Chapter 77

Snowboarding

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77.1 History

Sherman Poppen invented in 1963 the "snurfer", a snow surfer, which was a water ski with a curved up shovel and a line for steering. At that time, nobody had ever expected to ride high alpine territories with tilts of more than 50°. Meanwhile, even Mount Everest has been snowboarded. The Americans Jake Burton, Tom Sims and Dimtrij Milovich were snowboard pioneers in the US. The brothers Strunk with the swing bow and the freestyle skier Fuzzy Garhammer constructed the European "snow surfer".

Since the mid-1980s, this sport has experienced an enormous booming in America and in Europe. The boards have become controllable with the invention of steel edges, coatings and high-back binding systems. Snowboarding has developed into a trend sport for young winter athletes. Snowboarding has become an **Olympic** discipline in 1998 in Nagano with the two disciplines of half pipe and GS carving. At the Olympic Games in Turin in 2006, the snowboard cross (SBX) was introduced. Meanwhile, there are 10 million snowboarders worldwide. Snowboarding moves away from competitive stress towards free riding, just as in any other fun sports. The best snowboarding experience is the riding through deep powder snow and the jumping over hilltops into the soft snow (➢ Fig. 77.1).

Fig. 77.1 Perfect freeride (freerider: Gerry Ring/location: Val Grisenche).

The majority of snowboarders now favor riding in free territories and in deep powder snow as well as in fun parks (trend: "Off piste – out to the country side or fun park!").

77.2 Sport-specific strain/demand profile

Snowboarding requires a permanent change from front-side to backside, which puts a strain on the extensor and flexor of the lower extremity. This is different to skiing, where the balance can be spread on both legs and, thus, riding is energy saving (Knöringer et al. 1998). Each snowboard discipline uses different foot positions with different angles to the longitudinal axis of the board. This allows a better spread of the body weight, especially in freestyle and free-riding, which have different positions as alpine race disciplines.

The permanent change from front-side to backside requires fitness, coordination and a good sense of balance.

77.3 Epidemiology of injuries

The risk behavior of juvenile snowboarders matches the age. The major **risk group** is found

in juvenile male snowboarders at the age of 13–19 years (Kemeny 1989, Dann et al. 1996 and 1997, Made and Elmqvist 2004, Xiang et al. 2005). Thus, the injury risk for 16-year-olds is 9 times higher than for 25-year-old athletes (Dann et al. 1996 and 1997). They mainly ride in soft boots on freestyle boards and prefer the **half pipe** as favorite territory. The light snowboard helmets now commercially available is urgently recommended for beginners (Hagel et al. 1999, Tilburg 2000, Made and Elmqvist 2004).

In contrast, the injury risk of girls increases significantly after the age of 25. But beginners with rented equipment and ski boots – that are completely inappropriate for snowboarding – are at a risk of injury (Boldrino and Furian 1999).

77.3.1 Accident mechanisms

The **fall** is in 90% of the cases **self-induced**. Collisions only occur rarely (9.8%) and the majority are collisions with fixed objects. Collisions with skiers and with snowboarders are rare (Dann et al. 1997).

Most falls occur forwards (40.5%), followed by falls to the side (27.2%) and backwards (18.2%). Forward falls over the board shovel lead to injuries:

- of the upper extremities (39%)
- of the lower extremities (30%)
- of the spine as well as the head (11%) and
- of the thorax (9%).

77.3.2 Snowboard injuries in course of time

Lower extremities

At the beginning of snowboarding, many injuries were triggered by insufficient training and defective materials. Since improved materials, in particular binding and shoes, injury risk has decreased. Previous studies reported up to 55% of the injuries of the lower extremities, especially in the **region of ankle joints, lower legs and knee joints** (Pino and Colville 1989, Berghold and Seidl 1992, Campbell et al. 1992/1003, Janes and Fincken 1993, Shealy 1993, Zollinger et al. 1994, Oberthaler et al. 1995, Wambacher et al. 1995, Dann et al. 1997). The development of appropriate **snowboard boots** and tear-proof binding inserts has led to a reduction of injuries of the lower extremities.

This reduced the injury risk of lower extremities from 41.6% in 1988 (Wambacher et al. 1995) to 19.3% in 2004 (Wambacher et al. 2001,

Fig. 77.2 Soft slip-in system (company: K2, type cinch).

Made and Elmqvist 2004, Xiang et al. 2005). Nevertheless, knee injuries (9.2%) have been related to **hard boots** (Wambacher et al. 2001). These boots are worn nearly exclusively in alpine racing sport. About 95% of the snowboarders wear soft boots either combined with ratchet bindings or step or slip-in bindings, respectively (➢ Fig. 77.2 a and b).

Upper extremities

Injuries of **arms and shoulders** have clearly increased. The most frequent injuries are **injuries near the wrist** (36%), they constitute up to 53% of all serious injuries especially in beginners (Ferrara et al. 1999, Idzikowski et al. 2000, Machold et al. 1999 and 2002, O'Neill and McGlone 1999, Sacco and Sartorelli 1998, Shorter et al. 1999, Xiang et al. 2005).

A prospective randomized trial with 5,029 snowboarders in Norway demonstrated that **wrist protectors** in snowboard gloves reduce the injury risk at the wrist significantly (Ronning et al. 2001). Their usefulness was proven in an independent study (Staebler et al. 1999); the use of these extensor-and flexor-sided protectors had similar beneficial effects (Machold et al. 2002, O'Neill 2003, Made and Elmqvist 2004, Matsumoto et al. 2004). Industry has reacted and started production of adapted **gloves** (➢ Fig. 72.3; Dann et al. 2002).

Fig. 77.3 Wristguards (company: Ziener GmbH).

Torso and spine injuries

Japanese studies show that beginners of snowboarding show significantly more spinal injuries with and without impairment of the spinal cord or even **paraplegia** (Seino et al. 2001, Yamakawa et al. 2001). This is different to beginners of skiing. There have been reports of **serious craniocerebral injuries** even with **fatal** cases (Naguchi et al. 1999).

Interestingly, Genital injuries in Japanese female snowboarding beginners had developed by **falls on the buttocks and collisions** with the high-backs of the posterior soft binding (Kanai 2001).

In summary, these studies show that serious injuries mainly affect beginners, which is explained by lack of **training and experience**. Serious spinal injuries and cases of death occur typically in high-alpine territories, where falls over rocks, steep areas and avalanche accidents have led to polytraumas with lethal consequences (Gabl et al. 1991, Tarazi et al. 1999).

Two thirds to three quarters of all injuries are close to the wrist and can be prevented with extensor and flexor wrist protectors. Back protectors and snowboard helmets are urgently recommended for beginners, but also for advanced snowboarders.

77.3.3 Chronic injuries

35% of the examined snowboarders complained about permanent conditions in snowboarding. The **knee joint** had been affected with 34.2%, followed by the shoulder joint with 14.5% and the upper ankle joint with 9.4%. The lumbar spine as well as fingers and wrist had been next (Dann et al. 1997). Furthermore, many snowboarders reported **shoe pressure problems** (Kristen and Dann 1996).

77.4 Snowboard competition disciplines and their injury patterns

The following snowboard competition disciplines are distinguished:

- alpine competition disciplines with
  - parallel slalom (PS)
  - giant slalom also as a parallel competition (PGS)
- freestyle competitions with super, half and quarter pipe (snowboarding in artificially constructed obstacles, similar to skateboarding)
- straight jump or big airs (BA): jump disciplines, in which width (up to 40 m) and altitude of the jump (15 m) and performance are rated
- Snowboard cross (SBX) as latest competitive discipline – a fused competition of alpine and freestyle elements. After the joint start, several boarders ride through an artificially constructed course
- Free riding as most original snowboard discipline (riding in unprepared territories, surfing in deep powder snow); this is also performed as tour snowboarding or backcountry snowboarding with climbing supports such as snow shoes, short skis and split boards.
- Extreme free riding: a fully autonomous scene and competitive risk discipline of snowboarding sport is the snowboarding of extremely steep slopes with tilts of more than 50°.

77.4.1 Alpine disciplines

The alpine disciplines (racing, parallel slalom and parallel giant slalom) lost their appeal within the last 5 years, although GS carving has been chosen as an Olympic discipline in Nagano. Triangular gates adapted for snowboarding are passed similar to ski giant slalom. Symmetrical, stiff racing boards and hardboards are used for this (➢ Fig. 77.4). There are only few injury surveys of professional top snowboarders.

In a study of former ISF professionals (International Snowboard Federation; Kristen and Dann 1996, Dann et al. 2002), the **most common serious injuries** are:

- lower extremities in up to 39%
- upper extremities in 26%
- spine in 23% and
- cranium in 10%.

Fig. 77.4 Alpine racing: perfect carving technique (Gerry Ring/photograph: private).

The most frequent localizations of serious injuries have been the **shoulder** with 12%, the **knee** with 11% and the **cervical spine** with 11%. The injuries of **hands and fingers** caused by contacts to the gates poles account for 37%, shoulder and knee joints for 36% or 33%, respectively, and ankle joints for 28% of injuries in professional snowboarders (Schrank et al 1999). Four in 1,000 injuries have been recorded in competitive runs (Torjussen and Bahr 2005); dorsal, knee as well as forearm and wrist injuries were mostly affected.

77.4.2 Freestyle

The freestyle disciplines in the **classic half pipes** refer to a trend, which is very popular amongst young people. Freestyle is a game with the own body, in which **individuality, creativity and style** are expressed. It has become an Olympic discipline; individual runs are evaluated by difficulty level, performance and overall impression in competition by an independent jury.

Snow parks with half pipes are meanwhile widespread in many skiing areas. **Insufficient techniques** and **self-overestimation** often lead to serious falls and injuries.

Half-pipe snowboarding has 8.6% higher injury risk than piste snowboarding (Dann et al. 1996).

Previously, loss rates of 18% per season in men and 11% in women had been typical even in professional snowboarders (Dann et al. 1996).

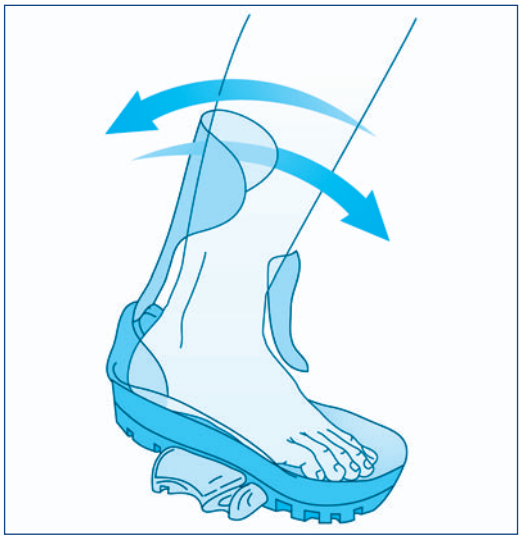

Fig. 77.5 Soft step-in system, injury mechanism of snowboarder's ankle.

Serious injuries of the **lower extremities** and **knee joint** occurred in 19.4% (primarily internal ligament and internal meniscus lesions). In recent years, **cruciate ligament injuries** increased. 10 m jumps are possible over the half-pipe edge. Landing in the flat part of the pipe presses the lower leg being into an "anterior drawer" (quadriceps tension in dorsal position and stiff high backs of the soft bindings), which ruptures **the anterior cruciate ligament**. **Tibial plateau fractures** with complex ligament injuries have also been observed.

The most frequent injury at the ankle joint of the freestylers is the **fibular ligament rupture** (50%), followed by 14% of external ankle fractures with and without involvement of the internal ankles and 7% each of midfoot and talus fractures.

Especially the fracture of the processus lateralis tali, described for the first time in 1996 as **"snowboarder's ankle"** is often ignored and affects 15% of all ankle joint injuries (Bladin and McCrory 1996, Kirkpatrick et al. 1998, Boldrino and Furian 1999, Estes et al. 1999, Platz and Sommer 2000). This injury mainly occurs at the anterior ankle in dorsal extension and hyperpronation if **landing** with soft boots (➢ Fig. 77.5; Kirkpatrick et al. 1998, Boldrino and Furian 1999, Estes et al. 1999, Platz and Sommer 2000). This injury is often misinterpreted and treated as fibular ligament lesion. It can be visualized by **tangential radiographs X-ray**, tomography or CT (➢ Fig. 77.6 a and b).

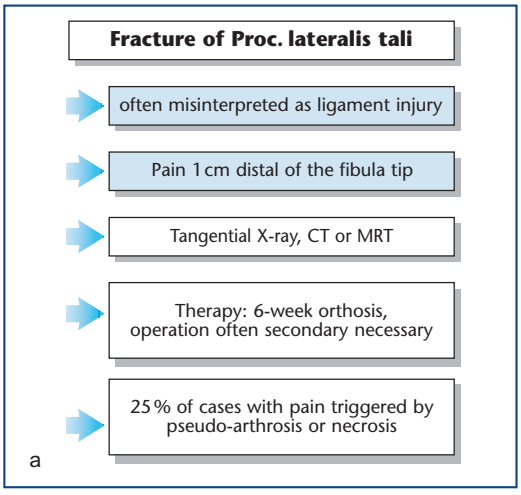

Fig. 77.6 Snowboarder's ankle (photograph: Dann).

77.4.3 Snowboard cross

Snowboard cross is a very popular and spectacular type of competition. It has been introduced to the tour program of the ISF and has also been accepted as competition by the FIS.

The snowboard cross presents a fusion of race disciplines and freestyle. Obstacles, such as rollers (ground waves), kickers (jump ramps), banks (heightened curves) and the boarders conquer corner jumps in a certain period of time. Typically, four participants mostly attempt to run the course together. The two fastest of the four are promoted to the next run. **Collisions** and **falls** often occur due to the **high velocities**, **far jumps** and difficult obstacles (➢ Fig. 77.7).

Serious **incisions** have been reported at first competitions. The loss rate amounted to 25% in men in the first season of the ISF pro tour.

The ISF has introduced **full-body protectors** (protection of back and extremities) and **helmets** in 1998/1999. This reduced the loss rate to 7% for men and to 5% for women in the following season.

Since 1999/2000, only snow **boards** with **rounded** tails and noses are allowed. **Distinct border-cross boards** have been produced and bindings and boots have been adapted to the demands of this discipline. Snowboard cross requires **good stability in boot and binding** for pick-hard courses and **flexibility of boots** to secure landing without jamming. 95% of all snowboard crossers ride on such strengthened soft boots with **step or slip-in bindings** with high-backs (spoilers) and firm toe abutments (➢ Fig. 77.2 a and b).

Medical consulting 2003 snowboard world cup in Murau

15 physicians had been present at the snowboarding world cup in Murau/Styria in 2003. 17 serious or moderate injuries resulted from a very inhomogeneous starter field with 350 athletes from 39 nations.

The world cup disciplines were alpine, parallel and parallel giant slalom, freestyle half pipe and big air and snowboard cross. The degree of injuries at this event had been significantly higher than at events of the former (International Snowboard Federation; Dann et al. 1996, Schrank et al. 1999).

Numerous ligament injuries at the knee and shoulder joints, complex fractures at the arms, numerous lacerations and incisions, cerebral concussions, and internal injuries had been treated and diagnosed.

Most injuries had appeared in the freestyle disciplines of half pipe, snowboard cross and big air, while the classic alpine competitions of parallel slalom and parallel giant slalom had only few injuries. For that reason, the Society of Orthopedic Traumatologic Sports Medicine (GOTS) suggested an improved safety for the athletes in cooperation with the snowboarding coordinator of the FIS.

Fig. 77.7 Snowboard cross (photograph: ISF).

Injury prophylaxis in snowboard competitions:

- helmets and back protectors (mandatory for alpine and freestyle competitions)
- additional full-body protectors for SBX
- rounding of the boards with protective caps at top and rear for SBX
- harmonization of athletes' levels
- separated difficulty degrees of men and women
- technical improvements of the half pipes and jumps with diverse fall and security precautions
- The attending physician may withdraw an injured athlete from competition against the will of the responsible trainer.

77.4.4 Extreme snowboarding

Media and industry encourage young and recreational athletes to imitate spectacular rides.

Extreme snowboarding rides over steep cliffs and requires an optimally exercised fitness level of highly experienced professional alpine athletes, combined with an exact knowledge of the territory. Weeklong documentation and observation of downhill runs and planned jumps allow exercising this sport. **Full-body protectors** consisting of protection vests and pants with synthetic plates are passive protections. **Protectors of the extremities** are also used. Basic **avalanche equipment** is mandatory and the backpack also serves as an additional back protection (Knöringer 2000).

77.5 New materials

Soft boots with step or slip-in bindings improved the strength transmission to the board and displaced hard boots almost entirely. The lock mechanism resembles clipless bicycle pedals.

The advantage of these systems is the convenient opening/closing of the binding and better strength transmission. They are suitable as **all-terrain solution**, especially for snowboarding in free, difficult territories with deep or compact snow and hard pistes. The classical **ratchet bindings** is still used and very popular with the hardcore boarders and freestylers.

Fig. 77.8 Basic equipment for freeriding (freerider: Gerry Ring).

The **boards** tend to become longer. Experienced snowboarders in free territories and in deep powder snow ride 2 m and longer boards. The **"swallow tails"** are used for powder boards.

Riding in free territories requires **basic freeride equipment**, endurance and skills. The basic equipment consists of the board and binding system mentioned above and also of avalanche beacon, probe, shovel and emergency equipment with first-aid kit and bivouac sack (➢ Fig. 77.8).

Summary

Since the Olympic Games in Nagano in 1998 snowboarding has turned from a trend sport to a winter sport of young people. More than 50 % of all serious injuries are fractures near the wrist. Wrist splints integrated into the snowboarder's glove can reduce this injury to a quarter. The

torso and extremity protector systems are of value for the alpine, freestyle, and snowboard-cross competitions. Young people now accept the helmets and they make sense in competition – especially in freeriding – and for children and teenagers. Beginners on rented equipment with inappropriate skiing boots are at highest risk of injuries. Injury risk is nearly similar to skiing. The injury risk of beginners is clearly higher.

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