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PREVENTING SPORTS INJURIES

Kathrin Steffen, Grethe Myklebust & Tonje Wåle Flørenes

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PREVENTING SPORTS INJURIES

Kathrin Steffen

Kathrin Steffen, PhD, is a researcher at the Oslo Sports Trauma Research Center. Besides her studies in Norway, she has a Master degree from The German Sports University (Diplom Sportwissenschaft) where she additionally has taken up-grading courses in Therapeutical Training and Physiotherapy. Her primary research field is sports injury prevention, with focus on female youth football and ACL research. Kathrin serves also as a research assistant at the Department of Medical & Scientific Activities in the International Olympic Committee (IOC). She is the assistant editor for the IOC journal British Journal of Sports Medicine Injury Prevention and Health Protection and involved in other IOC driven research projects.

Grethe Myklebust

Grethe Myklebust PT, PhD is an ass. professor at the Oslo Sports Trauma Research Center. She is also authorized as Specialist in Sports Physiotherapy by the Norwegian Physiotherapy Federation and as Sports Medicine Physical Therapist (Idrettsfysioterapeut FFI) by the Norwegian Society of Sports Physiotherapy. Grethe has served as team PT for the female national teams in team handball, soccer and the national teams in beach volleyball for twenty years.

Tonje Wåle Flørenes

Tonje Wåle Flørenes, MD, PhD was educated at the University of Lund in the south of Sweden. Tonje has been a team doctor for the Norwegian women football team 2007-08, and was one of the doctors in the Norwegian Olympic team during the Olympic Games in Beijing 2008, Vancouver 2010 and London 2012. She is now working at the department of Physical Medicine and Rehabilitation at Haukeland University Hospital in Bergen, Norway

SUMMARY

This text on injury prevention introduces you to the current evidence on injury prevention methods and training programs aimed at reducing the most common and severe types of acute injuries. The information presented is useful for athletes, coaches, medical personnel and everybody who is interested in learning more about injuries and injury prevention in sport. We will review the main mechanisms and risk factors for acute injuries, and you will find examples of prevention programs and exercises that can reduce the incidence of injuries by as much as 50%. In addition, we will show you how to identify athletes at risk. The application of this knowledge will reduce the burden of sports injuries.

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TAKE HOME MESSAGES:

- The exercise programs discussed and illustrated in this text should form a regular part of all physical education and training programs for all kinds of sports.
- Remember that all those involved in sport have a responsibility to promote a healthy sports environment.
- Adjust the programs to suit your specific sport and make them a part of normal training.
- Make the exercises fun and challenging to motivate athletes to continue this important training.
- Keeping athletes physically fit and injury-free will increase the number of high-quality training sessions and thereby improve performance for both the individual athletes and the whole team.

ACTIVE LIFESTYLES: BENEFITS AND RISKS

The physical activity guidelines of the American College of Sports Medicine recommend that adults do 20–30 minutes of vigorous exercise at least five days a week for optimum functional capacity and health. The numerous health benefits of physical activity have been well documented and include an overall reduced risk of premature mortality and, in particular, reduced risk of coronary heart disease, hypertension, colon cancer, obesity and diabetes mellitus. The motives for choosing an active lifestyle vary and may include pleasure and wellbeing, competitiveness, social interaction, and a desire to maintain or improve physical condition and health.

Participation in sport involves risk of acute and overuse injuries and, although rare, permanent disability or death. In Norway, 40–60% of all injuries in handball, football, and skiing/snowboarding – the most popular sports – occur in female athletes. Some types of injury are of particular concern, either because they are severe, such as head and knee injuries, or are common, such as ankle sprain and hamstring strain injuries. Consequently, injuries represent a considerable problem for the athlete, the athlete's team and, given the popularity of sport, for society at large.

In many cases, injuries result in a long-term absence from sports, but they may also result in an increased risk of early osteoarthritis, for example, after serious ankle and knee sprains – a sequel that cannot be prevented with current treatment methods. This is a particular concern for our female athletes in football, handball and basketball, whose rate of severe knee sprains is about four times higher than that of their male counterparts. In skiing, too, knee injuries are the most common type of injury. Nevertheless, many reports indicate that the health benefits of regular physical activity exceed the risks associated with injuries, even for elite athletes. Thus, to maximise the health benefits for athletes and to minimise the direct and indirect costs associated with injuries, early identification of sports and athletes with high injury risk is a significant goal. Providing athletes with tools to prevent sports injuries is also vital. However, we should keep in mind that injuries will always be – at least to a certain extent – a risk associated with sports participation.

Major acute injuries are often the focus in sport; however, the burden of overuse injuries and reduced athletic performance through persistent pain and limited function should not escape attention. Although the knowledge and understanding of overuse injuries lags behind that of acute injuries, overuse injuries obviously place a serious burden on an athlete, not only in terms of lost sports time.

Everyone involved in protecting the health of athletes – coaches, medical personnel, referees, sports governing bodies and the athletes themselves – can benefit from the information in this chapter. Our discussion will focus on female athletes, although most of the prevention strategies can be used by male athletes as well.

HOW TO INVESTIGATE AND MANAGE INJURY PREVENTION IN SPORT

We need research to help us develop effective tools to prevent injuries in our athletes. To reach this important goal, van Mechelen and co-workers described a four-step process in the early 1990s (Figure 1). First, the magnitude of the sports injury problem needs to be identified and described. Therefore, a systematic surveillance program to monitor injury trends over time is an important tool. Next, risk factors and injury mechanisms that play a

critical role in the occurrence of injuries require identification. The third step in the model is to introduce measures that are likely to reduce the future risk and/or severity of sports injuries. Finally, the effect of the preventive measures must be evaluated by repeating the first step (i.e. surveillance).

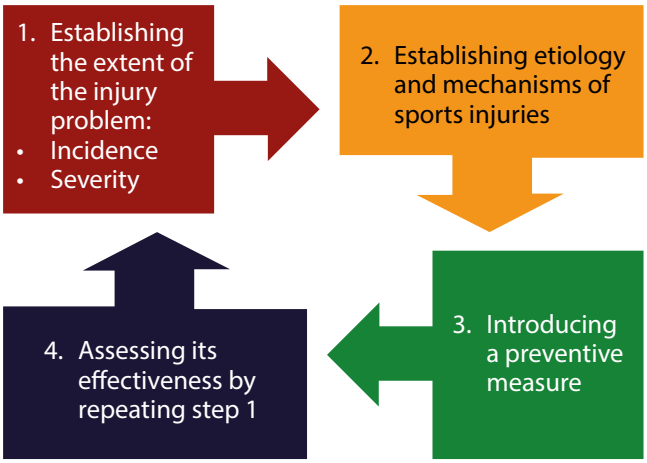


Figure 1. The 'sequence of prevention' of sports injuries. This four-step process was developed by van Mechelen et al. (1990). (Reproduced by kind permission of W. van Mechelen)

In 2006, Finch suggested an important addition to this model: the need for a planned implementation to ensure the preventive methods are readily adopted and used by athletes, coaches and sporting bodies. It is also crucial that governing bodies understand their responsibility in the prevention of sports injuries.

As outlined above, understanding the epidemiology of a particular injury (i.e. describing the origin and development of the injury) is the first step in formulating effective prevention strategies. Consequently, describing the specific occurrence and severity of common injuries in various sports is an important first step: we must know and understand the causes of injuries. Therefore, we have to look at all the factors involved, which includes obtaining information on why a particular athlete might be at risk in a given situation (i.e. the risk factors) and how the injury happens (i.e. the injury mechanisms).

Models have been developed to account for all of the factors that contribute to internal and external risk factors. Internal risk factors include an athlete's age, sex and body composition; external factors are those that affect the athlete from the external environment, for example, floor friction in handball, an uneven grassy surface in football and running on hard asphalt or with bad shoes (Figure 2). Nevertheless, the internal and external risk factors alone are rarely sufficient to cause injuries. However, the combination of, and the interaction between, these factors contributes to making the athlete *vulnerable* to injury. Then, a final inciting event is the link in the injury chain. Comprehensive models of this process have been developed, which include biomechanical perspectives and the characteristics of the sport in question. The effect of repeated sports participation has now been incorporated into these models, producing a complex and multi-factorial milieu for understanding why the injuries occur.

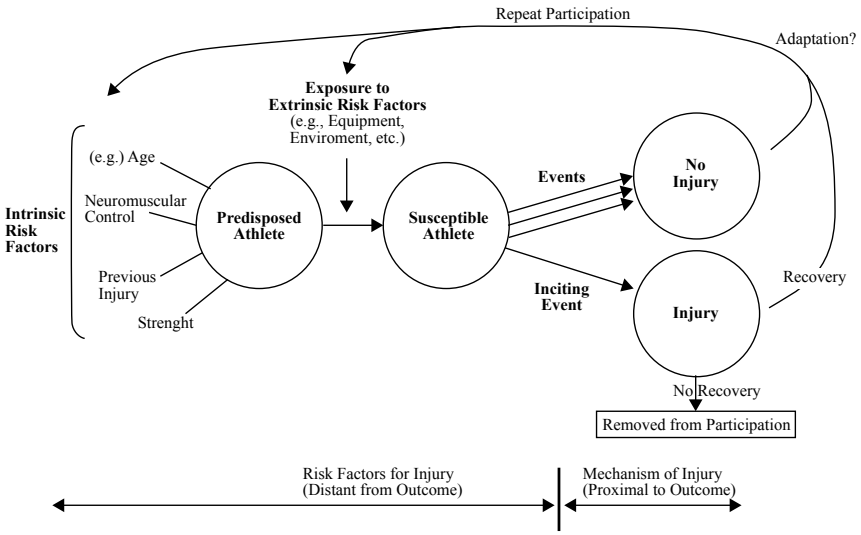


Figure 2. A dynamic, recursive model of the aetiology of sports injuries. (Reproduced by kind permission of W. Meeuwisse)

We will now briefly review the main risk factors and mechanisms for acute injuries of the ankle, knee, hamstring, groin and shoulder, as well as the evidence supporting the various strategies to prevent these injuries. Readers will initially be introduced to the importance of proper warm-up programs, and guidance will be presented on how to identify athletes at high risk of knee injuries. For a more in-depth and comprehensive description of preventive options for specific athletic injuries, please consult the *Sports injury prevention handbook*, published as part of the International Olympic Committee's series of handbooks on sports medicine and science. Furthermore, the Skadefri (Injury free) website (www.skadefri.no) provides you with interactive programs, including videos and detailed descriptions of preventive exercise programs for typical sports injuries in a variety of sports such as handball, football, skiing and snowboarding. All the programs and illustrations presented in this text can be found on this website (Figure 3), the written instructions are all in Norwegian but for the reader of this English text you can still grasp most of the content while watching the exercises.

Figure 3. The website Skadefri! The website is hosted by the Oslo Sports Trauma Research Center (www.skadefri.no).

INJURY PREVENTION

Approaches that have been proven successful in reducing injuries include (1) using specific exercise programs, (2) adopting the rules of play, and (3) using specific equipment developed to reduce the risk of injury. Here we will focus on exercise programs and training. The specific benefits of preventive exercise training on the risk of lower limb injuries have been documented in several trials. There is conclusive evidence that neuromuscular training[1] consisting of strength, balance and jumping exercises assists in the reduction of ligament injuries of the ankle and knee, and that eccentric[2] strength training can prevent muscular strains of the hamstrings and groin.

Effective prevention of sports injuries also requires successful implementation of efficacious interventions. This, in turn, requires knowledge about the implementation context, including how people, their attitudes and their safety (or risk) behaviours interact with these interventions. In other words, true injury prevention can only be achieved if some form of behavioural change occurs in all those involved with an athlete's safety and health (e.g. the athlete, coach, parents and referee). Therefore, one of the major goals should be to establish sound habits for injury prevention early in life.

Various sports may have widely different injury spectrums, different causes of and risk factors for injuries and, especially, different training traditions and requirements for performance. Nevertheless, a few general measures can be applied in many sports for both female and male athletes. However, as strategies for injury prevention naturally differ between sports, providing a complete description of all measures for all sports is beyond the scope of this chapter. Therefore, we describe the *principles* of prevention here, using examples mainly from handball and football of the most common types of injuries.

General measures to prevent injuries (warm-up programs)

A variety of injury-specific and sport-specific preventive exercise programs exist. Typically, such programs consist of exercises focusing on core stability, balance, dynamic stabilisation and muscle strength. These exercises are often designed as structured warm-up programs to ensure that all players are exposed to the preventive effects on a regular basis. Studies from various sports generally show that proper warm-up on a regular basis can reduce the risk of injury by 30–50%.

The '11+' program of the International Federation of Association Football (FIFA) is a good example of a multifaceted preventive program that includes core stability, balance, strength and running exercises. The exercises emphasise neuromuscular control, as well as hip control and knee alignment to avoid excessive knee valgus (collapsing or buckling inwards of the knee; see Figure 12 during both static and dynamic movements (Figure 4). The program is divided into three parts: part I begins with running exercises; part II involves six exercises with three levels of increasing difficulty to improve strength, balance, muscle control and core stability; part III concludes the program with further running exercises. The staged levels of difficulty increase the program's effectiveness and allow coaches and players to individually adapt the program to their needs. The 11+ takes about 20 minutes and replaces the usual warm-up before training. Before playing a match, players are advised to perform about 10 minutes of the running exercises only.

1 *Neuromuscular training* involves specific exercises to improve the control of muscle movements that stabilise the body and joints.

2 During an *eccentric* muscle contraction, the muscle lengthens as it resists an external force.

The 11+ program was primarily developed to reduce lower limb injuries in youth and amateur football. However, similar multifaceted warm-up programs exist for other sports such as floorball and handball, and the same concept can be applied to other sports settings as well.

Figure 4. The 11+ exercise program developed by the International Federation of Association Football (FIFA). The program is designed to prevent injury in youth football. You can access the program on http://f-marc.com/11plus/11plus/

For junior handball players, there is a similarly structured 20-minute warm-up program that focuses on neuromuscular control to avoid knee valgus, and on improving lower limb strength and technique (two-footed landings, cut and plant with a narrow stance). This program has been shown to reduce ankle and knee injuries by 50%. Visit the program on www.skadefri.no.

Preventing knee injuries

Injury characteristics

Serious injuries to the knee ligaments, such as injuries to the collateral or cruciate ligaments, are typical injuries for female athletes playing sports that require pivoting movements: handball, football, basketball and floorball, for example. In these sports, the prevalence of anterior cruciate ligament (ACL) injuries is about four times higher in women than in men. Elite alpine and freestyle skiing and snowboarding are activities also associated with a high risk of serious knee injuries. Typical injuries to the knee are ligament tears of the collateral and cruciate ligaments. These injuries may be associated with meniscal[3] tears or cartilage and bone damage of varying severity and, thereby, are associated with an increased risk of early osteoarthritis (degeneration causing pain and loss of function) in the knee joint. The majority of athletes who sustain an ACL injury will develop osteoarthritis within 15–20 years, regardless of treatment.

3 The menisci (singular = meniscus) are two crescent-shaped pieces of cartilage attached to the upper surface of the tibia (shin bone) in the knee joint. They disperse the load on the joint and reduce friction. Menisci are often injured when the knee is subjected to pivoting movements.

Risk factors

As for most other types of injury, recent studies have suggested that a history of knee injury is a risk factor for a subsequent injury. However, the reasons for the gender gap in the risk of ACL injury are not completely clear. Various researchers have suggested differences in anatomy and hormonal and neuromuscular function as potential reasons for the higher injury risk in women than in men. To date, however, there is little evidence linking all these potential internal risk factors to noncontact ACL injuries, and a great deal of controversy exists on the relative importance of the different factors.

The most commonly advanced external risk factor is the effect of friction between shoes and the playing surface. Investigations in Australian Rules football, European football and handball suggest that high shoe–surface friction is associated with an increased risk of injuries to the knee ligaments; for example, high friction results in the foot stopping abruptly when the athlete plants or suddenly changes direction (cutting). This can cause the knee to twist suddenly at foot strike and, in the worst case, collapse into knee valgus.

Mechanisms

ACL injuries are commonly noncontact in nature and often occur during plant and cut manoeuvres or during landings. Despite their noncontact character, however, the associated movement patterns in many cases involve perturbation by an opponent (e.g. body contact prior to occurrence of the injury). The mechanisms for noncontact ACL injuries are widely debated. What seems clear from several studies of skiing and various team sports is that anatomical knee valgus (knees turned inwards, 'knock knees', 'kissing knees') is an important factor in many cases, which implies that avoiding valgus knee motion is important for preventing injuries (Figure 5).

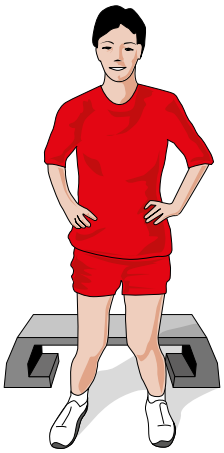


Figure 5. Knee valgus. In this condition, commonly called 'knock knees', the knees turn inwards, causing the legs to bow.

Studies from 2010 and 2011 used sophisticated video analysis to examine ACL injuries in team sports, alpine skiing and snowboarding. Although the exact mechanisms for injury may differ in the various sports, knee valgus was implicated in almost all of these injuries.

Prevention

A growing number of injury prevention programs have been developed to reduce the risk of ligamentous knee injuries in general, and ACL injuries in particular. The successful prevention programs attempt to alter the quality of the movement in the lower leg to increase core and lower limb stability and to raise awareness of the knee position in relation to the foot.

An essential part of the programs is to emphasise the 'hip-knee-toe-in-line position' in all types of exercises, both balance and strength exercises. The primary goal of this strategy is to maintain posture and lower limb balance in an attempt to correct knee positioning as far as possible (Figure 6).

The balance exercises are normally done on a balance board or on an unstable balance pad, with the knees and hips slightly flexed. Ball or partner exercises may also be included to make the training more challenging and fun. While proper hip and knee control is always emphasised, the exercises for balance, jumping and landing can be adjusted to suit all sports that are characterised by cutting and landing movements. These exercises can also be incorporated into a warm-up program. Though this program seems to focus on balance, strength elements are also included, such as two-leg and one-leg squats. Always remember: correct hip-knee-toe control.

During an initial training period of at least 5 weeks, the exercises should be done a minimum of three times per week, training for 10–15 minutes per session. Maintenance training once or twice a week continues throughout the competitive season.

Figure 6. A program to prevent injury of the anterior cruciate ligaments (ACL). Visit www.skadefri.no to access the program.

As described earlier, multifaceted warm-up programs all include balance and jumping exercises. These programs focus on strength, balance, coordination, jumping and agility training. As known from injury statistics in many sports, it is vital to avoid high-risk positions for the knee joint. Hence, athletes should be taught to land on both feet, because two-leg landings reduce the forces affecting each knee and thereby reduce the loading on the knee joints. In addition, studies of the mechanisms of knee injuries have shown that landing with flexed knees and hips helps avoid knee valgus by better absorbing the landing forces.

Several well-designed studies on football and handball showed that programs incorporating one or more exercise components to modify dynamic control of the lower limbs resulted in

remarkable reductions in the risk of ACL injuries and other injuries of the lower extremities. Balance training alone, and homed-based training without instruction and feedback on proper movement techniques (e.g. lower limb alignment, two-leg landings) is probably ineffective unless it is combined with other types of exercises for core and lower-limb strength, perturbation and jumping, with a focus on correct knee control.

Evidence from research on recreational alpine skiers shows that an educational program to increase awareness of high-risk situations and of how to appropriately modify behaviour can prevent ACL injuries. Although currently we do not have any prevention programs for skiers, we could reasonably assume that conditioning programs similar to those described for team sports would also work for these skiers.

Preventing ankle injuries

Injury characteristics

The most common ankle injury in sport is ankle sprain, with 9 of 10 injuries involving the lateral ligaments. This injury is the predominant type in many sports, and in both sexes. Although athletes with ankle sprains are usually back in training within a week, some serious sprains may result in longer absences. Nevertheless, since ankle sprains are so common in many sports, they account for a substantial part of the total injury picture. In female youth football, for instance, up to 40% of all injuries are ankle sprains; in volleyball, they account for up to 50% of all reported injuries. Therefore, from a public health perspective, treating ankle sprains constitutes a large part of the medical costs due to sports injuries.

Risk factors

The only well-documented, and probably by far the strongest, risk factor for an ankle sprain is a previous sprain within the past 12 months. Studies on various groups of athletes found that the risk of injury to a lateral ankle ligament was two to five times higher after suffering a prior ankle injury. There is strong evidence that an ankle sprain negatively affects neuromuscular control. As a result, a previously injured ankle is exposed to an increased risk of re-injury. However, there is conflicting evidence about the impact of other internal risk factors.

Mechanisms

Common mechanisms of ankle sprains are tackling, running or landing on uneven ground or on the foot of another player. Two specific injury mechanisms are reported in football: (1) player-to-player contact with impact by an opponent on the medial aspect of the leg just before, or at, foot strike. This laterally directed force causes the player to land with the ankle in a vulnerable position; and (2) forced plantar flexion when the injured player hits the opponent's foot while attempting to shoot or clear the ball. In volleyball, ankle sprains typically occur at the net and result from contact between teammates or opponents.

Prevention

Athletes with a history of ankle sprains, specifically those with sprain injuries during the preceding 6–12 months, represent a group that should be targeted for prevention. Ankle control is critical to keep the ankle in a safe, 'neutral' position, an ability that is often impaired after injury. External support (bracing, taping) has been shown to reduce the risk of re-injury in athletes with a history of ankle sprains, but not in athletes without any previous history. However, the most important measure is training to re-establish balance and strengthen the muscles protecting the ankle. Exercises on balance boards or mats have been shown to reduce the risk of ankle sprains by as much as 50%. However, equipment is not necessary

to improve balance. Standing on one leg with a straight knee and moving the other leg from side to side, or just standing on one leg while brushing your teeth or writing text messages, is effective (Figure 7).

Figure 7. An athlete using a balance mat to strengthen ankle control. The athlete stands on one leg and performs manoeuvres with the other leg and hand.

Importantly, specific technical training to avoid vulnerable situations may also be effective, at least in volleyball, where landing on a teammate's foot is a typical mechanism for ankle sprains. In football, late tackles resulting in laterally directed blows to the lower leg put the ankle in a vulnerable position when landing or running. A combination of more specific wording in the rules of the game with regard to late tackles, in particular two-footed tackles, and stricter penalties may prevent some ankle injuries.

Athletes with previous ankle injuries should complete a balance training program on a wobble board, balance mat or other uneven surface according to the '10-5-10' rule (i.e. 10 minutes, 5 times a week, for 10 weeks). This type of training may also be useful to prevent injuries in people with sound ankles. In the basic position, the athlete stands on one leg with a straight knee (Figure 8). The arms are crossed in front of the chest, and the goal is to use primarily an 'ankle strategy' to maintain balance; that is, to attempt to make all balance corrections using only the ankle joint and to use the arms, hips and knees as little as possible. At first, balancing on the floor may be an adequate challenge, particularly if the athlete has eyes closed. Ball or partner exercises may be added to make training more challenging and fun.

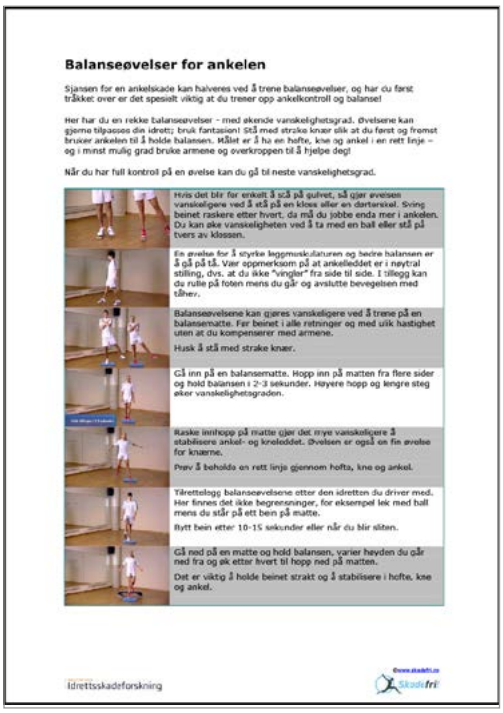


Figure 8. An ankle injury prevention program (see www.skadefri.no).

Preventing hamstring injuries

Injury characteristics

Common thigh injuries are contusions (bruising) of the thigh muscles and strains of the quadriceps or hamstring muscles. In many sports, hamstring strains are the most common of all injuries, particularly in the football codes or in other team sports; these sports are characterised by sudden accelerations and decelerations, often followed by changes of direction, and eccentric muscle activity during sprinting and kicking. Recent studies suggest that the incidence of hamstring strains has increased in football during the past decade as the sport has become more physically demanding, especially in terms of more frequent and higher intensity runs.

Risk factors

The two factors most consistently associated with hamstring strains are a history of a previous injury and age (older players are at higher risk). Some studies indicate that decreased hamstring strength during both concentric (muscle-shortening contractions) and eccentric contractions, a low hamstring-to-quadriceps strength ratio and a left-right difference in hamstring strength could be risk factors for strains. Poor flexibility of the hamstring muscles has also been suggested as a risk factor for muscular strains. However, this possibility has not been examined thoroughly enough to draw definitive conclusions.

Mechanisms

Most hamstring strains occur during maximal sprinting activities or at foot strike in the transition from eccentric to concentric muscle action.

Prevention

The most important step in preventing hamstring strain is to warm up thoroughly. While athletes should always warm up, a more thorough warm-up is essential for activities in cold weather. Because of the injury mechanism, some have suggested that eccentric strength is important in preventing hamstring strains. Studies confirm that eccentric strength training of the hamstring muscles increases their strength more effectively than concentric strength training and can reduce the risk of hamstring strains.

The Nordic Hamstring lower exercise is a partner exercise in which the athlete attempts to resist a forward-falling motion of the upper body using the hamstring muscles to maximise loading in the eccentric phase (Figure 9). In a study of Norwegian and Icelandic male football players, this exercise reduced the risk of hamstring strains by 65%. To perform the exercise (1) Have your partner stabilise your lower legs; (2) Lean forward in a smooth movement, keeping your back and hips extended, and work at resisting the forward fall with your hamstring muscles for as long as possible until you land on your hands.

There is little or no evidence in the literature to suggest that flexibility training alone can prevent hamstring strains in football or in other sports. One explanation may be that most hamstring strains occur during maximal sprinting, when the hamstring muscles are not stretched to their maximum range. However, eccentric hamstring training using the Nordic Hamstring exercise has been included in several general programs to prevent injury of the lower extremities in young athletes.

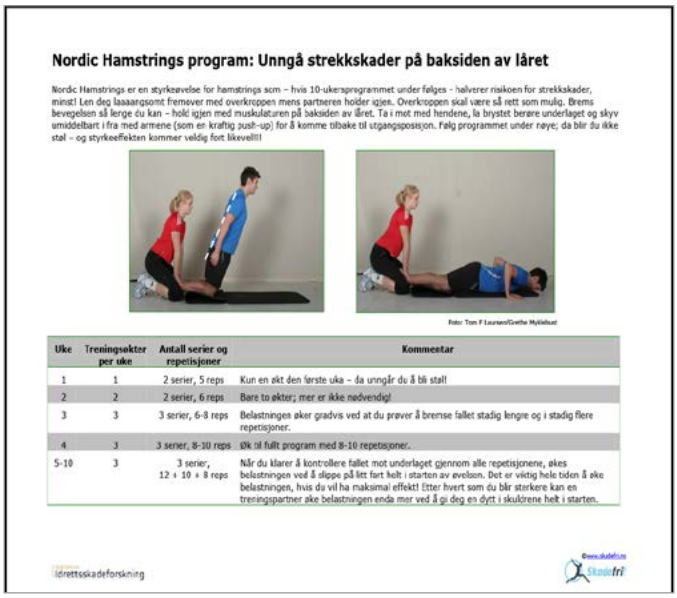


Figure 9. Performing the Nordic Hamstring exercise (see www.skadefri.no).

Preventing groin injuries

Injury characteristics

Groin injuries are among the top six most-cited injuries in many sports, for example, football, rugby, American football, ice hockey, speed skating, swimming and athletics. These injuries account for more than 10% of all injuries, and 20–40% of all muscle strain injuries. A strain to the groin muscles may start as an acute injury but often becomes chronic in nature. Suffering from persistent groin injuries results in extensive rehabilitation time and longstanding pain. For instance, 40% of groin injuries in football result in more than a week's time loss, and 10% in loss of more than a month.

Risk factors

Evidence demonstrates that a previous strain of the groin muscles on the same side is a strong predictor for a recurrent injury. This increased risk may be due to scar tissue in the muscle or tendon, or to inadequately rehabilitated strength or flexibility. Other internal risk factors believed to be involved in groin injuries are reduced adductor strength and decreased flexibility of the hip abductors. However, the evidence is conflicting, as is the evidence for age and sports exposure as risk factors for groin injuries.

Mechanisms

Groin injuries often become overuse conditions with persisting pain and reduced function. Thus, the initial groin injury and the injury mechanisms are hard to establish in many cases. Many athletes who develop groin problems are engaged in sports involving kicking, rapid changes of direction, sprinting and stopping. The adductor muscles may be acutely strained during an eccentric contraction, for example, in a forced abduction, most likely when the limb is in abduction. For instance, this could occur from a sudden resistance caused by an opponent's foot in an attempt to reach a ball, or during a sliding tackle in football. The adductor muscles can also be strained in a forceful concentric contraction, such as occurs during a kick after a ball in the air.

Prevention

A previous groin injury is the most reliable risk factor for groin strain, which emphasises the need for adequate rehabilitation after the primary groin injury before returning to play. Stretching of the adductor–abductor muscles and other muscles that flex the hip has shown to be ineffective in the prevention of groin injuries. However, a functional flexibility of these muscles and a good hip range of motion may be of importance.

As many groin injuries occur during eccentric loading, reduced eccentric strength of the adductor muscles has been suggested as a possible risk factor. However, studies on athletes playing various sports (e.g. ice hockey, football) do not provide conclusive evidence that general strengthening exercises prevent injuries. Nevertheless, exercise programs that include specific strength training of the adductor muscles (static, concentric and eccentric strength) and core stability exercises for the pelvic muscles have been proven effective in the treatment of adductor-related groin injuries. The exercises shown in Figure 10 are commonly included in general prevention programs for injuries of the lower extremities (e.g. the 11+ warm-up program).

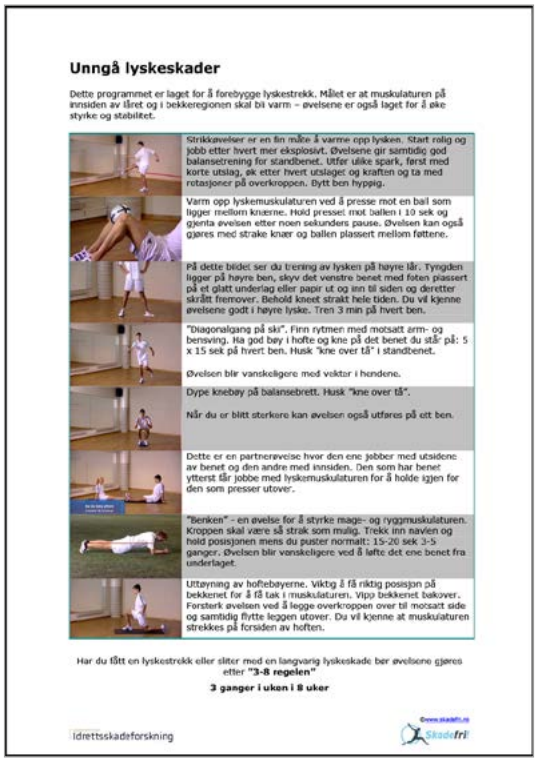


Figure 10. A prevention program for groin injuries (see www.skadefri.no).

Preventing shoulder injuries

Injury characteristics

Acute shoulder injuries are typical in sports that involve powerful and intentional body contact, such as certain football codes and ice hockey. However, they are also common in sports characterised by high-energy falls on the shoulder, such as skiing, snowboarding, ice skating and cycling. The severity of an acute shoulder injury depends on the direction of the forces and the anatomical structure(s) affected. Most acute shoulder injuries are minor, resulting in contusions of the soft tissue around the joint. More severe trauma may result in a shoulder dislocation, fracture or dislocation of the clavicle, or fractures of the upper arm.

Risk factors

The risk factors associated with acute shoulder injuries are unknown.

Mechanisms

An acute shoulder injury most often occurs as a direct result of falls or blows on the shoulder.

Prevention

The literature offers no evidence about methods to protect an athlete from acute shoulder injuries. However, any measures that reduce the risk of falls in sports should reduce the risk of shoulder injury. Theoretically, shoulder pads can spread the forces from an impact over a larger surface area of the body and can absorb energy, for example, the shoulder pads used in American football. However, no studies have proven the effectiveness of shoulder pads in reducing the risk of shoulder injuries.

Proper falling techniques can be taught to potentially lessen the direct impact across the shoulder joint; that is, learning to roll when landing rather than landing directly on the shoulder. Handball has adopted strict penalties for tackling the attacker's arm from behind and for holding the player's arm when shooting. These penalties are assumed to reduce acute lesions to the shoulder joint, although direct evidence is lacking.

Generally, most epidemiological studies in sports such as handball have assessed acute injuries, in particular acute injuries to the lower extremities. Shoulder overuse problems can involve pain and joint instability and, in many cases, will influence an athlete's performance. A recent study in handball showed that approximately 40% of elite female players suffer from shoulder pain and reduced function that affects their performance. Shoulder stabilising exercises are highly recommended for incorporation in general warm-up activities (Figure 11). However, clear evidence of the preventive effect of such exercises on acute and overuse injuries is still lacking.

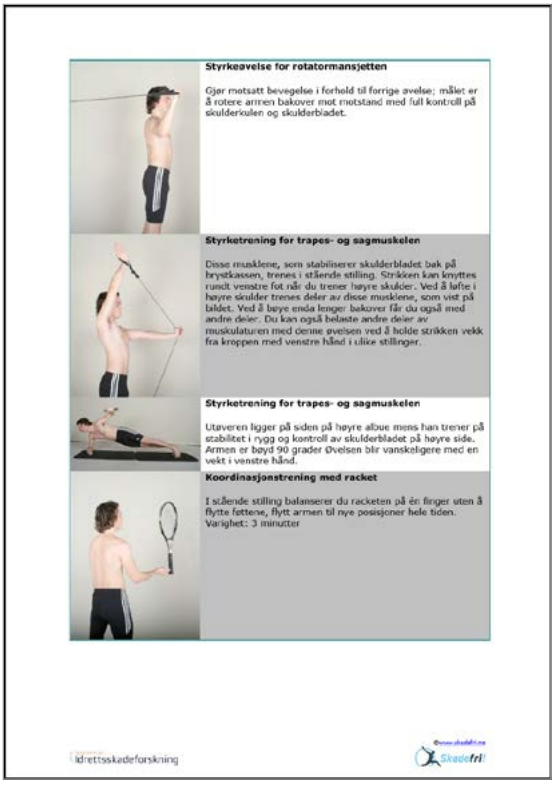


Figure 11. Shoulder stabilising exercises (see www.skadefri.no).

GET SET – NEW, FREE APP FOR INJURY PREVENTION TRAINING

The app “Get Set – Train smarter” provides injury prevention exercises presented via video and can be easily accessible on your smartphone (Android, iOS) – for free!

You can halve the risk for injuries

Get Set was created by the Oslo Sports Trauma Research Center in collaboration with the International Olympic Committee (IOC) to help prevent sports injuries by providing the most effective and evidence-based workout routines for your needs.

Get Set is suitable for all those who love sport and physical activity, not just for elite athletes.

All exercises are presented through videos, supported by short descriptions on how to perform the exercise correctly. Exercises are presented with variations as well as 3 levels of difficulty to make them more challenging as you progress.

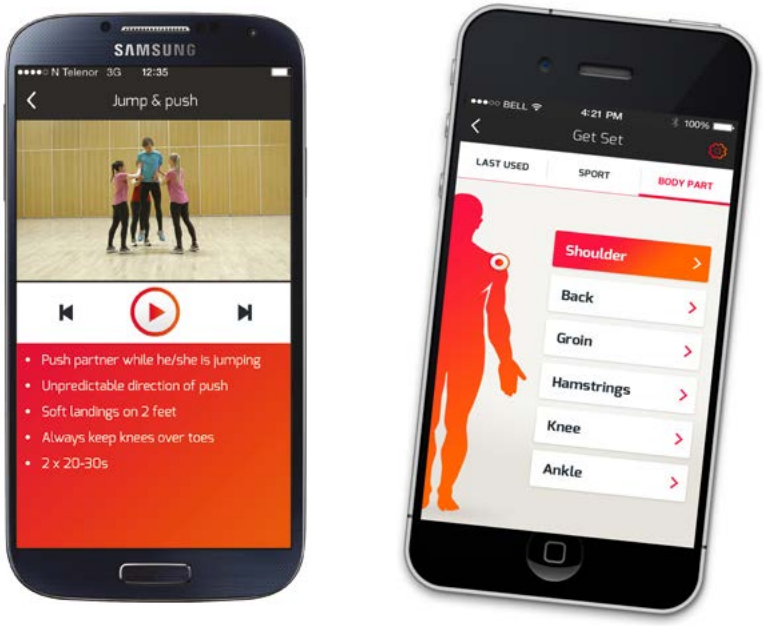
The Get Set exercises are designed to be carried out with a minimum of equipment, to make them safe and easy to implement wherever you are.

Tailored exercise programs for 30 summer sports

When you open the Get Set for the first time you are greeted by a short description of the app, followed by a motivational video with one of the world’s best handball players, Linn Jørum Sulland (NOR). Then, Get Set has 2 inputs. You can choose to find exercises for a sport or a body part. Under “Sport”, you can find your sport among the 30 summer sports, and as another option you can find injury prevention exercises targeting specific body parts.

In other words, for each of the 30 sports, the exercise program is tailored to the injury risk profile of the sport. Likewise, under “Body”, you will find exercises developed to prevent shoulder, back, groin, hamstring, knee, or ankle injuries.

DOWNLOAD GET SET!



ANDROID or iOS

IDENTIFYING ATHLETES AT RISK

A drop-jump test is an easy way to identify athletes with poor hip and knee control. Athletes who are not able to perform a drop-jump test without having 'kissing knees' are at increased risk of knee injuries and need to focus specifically on neuromuscular training in combination with strength exercises for the core and lower limbs (Figure 12). These athletes need careful follow up to learn proper knee control.

Figure 12. Two tests for hip and knee control to identify athletes at risk of serious knee injuries. The photographs illustrate the correct (left) and the incorrect (right) knee positions for the drop-jump (top) and single-leg squat tests (bottom). (Reproduced with kind permission from Håndballmagasin 3/2010)

Coaches should assess the hip and knee control of all athletes in the preseason. The drop-jump test is recommended. The test should be repeated throughout the season to precisely follow up the athletes for changes in hip and knee control and landing patterns.

CONCLUSION

In summary, comprehensive neuromuscular training programs combining jumping, strength, balance, sport-specific techniques and agility exercises can improve measures of strength, balance and movement control that are related to injury risk of the lower extremities. Proper warm-up before training and competition is of significant importance to prepare the body

physically and mentally for the up-coming loading. When using preventive exercises in training, emphasis should be placed on proper landing technique, with the lower limbs aligned and knee and hip flexion engaged on landing. Landing on two feet is encouraged whenever possible. In cutting and landing manoeuvres, athletes should always aim for the hip-knee-over-toe position and avoid the knee valgus position.

Proper rehabilitation of the injury: The strong association observed between previous injuries, reduced function of specific muscles and joints, and the risk of recurrent injuries suggests that preventing re-injury should be emphasised. Identifying athletes with previous injuries or impaired neuromuscular control is critical for providing optimal treatment and for preventing further injuries. As is true for all injuries, appropriate rehabilitation programs and adequate time for the athlete to become symptom free before returning to play are vital.

Start early and identify athletes at risk: One goal in the prevention of sports injuries is to teach athletes safe techniques and movements. We therefore recommend that the programs discussed in this chapter be implemented in both schools and sports clubs at an early stage in the development of young athletes.

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