapula fractures (compared to other shoulder injuries)
- Occupants with scapula fractures more likely to have been in a rollover or side impact
  - About 50% of scapula fractures caused by contact with vehicle side interior
- Future research is needed on the role and design of side airbags in preventing scapula fracture
- Different bones in the same anatomical region (shoulder) may need to be considered separately when improving vehicle interiors and safety systems for injury prevention

Limitations

- CIREN is not a representative database
  - Selection bias
- Type of side airbag not considered (due to small numbers)
  - May explain lack of protective effect
- Occupants with only scapula (AIS 2) fractures and no other AIS 2+ injuries in other body regions would not meet inclusion criteria
  - May increase association between scapula fractures and other more serious concomitant injuries in other body regions