

# First-time anterior shoulder dislocation after snowboard accidents in amateur athletes

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## Abstract

**Aim:** The glenoid rim fractures, bony bankart lesions and/or tuberculum majus fractures that occurred due to snowboarding-related first-time shoulder dislocations may have differences specific to these athletes. Thus, we aimed to examine the characteristics of bone lesions in cases with snowboarding-related first-time shoulder dislocation.

**Materials and Methods:** The cases diagnosed with first-time shoulder dislocation and received a closed reduction in the emergency department between 2018 and 2020 were examined retrospectively. 18 patients with snowboarding-related dislocation, and 24 patients with first-time shoulder dislocation by a different injury mechanism other than winter sports injury mechanism were included in the study. Those with snowboarding-related injuries were classified as Group A and other cases were classified as Group B. Comparison was made between the two groups.

**Results:** The average age was  $27.11 \pm 6.14$  years in Group A, and  $26.17 \pm 5.44$  years in Group B ( $p:0.656$ ). There were 12 men (M) and 6 women (W) in Group A, and 16 M and 8 W in the Group B ( $p:0.999$ ). The two groups were similar in terms of Hill-Sachs lesion, tuberculum majus fracture, bony bankart lesion, and additional injury ( $p>0.05$ ). In the snowboarders, a relationship was found between the injured side and the lead foot ( $p: 0.013$ ). There was a significant difference between the injury mechanism and the presence of Hill-Sachs lesion in the snowboarders ( $p:0.033$ ).

**Conclusion:** The characteristics of bone lesions in snowboarding-related first-time shoulder dislocations may be similar to that of shoulder dislocations occurred by different mechanisms. In snowboarding, the direction of sliding may put the shoulder at a higher risk of dislocation for a particular side. For these athletes, the injury mechanism may be a factor affecting the formation of Hill-Sachs lesion.

**Keywords:** Amateur athletes; first dislocation; shoulder; snowboard

## INTRODUCTION

Snowboarding is one of the exciting and increasingly popular sports (1,2). Serious injuries are observed at a higher rate for this sport than other sports (1). About 50% of these injuries involve the upper extremity (3). With the increasing popularity of snowboarding, shoulder injuries have also been seen more frequently (2). In this sense, one of the common injuries is anterior shoulder dislocation (4).

A study suggested that skiing-related shoulder injuries might cause apparent morbidity of general upper extremity functions. Thus, it revealed the need to further address and study the prevention of skiing-related shoulder injuries (5). We think that this is important not only for skiing but also for snowboarding.

Snowboarders may specifically suffer from shoulder instability secondary to muscular imbalance around the shoulder (6). The risk factors associated with bone

structures for redislocation after a first-time shoulder dislocation include tuberculum majus fracture, bony bankart lesion, and Hill-Sachs lesion (7). Considering the fact that the snowboarder has a certain position and speed at the time of accident, the mechanism of trauma transfer to the joint may be different for snowboarding-related shoulder dislocations from other shoulder dislocation mechanisms due to the height of energy transfer to the joint, the snowboarding position of the snowboarders and/or inability to use the lower extremity fixed to the board while trying to maintain balance during the accident. Therefore, shoulder dislocation-related bone lesions may have different characteristics of snowboarding accidents. This may affect the approach to shoulder dislocations and the treatment decision for the population dealing with snowboarding.

We suggest that for snowboarding-related shoulder dislocations, the redislocation risk factors associated

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with the bone structure, such as tuberculum majus fracture, bony bankart lesion, and Hill-Sachs lesion, may have different frequencies or characteristics. In case of more severe trauma or depending on the characteristics of bone lesions, the need for anesthesia may be increased during the closed reduction of the joint. Based on this hypothesis, we compared the cases with first-time shoulder dislocation related to snowboarding with the first-time dislocation cases in the normal population. We aimed to examine whether there is a difference between the two groups.

## MATERIALS and METHODS

The records of the patients diagnosed with first-time shoulder dislocation in the emergency department between 2018 and 2020 were examined retrospectively. The files of 18 patients who were amateur athletes and had first-time shoulder dislocation related to snowboarding accidents in Sarikamis ski center between the winter seasons 2018-2019 and 2019-2020 were included in the study. The records of 24 patients who were diagnosed with first-time shoulder dislocations with a different injury mechanism than winter sports injury mechanism were also examined retrospectively. Professional snowboarders, patients over the age of 40, those with previous shoulder dislocation history, and patients under the age of 18 were not included in the study.

All the cases underwent closed shoulder reduction in the emergency department. The reduction was performed under anesthesia where closed reduction could not be achieved after a few trials. The closed reductions were performed using the Hippocratic method (8). The patients underwent neuromuscular examination following the reduction and were immobilized in a sling. The patients treated with closed reduction without anesthesia were called for outpatient clinic with the recommendation of analgesics and a 3-week immobilization in a sling. The patients treated with reduction under anesthesia were kept under observation in the hospital for 1 day, then their discharge was planned with relevant recommendations. No cases underwent open reduction.

On computerized tomography (CT) images, the depth and width of the Hill-Sachs lesions were measured using the method of Celtik et al. (9). For the cases with bony bankart, the size of glenoid rim was measured using the method of Chuang et al. On CT images (10).

The diagnosis of hypermobility was based on the Beighton and Honsan's hypermobility score of  $\geq 5$  and the positive sulcus finding in clinical examination, as in the study by Robinson et al. (11-13).

The leading extremity side in the snowboarding activity was recorded (14). For how many years the snowboarders have been snowboarding was learned. The number of seasons they have actively done snowboarding from the time they have started this sport to the day of the accident were collected and recorded as the duration of experience.

The patients' age, gender, injury mechanisms, presence and size of bony bankart, presence/depth/size of Hill-Sachs, presence of tuberculum majus fracture, whether anesthesia has been administered, and presence of hyperlaxity, additional injuries, dominant hand, dislocated side and direction of sliding for snowboarders were recorded. The cases with snowboarding-related injury were classified as Group A, and the cases with non-snowboarding related injuries were classified as Group B. The obtained data were analyzed. Statistical comparison was made between the two groups.

The normal distribution suitability of the data was tested by the Shaphiro wilk test. When comparing the digital data in 2 independent groups, the Student-t test was used for the parameters with normal distribution and the Mann Whitney U test for those without normal distribution. The ANOVA test was used to compare the parameters with normal distribution in more than two groups. The Chi-square test was used to evaluate the relationship between two independent variables at the level of categorical measurement. For the descriptive statistic, the number and % values were given for the categorical variables, and the mean  $\pm$  standard deviation values were given for the numeric variables. SPSS Windows version 24.0 package program was used for the statistical analyses, and the p-value 0.05 was considered statistically significant.

## RESULTS

The average age was  $27.11 \pm 6.14$  years in Group A, and  $26.17 \pm 5.44$  years in Group B ( $p:0.656$ ). There were 12 men (M) and 6 women (W) in Group A, and 16 M and 8 W in Group B ( $p:0.999$ ). There was a Hill-Sachs lesion in 13 cases (72.2%) in Group A and 15 cases (62.5%) in Group B ( $p:0.742$ ). There was a concomitant tuberculum majus fracture in 7 cases (38.9%) in Group A and 5 cases (20.8%) in Group B ( $p:0.302$ ). There was a bony bankart lesion in 6 cases (33.3%) in Group A and 4 cases (16.7%) in Group B ( $p:0.281$ ). There was hypermobility in 1 case (5.6%) in Group A and 2 cases (8.3%) in Group B ( $p:0.726$ ). Closed reduction under anesthesia was performed in 10 cases (55.6%) in Group A and 10 cases (41.7%) in Group B ( $p:0.533$ ). The dominant hand is the right hand in 66.7% of cases in Group A and 50% of cases in Group B (0.353). There was left shoulder dislocation in 8 cases (44.4%) in Group A and in 11 cases (45.8%) in Group B ( $p:0.929$ ). In Group A, the dislocation occurred due to hitting a tree in 3 cases (16.7%), collision with another person in 4 cases (22.2%), and falling in 11 cases (61.1%). In Group B, the dislocation occurred due to in-vehicle traffic accidents in 1 case (4.2%), non-vehicle traffic accident in 3 cases (12.5%), falling (54.2%) in 13 cases, and sport activity in 7 cases (29.2%). There was an additional hand injury in 5 cases in Group A and in 4 cases in Group B ( $p:0.385$ ). The additional injuries data were summarized in Table 1.

5 cases (27.8%) in the snowboarding group stated that the length of the arm sling immobilization after the closed reduction was long. They stated that they would return to snowboarding if the pain allows before the holiday is over

in the winter season when the accident happened. Even, 1 of them has applied to the emergency department due to distal radius fracture occurred while snowboarding in the 3<sup>rd</sup> day of the closed reduction.

**Table 1. Distribution of additional injuries by groups**

	Group A		Group B		p
	n	%	n	%	
<b>Additional injury</b>	1	5.6	0	0.0	0.311
Distal radius fracture	0	0.0	1	4.2	
Femur fracture	1	5.6	0	0.0	
Head trauma	0	0.0	1	4.2	
Clavicle fracture	3	16.7	1	4.2	
Rib fracture	0	0.0	1	4.2	
Finger fracture	13	72.2	20	83.3	
No					

The P-value was obtained with the chi-square exact test

The depth of Hill-Sachs was  $2.56 \pm 1.77$  mm in Group A and  $2.07 \pm 1.71$  mm in Group B ( $p:0.364$ ). The width of Hill-Sachs was  $3.37 \pm 0.62$  mm in Group A,  $2.2 \pm 1.86$  mm in Group B ( $p:0.245$ ). The size of bony bankart lesion was  $2.57 \pm 6.17\%$  in Group A and  $0.56 \pm 1.31\%$  in Group B ( $p:0.168$ ) (Table 2).

**Table 2. Relation between quantitative variables by groups**

Variables	Snowboard (n=18)	Normal (n=24)	p
	mean±sd	mean±sd	
Age	$27.11 \pm 6.14$	$26.17 \pm 5.44$	0.656
Hill-Sachs depth	$2.56 \pm 1.77$	$2.07 \pm 1.71$	0.364
Hill-Sachs width	$3.37 \pm 0.62$	$2.2 \pm 1.86$	0.245
Bony bankart size	$2.57 \pm 6.17$	$0.56 \pm 1.31$	0.168

SD: Standard Deviation, the p-value was obtained by the Mann Whitney U test

**Table 3. The relationship between the dominant hand and the board forefoot side in the snowboarding group**

	Dominant Side				p
	Right		LEFT		
	n	%	n	%	
<b>Front foot</b>					
Right	10	83.3	1	16.7	0.013
Left	2	16.7	5	83.3	

The P-value was obtained with the chi-square exact test

In the snowboarders, a relationship was found between the dominant extremity side and the front foot ( $p=0.013$ ). It was observed that the front foot was the right for the right-handed individuals (83.3%), and the lead foot was the left for the left-handed individuals (83.3%) (Table 3).

In the snowboarders, a relationship was found between the injured side and the front foot ( $p=0.013$ ). The injured side was right in 90% of those whose front foot is the right foot, while the injured side is left in 75% of those whose front foot was left foot. A statistical relationship was found between the dominant hand and the injured shoulder ( $p=0.321$ ) (Table 4). The average experience of the snowboarders was  $3.56 \pm 1.95$  seasons. In the snowboarders with Hill-Sachs, the rate of those injured due to falling (90.9%) was statistically higher than those suffered shoulder dislocation as a result of hitting a tree (25.0%) and collision (66.7%) ( $p=0.033$ ). No significant relationship was found between the injury mechanism and the presence of bony bankart or tuberculum majus fracture ( $p>0.05$ ). No significant difference was found between the injury mechanism and the duration of experience ( $p=0.994$ ). There was no significant relationship between the closed reduction under anesthesia and the depth/width of Hill-Sachs lesion ( $p>0.05$ ).

**Table 4. The relationship between the lead foot, dominant hand, and injured shoulder**

	Injured Side				p
	Right		Left		
	n	%	n	%	
<b>Front foot</b>					
Right	9	90.0	2	25.0	0.013
Left	1	10.0	6	75.0	
<b>Dominant side</b>					
Right	8	80.0	4	50.0	0.321
Left	2	20.0	4	50.0	

The P-value was obtained with the chi-square exact test

## DISCUSSION

Injury rates of snowboarding are almost two times higher than that of skiing (4). This is because both feet are fixed to the board while snowboarding (15). Thus, the hands and the arms take the impact force when falling on the ground (15). The common snowboarding-related shoulder injuries are rotator cuff tears, glenohumeral dislocations, acromioclavicular separation, and clavicle fractures (4). The common snowboarding-related shoulder dislocations may occur due to excess rotation and direct excessive loading of the hand while falling (3,5). This may be accompanied by proximal humerus fractures, tuberculum majus fractures, Hill-Sachs lesion, rotator cuff tear, and neurovascular damage (3). In this study, it was aimed to examine the characteristics of first-time anterior shoulder dislocations related to snowboarding, and whether they are different from first-time dislocations with other injury mechanisms. Because it will be very important to comprehensively classify the patients with first-time dislocation according to the risk of shoulder instability recurrence (16). Therefore, the optimal treatment may be recommended for a specific patient, and each patient may achieve the best treatment outcome (16). Knowledge of

the characteristics and frequency of redislocation risk factors may provide insight into the treatment decision as well as the protective measures and the specific approach to the patient.

A closed reduction immediately after the shoulder dislocation will relieve pain in athletes. Thus, muscle spasms due to delays in treatment will be avoided, and the reduction will be performed relatively easier with a reduced need for sedation (17). The closed reduction failure is rare, but in such a case, possible bone or soft tissue blocks should be considered for the reduction (17). A deeper Hill-Sachs lesion may lead to the greater surface area of the glenoid rim embedded into this pit at the time of dislocation. We previously thought that this would form block during closed reduction under anesthesia, causing higher rates of reduction. However, the results of our study did not support this. Post-traumatic pain experienced by the patient and muscle spasm may be the main factors determining the need for anesthesia during closed reduction.

Glenoid rim fractures are seen in 4-22% of first-time anterior shoulder dislocations (18). The resistance of a previously dislocated shoulder joint to redislocation may be significantly affected by the presence or lack of a glenoid rim fracture or defect (19). The rate of glenoid rim fracture was 16.7% in cases with non-snowboarding related injuries, in consistent with the literature. This rate was 33.3% in those with snowboarding-related injuries, which was higher compared to the literature. However, there was no significant difference between the two groups. Snowboarding-related accidents occur in motion at a certain speed. The energy of trauma causing shoulder dislocation may be higher than normal mechanisms. Higher energy transfer to the shoulder joint may have contributed to the higher rate of glenoid rim fracture accompanying the dislocation.

Hill-Sachs lesion occurs 54-100% of first-time anterior shoulder dislocations due to the impact of the dislocated humeral head onto the hard anterior glenoid rim of the soft posterosuperolateral bone (17,18). The presence of Hill-Sachs lesion increases the risk of recurrent dislocation (7,20). The rates of Hill-Sachs lesions in both groups in our study were consistent with the literature. The characteristics of the Hill-Sachs lesions were similar for both groups.

Winter sports-related traumatic shoulder injuries are associated with falling or collision (2). Winter sports-related injuries may be also associated with experience and injury mechanisms (14). In our study, the majority of cases had a dislocation due to falling and collision. There was no significant relationship between the experience and the injury mechanism. On the other hand, there may be a relationship between the injury mechanism and the formation of Hill-Sachs lesion. Snowboarders cannot use their legs attached to the board to maintain balance when falling. They have to use only their arms when falling, which may have contributed to the formation mechanism of Hill-Sachs.

There is a tuberculum majus-related fracture in about 15-35% of all glenohumeral fractures (21). In this study, the rate was reported as 6% for the snowboarding-related shoulder dislocations (5). The presence of a tuberculum majus related fracture is a good prognostic factor. The chance of redislocation is lower for patients with such fracture after shoulder dislocation (7,22). The rate of tuberculum majus fracture in non-snowboarding related shoulder dislocations reported in our study was consistent with the literature; however, it was observed in a higher rate in the snowboarding group. More severe trauma may result in repetitive fractures other than a ligamentous lesion (16). This may have caused by the fact that trauma is more severe in snowboarding-related accidents.

The upper extremity injuries may be associated with the fact that snowboarders tend to put their hands on the ground in the anteroposterior position when they fall (4). The athlete falls towards the front of the board when sliding forward (4). Our study found a relationship between the front foot and the injured side. This may have caused by falling in front of the board when sliding. In cases injured due to hitting a tree or collision, this may have also caused by the athlete's effort to protect himself/herself with his/her extremity in the direction of sliding.

Shoulder dislocations are mostly seen among men in the second or third decade. They usually occur during contact-sports (18). In our study, more than half of the cases were men in both groups. A study on snowboarding-related upper extremity injuries reported that the injured men had longer experience than the women (14). Our study found no relationship between experience and gender. This may be due to the inclusion of only shoulder dislocation in the study. Or, this may be due to the exclusion of amateur snowboarders who do freestyle snowboarding

Kralinger et al. evaluated the factors affecting the recurrence rate, especially after a sport activity-related primary anterior traumatic shoulder dislocation. They emphasized that younger age is a factor affecting recurrence (23). They suggested that athletes were at higher risk of redislocation than non-athletes (24). In a study, only half of the patients with recurrent shoulder dislocations, even in the high-risk group, requested surgery. The authors concluded that early surgery based on the presumption of future dislocations, unhappiness, and disability could not be justified (25). In our study, 27.8% of cases in the snowboard group have wanted to return to sports without waiting for the arm immobilization period. Perhaps, other factors than trauma causing the dislocation probably contributed to the higher rate of shoulder dislocation in the athletes. Perhaps, the athletes have wanted to return immediately to sport because they have attached great importance to their activities. Perhaps, this elevated risk in athletes was probably caused by the overweighed request against the health and the necessary measures.

The shortcomings in the study were the retrospective design, small-size of the study group, lack of data regarding the materials and protective equipment used

during the sport, lack of MRI in our hospital, lack of data on long-term follow-up, functional results and treatments administered to the patients (surgical or conservative).

## CONCLUSION

The characteristics of bone lesions in snowboarding-related first-time shoulder dislocations may be similar to that of shoulder dislocations that occurred by different mechanisms. In snowboarding, the direction of sliding may put the shoulder at a higher risk of dislocation for a particular side. For these athletes, the injury mechanism may be a factor affecting the formation of Hill-Sachs lesion.

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