Snowboard Wrist Guards–Use, Efficacy, and Design
A Systematic Review

Suezie Kim, M.D., and Steve K. Lee, M.D.

Abstract
The popularity of snowboarding has brought awareness to injuries sustained during the sport. Wrist injuries are among the most common injuries, and there is an interest in using protective equipment to prevent these injuries. The purpose of this study was to review the literature on wrist guard use, injury prevention, the biomechanical effects of wrist guards, and the various types of wrist guards commercially available for consumers. A literature search was done using MEDLINE® Ovid (1950 to January 2009), MEDLINE® PubMed® (1966 to January 2009), and EMBASE® (1980 to January 2009) for studies on snowboard injuries and wrist guards. References from the studies found were also reviewed. Two randomized controlled studies (Level I), one meta-analysis (Level II), eight prospective case control studies (Level II), one cross-sectional study, and four biomechanical-cadaveric studies were found from the literature search. Based on the review of this literature, wrist injuries are among the most common injury type, and wrist guard use may provide a protective effect in preventing them. There is no consensus as to what type or design of wrist guard is the most effective and which wrist guards are available for use by the consumer.
biomechanical effects of wrist guards, and the specific design of wrist guards.

Materials and Methods
A literature search was conducted using the computerized literature databases MEDLINE® Ovid (1950 to January 2009), MEDLINE® PubMed® (1966 to January 2009), and EMBASE (Excerpta Medica Database) (1980 to January 2009). Databases were searched using the keywords “snowboard,” “wrist injuries,” “upper extremity,” “wrist splint,” “wrist brace,” and “wrist guard.” References from the articles were also reviewed for inclusion.

After reviewing all of the articles obtained through the searches, studies were included if they involved snowboard data collection on wrist guard use, injuries sustained due to wrist guard use, evaluated injury prevention-efficacy of wrist guards in snowboarding, cadaveric, or biomechanical studies on wrist guards.

Results
Sixteen studies were found in the literature search that included information on wrist guards with the above mentioned inclusion criteria.

Prospective Randomized Controlled Trials (Level I)
Two randomized controlled trials (RCT) were found in the literature search (Table 1). Machold and associates24 conducted a study of 721 Austrian students (mean age, 15 years) who snowboarded as part of their winter sport vacation; 342 participants were randomly assigned to the protected group, and 379 were assigned to the control, or unprotected, group. The protected group wore a wrist guard that was designed specifically for the study; it was palmar in location, curved at the area of the carpus, the distal end did not exceed the proximal flexion crease of the hand, and it had an extension of the palmar support to the forearm. Injuries were classified according to the Abbreviated Injury Scale (minor: contusion or sprain, or both; moderate: nondisplaced fracture or epiphysiolysis of radius; severe: displaced fracture). The incidence of severe wrist injury was 1 of 342 snowboarders (0.0029) in the protected group and 9 of 379 snowboarders (0.023) in the unprotected group. There was a decrease in risk by a factor of 0.13 using the wrist guard (p = 0.05).

Ronning and colleagues22 studied 5029 snowboarders at the Hafjell Alpine Center in Norway. They randomized 2515 to the braced group and 2514 to the control group. The randomly assigned braced group used a D-ring wrist brace with an aluminum splint on the volar side (Smith & Nephew, Nesbru, Norway). Both groups were evaluated for an end point of wrist fracture or sprain; 29 (1.2%) of the unprotected group sustained wrist injuries, compared with 8 (0.3%) of the protected group (p = 0.001).

Meta-Analysis (Level II)
One study was found that reviewed the literature to examine the effectiveness of wrist guards in preventing wrist injuries in snowboarders (Table 2). Russell and coworkers25 found six studies that demonstrated a comparison between wrist guard snowboarders and unguarded snowboarders and the wrist injuries sustained. They concluded that based on the literature search, wrist guard use did significantly reduce the risk of wrist injury. The investigators did note that due to the various wrist guards that were used in all of the included studies, no particular wrist guard was deemed optimal to reduce the number of wrist injuries.

Prospective Case Control Studies (Level III)
Eight prospective case control studies were found in the literature search (Table 3). A case control study was performed in 20 large ski areas in Quebec, Canada by Hagel and associates.23 The case group consisted of 1066 persons, who sustained an upper extremity injury. The control group included 970 injured snowboarders, who sustained injury to a body region other than the upper extremity. The prevalence of wrist guard

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<th>Study</th>
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<tr>
<td>Machold et al.24</td>
<td>721 Austrian students, 342 protected vs 379 unprotected</td>
<td>Wrist guard prototype: palmar, curved at carpus, distal end did not exceed proximal flexion crease of hand, extension proximally to forearm</td>
<td>Abbreviated Injury Scale</td>
<td>Severe wrist injury incidence: 1 of 342 snowboarders in protected group, 9 of 379 snowboarders in unprotected group</td>
<td>- Risk decreased by factor of 0.13 with protector (p = 0.05) - Risk decreased by factor of 0.83 for each half day of accumulated experience</td>
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<tr>
<td>Ronning et al.22</td>
<td>5029 participants at Hafjell Alpine Center in Norway, 2515 protected vs 2514 unprotected</td>
<td>D-ring wrist brace (Smith &amp; Nephew, Nesbru, Norway), aluminum splint on volar side</td>
<td>Wrist sprains and fractures</td>
<td>1.2% unprotected group sustained wrist injury vs 0.3% protected group</td>
<td>Frequency of wrist injury protected vs unprotected significant (p = 0.001)</td>
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use among snowboarders with upper extremity injuries was 1.6%, compared with 3.9% in snowboarders with other injuries. There was no mention of the brand of wrist guards used by participants in the study. Upper extremity injuries included bruises, dislocations, fractures, and sprains. It was found that wrist guard use reduced hand-forearm wrist injury by 85% (95% CI, 0.05-0.45). Injuries to the elbow-shoulder were found to be increased two-fold, but were not significant (95% CI, 0.70-7.8; p = 0.17).

Upper extremity snowboard injuries were also studied by Idzikowski and colleagues13 in Colorado. The study involved 10 seasons (1998-1998) and included injured snowboarders who sought medical treatment in 47 medical facilities near Colorado ski resorts. The study consisted of 7430 snowboard injuries and 3107 non-injured snowboarders as a control group. The characteristics of the control group were obtained from the 1995 and 1996 Ski Industries of America Snowboard Survey and the 1994 Canadian Ski Council National Snowboard Survey; 5.6% of the injured group wore wrist guards (no specific brands listed). The control group did not have information related to the use of wrist guards. Wrist injuries were defined as fractures, dislocations, sprains, and contusions; 21.6% of all injuries were wrist injuries. Injured snowboarders without wrist guards were twice as likely to be seen for a wrist injury as those who wore them (p = 0.0001).

First-day injuries among skiers, snowboarders, and skiboarders in Scotland were assessed by Langran and Selvaraj.26 Injured participants at Cairngorm, Glenshee, and Nevis Range ski areas, during three winter seasons (1999-2002), who were evaluated by the ski patrol or those who presented to Aviemore Medical Practice, were included in the study; some subjects were seen by both. The data included 2124 injuries and 1782 control participants. Demographics and injury information data were obtained. Control data was collected by face-to-face interviews on a variety of days and times. In the injured population, no wrist guards were worn among the first-day participants, while 1.3% of all injured snowboarders wore them (p = 0.305). There was no mention of the specific types of wrist guards that were worn. Injuries sustained by the participants were categorized as fracture, laceration, sprain, dislocation, subluxation, or bruising. The most common injury location among snowboarders was the wrist, 33.3% among first-day participants and 21.2% among all others.

Machold and associates15 also performed a controlled case study with a similar population of Austrian students as the prospective randomized controlled trial24 mentioned in the previous section. A total of 2579 snowboarders were included in the study during one snowboard season 1996-1997; 152 injured snowboarders were evaluated. A total of 39% (999 snowboarders) wore wrist guards. There was mention of multiple gloves, with integrated wrist guards available on the market, but none were specified in association with injuries. Wrist injuries were defined as minor (sprains-contusions), moderate (fractures of the radius), and severe (displaced fractures of the radius); 32.2% of all injured snowboarders had a lower arm-wrist injury. Lack of use of wrist guards increased risk of injury by 2.78 (95% CI, 1.05-7.35; p = 0.039).

Made and Elmqvist16 conducted a 10-year study of

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<th>Study</th>
<th>Study Type</th>
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<th>Wrist Guard Design and Use</th>
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<tr>
<td>Russell et al.25</td>
<td>Meta-analysis</td>
<td>Six studies, including randomized controlled trials, cohort studies, and case control studies</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>- 77% decrease in risk of wrist injuries with wrist guard use (RR: 0.23, 95% CI, 0.13-0.41)</td>
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<tr>
<td>Kroncke et al.29</td>
<td>Cross sectional survey</td>
<td>226 snowboarders of the 333 adolescents surveyed in skate park, ski lodge, high school, and lake front in central and southeast Wisconsin</td>
<td>- 16.7% of snowboarders used wrist guards.</td>
<td>- No mention of wrist guard design</td>
<td>N/A</td>
<td>- Parents most common reason for use of any protective equipment (35%)</td>
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<td>- Rule-requirement (23%), friends (20%), sibling (5%), coach (4%), celebrity-advertisement (3%), and physician (3%)</td>
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snowboard injuries in Lapland, Sweden, at Tarnaby and Hemavan ski resorts; 568 injured snowboarders were included in the study. An injury form that included demographics, circumstances surrounding the injury, previous injuries, and snow conditions was completed by the patients and the physician. The control group was based on interviews of uninjured participants on the slopes, and the same form was used to collect data. Eleven percent of the injured snowboarders wore some kind of wrist guard (no specific brand mentioned). Wrist guard use was more prevalent in the advanced group (19%), compared with the intermediate group (10%) and the beginner group (7%). Injuries were defined as fractures, contusions, sprains, dislocations, lacerations, and other. Thirty-five percent of all snowboard injuries involved the lower arm-wrist.

Matsumoto and coworkers\(^5\) conducted a prospective comparative study of upper extremity injuries sustained between 1995-2000 and presented to Sumi Memorial Hospital, the only emergency hospital covering more than 10 skiing facilities; 6837 snowboard injuries were included in the study, compared to 3 million snowboard participants

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<th>Study</th>
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<th>Wrist Guard Use</th>
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<tr>
<td>Hagel et al.(^{23})</td>
<td>1066 injured snowboarders vs 970 control in 19 of largest ski areas in Quebec</td>
<td>- 1.6% snowboarders with upper extremity injuries wore wrist guards</td>
<td>No mention</td>
<td>26% of all injured snowboarders had a wrist injury</td>
<td>Wrist guard use reduced hand-forearm wrist injury by 85% (95% CI, 0.05-0.45)</td>
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<td>(one season)</td>
<td>- 3.9% snowboarders with other injuries wore wrist guards</td>
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<tr>
<td>Idzikowski et al.(^{13})</td>
<td>7430 snowboard injuries vs 3107 non-injured snowboarders at 47 medical facilities</td>
<td>5.6% injured snowboarders wore wrist guards</td>
<td>No mention</td>
<td>21.6% of all snowboard injuries were in the wrist</td>
<td>Injured snowboarders without wrist guards were twice as likely to be seen for a wrist injury as those who wore guards (p = 0.0001)</td>
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<td>near Colorado ski resorts (10 seasons)</td>
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<td>Langran et al.(^{26})</td>
<td>2124 snowboard injuries vs 1782 control at three ski areas in Scotland</td>
<td>- No first-day participants wore wrist guards</td>
<td>No mention</td>
<td>- 33.3% first-day participants injured wrist</td>
<td>N/A</td>
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<td></td>
<td>Cairngorm, Glenshee, Nevis Range</td>
<td>- 1.3% of all other injured snowboarders wore wrist guards</td>
<td></td>
<td>- 21.2% all other snowboarders sustained wrist injury</td>
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<tr>
<td>Machold et al.(^{15})</td>
<td>152 injured snowboarders vs 2579 controls in Austria, during winter sport week</td>
<td>39% of all snowboarders wore wrist guards</td>
<td>Mention of gloves with integrated wrist guards available on market, but not specified in association with injury</td>
<td>32.2% of all injured snowboarders had a lower arm-wrist injury</td>
<td>Lack of use of wrist guards increased risk of injury by 2.78 (95% CI, 1.05-7.35, p = 0.039)</td>
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<td>from 86 schools (one season)</td>
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<tr>
<td>Made et al.(^{16})</td>
<td>568 snowboard injuries at Tarnaby and Hemavan ski resorts, Sweden (10 seasons)</td>
<td>- 11% injured snowboarders wore wrist guards</td>
<td>No mention</td>
<td>35% of all snowboard injuries involved wrist, lower arm</td>
<td>N/A</td>
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<td></td>
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<td>- 19% advanced group vs 10% intermediate group vs 7% in beginner group wore wrist guards</td>
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in the control group (based on number of passes sold). All injured participants were asked to fill out a questionnaire, including use of protective equipment; however, there was no mention about which types of equipment were used (i.e., wrist guard, helmet, etc.). Among the participants who had upper extremity injuries, protective equipment was worn by 13%, as compared to 87% without. The most common location of snowboard injury was the upper extremity, 40%, compared with 19% in skiers (p < 0.001). When comparing all the fractures sustained by snowboarders in the upper extremity, 62% were fractures of the wrist.

O’Neill et al. conducted a prospective control trial in the White Mountains of New Hampshire. All included participants were involved in the “Learn to Snowboard” program, where rental equipment, line ticket, and a 2-hour lesson was part of the package. This study was conducted during two winter seasons (1998-2000). The total number of participants was 2355, of which 551 were in the wrist guard group, and 1804 were in the control group. All participants were offered a wrist guard (Seneca Sports Inc., Milford, Massachusetts), and those who refused were put in the control group. Wrist injuries included sprains (soft tissue swelling in the area of wrist, with pain significant enough to seek medical attention) and fractures; 2.2% of the unprotected group sustained wrist injuries, compared with 0% in the group with wrist guards (p < 0.001).

Slaney et al. did a case control study from Mount Buller Medical Center, Victoria, Australia, during one snowboard season; 119 injured snowboarders were included. The control group included the people wearing snowboard boots in the clinic as patients or as companions. Injured snowboarders with wrist fractures numbered 119 and the control group 375; 15% of snowboarders with wrist fractures wore wrist guards, whereas 20% of the control group wore wrist guards. Use of wrist guards demonstrated a 42% reduction in wrist fracture, though not statistically significant.

Cross-Sectional Survey
Kroncke and colleagues surveyed the use of protective equipment among adolescent in-line skaters, skateboarders, and snowboarders in central southeast Wisconsin, from August 2003 to March 2004. A total of 226 of the 333 surveyed were adolescent snowboarders (Table 2); 16.7% of the snowboarders stated that they used wrist guards. Participants were not asked about specific brands of wrist guards used. Parents were the most common reason for the
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<th>Study</th>
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<td>Greenwald et al.³⁰</td>
<td>Cadaveric</td>
<td>Six pairs fresh-frozen cadaveric arms</td>
<td>- Wrist guard constructed of Kleyndex (Kleerdex Corp., Mount Laurel, New Jersey), with ventral splint from metacarpophalangeal joint to mid-forearm; secured with three Velo® straps (Velo® USA Inc., Manchester, New Hampshire)</td>
<td>Drop fixture, with specimen secured to mounting stage; fixture placed over a force platform (AMTI Corp., Watertown, Massachusetts)</td>
<td>Specimen dropped at height of 40 cm onto force platform</td>
<td>- Increase in impulse applied by force platform to forearm before failure in braced group (p &lt; 0.01).- Wrist guard use may have some prophylactic effect in low energy falls but not at higher loads</td>
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<tr>
<td>Hwang et al.³¹</td>
<td>Human subject</td>
<td>30 participants, in cable-released fall testing set-up</td>
<td>Bone Shieldz (Litchfield, Illinois)</td>
<td>- Landing plate mounted on inclined wall (20° from vertical) - A force transducer measured impact and braking force</td>
<td>Subject leaned forward or backward using a control cable; on cable release, subject used both hands to stop fall onto landing plate</td>
<td>- Only significant change with wrist guard use was impact force parameter of backward fall- Wrist guards did not provide statistically significant reduction of maximum force transmission</td>
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<tr>
<td>Kim et al.³²</td>
<td>Mechanical surrogate</td>
<td>Enhanced air bag interaction arm (EAI)</td>
<td>- Generic brand guard (UltraWheels, First Team Sports Inc, Anoka, Minn) - Sorbothane glove (Ergotech Canada Inc, Ontario, Ca) - Air cell (Aircast Inc., Summit, NJ) - Air bladder (Dielectrics Industries, Chicopee, Mass)</td>
<td>Guillotine style platform with a vertical slider-drop fixture placed over a commercial force plate (Type 4600-10, Bertec, Columbus, Ohio), and forearm load cell</td>
<td>Mechanical surrogate dropped at four different heights (13, 25, 38, 51 cm) with five different conditions (bare, generic wrist guard, Sorbothane glove, air cell, air bladder)</td>
<td>- Radius fracture at 2245 N force- All padded conditions had smaller peak impact forces than the bare hand (p &lt; 0.05)- Wrist guard became ineffective at height of 51 cm</td>
</tr>
<tr>
<td>Staebler et al.³³</td>
<td>Cadaveric</td>
<td>Three pairs fresh-frozen cadaveric upper extremities</td>
<td>Guard A: Bone Shieldz (Litchfield, Illinois) Guard B: Rollerblades (Minnetonka, Minnesota)</td>
<td>Servohydraulic materials testing machine - Bone strain measured in distal radius, distal ulna, midshaft of radius</td>
<td>Load applied a volar pole scaphoid and fall contact position</td>
<td>- Dorsal distal radius strain: wrist guard A 46% less than unguarded, wrist guard B 23% less (both p &lt; 0.05)- Volar distal radius strain: wrist guard A 80% less (p &lt; 0.05), wrist guard B 30% less (not stat signi)- Dorsal midshaft strain: wrist guard A 61% less (p &lt; 0.05), wrist guard B min difference- Volar midshaft strain: wrist guard A 61% less (p &lt; 0.05), wrist guard B min difference</td>
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use of any protective equipment (35%), while other factors, such as rule-requirement (23%), friends (20%), sibling (5%), coach (4%), celebrity-advertisement (3%), and physician (3%) were also mentioned.

**Biomechanical and Cadaveric Studies**

Four biomechanical studies were found in the literature search relevant to the evaluation of wrist guards as protective apparel (Table 4). Greenland and coworkers® performed a cadaveric study with wrist guards. Twelve arms from six fresh-frozen cadavers were used. Each specimen was mounted to a drop fixture (guillotine-type track), which was positioned above a force platform (AMTI Corp., Watertown, Massachusetts). The arms were randomly assigned to a wrist guard constructed of Kydex® (Kleerdex Co. LLC, Mount Laurel, New Jersey), with a ventral splint from the metacarpophalangeal joint to the mid-forearm and strapped with three Velcro® straps (Velcro® USA, Inc., Manchester, New Hampshire). The specimen was dropped from a 40 cm height onto the force platform. The braced group had a higher impulse (change in momentum) applied by the force platform to the drop complex before failure (p < 0.01). It was noted that the greatest reduction in momentum was during the first two loading phases in the vertical force platform. This suggests that the brace was not useful in reducing momentum after a certain amount of force. The study concluded that the wrist guard used may have some prophylactic effect in low energy falls, but not at higher loads.

A biomechanical human subject study was performed by Hwang and associates.31 The experiment consisted of 30 young adults; each subject had two trials, randomized with and without wrist guards. The wrist guards used in the study were Bone Shieldz (Litchfield, Illinois). A landing pad with a force transducer was mounted on an inclined wall (20° from vertical) in front of the subject. A cable was used to hold the subject leaning 10° forward or backward and was randomly released. The subject stopped the fall with outstretched arms onto the landing pad, from which impact and braking forces were measured. It was found that wrist guard use had a significant change in only the impact force parameters of the backward fall. The investigators concluded that the wrist guards did not provide statistically significant reduction of maximum force transmission.

Kim and colleagues32 designed a biomechanical study with a mechanical surrogate. The surrogate was the forearm load cell and a commercial force plate (Type 4600-10, Bertec, Columbus, Ohio). The surrogate was mounted on a guillotine-style platform and was dropped in full extension at four different heights (13 cm, 25 cm, 38 cm, 51 cm) onto an aluminum block (ensuring palmar impact) and force plate. It has been reported that the force for fracture of the radius is 2245 N. The peak impact forces were smaller in all of the padded conditions, compared with the bare hand condition (p < 0.05). The air bladder maintained forces below the peak of 2245 N at all falling heights, while the rest of the protective devices became ineffective at various heights. The wrist guard became ineffective at a height of 51 cm. The investigators concluded that wrist guards may be effective, but may not be protective in all the various types of impacts in different sporting activities. It was criticized that common wrist guards are made of rigid splints and do not absorb and store energy sufficiently. They suggested a wrist guard design with a pneumatic spring mechanism and more padding to provide more shock absorption and increase fracture strength.

A cadaveric study was done by Staebler and coworkers33 to determine the effect of wrist guards on bone strain. Three pair of fresh-frozen cadaver upper extremities were used. Each specimen was tested unguarded and with two different wrist guards. Guard A was the Bone Shieldz wrist guard, which had a wraparound design, with the volar splint elevated off of the wrist. Guard B was the Rollerblades wrist guard (Minnetonka, Minnesota) with a slip-on design, where the volar plate was not elevated. A servohydraulic materials testing machine was used to apply load onto the specimen at the volar pole of the scaphoid and the load surface (volar angle where the guard would be in contact with the surface). Strain gauges were attached to the distal radius (both volar and dorsal), the volar radial shaft, and the dorsal distal ulna. With wrist guard A, the strain in the dorsal distal radius was 46% less than with the unguarded specimen, compared with 23% lower with wrist guard B (p < 0.05). The strain on the volar distal radius was 80% lower with wrist guard A (p < 0.05) versus 30% lower with wrist guard B (not statistically significant). Only wrist guard A showed a decreased strain in the dorsal and volar midshaft (61% and 44% respectively).

**Discussion**

The growing popularity of snowboarding as a winter sport has brought attention to the injuries that can be sustained with participation. All of the studies found in the literature recognize that wrist injury is one of the most common injuries among snowboarders. The literature search demonstrated a large number of studies that advocate the use of wrist guards to prevent lower arm-wrist injuries.

Several studies found that beginners injured their wrists more often than higher-level snowboarders. This can be explained by the fact that beginners are more likely to fall, especially during the early part of their snowboard
participation. First-day participants were noted to have a higher prevalence of wrist injuries when compared with all other snowboarders. Without proper education on how to fall, beginners will instinctively fall with their arms outstretched. This mechanism is classic for distal forearm-wrist injury. As a snowboarder becomes more advanced in the sport, he or she is less likely to fall as often and also more likely to attempt, as part of advancing their skills, acrobatic or aerial maneuvers, or both, that may put them at risk for other injuries.

Use of protective equipment for the wrist is a method for prevention of injury. The most compelling evidence is found in the two randomized control trials that studied the protective effect of wrist guards. Both demonstrated a statistically significant reduction in wrist guard injury in the guarded group, compared with the unguarded.

Our search found numerous studies that looked at the effect of wrist guards; however, there was no consensus on which particular type of wrist guard would be most effective. The majority of the studies that we reviewed did not mention a brand name or a description of the type of wrist guard that was used by participants. Given the wide array of wrist guards on the market, it is important to know the type and material of a wrist guard when trying to study the effectiveness of a product.

There were also several studies that looked at the biomechanical aspect of wrist guards. Each study used a different setup to simulate a fall and measure the force on the lower arm. Live human subjects, cadavers, and an EAI arm were used to measure the forces occurring with falls. The simulation of falls can only be generalized, because it is very difficult to imitate the environmental factors seen on a snow covered mountain, and the precise orientation of the forearm-wrist when a subject falls. There were also various wrist guards—materials used in all these studies, with no mention of the availability of these products to the consumer.

The evidence of the protective effects of wrist guards will not be effective in preventing injuries unless snowboarding participants use them during sport activity. Many of the studies found low usage of wrist guards by participants. Some issues to consider are the aesthetics of the wrist guards, social acceptance, fit of the wrist guard, and availability.

There is also concern for injuries sustained due to the wrist guard itself. Cheng and associates did a case report on “splint top” fractures sustained by rollerbladers wearing wrist guards. All cases had fractures seen near the proximal border of the wrist splints. There were no studies found in our literature search about cases with fractures due to snowboard wrist guards.

**Conclusion**

This study provided multiple literature findings that support the high prevalence of wrist injuries in the snowboard population, as well as the protective effect of wrist guard use. It is important to understand that these studies did not provide a consensus on the effectiveness of any one particular wrist guard type. Further research is required to determine the degree of effectiveness of wrist guards that are currently available to consumers.

**Disclosure Statement**

None of the authors have a financial or proprietary interest in the subject matter or materials discussed, including, but not limited to, employment, consultancies, stock ownership, honoraria, and paid expert testimony.

**References**