Snowboarding

82

Tobias Baumgart and Christian Ehrnthaller

82.1 Characteristics of the Sport

Snowboarding developed in the late 1960s and was influenced by surfing and skateboarding. Initially, two bundled skis were used to glide through the snow. Developed by Sherman Poppen, an American engineer, as a gift for his daughter, the first so-called "snurfer" was born. The constant development and takeover of technology from the ski sector led in the beginning 1980s to the foundation of the first commercial snowboard companies. The first snowboard competition was organized in 1981 and in 1983 for the first time world championships were held in California. The first World Cup took place in 1985 in Zürs, Austria, and gradually developed into a professional competition scene. With the admission as an Olympic discipline in Nagano 1998 snowboarding (halfpipe and giant slalom) was firmly established in winter sports. At the Olympic Games in Sochi 2014 snowboarding competitions were held in five disciplines. In addition to halfpipe, snowboardcross and parallel giant slalom, there was also a premiere of competitions in parallel slalom and slopestyle.

Basically, snowboarding consists of three different disciplines alpine, snowboardcross and freestyle. This leads to different demands on the respective athletes. In the field of alpine snowboarding, strength, high-speed strength, and strength-endurance are required in addition to coordinative skills. The ability to handle high angular-acceleration and radial-accelerations is of particular importance here. In the field of snowboardcross, another factor is the confrontation and competition man against man. In addition to the important physical conditions like strength, size, and weight, the ability to anticipate is of great importance here. Freestyle is characterized by high demands in terms of body coordination and high-speed strength. But also the fast anticipation and the three-dimensional spatial orientation are of the utmost importance.

82.2 Physiological and Biomechanical Demands on Athletes

Due to the dynamic requirements and biomechanical characteristics, special demands are placed on the body of the athletes. Several studies have already investigated the anthropometric characteristics among professional snowboarders. A slightly higher weight is found with a relatively

T. Baumgart (✉)
Department of Knee, Hip and Shoulder Surgery, Schoen Clinic Munich Harlaching, Munich, Germany

C. Ehrnthaller
Department of General, Trauma and Reconstructive Surgery, University Hospital, LMU, Munich, Germany

W. Krutsch et al. (eds.), *Injury and Health Risk Management in Sports*,
https://doi.org/10.1007/978-3-662-60752-7_82

low body fat percentage and consequently a pronounced muscle mass. These are crucial factors and have a direct influence on the kinetic energy and the dynamic frictional force. Using snowboards with a short side cut radius, the carving technique is easy to learn and makes it possible for all skill levels to undergo the attraction of radial acceleration and high g-forces. A resulting narrow curve radius and small sliding section leads to high physical loads. Muscular strength and power is a prerequisite for success in professional snowboarding. Research has shown that the athletes have excellent values in the area of lower limb strength. However, core strength is also important to cope with the high forces encountered during turning. During snowboarding as well as during skiing in the swing phase, similar muscle groups are activated. These include, in particular, the tibialis anterior, gastrocnemius medialis, vastus lateralis, rectus femoris, and gluteus maximus. The intensity of activation differs only slightly in the calf muscles. This is due to the asymmetrical body position to the riding direction and equipment-specific reasons with softer boots and bindings in case of snowboarding. Overall, the data show that sufficiently trained quadriceps muscles are needed to handle g-force and to avoid possible injury.

82.3 Epidemiology of Injuries

In 2010, there were an estimated 8.2 million snowboarding in the USA. In Germany at the moment, there are about 2.2 million active snowboarders.

According to a major Swiss insurance company, snowboarding represents the most dangerous sport after soccer and ice hockey. Overall, the risk of getting injured was estimated to be about twice as high as for skiing, as snowboarders represented almost half of the patients in the emergency departments but only a quarter of all participants on the slope. Recent studies were able to document an almost equal incidence of injuries between snowboarding and skiing probably due to the increasing incidence of free-skiing injuries. Approximately 40–59% of all injuries occur in snowboard beginners with 13–23% of injuries occurring on the first day of snowboarding.

In recreational snowboarding, the typical injured snowboarder is male and between the age of 15 and 29. Already in 1985, a higher rate of wrist and ankle injuries compared to skiing were demonstrated. In 2010, a case-control study was published by analyzing snowboard- compared to skiing-injuries over 18 years of time. In the group of injured snowboarders, injuries of the wrist, ankle, and shoulder were more frequent, while most of the injuries in skiers were seen in the knee joint. But the injury pattern in snowboarding also changed during the decades: the number of sprains of the medial collateral knee ligament and ankle injuries decreased, while incidence of fractures of the clavicle increased. The overall most frequent type of injury in snowboarding was an injury to the wrist.

Fewer is known about the incidence of injuries in professional snowboarding. It seems that competitive snowboarders are conflicted with fewer wrist but more knee and back injuries. While the number of injuries decreases during a competitive career towards World Cup Level, the injury severity increases with a higher number of multiple injuries and injuries of the trunk. During competition, the final runs seem to have the highest risk of getting injured. The type of discipline in snowboarding has a high impact on injury incidence and expected injury distribution. The injury incidence is relatively low for speed disciplines while athletes in disciplines with jumps and body contact such as snowboardcross, halfpipe, and slopestyle are more likely to get injured.

Regarding injury distribution, alpine snowboarding mostly results in injuries to the wrist because of the impact of the finger/hand onto the pole or the gate panels as well as ankle injuries, possibly due to excessive over-movements to the ankle while the foot being firmly fixed to the board. Overall, injury severity is the lowest in alpine snowboarding (Fig. 82.1).

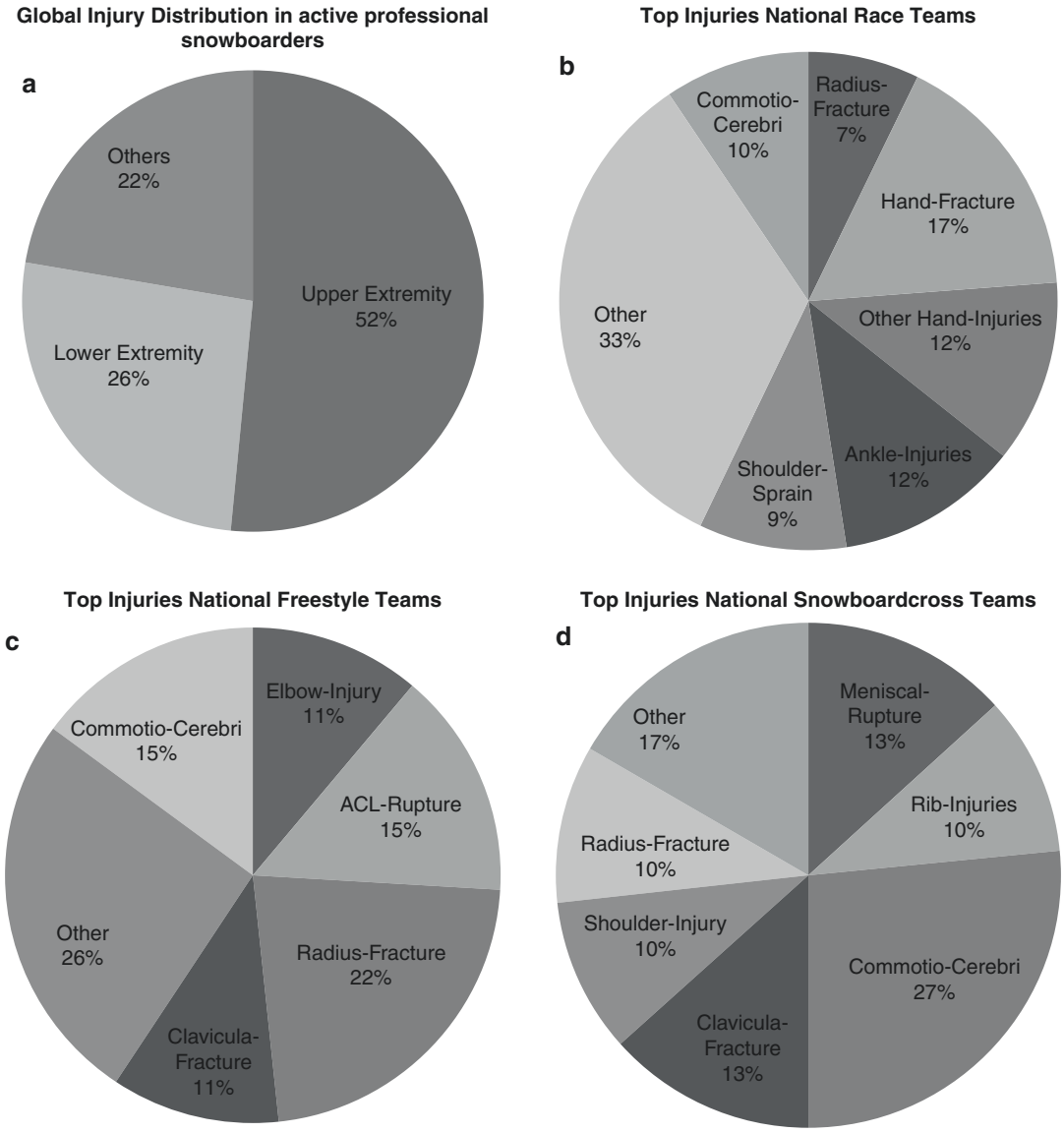

Fig. 82.1 Diagrams of the injury distribution of the 2012/2013 German-speaking national snowboard teams in percent. Notes: (**a**) global injury distribution of all disciplines; (**b**–**d**) predominant injuries regarding the different snowboarding disciplines, in percent. *ACL*: anterior cruciate ligament

Freestyle athletes mostly exhibit injuries to the wrist and knee joint after falling. While injuries to the wrist mostly happen by direct impact on the upper extremity while attempting to prevent a fall, knee joint injuries may also happen while landing on a flat bottom instead of the transition area after a jump in the halfpipe or slopestyle course.

The most variability and severity of injuries is seen in the group of snowboardcross athletes. Most injuries occur to the head and shoulder, but injuries of the trunk and knee joint are also frequent. This reflects the character of the discipline with four riders competing against each other over jumps and obstacles, creating more accidents due to collision and body contact than in other disciplines.

82.4 Specific Rehab and Return to Sport

Rehabilitation program largely depends on the injury pattern and the specific discipline of the athlete. In speed disciplines with predominant injuries to the upper extremity, after an acute healing phase, splinting may provide enough stability and pain relief to return to competitive snowboarding even early after the accident. Injuries to the lower extremity are more momentous and usually need a longer rehabilitation period. After an initial, diagnose-specific medical treatment, rehabilitation should focus on the restoration of the discipline-specific needs. Besides restoration of joint function and muscle strength, proprioceptive and coordinative training is of special importance, as snowboarding has a high demand of coordinative ability and should therefore be focused in the rehabilitation process. As snowboardcross and freestyle athletes suffer from more severe injuries, return to sport usually takes longer compared to speed disciplines.

82.5 Specific Aspects in Different Subpopulations

82.5.1 Alpine

Alpine snowboarding currently consists of the disciplines parallel giant slalom (PGS) and parallel slalom (PSL). Special requirements for this discipline are strength and high-speed strength as repetitive turns follow each other very quickly, often less under a second. The already mentioned asymmetrical body position, left or right foot in front, can lead to different force distribution in the lower extremities. Current data show that in parts of alpine snowboarding it is important to prevent the development of strength asymmetry in the legs and an associated increased risk of injury. One of the biggest challenge for the snowboarder is to maintain balance, under dynamic, ever-changing conditions while accelerating and gaining speed whenever possible. Training priorities should be set in the following fields:

- Improvement through integrative mental training and improvement of motor, proprioceptive and coordinative skills, agility and balance. Here are also new training methods used, e.g., Life Kinetic.
- Training of high-speed strength. Torso-stabilizing training to withstand the g-forces during the turn phase and to maintain a centered body position to effectively apply pressure to the edge of the board.

82.5.2 Snowboardcross

In snowboardcross, four athletes usually compete against each other in a course consisting of various obstacles, such as banks and berms, rollers, kickers, and jumps. The challenge is the confrontation man against man. In addition to the athletic ability, excellent fitness and the perfect control over the snowboard even in the most demanding situations are crucial, as well as fast perception and anticipating of the strategy of the opponents. A pronounced sense of balance is important when athletes possibly touch each other during a race. Already at the start, the competition is often decided by the responsiveness and the high-speed strength of the individual athletes. This is where specific integrative training strategies come into play. The focus should be on improving reactive, cognitive, and coordinative abilities.

82.5.3 Freestyle

Freestyle snowboarding is divided into the categories halfpipe, big air, and slopestyle.

A halfpipe is a sloped stretched hollow with half elliptical formed side walls. The length differs between 150 and 170 m. A normal competition run takes up to 30 s and the rider executes approximately 5–8 jumps where tricks are performed. The big air is a single straight kicker-jump, over which a single trick is performed. Hereby, a high air stand is achieved and during the flight phase complex tricks are performed. The slopestyle course consists of several consecutive obstacles, such as kicker-jumps, rails, boxes, hip

and corner jumps. There are currently no regimental specifications for course construction.

All of the freestyle sub-disciplines are skill disciplines and are characterized by high demands in terms of body coordination and high-speed strength. But also the fast anticipation and the three-dimensional spatial orientation are of the utmost importance. There are high demands on the anaerobic ability during the runs. Because of the high centrifugal forces and impact forces that occur in these disciplines, the knee joints and especially ankle joints perform movements close to the possible physical capabilities. The meanwhile considerable size of the jumps has a major influence on the athlete body impact loads. Therefore, especially specific torso-stabilizing training and training of endurance and force perseverance are advised.

82.6 Prevention Strategies

Prevention of injuries can be either influenced by optimization of external factors decreasing the likelihood of an accident and secondly by reducing the impact on the athlete when falling.

Improvement of competition courses by optimal shaping of the kicker-jumps and halfpipes can greatly decrease the risk of getting injured and therefore reduce injuries in freestyle and snowboardcross. In speed disciplines, improvement of external factors is mainly limited to the best possible preparation of the slope and current snow conditions.

Personal protection gear can greatly reduce injury incidence in snowboarding. Especially wrist guards are known to provide a great protective benefit, which could be demonstrated in several studies. However, only about 16–53% of active snowboarders are using wrist guards due to discomfort while riding, with the percentage being even lower in professional athletes. Even development of wrist guards included in gloves did not increase the acceptance rates.

The protective effect and use of helmets is largely accepted throughout the collective of snowboard athletes especially since helmets are required for participation in competitions. Several studies showed that helmets are capable of reducing the severity of head injuries, making them the most important protective gear with a recommended use in all snowboard athletes.

82.7 Equipment and Protection Considerations

Both the hardware (boots and bindings) and the additional protection equipment can significantly influence the potential risk of injury.

With regard to the aforementioned injury pattern, the helmet has the greatest benefit in terms of injury and health risk management. In Europe, helmets are certified according to the "TÜV EN 1077" standard. This standard is subdivided into A and B Category. "A" helmets are high performance safety helmet for alpine skiers and snowboarders used by professionals and in competitions. Category B helmets are designed for recreational use. Snowboard helmets are currently very widespread and are worn by almost every rider.

Various other protective equipment, such as spine protectors, paddings on exposed areas (hip and elbow), and knee braces, are worn potentially having a protective effect and reducing the risk while snowboarding. Currently there is no data which has proven their protective effect yet.

The use of back protectors has become very common and athletes expect to be protected of severe spine injuries by using them. They are also increasingly used in recreational snowboarding. However, until now, no definite data exist about a protective effect in snowboarding. This might be due to the fact that most injuries to the spine happen by axial compression forces, while the effect of back protectors is limited to a direct impact to the spine.

For professional snowboarding and skiing, combinations of spine protectors and airbag systems were developed, which are partially used. Those are especially protecting the neck area from hyperextension forces. Furthermore, in the alpine disciplines, protectors on the lower extremities are used in the competition scene to prevent injuries caused by the gate poles. Particularly in

the disciplines of freestyle and snowboardcross, high forces appear after large jumps that have to be compensated by the body of the athlete. It has been shown that the physical characteristics of boots and bindings absorb a significant portion of the forces involved, thus minimizing the risk of injury. Over the years, a trend has been seen towards stiffer boots and bindings. Also proper clothing is very important in both professional and recreational snowboarding. It protects against environmental influences, such as cold temperatures, wind, snowfall, and moisture.

82.8 Other Health Aspects and Diseases

Acute, mainly internal diseases can lead to a loss of performance. An interruption of the training or even a longer timeout of competitions can be the result. There is certain evidence that especially excessive cardiovascular training temporarily leads to a loss of white blood cell immune function. This results in a transiently weakened immune system that in particular increases the probability for infections. Therefore, a healthy and strong immune system is an important factor in minimizing injury and health risks. The immune system must resist infections even under serious physiological and mental stress. A healthy lifestyle with sufficient rest periods, regular sleeping phases, and healthy nutrition represent the basic requirements.

Certain circumstances in professional winter sport may increase the athletes' susceptibility to infection. The combination of intensive training and cold dry air significantly increases the likelihood for upper respiratory infections. In addition, if the bronchial response to this type of breathing air is particularly sensitive, this can lead to a disease called bronchial hyperresponsiveness (BHR). Furthermore, exercise-induced asthma (EIA) plays an important role among winter sport athletes. Both have a significantly higher prevalence among professional athletes than in the normal population. Recent studies show that 40 up to 60% of all acute cases of athlete disease during competitions affect the respiratory tract. In descending likelihood other affected body parts are: the digestive system, skin and underlying tissue as well as the urogenital system.

Asthma with its various pathophysiological reasons is the most common chronic disease reported in the Olympics. Supportive treatment with bronchodilators should be used to relieve bronchial constriction if existing. Another problem of cold air at higher altitudes is the low humidity. The body of the athlete must moisten the air with every breath. In addition to transpiration, a relevant amount of body fluid is lost through the humidification process while breathing. Sufficient hydration, especially at high altitudes is highly recommended. Another point is that the cold environment can increase the risk of hypothermia, thus increasing the risk for internal diseases such as influenza and broncho-pulmonary infections. In addition, thirst is physiologically reduced under these conditions, making controlled regular oral fluid intake essentially.

82.9 Match Rules with Medical Importance

In the competitive part of snowboarding, there are exact guidelines regarding possible medical and pharmacological therapies. Anyone involved, athlete, trainer, doctor, or physiotherapist must ensure that specific treatment is not banned before using it. These standards are created by the World Anti-Doping Agency (WADA). In addition, each country has a national anti-doping agency. Access to this information is easy. If necessary, it can be reviewed in e.g., multimedia apps used on smartphones and tablets.

82.10 Fact Box

– During snowboarding, speed, turn radius, and centrifugal force determine the resulting forces on the athlete's body. Those have to be primarily withstand by legs and torso. Thus, extremely high demands are placed on the strength, endurance, and springiness of the athletes.

- Besides concussion, injuries to the hand and wrist are most common in snowboarding, followed by ankle injuries.
- The highest injury severity is seen in snowboardcross and decreases towards freestyle and alpine disciplines.
- Wrist guards could greatly reduce injury incidence but lack acceptance and helmets are the most important personal safety equipment.

Recommended References

1. Ehrnthaller C, Kusche H, Gebhard F (2015) Differences in injury distribution in professional and recreational snowboarding. Open Access J Sports Med 6:109–119. https://doi.org/10.2147/OAJSM.S78861
2. Vernillo G, Pisoni C, Thiébat G (2018) Physiological and physical profile of snowboarding: a preliminary review. Front Physiol 9:770. https://doi.org/10.3389/fphys.2018.00770
3. Hébert-Losier K, Holmberg HC (2013) What are the exercise-based injury prevention recommendations for recreational alpine skiing and snowboarding? A systematic review. Sports Med 43:355–366. https://doi.org/10.1007/s40279-013-0032-2
4. Carlsen KH, Anderson SD, Bjermer L, Bonini S, Brusasco V, Canonica W et al (2008) Exercise-induced asthma, respiratory and allergic disorders in elite athletes: epidemiology, mechanisms and diagnosis: part I of the report from the joint task force of the European Respiratory Society (ERS) and the European Academy of Allergy and Clinical Immunology (EAACI) in cooperation with GA²LEN. Allergy 63:387–403. https://doi.org/10.1111/j.1398-9995.2008.01662
5. Helmig K, Treme G, Richter D (2018) Management of injuries in snowboarders: rehabilitation and return to activity. Open Access J Sports Med 9:221–231. https://doi.org/10.2147/OAJSM.S146716