Acromioclavicular joint dislocations: incidence, injury profile, and patient characteristics from a prospective case series

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Background: Acromioclavicular joint (ACJ) dislocations are common but evidence regarding the epidemiology of these injuries is incomplete. This study aims to describe the incidence, injury mechanisms, distribution of classifications, risk factors, and patient characteristics for ACJ dislocations in a general population.
Methods: Inclusion was performed prospectively during a 4-year period with the following criteria; age 18-75 years, shoulder trauma within 2 weeks, a clinical suspicion of ACJ dislocation, and radiographs that excluded fracture. The injuries were classified according to the Rockwood system, and epidemiologic variables were obtained. Rockwood types 1-2 were defined as low-grade injuries and types 3-6 as high-grade. Age groups were defined with a young group (18-39 years), an intermediate group (40-59), and an old group (60-75).
Results: A total of 158 patients were included; 139 were male and the mean age was 39 years (range 18-74). There were 73 low-grade and 85 high-grade injuries. The incidence was 2.0 [95% confidence interval (CI) = 1.7-2.4] per 10,000 person-years, gradually decreasing with higher age, groupwise. The incidence rate ratio (IRR) for men vs. women was 7.6 (95% CI = 4.7-12.6) and IRR >1 was seen comparing younger age groups to older. Odds ratio calculations showed that risk factors for high-grade injury were older age and traffic accidents.
Conclusion: The incidence of ACJ dislocations was 2.0 per 10,000 person-years in a general population. Male gender and younger age group were risk factors for injury, whereas the risk for high-grade injuries were greater in older patients and after traffic accidents.

Acromioclavicular joint (ACJ) dislocations are common, representing 10% of all shoulder injuries in an urban population.[3] A direct force to the superior acromion is the most common trauma mechanism, and with increasing force the soft tissues stabilizing the joint are assumed to be disrupted sequentially in the following order: the acromioclavicular (AC) ligaments, the coracoclavicular ligaments, and the deltotrapezoidal fascia. Depending on the extent of soft tissue injury, ACJ dislocations are classified using radiographs and clinical examination into 6 different types according to Rockwood.[5,11,12]

Despite the common occurrence of ACJ dislocations, we have found only 1 previous study presenting detailed epidemiologic data and an incidence of 1.8 per 10,000 person-years.[2] It used a retrospective database search to identify participants, but no prospective study has confirmed the results. Two further studies covering the epidemiology of all shoulder girdle injuries in 2 urban populations report incidences for ACJ dislocations of 4.6 and 0.8 per 10,000 person-years, respectively.[3,10]

Although evidence from a general population is limited to the studies above, the epidemiology of ACJ dislocations in selected populations of sports participants is more thoroughly described. The injury is common in contact sports such as American football, rugby, and ice hockey.[6,8,9,13] It is also common in noncontact, high-speed sports such as skiing and cycling.[4,7]

The aim of this study was to describe the incidence, injury mechanism, patient characteristics, and classification of ACJ dislocations in a general urban population and suggest risk factors associated with this injury.

Materials and methods

Between January 2013 and December 2016, patients were prospectively included according to the following inclusion criteria: age 18-75 years, shoulder trauma within 2 weeks, a clinical

suspicion of ACJ dislocation, and initial radiographs that excluded fracture. The study was conducted in the south of Sweden at Helsingborg hospital with a catchment area that consists of 8 neighboring municipalities of mainly urban population with a total of 280,251 inhabitants on December 31, 2016. The hospital has the only orthopedic emergency department in the area, and the staff working there were continuously informed about the study. To further increase recruitment, information was given to all primary care facilities and physical therapists in the area, and they were encouraged to refer patients meeting the inclusion criteria to us.

Eligible patients were identified and routine treatment was initiated, after which the patients were referred to one of 4 different study group physiotherapists with special shoulder training. They confirmed the suspicion of ACJ dislocation, acquired written consent to participate, and ordered study radiographs where both ACJ were exposed in a nonweighted panorama view. The patients were then seen by one of the study group orthopedic surgeons, who confirmed the diagnosis and classified the injury according to Rockwood using clinical examination and radiographs (Table I). Epidemiologic data including gender, age, injury mechanism, and type of trauma were acquired. Injury mechanism was divided into direct and indirect force, and type of trauma was defined as the activity during which the injury occurred.

The patients were subdivided into 3 age groups: the young group, 18-39 years; the intermediate group, 40-59 years; and the old group, 60-75 years.[2] Type of trauma was grouped into 4 different categories: traffic accidents, sports, falls, and miscellaneous. Traffic accidents included all injuries to patients traveling in or on vehicles, both motorized and nonmotorized. Injuries during bicycle riding were divided according to the purpose of the ride between the sports and traffic accidents categories. We defined Rockwood type 1 and 2 as low-grade injuries and type 3-6 as high-grade injuries.

The population at risk was defined as the sum of persons aged 18-75 years living in the catchment area on December 31 for each of the studied years 2013-2016. The catchment area consisted of the municipalities Bjuv, Båstad, Helsingborg, Höganäs, Klippan, Åstorp, Ängelholm, and Örkelljunga. Population data were retrieved from Statistics Sweden, the government agency responsible for statistics regarding the Swedish society.

Statistics

The incidence was calculated by dividing the total number of cases by the total number of person-years at risk and presented as number of cases per 10,000 person-years. An adjusted logistic regression model was used to calculate the odds ratios for high-grade injury depending on the epidemiologic variables of gender, age group, and type of trauma. Poisson regression was used to calculate incidence rate ratios (IRR) between genders and age groups; 95% confidence intervals (CI) were used throughout.

Calculations were performed using SAS 9.4 (SAS Institute Inc., Cary, NC, USA).

Results

One hundred sixty-six patients were included and, from among them, 9 were subsequently excluded, leaving 157 patients in the study (Fig. 1). The mean age was 39 years (range 18-74), and 139 of the patients (89%) were male. For the male patients, the mean age was 35 years (range 18-74), and for female patients, it was 45 years (range 27-64).

The overall incidence was 2.0 (CI 1.7-2.4) per 10,000 person-years, gradually decreasing with higher age, groupwise (Table II). There were 21 Rockwood type 1 ACJ dislocations (13%), 51 type 2 (32%), 52 type 3 (33%), 2 type 4 (1%), and 31 type 5 (20%). In total, there were 72 low-grade (46%) and 85 high-grade injuries (54%).

ACJ dislocations were more common in the younger age groups and in males, with an IRR of 7.6 (95% CI 4.7-12.6) for men vs. women (Table III). Although more common in younger patients, the severity of the injuries increased with age, with an odds ratio for high-grade injury of 2.6 (95% CI 1.2-5.4) comparing the intermediate to the young age group, and similar trends when comparing the old age group to the intermediate, odds ratio 3.6 (95% CI 0.89-14.1) (Table IV).

The patients were most commonly injured during sporting activities or traffic accidents, with the 2 categories representing 66 (42%) and 54 (34%) of cases respectively (Table V). A direct force to the shoulder was the cause of injury in 150 of the cases (96%). Although injuries during sports were the most common, traffic accidents held the greatest risk of causing a high-grade dislocation when compared to the other types of mechanisms (Table IV).

In the young age group injuries during sports were most common, in the intermediate age group traffic accidents, and in the old age group falls (Table VI).

Discussion

This is the only prospective study that in detail describes the epidemiology of ACJ dislocations in a general population. We calculated the incidence to 2.0 per 10,000 person-years for people aged 18-75 years and found that male gender and young age were risk factors. The risk of high-grade dislocation was greater in older patients and when injured in traffic accidents.

The incidence of ACJ dislocations in a general population has been previously described in 3 studies.[2,3,10] The most recent of these, by Enger et al,[3] was prospective and aimed at presenting the profile of shoulder injuries in a general population. They divided the ACJ dislocations into 2 groups, "AC contusion/sprain/strain" and "AC separation/dislocation"; in the contusion/sprain/strain group, radiographs were normal, and in the separation/dislocation group, there was widening of the ACJ or coracoclavicular interval. These

Table I
Definition of Rockwood classification

Rockwood type	AC ligaments	CC ligaments	Deltotrapezoidal fascia	Radiographs	Clinical examination of ACJ
1	Intact or partial injury	Intact	Intact	Normal	Stable
2	Torn	Intact or partial injury	Intact	Normal or widening of ACJ and/or slight increase in CC distance	Horizontal instability
3	Torn	Torn	Lateral avulsion	25%-100% increase in CC distance	Horizontal and vertical instability
4	Torn	Torn	Dorsal injury	Increased or normal CC distance. Possibly visible on lateral or axillary view	Large horizontal instability
5	Torn	Torn	Torn	>100% increased CC distance	Horizontal and large vertical instability
6	Torn	Torn	Torn	Inferior dislocation of clavicle	High risk of neurovascular insult

AC, acromioclavicular; *CC*, coracoclavicular; *ACJ*, acromioclavicular joint.
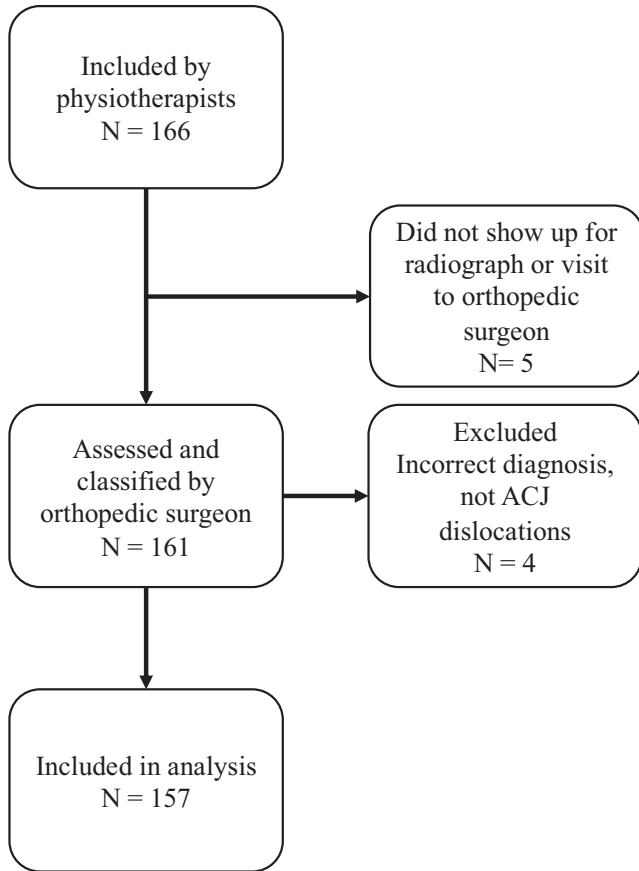
Figure 1 Flow chart describing inclusion of patients.

subgroups were similar but not identical to our low- and high-grade groups. An incidence of 4.6 per 10,000 person-years was reported, more than twice compared to our study. This high incidence appears to be explained by a large number of AC contusions/sprains/strains, 3.1 per 10,000 person-years compared to our

Table II
Overall incidence per gender and age group

Variables	Cases, n	Person-years at risk, 10³	Incidence (95% CI)
Total	157	781	2.0 (1.7, 2.4)
Injury type			
Low grade	72	781	0.92 (0.73, 1.2)
High grade	85	781	1.1 (0.88, 1.3)
Gender			
Female	18	390	0.46 (0.29, 0.73)
Male	139	391	3.6 (3.0, 4.2)
Age group			
18-39 y	82	290	2.8 (2.3, 3.5)
40-59 y	61	288	2.1 (1.6, 2.7)
60-75 y	14	203	0.69 (0.41, 1.2)
Gender and age group			
Female			
18-39 y	5	142	0.35 (0.15, 0.84)
40-59 y	10	144	0.70 (0.38, 1.3)
60-75 y	3	103	0.29 (0.09, 0.90)
Male			
18-39 y	77	147	5.2 (4.2, 6.5)
40-59 y	51	144	3.5 (2.7, 4.7)
60-75 y	11	100	1.1 (0.61, 2.0)

CI, confidence interval.
Person-years at risk is the sum of population in our catchment area. Incidence was calculated as cases per 10,000 person-years.

Table III
Incidence rate ratios (IRRs) for subgroup comparisons

Variable	Comparison	IRR (95% CI)
Gender	Male vs. female	7.6 (4.7, 12.6)
Age group, y	18-39 vs. 40-59	1.3 (0.95, 1.8)
	18-39 vs. 60-75	4.0 (2.3, 7.0)
	40-59 vs. 60-75	3.0 (1.7, 5.4)

CI, confidence interval.
Calculations using adjusted poisson regression.

results for low-grade injuries of 0.93 per 10,000 person-years. The AC contusion/sprain/strain group of Enger et al includes all Rockwood type 1 and many of the Rockwood type 2 injuries, almost identical to our low-grade group, making the large difference in incidence between our studies peculiar. The incidence of high-grade injuries differed less, 1.4 compared to 1.1. To what extent these results reflect a true difference in incidence in the 2 studied populations, possibly related to demographic factors or different sporting or traffic habits, cannot be determined. However, we believe it likely that some patients with low-grade injuries were missed in our study because of patients seeking care elsewhere or not seeking care at all. Enger et al presented data to suggest that 83%-86% of their catchment population used their department in case of upper extremity injuries. No data were available to make similar estimates regarding our geographical area.

The study by Nordqvist and Petersson presented an incidence of ACJ dislocations of 0.8 per 10,000 person-years, which is the lowest in the literature.[10] The reason for the relatively low incidence cannot be determined. However, it is possible that a different definition of ACJ dislocation, which relied on the presence of pathologic radiographic findings, was used, and this would exclude many low-grade injuries.

The only previous study aiming to investigate the epidemiology of ACJ dislocations in more detail in a general population was published by Chillemi et al.[2] The study was retrospective, and patients were included using a database search and assessment of radiographs by 2 of the authors. Despite the difference in design, their results were comparable to ours with an incidence of 1.8 per 10,000 person-years and similar ratios of low- to high-grade injuries as well as the male-to-female injury rate.

The study included 108 patients with a mean age of 37.5 (13-69) years; 51% of the injuries occurred in those between 20-39 years old, and 90% of the patients were men. It was concluded that male gender and age between 20-39 years were significant demographic risk factors for ACJ dislocations, although statistical calculations were not provided to support the latter part of this statement. We confirmed these conclusions by showing higher IRR for males vs. females and for younger age groups compared with older.

Chillemi et al[2] did not find any significant association between type of trauma or age and Rockwood classification. In our material, we found that the risk of high-grade injury increased with age, groupwise, and injuries from traffic accidents caused more severe

Table IV
Odds ratios (ORs) for high-grade ACJ dislocation

Subgroup	Comparison	OR (95% CI)
Age group, y	40-59 vs. 18-39	2.6 (1.2, 5.4)
	60-75 vs. 18-39	3.6 (0.89, 14.1)
Gender	Male vs. female	1.3 (0.43, 3.8)
Type of trauma	Traffic accident vs. fall	3.8 (1.5, 10)
	Traffic accident vs. sport	2.3 (1.1, 5.3)
	Traffic accident vs. miscellaneous	7.7 (0.74, 100)

ACJ, acromioclavicular joint; *CI*, confidence interval.
Calculations using adjusted logistic regression model including all subgroups.

Table V
Trauma mechanisms and the distribution of low-/high-grade dislocations

Type of trauma	Total, %	Low-grade injury, %	High-grade injury, %
Activities			
Total	157	72 (46)	85 (54)
Soccer	19 (12)	11 (15)	8 (9)
Martial arts	11 (7)	8 (11)	3 (4)
Skiing	9 (6)	3 (4)	6 (7)
Bicycle sport	8 (5)	4 (6)	4 (5)
Ice hockey	6 (4)	4 (6)	2 (2)
Floorball	4 (3)	2 (3)	2 (2)
Horseback riding	5 (3)	1 (1)	4 (5)
Rugby/American football	3 (2)	1 (1)	2 (2)
Parkour	1 (1)	1 (1)	0
Bicycle transport	29 (19)	5 (7)	24 (28)
Motorcycle/moped	16 (10)	5 (7)	11 (13)
Car	4 (3)	2 (3)	2 (2)
Other traffic accident	5 (3)	3 (4)	2 (2)
Falls	32 (20)	18 (25)	14 (17)
Miscellaneous	5 (3)	4 (6)	1 (1)
Type of trauma subgroups			
Sports	66 (42)	35 (49)	31 (37)
Traffic accidents	54 (34)	15 (21)	39 (46)
Falls	32 (20)	18 (25)	14 (17)
Miscellaneous	5 (3)	4 (6)	1 (1)

Values are number of cases in each group. Other traffic accidents include segway, kickbike, and longboard. Miscellaneous includes, for example, getting hit by door caught by wind and failing to stand on one's hands.

Table VI
Type of trauma per age group

Age group	Sports, %	Traffic accidents, %	Falls, %	Miscellaneous, %
18-39 (n = 82)	45 (55)	22 (27)	11 (13)	4 (5)
40-59 (n = 61)	20 (33)	25 (41)	15 (25)	1 (2)
60-75 (n = 14)	1 (7)	7 (50)	6 (43)	0

Values are total number of cases in each subgroup.

dislocations than those occurring during sports or from falls. A possible reason for these differences in results may be our subgrouping of the patients according to Rockwood classification into low-grade (type 1 and 2) and high-grade (type 3-6) injuries. This subgrouping was clinically logical, as low-grade injuries are not proper dislocations and always treated conservatively, whereas high-grade injuries represent a complete dislocation of the ACJ and surgery may be considered for certain patients.[12] Comparing subgroups increased the ability to detect relevant relationships between the different variables.

ACJ dislocations are predominantly caused by a direct trauma to the shoulder and therefore common in activities such as contact or high-speed sports and traffic situations. Chillemi et al[2] were the first to report on the distribution of the type of trauma from a general population. Similar to our study, they found sports to be the most common mechanism, but the types of sports differed somewhat between our studies, probably because of local tradition and geographical differences. For example, we had injuries from both skiing and ice hockey, whereas Chillemi et al reported cases caused by rollerblades and basketball.

In both studies, more than 1 of 5 patients were injured during bicycling, and this appears to be a particularly high-risk activity with regard to the severity of the injury. Seventy-six percent of the bicycle-related cases were high-grade injuries in our study. We also showed that the traffic accidents subgroup had a higher risk of high-grade injury, and in this group 54% of the cases were caused by cycling. Other research has also shown that ACJ dislocations are common during cycling.[4]

This study has both strengths and weaknesses. Important strengths of the study include the prospective design and well-controlled method for diagnosing and classifying the injuries. A significant weakness of the study is that the inclusion is probably incomplete, caused by patients with ACJ dislocations eligible for the study not seeking care or not being referred to our department. Supporting this is that Enger et al[3] showed a much higher incidence of low-grade injuries compared to our results and the fact that conspicuously few patients from the major elite ice hockey and soccer teams in our catchment area were included in our study. The

incidence presented should therefore be considered as the minimal true incidence. Further, patients in Sweden are allowed to seek care where they please, and the catchment area is located in a densely populated part of Sweden where commuting is common. It is therefore possible that patients from other catchment areas have chosen to seek care at our institution. We have not excluded these patients as the probability of the opposite, a patient from our area seeking care elsewhere, should be similar. We also limited our inclusion to people between 18-75 years. This was done for both practical reasons and the fact that ACJ dislocations in the skeletally immature have different pathoanatomy than in adults, and existing data indicate that the injuries are uncommon in younger people and virtually nonexistent in those older than 75 years.[1-3]

Conclusion

The incidence of ACJ dislocations was 2.0 per 10,000 person-years in a general adult population. Male gender and young age were risk factors, and most injuries occurred during sports. However, the risk of high-grade dislocations was higher in older patients and when injured in traffic accidents.

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Disclaimer

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