



Injury mechanism, epidemiology, and Hospital trends of scapula fractures: A 10-year retrospective study of the National Trauma Data Bank[☆]



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ABSTRACT

Background: This 10 year retrospective study of the NTDB is the first to describe trends in scapula fracture diagnosis frequency, epidemiology, injury mechanisms and the type of hospital where the condition is treated.

Methods: Demographics, ISS scores, hospital data, mechanism of injury, complications, and hospital length of stay were recorded for patients with diagnosed scapula fractures (ICD-9, 811.0) recorded in the NTDB, v7.2 (2002–2012). Mean and standard deviation for continuous variables and proportions for binary variables are calculated.

Results: The prevalence of scapula fractures in all patients submitted to the NTDB (2002–2012) was 1.74%. Between 2006–2007, the reported incidence doubled from 1% to 2.2%. There was a predominance of injury to white males (75% and 78% respectively). Forty-one percent were treated at a Level 1 trauma center and had a mean ISS of 20.1 (SD-11.8). Scapula fracture rates declined in patients 0–19 years and increased in the 60–79 and 80+ age groups. The increasing incidence of the aged population is also reflected in the increase of falls as the mechanism of injury in the elderly population.

Conclusion: This study is the first to describe a full decade of scapula fracture epidemiology on a national scale. The number of diagnosed scapula fractures increased substantially in the NTDB between 2002–2012. Scapula fractures diagnosed in the geriatric demographic and fractures resulting from falls are both on the rise, whereas the reported incidence is decreasing in the younger demographic. Additionally, fractures as a result of motor vehicle accidents also decreased precipitously during the reported decade.

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Introduction

Operative treatment and functional outcome of patients with scapula fractures is an area of increasing orthopaedic interest over the past decade. Prior to this time, nonoperative treatment was the predominant standard of care, which has been shown to result in decreased range of motion and function in subsets of patients [1–4]. Recent studies have reported good functional outcomes with operative treatment; however operative indications remain somewhat arbitrary and based largely upon expert opinion [5–12].

Scapula fractures typically result from high-energy mechanisms (88%) [13] and are associated with severe concomitant trauma [14–21]. The literature currently lacks a contemporary description of epidemiology and injury trends of patients diagnosed with scapula fractures. Information related to the geographical location and trauma level of hospitals treating patients with scapula fractures has not been published to date. Understanding nationwide changes in trends can be predictive of future needs in patient care.

Using the National Trauma Data Bank (NTDB) data, the objectives of this study were to; (1) identify changing trends and incidence in the rate of scapula fracture diagnosis over a decade as reported in the NTDB (2) describe nation-wide trends in hospitals where scapula fractures are diagnosed (geography, hospital type, teaching status), (3) describe demographics, severity of bodily injury as identified by ISS score (Injury Severity Score), concomitant injury, injury mechanism, hospital complications, discharge dispositions, and length of hospital stay, and (4) describe

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a decade of changes in fracture rate and injury mechanisms in the context of an increasing elderly population and advancing safety regulations of the automotive industry.

Methods

This descriptive study is a retrospective database analysis of the National Trauma Data Bank (version 7.2). The NTDB is managed by the American College of Surgeons and is the largest existing consortium of hospital trauma records in the United States. The bank consists of 2.7 million cases voluntarily submitted by 900 participating U.S. trauma centers. Of these facilities, 55% are level 1 trauma centers, 35% level 2 trauma centers, and many level 3 centers. Patients were identified in research data sets from 2002 to 2012 (the most recent data sets available). Diagnosis code (ICD-9) 811 was used to identify scapula fracture patient records and all identified patient records were included in the study. Diagnosis code (ICD-9) 87.41 was used to identify Chest CT. Demographics, Hospital descriptive (region, teaching status, and trauma level), external causes, injury diagnosis, ISS, complications, and discharge disposition was extracted for analysis. Analyses were performed in SAS/STAT 9.3 (SAS Institute, Cary, NC). This study was approved by the Institutional Review Board.

Results

Diagnosis frequency

A total of 106,119 patients with diagnosed scapula fractures were identified in the National Trauma Data bank between 2002 and 2012. The number of diagnosed scapula fractures increased substantially each year during this decade. The trend corresponds with the rising number of patients submitted to the registry. The increase of diagnosed scapula fractures from 2005 to 2007 rose markedly and the trend has continued. (Fig. 1A) the advent of spiral CT scans for trauma patients, became a diagnostic screening tool within a similar time period. The percent of patients with

diagnosed scapula fractures and a diagnosis code for chest CT began to increase dramatically at the same time point of reported scapula fractures in the NTDB, and this increase has continued each year (Fig. 1B).

Hospital descriptives / geographical distribution

The majority of these fractures were diagnosed at University (55.7%, Fig. 2A), Level 1 (41%, Fig. 2B) trauma centers. A strong association is described between the percentage of the total population in a given region and the percentage of diagnosed scapula fractures in that region (Fig. 2C). There is a deviation from this trend in the Northeast where there is a smaller percentage of diagnosed scapula fractures relative to the regional percentage of population in the United States. Trends in hospital type, hospital trauma level, geographical location of diagnosis, and percent of regional population remained consistent throughout the decade and are reported as a percentage of the total population (2002–2012).

Demographics

The percentage of patients with scapula fractures in the total NTDB population data set, decreased throughout the decade (2002–2012) in both the 0–19 and 20–39 year age demographic (Fig. 3). However, there was a substantial increase of 57% in the 60–79 year demographic as well as in the 80+ year old demographic of 25% (Fig. 3). Trends in race and gender distribution remained consistent throughout the decade and are reported as a percentage of the total population (2002–2012). Gender was predominantly male (78%). The majority of patients were white (75%), followed by black (12%), Hispanic (9%), Asian (1%), and other (3%). The associated ISS score of the injured patients also remained consistent throughout the decade and is reported as mean/standard deviation of the total population (2002–2012). A mean ISS scores of 20.1 (SD, 11.8) indicate that severe trauma was associated with scapula fracture injury.

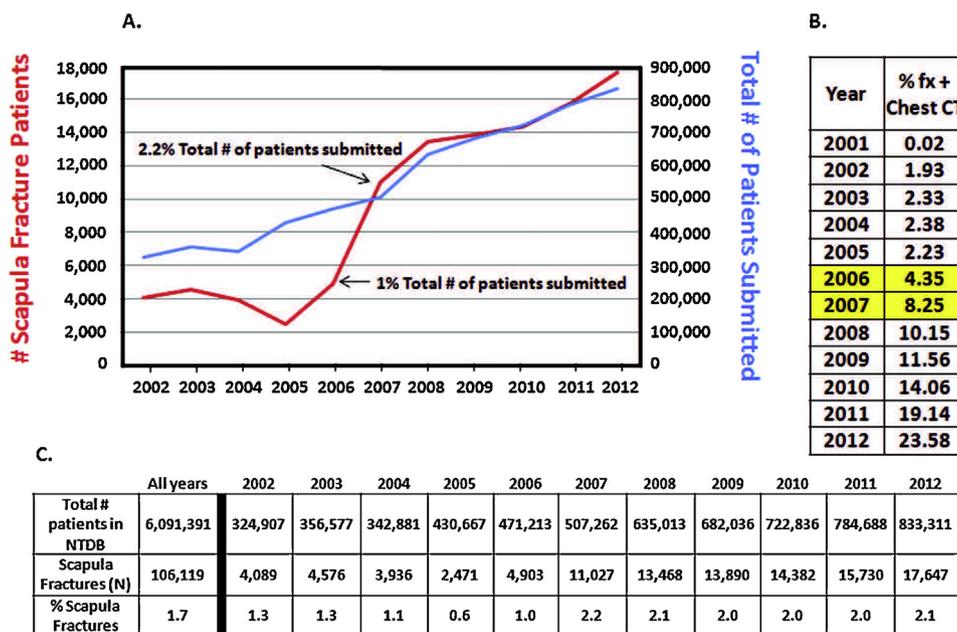


Fig. 1. A. Diagnosed scapula fractures by year (red) vs total number of patients submitted to the NTDB by year (blue). B. Percent of patients with diagnosed scapula fractures and a diagnosis code for chest CT (2001–2012) C. Percentage of patients with diagnosed scapula fractures by year (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article).

Hospital Descriptive (A. Hospital Type, B. Trauma level, C. Geographical distribution)

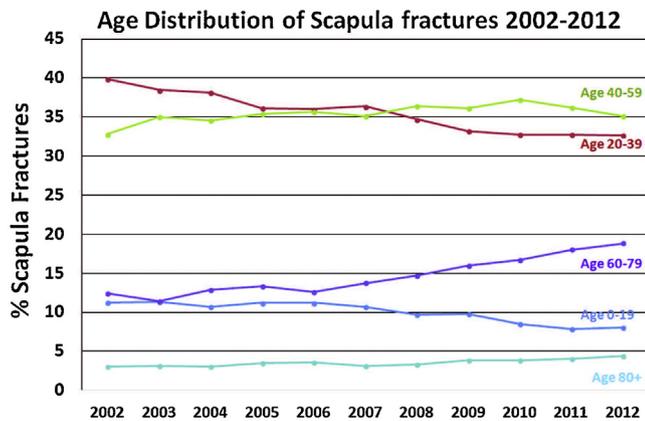
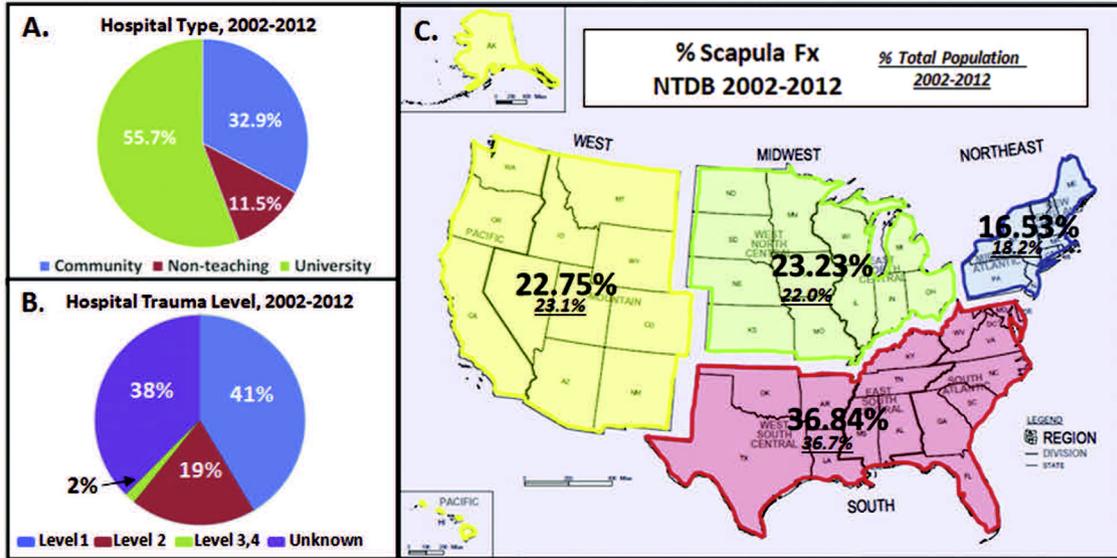


Fig. 3. Age distribution of scapula fracture patients by year (2002–2012).

Complications / concomitant injury

Documented complications in association with their injury were indicated for 33% (N=35,019) of patients with scapula fractures. Pneumonia (19.4%), ARDS (7%), and DVT/thrombophlebitis (5.6%) were of highest frequency. The greatest frequency of concomitant fractures were Rib (63.9%) followed by Vertebral (40.6%), Clavicle (25.8%), Humerus (9.7%), Ulna (9.0%), Hand (6.2%), and Skull (0.8%). Complications and concomitant injury are reported as a percentage of the total population (2002–2012).

Mechanism of injury

Motor vehicle accidents were the mechanism of injury for 40.7% of all scapula fractures in 2002. By 2012, motor vehicle accidents were reported at a rate of 27.8%. However, motorcycle injury rate was 17.7% in 2002 and was reported at a rate of 24.6% in 2012. Similarly, the rate of fractures resulting from falls was 10.6% in 2002 and 17.8% in 2012. (Fig. 4A)

The mechanism of injury as described by age distribution reveals the percentage of pedestrians sustaining a scapula fracture

decreases as age increases up to 39 years of age. However, there is a steady rise of fall related fractures from age 13–19 demographic to the 75+ demographic. (Fig. 4B)

With regard to mechanism of injury as described by gender, motor vehicle accident was the dominant cause of injury in females (45%) followed by falls (19%). Motor vehicle accidents (28%) and motor cycle accidents (26%) are the leading cause of injury in males. (Fig. 4C)

Hospital discharge disposition

Hospital discharge dispositions reflect an increasing percentage of patients discharged to rehab facilities (18% in 2002, 26% in 2012). Modest decrease in discharge to home (63% in 2002, 59% in 2012) and hospital transfer (7% in 2002, 3% in 2012) discharge dispositions are reported.

Complications / concomitant injury

Scapula fractures have reportedly occurred at a rate of 0.5% of all fractures [22]. This rate is similar to other fracture types such as distal humerus (0.5%), midfoot (0.4%), distal femur (0.4%) and talus (0.3%) [22]. Although this fracture type is relatively infrequent, the number and proportion of diagnosed scapula fractures increased substantially in the National Trauma Data Bank between 2005 and 2007 and continues to rise. The use of the CT scan for diagnostic evaluation of trauma patients began in approximately 2005, and has become ubiquitous across trauma institutions. This may partly explain the increasing rise in diagnoses. Another contributor to this trend may be the rise of geriatric fractures, as this population continues to become a greater percentage of the population each year. In addition, there is a greater recognition of scapula fractures due to an increase in the published works on scapula fractures as the decade has progressed. Any or all of these variables may be a contributing factors.

The majority of scapula fractures are treated effectively with non-operative management. Published literature has shown scapula fractures which meet operative indications, are only 12% and 13.6% of all scapula patients presenting to the trauma unit

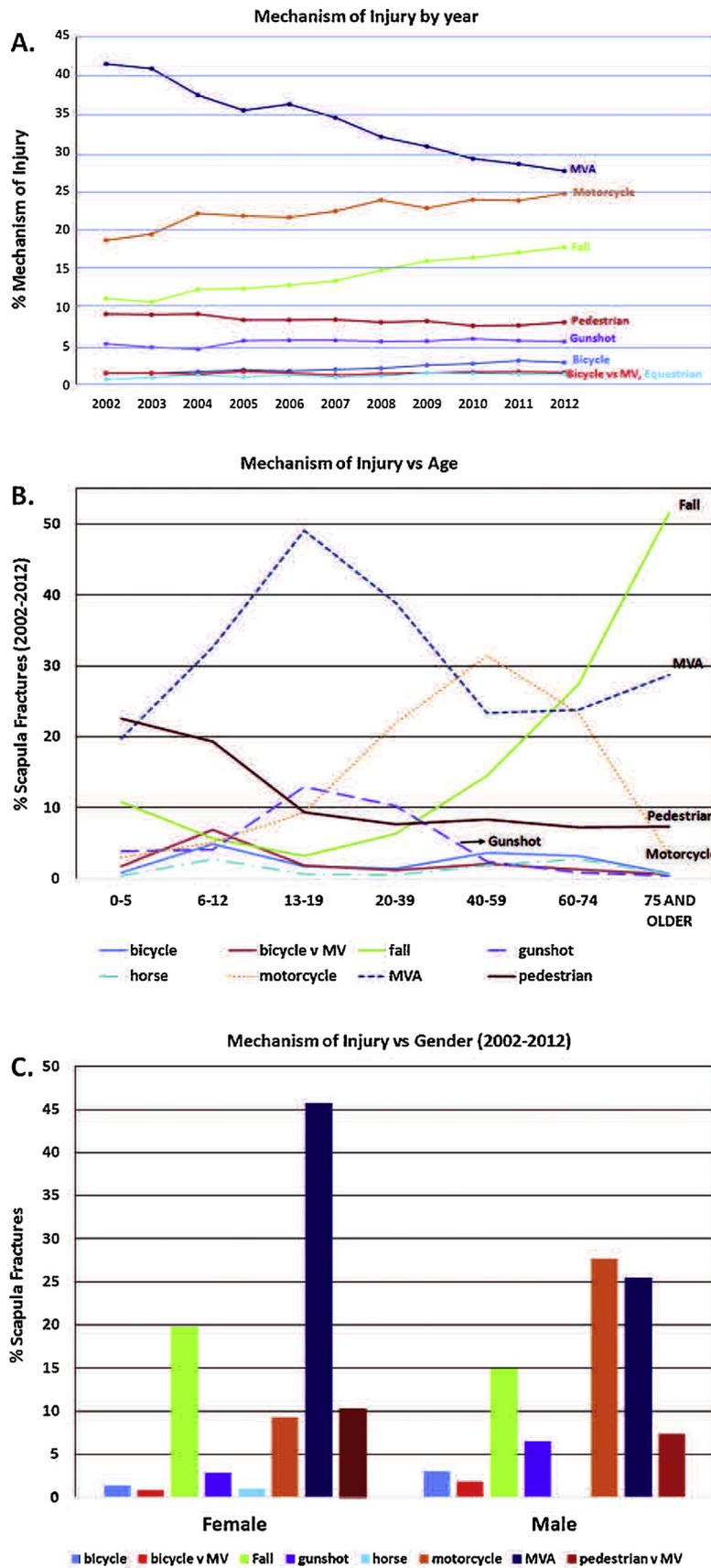


Fig. 4. A. Mechanism of injury reported by year (2002–2012). B. Mechanism of injury by age. Reported as a percentage of the total population (2002–2012). C. Mechanism of injury by gender. Reported as a percentage of the total population (2002–2012).

[6,8]. The data available in the NTDB does not allow for the determination of operative and non-operative treatment within the population of scapula fracture patients, even at trauma units who may have a proactive response to operative treatment.

The majority of scapula fractures in this study were diagnosed at University, Level 1 trauma centers. This is consistent with the high energy mechanisms generally associated with this injury. University and Level 1 centers provide referral centers for patients with poly-traumatic injuries, including thoracic injuries which occur in over 50% of scapula fracture patients [14,20] and approximately 70% in studies including only scapula fractures which meet operative criteria [8,12]. The percentages of scapula fractures in the Midwest and South regions were moderately higher than the percentage of the population in each region. The percentages of scapula fractures in the Northeast and West regions were less than the percentage of the population in each region. This may reflect the heavily urbanized societies in which the population density may affect the capacity or likelihood for high energy traumas occurring on interstate highways and outdoor recreational zones of our country, or perhaps differences in risk or recreational behavior or culture of safety.

Throughout the decade studied, scapula fractures diagnosed in the geriatric demographic in addition to the percentages of fractures resulting from falls are both on the rise. Throughout the timeline of this study, the U.S. population of those age 65 and older increased from 12% of the total population in 2002 to 13.4% in 2012 [23]. Another report from the US Census Bureau estimates in 2012, 43.1 million people age 65 and older lived in the United States [24]. It is projected that this population will almost double (to 83.7 million) by 2050 [24]. Although scapula fractures are typically associated with high impact trauma, fragility fractures are rising at an increasing rate, and scapula fractures are apparently no exception [22]. As the geriatric community continues to become a greater percentage of our population, this data suggests a greater need for diagnostic and treatment protocol of scapula fragility fractures.

The percentage of patients with scapula fractures decreased throughout the decade in both the 0–19 and 20–39 year age demographic. This decrease may represent improved auto safety measures and advent of air bag regulation across the auto industry which has become increasingly regulated nationwide. In support of this, fractures as a result of motor vehicle accidents decreased 31.7% between 2002 and 2012.

Remarkably, patients with scapula fractures were also found to have a 33% complication rate. Pulmonary complications [pneumonia (19.4%), ARDS(7%), and DVT/thrombophlebitis (5.6%)] were the three most frequent complications documented for patients with scapula fractures. However, because of the high rate of concomitant injury, it is not possible to associate the complication directly with scapula fracture, rather this could imply that scapula fracture is a marker for injury severity and morbidity from trauma. Concomitant rib fractures occur in 63.85% of patients with scapula fractures and most likely contribute to frequency of pulmonary complications.

Hospital discharge dispositions reflect an increasing percentage of patients discharged to rehab facilities. This relates to different patterns in healthcare such as primary hospital length of stay and the increase in the role of the transitional care unit but potentially, the increase in scapula fractures in the elderly demographic who tend to be more dependent upon extended care facilities after discharge. It is important to consider that these injuries are most often associated with polytrauma and therefore, discharge patterns to extended care facilities could be influenced by other fractures than scapula. However, as fracture rates in the geriatric population continue to increase, the need for a rehabilitation facility will continue to rise and scapula fractures will not likely be an exception particularly with the concomitant injury rate.

The NTDB is valuable for confirming nationwide trends in patient care and injury, however as previously noted, there are several limitations the databank and this study. Data accuracy of the NTDB cannot be verified and the reporting is voluntary. All hospitals do not contribute and it is also well known that complications are often under reported and that missing data may influence results. The NTDB requires all participating hospitals to enroll all eligible patients. However, capture rate of patients for each institution is not tracked or documented by the NTDB therefore, capture rate cannot be verified. Because the majority of hospitals are level 1, University hospitals, data is a greater representation of fractures associated with high energy trauma and may underrepresent low energy or fragility fractures. For this reason, the rate of scapula fractures in this study (1.74% of all patients submitted to the NTDB), is not directly comparable with previously published data of scapula fracture rate as a percentage of all fractures (0.5%) [22]. However, if this were true, it would only underscore the importance of the trend in the elderly population for an injury which has been historically associated with high energy, younger, male trauma. Despite these limitations, the increasing rate of total scapula fractures, scapula fractures of the geriatric population, and fracture resulting from a fall was clearly observed throughout the decade studied. It is also acknowledged that the results and observations are specific to the United States of America, and may not reflect findings in other countries, however often such NTDB studies serve as an epidemiologic marker for what could be happening in other countries, raising an awareness as to the importance of appropriate diagnosis and treatment.

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Conclusion

This study is the first to describe a full decade of scapula fracture demographics, injury mechanisms, injury severity, and hospital region/trauma level data. This is also the first study to describe the trends in geographical region and the hospital trauma/teaching level of facilities diagnosing scapula fractures. The continuous rise in diagnosed scapula fractures suggests a growing need to further advance understanding and care of these injuries. As a result of increased geriatric fracture diagnosis and fragility related fracture over time, patient care and diagnostic protocols in this population must advance. This data will be predictive and instrumental in design of future research studies, and may improve health care provider education and trauma system performance.

Disclosure

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