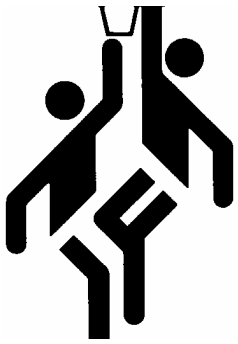
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Safety in Sports

Inventory on the Burden of Basketball Injuries, Existing Prevention Measures and Safety Promotion Strategies



Patrick Luig & Thomas Henke

Ruhr-University Bochum

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SVENSK BASKET

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We Are Basketball

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KfV Kuratorium für Verkehrssicherheit

EuroSafe
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1. Introduction

Basketball has its early roots in the end of the 19th century. It was firstly noticed in the north-eastern states of the USA. In 1891 Dr. James Naismith, a Canadian professor, drew up a first set of 13 basketball rules at the YMCA training school in Springfield, Massachusetts. Naismith originally intended to offer a non-contact indoor activity for bad weather days to his students. Thenceforward basketball quickly spread throughout the USA starting to become one of the most widespread games of today. It enjoys a large popularity all over the world, especially with regard to the recreational level, where it is also played outdoors in parks and even in backyards.

On June 18th 1932 the International Basketball Federation FIBA (Fédération Internationale de Basketball Amateur) was founded. Four years later men's basketball became Olympic for the first time during Summer Olympics 1936 in Berlin. At that time above-mentioned James Naismith was named honorary president of the FIBA. In 1950 the first Men's World Championships took place in Argentina. Another three years later in 1953, the first Women's World Championships were held in Chile. Women's basketball finally became Olympic in Montreal in 1976. Originally, the FIBA provided only amateur sports. Since April 1989 FIBA has allowed Olympic participation of professional basketball players by eliminating the distinction between professionals and amateurs. The word "amateur" was dropped at that point. However, the A in FIBA was kept due to reasons of tradition. In 1992 in Barcelona professionals entered the Olympic courts for the first time. World Championships both for men and women take place every four years, alternating with Olympic Games (FIBA 2010). Until today the USA, home of the generally admitted best basketball leagues NBA (National Basketball Association) and WNBA (Women's National Basketball Association), have commonly dominated international and Olympic tournaments, although the rest of the World, including European Basketball has caught up and is on par by now. Spain is current men's world champion.

By March 2007 the International Basketball Federation states 213 countries where basketball is played in an organized manner. Worldwide approximately 450 million citizens play basketball either on competitive or recreational level (FIBA 2010). Concerning the situation in the EU 27 states, nearly 1.7 million citizens are licensed basketball players. In addition, another 11.4 million citizens are expected to play basketball on a recreational level (Tab. 1). Thus, basketball is one of the most popular and most widespread team sports in Europe.

Basketball is characterized by moderate body contact, highly intermittent running, demanding one-on-one situations, frequent jumping, quick direction changes in combination with challenging technique and coordination elements like catching, throwing, passing and dribbling. These traits can already be seen as potential injury risk factors that are underlying the game.

Considering different injury definitions the overall incidence of an acute time-loss injury in basketball is around 3-6/1000h (McKay 2010, Cumps et al. 2007, Messina et al. 1999, Gomez et al. 1996, Arendt/Dick 1995, Lanese 1990). Taking current literature into

consideration it seems obvious, that in competition the incidence is at least twice as high as in practice (Comstock et al. 2009, Dick et al. 2007, Agel et al. 2007, Meeuwisse et al. 2003) independently from age, gender and performance level, where studies are contradictious. In general, ankle sprains are the predominant type of injury mainly deriving from landing on an opponent's foot, in particular when coming down from rebounds and jump shots.

The necessity of effective prevention measures is therefore absolutely perspicuous. Despite national as well as European-wide efforts to promote injury prevention in basketball, the topic still seems to be not very popular among athletes, coaches and functionaries. Rather than the pure effectivity, there are in particular compliance and acceptance among these groups that propel prevention programmes. Preventive measures therefore have to focus on basketball-specific performance enhancement to increase the chances of success of sustainable injury prevention. Besides the above mentioned consideration the already impressive relevance of (recreational) basketball for public health can still be increased when the risk of injuries is reduced.

The purpose of this inventory report is to give an overview of existing prevention measures and safety promotion strategies, which have already been documented in any sort – either on national or international level. The following sections intend to illustrate the aetiology of basketball injuries on the basis of underlying physiological demands and with special regard to the current epidemiology of basketball injuries.

Identified preventive measures will be divided into five branches, namely 'Training & Physical Preparation', 'Technical & Political Approaches', 'Equipment & Facilities', 'Medical & Non-medical Support' and in addition, when addressing at least two of the aforesaid branches 'Multifaceted Approaches'. As the aetiology of injuries in basketball is clearly sports-specific and hereby reflecting the characteristics and demands of the game, it is obvious that the findings will not emerge equally in all branches. As the applied differentiation was developed for sports in general, it can be assumed that in team sports an overweight within 'Training & Physical Preparation' is usually observed in marked contrast to other sports such as parachute jumping, for example, where 'Equipment & Facilities' and/or 'Medical & Non-medical Support' may be specifically important with respect to injury prevention. The apparent bias is a direct consequence of the sport-specific main injury risk factor which is, in the first case, the inevitable contact with opponents, whereas in the latter case environmental conditions play a predominant role.

The basketball related activities within the project "Safety in Sports" are carried out in close collaboration with FIBA-Europe. FIBA-Europe is the governing body for basketball in Europe, one of five zones of FIBA (along with Africa, Americas, Oceania and Asia).

1.1 Sports Participants in Basketball

Each European country has its own traditions and cultural elements. According to this fact the social value of basketball and its popularity vary remarkably from country to country. Table 1 gives a comprehensive view on the number of licensed and unlicensed (recreational) basketball players within the 51 member federations of the European Basketball Federation (FIBA Europe), also including the EU-27 nations.

Tab. 1. *Population, players and ranking of all 51 FIBA Europe member federations (grey = EU-27)*

	Population	Basketball Players			Teams	FIBA Ranking		Unlicensed Basketball Players
		Men	Women	Absolut		Men	Women	
ALB	3,500,000	803	591	1,394	37	21	22	500
AND	83,888	291	144	435	8	21	22	180
ARM	3,700,000	2	23	25	6	21	22	300
AUT	8,300,000	11,258	3,440	14,698	185	21	22	5,000
AZE	8,300,000	150	60	210	20	21	22	6,000
BEL	10,500,000	65,497	22,421	87,918	664	21	11	n.a.
BIH	3,800,000	n.a.	n.a.	n.a.	n.a.	16	22	n.a.
BLR	9,800,000	310	97	407	8	21	6	n.a.
BUL	7,700,000	3,290	2,156	5,446	113	17	22	18,328
CRO	4,400,000	11,024	1,542	12,566	137	8	17	2,000
CYP	800,000	700	300	1,000	21	21	22	1,500
CZE	10,300,000	23,490	12,980	36,470	453	19	3	3,500
DEN	5,400,000	8,204	3,695	11,899	143	21	22	n.a.
ESP	40,700,000	188,110	115,586	303,696	23,145	1	2	4,350,157
EST	1,300,000	856	516	1,372	679	21	22	8,890
FIN	5,200,000	10,500	6,000	16,500	260	21	22	50,000
FRA	59,600,000	249,143	159,861	409,004	4,545	7	4	1,650,000
GBR	60,400,000	24,647	7,605	32,252	720	21	22	n.a.
GEO	4,300,000	n.a.	n.a.	n.a.	n.a.	21	22	n.a.
GER	82,600,000	145,133	52,284	197,417	200	5	19	5,000,000
GBZ	28,750	225	150	375	20	21	22	400
GRE	11,000,000	272,000	70,000	342,000	1,350	2	8	n.a.
HUN	10,100,000	n.a.	n.a.	n.a.	n.a.	21	15	n.a.
IRL	4,000,000	525	317	842	250	21	22	35,400
ISL	300,000	n.a.	n.a.	n.a.	60	21	22	6,500
ISR	7,000,000	25,000	2,500	27,500	1,300	12	18	n.a.
ITA	57,300,000	167,800	31,364	199,164	3,700	6	16	340,323
LAT	2,300,000	470	250	720	57	13	7	n.a.
LTU	3,500,000	13,418	5,020	18,438	138	4	5	70,000
LUX	400,000	3,038	1,623	4,661	35	21	22	175
MDA	4,500,000	180	64	244	12	21	22	500
MKD	2,000,000	1,800	700	2,500	85	21	22	1,500
MLT	400,000	658	599	1,257	21	21	22	250
MNE	672180	n.a.	n.a.	n.a.	n.a.	21	22	n.a.
MON	30,000	n.a.	n.a.	n.a.	n.a.	21	22	n.a.
NED	16,200,000	33,323	12,264	45,587	12,264	21	22	n.a.
NOR	4,400,000	3,500	1,500	5,000	170	21	22	7,000
POL	38,200,000	900	390	1,290	380	18	13	11,000
POR	10,400,000	n.a.	n.a.	n.a.	n.a.	15	22	n.a.
ROU	21,800,000	5,750	5,298	11,048	169	21	20	11,380
RSM	31,538	n.a.	n.a.	n.a.	n.a.	21	22	n.a.
RUS	142,100,000	1,366	772	2,138	51	9	1	560,000
SCO	5,094,800	925	421	1,346	58	21	22	n.a.
SLO	2,000,000	5,656	1,210	6,866	120	11	12	10,387
SRB	10,100,000	14,400	2,500	16,900	504	3	9	30,000
SUI	7,300,000	11,000	4,500	15,500	206	21	22	1,358
SVK	5,400,000	2,989	2,491	5,480	112	21	22	500
SWE	8,900,000	5,747	5,567	11,314	467	20	10	100,000
TUR	70,200,000	67,517	16,296	83,813	6,312	10	14	n.a.
UKR	47,100,000	2,500	750	3,250	45	14	21	10,000
WAL	2,903,085	1,096	118	1,214	88	21	22	4,500
SUM	**428,600,000**	**1,209,455**	**434,020**	**1,643,475**	**49,471**			**11,390,733**
SUM	**674,254,176**	**1,385,191**	**555,965**	**1,941,156**	**49,304**			**12,297,528**

However, the before mentioned figures of the 51 member federations have to be handled with some caution. In particular the numbers of unlicensed players only seem to be rough estimations in most cases. Regarding the 5,000,000 recreational basketball players that are mentioned for the German area it must be supposed that these numbers are probably also including school sports where basketball is one of the most commonly played sports. It has to be doubted that such a large number regularly plays basketball on a recreational level. By contrast the reported number of licensed players in Russia (2,138) is probably too low considering the population (approx. 140 million), the national popularity of basketball and the numbers of unlicensed players.

Thus, table 1 gives only a first idea of the real number of both competitive and recreational participants in basketball. Dealing with these numbers, one can conclude that in the EU-27 region approximately 1.7 million basketball players regularly participate in basketball training and competition. Taking the assessed numbers of the FIBA into consideration which reports a worldwide number of 450 Million players in 213 countries either on competitive or recreational level and keeping in mind that North America in particular the United States are recorded as the core region of basketball, the fore cited number of 1.7 million licensed basketball players and the stated 12 million unlicensed players in Europe sound quite proper and are used for further considerations (e.g. burden of injuries). Furthermore, it is absolutely striking that basketball in comparison to other sports is of great importance when regarding the area of recreational sports. ‘Streetball’ is inherent part of urban and rural street sports culture all over the world. The FIBA even provides official rules for the recreational version of basketball (cf. FIBA 33).

In Spain, Italy and France, where basketball is particularly popular, the share of the officially basketball playing population is approximated with 0.5 – 1%. In Greece the basketball playing population accounts for astonishing 3%, so that one can conclude that in these countries basketball enjoys the largest popularity within the European area. The share of the basketball playing population is definitely higher than in the rest of Europe.

Irrespectively from above-mentioned restrictions to the validity of the number of participants table 1 may assist in giving a realistic view on the ratio between male and female basketball players. Approximately 75% of all licensed basketball players in Europe are male. This ratio is a certainty in most FIBA Europe member federations. Only Sweden and Romania show a balanced gender ratio. Despite yet lower absolute numbers of participants, women’s basketball carries a great weight with regard to prevention, in particular with an eye on women’s increasing participation in basketball and their higher vulnerability to largely severe knee injuries. However, the numbers show that – independently from gender – Europe has a strong demand for preventive measures and safety promotion strategies. In particular those countries with high numbers of (injured) basketball players (e.g. Greece, France, Spain, Italy) do not only have a high demand for prevention but probably also offer the widest variety of prevention programmes.

Nevertheless it has to be stated that the USA is not only the origin of basketball but still a clear core region and thus should also be recognized when searching for and compiling preventive ideas.

1.2 Characteristics of the Game

Modern basketball is a highly demanding sport, which is characterized by huge dynamics and intense body contact, even though the nature of basketball is primarily noncontact and the rules do not allow most forms of contact. Drakos et al. (2010) point out that basketball has evolved into an increasingly physical game in which contact is accepted and expected. The complexity of the game, which combines technical, tactical, athletic and cognitive elements commonly at the same time, is reflected in its multi-faceted aetiology. One can hardly identify single injury mechanisms as in most cases it is a combination of multiple factors that is finally leading to an injury.

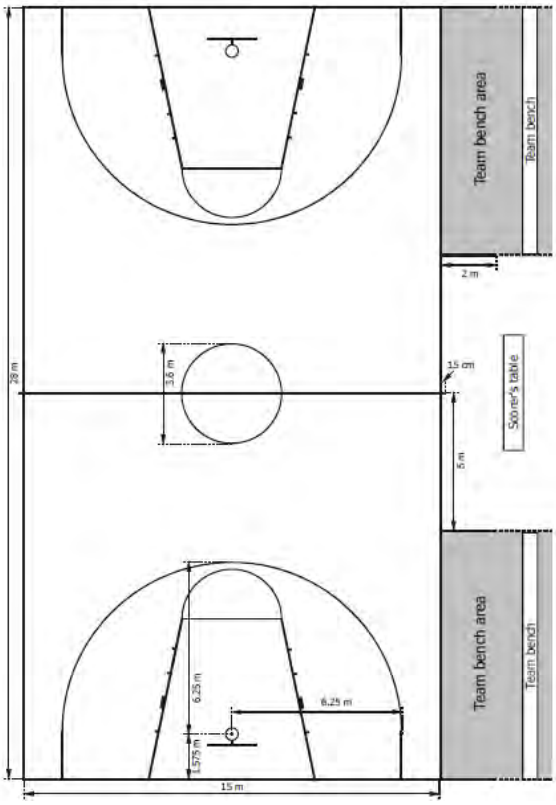


Fig. 1. *Dimensions of a basketball court (FIBA 2008)*

Basketball is an indoor sport, although it is also played outdoors on recreational level. The playing court (Fig. 1) is a 28 meter long and 15 meter wide rectangle. For each team there is a two point area near the opponent's basket and a three-point area which is the entire floor area except the two point area. Subject to the respective venues, it is either played on wooden or on artificial floors. Two teams are playing against each other, both trying to score baskets with a basketball. The team that has scored the most points when the playing time is over is the winner. In official adult games the playing time is 4 x 10 minutes. Each team consists of up to 12 players. On court there are five players. All players of each team are interchangeable when the ball is dead and the game clock is stopped. A substitution shall not be permitted to the scoring team when the game clock is stopped following a successful field goal during the last two minutes of the fourth period or the last two minutes of each extra period unless an official has stopped the game (FIBA 2008).

According to the rules of the International Basketball Federation the touching of an opponent with hands is, in itself, not necessarily a foul. The officials shall decide whether the player who caused the contact has gained an unfair advantage. If contact caused by a player in any way restricts the freedom of movement of an opponent, such contact is a foul. Illegal use of the hands or extended arms occurs when the defensive player is in a guarding position and his hands or arms is placed upon and remains in contact with an opponent with or without the ball, to impede his progress. Once the defensive player has established an initial legal guarding position, he may move to guard his opponent, but he may not extend his arms, shoulders, hips or legs and by doing so cause contact to prevent the dribbler from passing by him. To repeatedly touch or jab an opponent with or without the ball is a foul, as it may lead to rough play. It is a foul by an offensive player with the ball

to hook or wrap an arm or an elbow around a defensive player in order to obtain an unfair advantage, to push off to prevent the defensive player from playing or attempting to play the ball, or to create more space between himself and the defensive player and to use an extended forearm or hand, while dribbling, to prevent an opponent from gaining control of the ball. A player who has jumped into the air from a place on the playing court has the right to land again at the same place. He has the right to land on another place on the playing court provided that the landing place and the direct path between the take-off and landing places is not already occupied by an opponent at the time of take-off. An opponent may not move into the path of a player after that player has jumped into the air. A player shall not hold, block, push, charge, trip or impede the progress of an opponent by extending his hand, arm, elbow, shoulder, hip, leg, knee or foot, nor by bending his body into an 'abnormal' position, nor shall he indulge in any rough or violent play. Any violation shall be charged as foul to the offender (FIBA 2008). Thus, the rules implicate intended and unintended body contact. The borderline between allowed and not allowed contacts always depends on the interpretation of the referees and on the comprehension of the acting players. It is self-evident that not each body contact is directly judged as a violation of the rules. Thus, contact, collisions, checking and tackling that vary extremely in their severity have to be seen as game immanent risk factors that imply clear injury mechanisms.

Basketball is a so-called transition game, always switching between defense and offense play. Thus, the game action is characterized by intermittent running and sprinting. Whenever a player gains control of a live ball on the playing court, his team must attempt a shot for a field goal within twenty-four seconds. There are only few breaks within a game. As a result repeated player substitutions are commonly used for regeneration. Motion-analysis has shown that depending on individual playing-time basketball players cover a maximum between 4.6 and 5.8 km per game (Schmidt/Benckendorff 2003, Janeira 1998, Moreno 1988). Literature reports mean heart rates between 165 and 170 beats which is equivalent to 80-90% of individual HR_{max} (Zimmermann et al. 2006, Sugiyama et al. 1999, Janeira 1998, McInnes 1995). Regarding these facts the necessity of a highly-developed basic endurance in terms of pronounced aerobic capacities becomes obvious. In addition, players need a proper athletic condition with regard to strength, agility, acceleration, deceleration and in particular jumping as the match level of play includes running forwards, backwards and sidewards, planting, cutting, feints, jumps, landings, turns during repeated one-on-one situations where additional contact can occur. Beside an intensive load for the locomotor and neuromuscular system this implies the need for a well-trained anaerobic metabolism in addition to succeed in the game. In particular, the high-intensity phases during crunch time play sometimes including repeated sprints stress the anaerobic glycolytic metabolism, finally leading to higher blood lactate concentrations. Hence, it can be concluded that the physiological requirements in basketball are quite high, calling for considerable demands of the cardiovascular and metabolic capacities as well as for the musculoskeletal system of the players.

These conclusions allow by implication that athletes in bad athletic condition are more prone to injuries.

1.3 Aetiology and Burden of Injuries

Keeping game characteristics, extrinsic and intrinsic demands at the back of one's mind, basketball can be indicated as a high risk sport. Considering the popularity of basketball and its social value for the European population it is undoubtedly necessary to investigate aetiology and extent of sports injuries in basketball. In the following part surrounding circumstances (e.g. injury mechanisms, injury situations) of basketball injuries with special regard to epidemiology, topography, promotive factors and consequences are being described - whenever possible and meaningful differentiated between gender, age and performance level. Analyses are primarily based on own data from mostly popular basketball as described in the section 2.1 "Surveys on Sports Injuries in basketball", complemented with and discussed in the light of current international literature.

Before analyzing the aetiology of basketball injuries, some methodological points with respect to injury definitions and injury reporting should be mentioned. Presented results have to be handled with minor restrictions, as data collection, analysis and interpretation are not identical in all cases (Frisch et al. 2009; Brooks & Fuller 2006).

According to widely accepted consensus agreements a sports injury is defined as "any physical complaint sustained by a player that results from a (…) match or a (…) training". Furthermore, if a player receives medical attention, injuries are referred to as "medical attention injury", whereas an injury that causes a player to miss at least a full part in future training or match play is constituted as "time-loss injury" (Fuller et al. 2006, 2007). Bahr (2009) points out that the time-loss definition is probably the most commonly used, as it at least covers the most relevant injuries. In addition, time-loss injuries are quite comprehensible, in particular when recorded retrospectively.

However, in general there is a clear distinction between acute/traumatic and chronic/over-use injuries. Corresponding to the above-cited consensus documents an acute/traumatic injury results from a specific, identifiable event whereas chronic/overuse injuries are caused by repeated micro-trauma without a unique identifiable event responsible for the injury. As these definitions were defined for football and rugby, both team sports with frequent contact between participating players, they may be quite appropriate for modern basketball as well.

Although chronic injuries are not uncommon in basketball, in particular knee pain (jumper's knee), they are hardly quantifiable due to heterogeneous reporting methodologies. Cumps et al. (2007) report an overuse injury incidence of 3.8 per 1000 hours in contrast to 6 acute injuries per 1000 hours which is an acute-overuse injury ratio of 1.58:1. These results are supported by Hickey et al. (1997) who examined an average ratio of 1.66:1. In general, minor injuries and overuse injuries are mostly underrepresented regarding recordings from hospital records, insurance companies or large national surveys that commonly present large numbers of more serious and/or acute injuries. Thus, the here ~~present~~ inventory report mainly deals with acute injuries.

Distribution of injuries and injury incidences

Basketball has become a game with considerable body contact. It is therefore not surprising that injury incidences in basketball are comparable to other team sports where one-on-one situations with inevitable contact frequently occur (e.g. handball, football).

Tab. 2. *Comparison of overall incidences in current literature (time-loss injuries)*

		Overall incidences per 1000h		Overall incidences per 1000 athlete exposures	
Study		**Male**	**Female**	**Male**	**Female**
Lanese et al.	**1990**	4.5	4.8		
Yde/Nielsen	**1990**	3.0			
Arendt/Dick*	**1995**			5.6	5.2
Weir/Watson	**1996**	5.6			
Gomez et al.	**1996**	-	4.0		
NCAA	**1998**			5.7	5.6
Messina et al.	**1999**	3.2	3.6		
Powell/Barber-Foss	**1999**			4.8	4.4
McKay et al. [a]	**2001**	26.9	23.0		
McKay et al. [p]	**2001**	22.0	25.7		

*all reported injuries
[a] amateur/recreational athletes
[p] elite/professional athletes

Tab. 2 gives a brief overview on studies that applied a time-loss injury definition when assessing injuries. Although injury data in basketball suffers from heterogeneous methodologies, it is quite safe to assume that, according to recent scientific research, the overall incidence for suffering an injury is around 3-6 injuries per 1000 hours of basketball exposure or 4-6 injuries per 1000 athlete exposures. Commonly studies report injury distribution and incidences relative to training and match.

Tab. 3 *Share of match and training injuries with regard to age and gender (own data)*

	<14		**15-21**		**22-35**	
	male (n=245)	**female** (n=116)	**male** (n=799)	**female** (n=381)	**male** (n=878)	**Female** (n=355)
Match	39.2%	37.9%	44.1%	56.2%	49.5%	58.3%
Training	60.8%	62.1%	55.9%	43.8%	50.5%	41.7%

Tab. 3 shows an overall shifting from mainly training injuries towards match injuries with increasing age. While in young ages nearly 2/3 of all injuries occur during training, among adolescents and adults match injuries cover approximately half of all injuries even though the training-match exposure ratio emerges inversely proportional. These numbers support the conclusion that injuries in competition gain more significance with increasing age, in particular with view on female match injuries. This fact is corroborated by several studies that demonstrate a significantly higher risk for basketball players to suffer an injury during competition, independently from gender and performance level. Although one should

consider clear distinctions in calculating training and match exposures (e.g. athlete exposures vs. hours of exposures), match incidences, if regarded separately, are at least twice as high as training incidences (Tab. 4).

Tab. 4. *Comparison of match and training incidences in current literature (time-loss injuries)*

		Training		Match		Training		Match	
		per 1000h				per 1000 athlete exposures			
Study		**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**
NCAA*	**1998**					4.50	4.70	10.20	9.30
Meeuwisse et	**2003**					4.52	-	5.97	-
Deitch et al.	**2006**					-	-	19.30	24.90
Agel et al.*	**2007**					-	3.99	-	7.68
Cumps et al.	**2007**	2.00	2.40	46.80	55.30				
Dick et al.*	**2007**					4.30	-	9.90	-
Borowski et al.	**2008**					1.38	1.43	2.93	3.66
Comstock et al.	**2009**					0.95	0.87	2.32	3.13
Drakos et al.	**2010**					-	-	19.10	-

*all reported injuries

With regard to sex the current literature presents heterogeneous results. It cannot be proved beyond all doubts that sex plays a decisive role considering overall, training and match incidences, although some studies have found higher injury rates for females. Deitch et al. (2006), for example, examined that WNBA players were more frequently injured in both practices and games, and experienced statistically significantly higher game-related injury rates than NBA players. However, it is absolutely clear that women are more vulnerable to specific injuries, in particular knee injuries (Deitch et al. 2006, de Loës et al. 2000, Arendt et al. 1999, Messina et al. 1999, Arendt/Dick 1995). In general, there seem to be no clear differences between European and US basketball.

Localisation and Injury Types

According to available literature acute injuries can essentially be attributed to four body regions. Regarding the upper body head and hand/wrist emerge as core regions for injuries, whereas when talking about the lower extremities knee and foot/ankle are mainly affected by injuries. Our own data show up similar allocations (Fig. 2) even though from our point it seems to be necessary to describe the topography more detailed (Tab. 5) in particular with regard to aimed countermeasures. Regardless from age, gender and performance level there is a general tendency that the majority of all injuries affect the lower limbs with the ankle joint being the predominantly injured body part. More than 1/3 of all injuries touch the ankle joint. Our own data support the above-mentioned fact that female athletes injure their knee joints more often than their male counterparts.

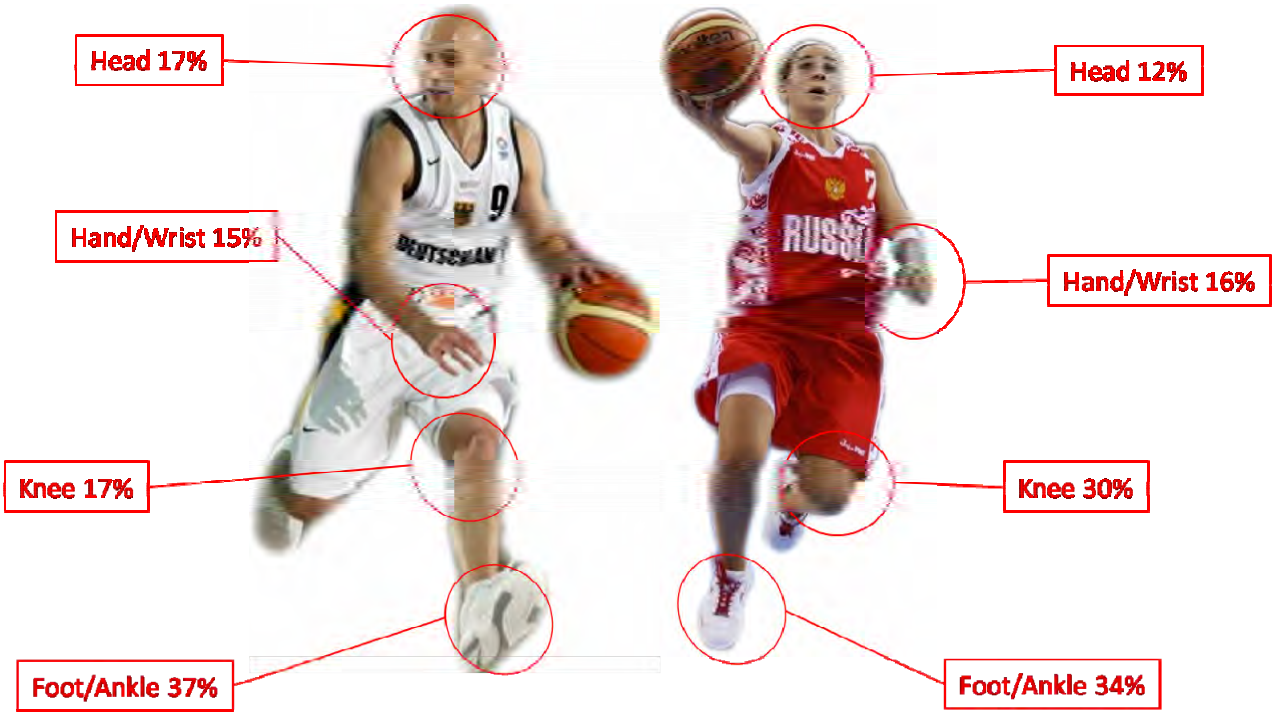


Fig. 2 Localisation of acute injuries among adolescents and adults (14-49 years; n=971) (own data)

Putting a finer point to the topography of handball injuries some relevant differences become apparent. Younger athletes seem to be more prone for injuries of the upper body regions, especially finger injuries deriving from incorrect ball handling. More than 40% of injuries in the group of under-14-aged players affect hand/wrist or head. With advancing age there is an increase in injuries of the lower extremities, in particular in knee injuries. Throughout all age groups ankle injuries are leading.

Tab. 5. *Localisation of match injuries with regard to age and gender (own data)*

	<14		15-21		22-35	
	male (n=86)	**female** (n=35)	**male** (n=329)	**female** (n=201)	**male** (n=419)	**female** (n=203)
Head/Neck	10.5	5.7	14.3	16.4	15.5	8.9
Trunk	-	-	0.6	1.0	1.9	1.5
Shoulder	-	5.7	1.5	1.0	4.1	1.0
Arm (upper/lower)	7.0	-	1.8	0.5	0.5	-
Elbow	1.2	-	2.4	1.5	0.7	-
Hand/Wrist	30.3	37.1	11.6	12.9	12.6	9.9
Hip	1.2	-	0.3	0.5	0.2	-
Thigh	2.3	-	0.6	-	0.2	0.5
Knee	12.8	5.7	17.9	22.4	21.7	31.5
Lower leg	2.3	-	3.0	0.5	6.4	3.4
Ankle	30.2	37.1	41.9	40.8	32.7	40.9
Foot	2.3	-	2.1	1.0	2.6	1.5

Independently from age, gender and performance level it seems that the most common acute injuries are sprains, with ankle, knee and finger joints being the most frequently affected locations, followed by muscle strains, contusions and fractures (Drakos et al. 2010, Borowski et al. 2008, Deitch et al. 2006, McKay 2001, Powell & Barber-Foss 2000, Messina et al. 1999, Siebert et al. 1997, Gomez et al.1996). Younger athletes are typically more vulnerable to fractures than older athletes, in particular with regard to fractures of finger and wrist. It has to be stated that there is a subtle risk for concussions as well as for facial and dental injuries (Labella et al. 2002, Powell & Barber-Foss 1999)

Chronic injuries, if covered by any studies, usually result from repetitive stress on biological tissues such as capsules, ligament or tendons, leading to instabilities of the affected joints. In basketball, the most common overuse injury is the so called jumper's knee becoming apparent by means of patellar inflammation, patellar tendinopathy or anterior knee pain respectively (Cumps et al. 2007, Siebert 1997). Lian et al. (2005) observed highest prevalence for symptoms of jumper's knee in basketball. Drakos et al. (2010) even reported highest numbers of missed NBA games due to patellofemoral inflammation.

Mechanisms, Situations and Causes

Existing studies roughly differentiate between contact situations (with opponent or other player), whether legal contact or foul play, and non-contact situations. As basketball has become physical highly demanding it is not surprising that at least half of all injuries seem to occur in contact situations (Agel et al. 2007, Dick et al. 2007., Meeuwisse et al. 2003, McKay et al. 2001) Among others, Borowski et al. (2008) reported that rebounding is the activity that most frequently leads to injuries in basketball athletes. Typically, landing on the opponent's foot when coming down from jump shots or rebounds is frequently described as inciting event, in particular with regard to the large amount of ankle sprains. The paint (or key) area, particularly below the boards, where jumping and landing alongside with body contact takes part numerously, is a clear high-risk zone (Kofotolis & Kellis 2007, Meeuwisse et al. 2003). Head and facial injuries derive almost solely from contact with opponents.

In contrast, the majority of all knee injuries, in particular ACL injuries have been reported to be caused during non-contact situations, typically running with quick direction changes, cutting manoeuvres, dynamic starts and stops, twisting or turning and single-leg landings. (Krosshaug et al. 2007, Piasecki et al. 2003, Arendt & Dick 1995). Undoubtedly, women are more prone to these non-contact knee injuries (Agel et al. 2005). Arendt et al. (1999) measured a three time higher ACL injury rate for female athletes compared to their male counterparts. As possible reasons for female's greater ACL injury risk deficits in neuromuscular control as well as greater joint laxity and stiffness are put forward (Renstrom et al. 2008) There are no hard and fast rules about how much a general poorer athletic condition (e.g. in terms of muscle strength) can be seen as predictor but it should be taken into consideration.

Krosshaug et al. (2007) reported that in most cases of analysed non-contact ACL injuries at least a decent contact by another player could be observed immediately before time of injury. Thus, it is indisputable that the combination of above-mentioned crucial basketball motions and simultaneous physical contact vastly increases the injury risk. Video analysis has shown that even modest contact during jumping phase, pivoting and feinting can make players loose body control.

Own data clearly indicate that previous injuries promote recurring injuries. With view on ankle injuries this is supported by several studies (Kofotolis & Kellis 2007, McKay et al. 2001).

Knowing the risk factors and with regard to prevention interventions it seems therefore appropriate to educate players in successfully managing contact situations, to increase typical basic motor patterns such as jumping, landing and cutting – also in combination with contact (body control) – and to improve the general fitness level of the athletes. The latter also includes sufficient regeneration.

Playing Position and Performance Level

Game demands certainly vary upon playing position. Center players are destined to collect most of the rebounds. In addition, they normally play most of their time in the key area, which has emerged as area of greatest injury risk. Thus, it could be supposed that center players have higher incidences compared to guards and forwards who have more game action around the arch.

There are only few studies that examined the context of playing position and injuries. But when this relation has been assessed, there is indeed a strong scientific support for above-mentioned hypothesis. According to current literature centres have a greater overall injury risk (Meeuwisse et al. 2003, Siebert 1997) and in particular a greater risk to suffer ankle injuries (Kofotolis & Kellis 2007). Cumps et al. (2007) also reported a higher prevalence of Anterior Knee Pain for center players compared to forwards. These facts seem to reflect the increased jumping tasks of center players which have been demonstrated to be the main injury mechanism for basketball athletes as depicted in the previous section.

Regarding level of competition current research is ambiguous. Two US studies revealed higher injury risks on higher performance level (Dick et al. 2007, Agel et al. 2007) whereas an Australian investigation (McKay et al. 2001) was not able to proof any differences between recreational and elite athletes. Further research is necessary to present clear results.

Severity and Burden of injuries

Except for dental injuries which, according to Labella et al. (2002), cause costs around $ 1,000 per injury, injuries to upper extremities can usually be classified as less serious. In fact, head contusions, if not leading to serious concussions, and minor wounds to soft

tissues, which predominantly occur during games and competitions are not necessarily perceived by the athletes themselves as being injuries. The large amount of finger injuries causes comparatively low costs as these injuries are commonly jammed fingers i.e. sprains of interphalangeal joint capsules whereas fractures are observed less often.

As described in previous sections ankle injuries amount for the largest share of basketball injuries. However, it should be remembered that most of the ankle injuries are sprains and twisted ankles which are seldom serious and cost-intensive. With knee injuries, on the other hand, there are more cases of serious ligament injuries which have to be treated by means of surgery. For male basketball players de Loës et al (2000) reported medical treatment costs of $ 1,427 per knee injury. Cumps et al. (2008) figured out that ACL injuries - independently from sports activity - cause the highest direct medical costs (€ 1,358) in contrast to ankle injuries that accounted for only € 197 on average. These numbers do not include indirect costs such as absence from work. Thus, our own data from German sports point at even higher costs, not only for knee injuries (€ 2,300) but also for average expenses of overall injuries (€ 700). It is important to say that there are considerable differences between national health care systems within Europe leading to heterogeneous numbers in this field.

Taking 1.7 million licensed basketball players in the European area into consideration, assuming an overall incidence of 3-6 injuries per 1000 hours of basketball exposure, one had to face at least 720,000 basketball-related injuries a year, not including injuries during recreational basketball. With regard to frequency and severity knee injuries and ankle injuries cause the most costs – 20% respectively.

Calculating € 2,300 per knee injury and average expenses around € 700, basketball injuries cause an amount of approximately € 500 million a year (knee injuries: € 100-200 million/year).

These estimations are quite conservative. Actual costs are probably higher due to higher numbers of participants and higher incidences.

2. Methods

The following section deals with methods and tools which have been applied during the compilation of the ~~present~~ inventory report.

Starting with a short description of primarily used injury databases, the search strategy is depicted explicitly. Moreover subcategories of preventive measures and strategies are defined. Finally the structured template which was developed for summing up preventive contents is presented.

2.1 Survey on Sports Injuries in Basketball

As already mentioned in previous sections, the Dep. of Sports Medicine of the Ruhr-University Bochum owns datasets on sports injuries, which have been built up in the frame of research projects mainly carried out with ARAG Sports Insurance (Düsseldorf, Germany). For further information please see respective literature (Henke 2003, Henke 2004, Henke et al. 2008). Hence, information drawn from own injury databases in basketball contain:

Data from a continuous survey among German sports clubs. Athletes, who report an injury, receive a questionnaire asking for details of the accident, injury onset and its treatment. In addition, information on sports activities (club sports and recreational sports) and general information on surveyed athletes is collected. Since 1986, 170,000 injuries have been recorded. To keep the analyses in this inventory report up to date, only data of basketball injuries from 1999 onwards have been considered (n=1,095).

The free text descriptions were analysed by means of specially developed encoding lists which were geared to the ICECI (International Classification of External Causes of Injury). This provides additional information about injury situations and injury mechanisms.

2.2 Search Strategy

The authors independently performed a structured database and literature search for relevant publications. As of September 2009, PubMed, the Cochrane library, SportDiscus, BISp-databases and EMIP were browsed, using multiple combinations of the keywords INJUR*, PREVENT* and BASKETBALL.

A total of 4079 articles were identified for the fixed publication period of 1990 to 2009.

After title and abstract review and removal of duplicates 48 publications were considered for detailed review. In addition to the database research a multi-lingual web search using the internet search engine Google.com was conducted. Figure 5 provides an overview of the applied keywords. This approach compiled another 33 references for the advanced reviewing process.

Tab. 6. *Multi-lingual keywords used for web search with Google.com*

Language	FIBA Rank*	Keyword 1	Keyword 2	Keyword 3
ENG	1 (US) / 76 (GB)	Basketball	Injury	Prevention
ESP	2	Baloncesto	Lesion	Prevención
RUS	4	Баскетбол	Вред	Предупреждение
GRE	7	Μπάσκετ	Τραυματισμός	Πρόληψη
FRA	11	Basket-ball	Blessure	Prévention
CZE	12	Basketbal	Zranění	Prevence
GER	13	Basketball	Verletzung	Prävention
ITA	21	Basket	Pregiudizio	Prevenzione
SLO	26	Košarka	Škode	Preprečevanje
SWE	39	Basket	Skada	Förebyggande
ROU	61	Baschet	Leziuni	Prevenirea

**combined ranking 2010 men+women*

Following these two initial literature searches, the reference lists of the retrieved articles were manually scanned for further information. Additionally, available authors and co-authors had been contacted for complementing the findings with articles from their personal archives, gathering further 30 references (12 by author's contributions and 18 by reference browsing). Finally, 111 articles were regarded for full text review.

2.3 Article Selection and Inclusion Criteria

The full text of each of the 111 compiled articles was reviewed in order to be selected or excluded for the inventory of existing preventive measures and safety promotion strategies. For definite inclusion, the article had to meet the inclusion criteria in accordance with both authors. Relevant findings were selected on the basis of the following criteria.

- Separated or at least closer consideration of basketball
- Autonomous recommendation of the author towards injury prevention in team sports, at least generally including basketball

On the basis of these criteria 42 articles were excluded. Fig. 3 illustrates the complete search strategy including all reviewing steps. In the end 69 findings were retained for the inventory.

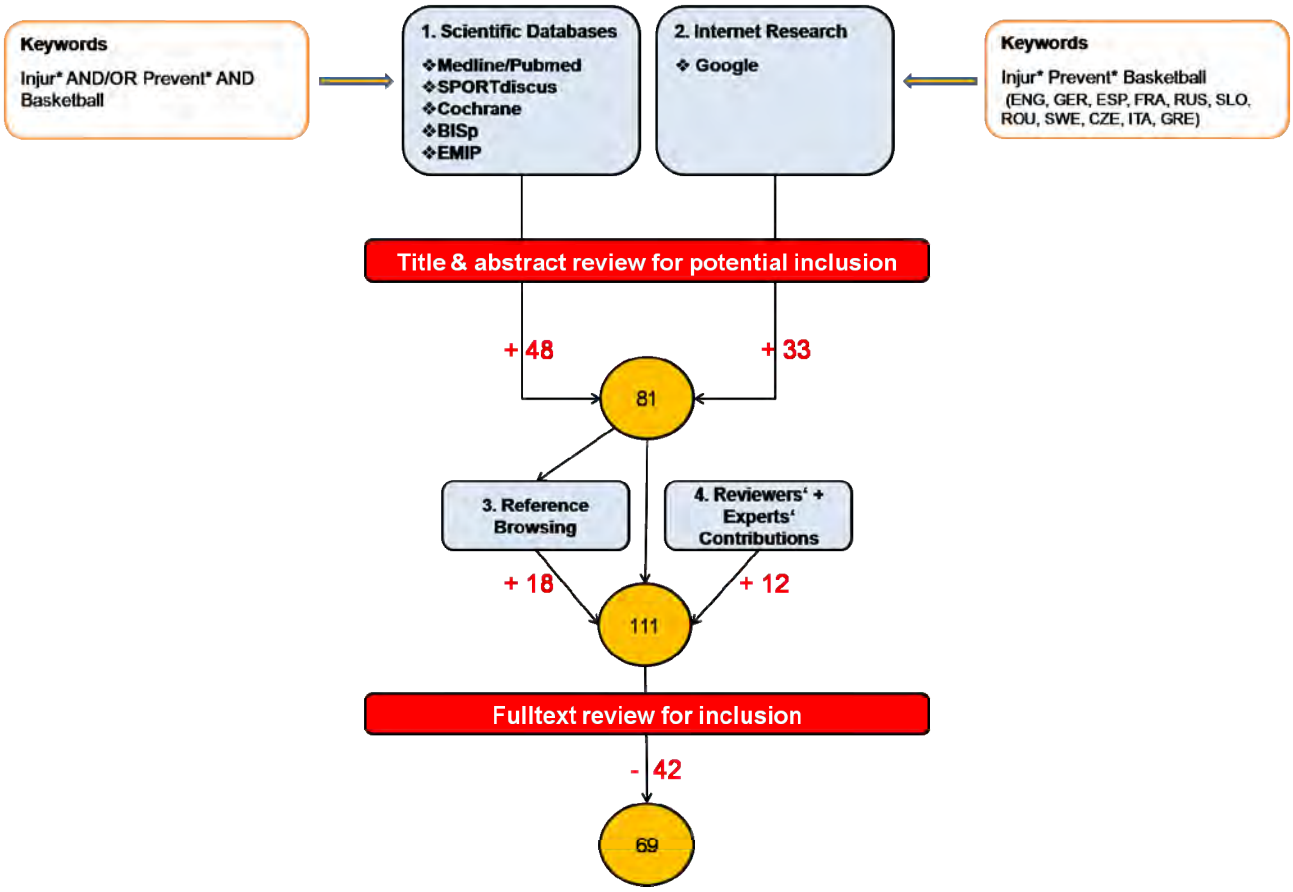


Fig. 3. Literature flow of the inventory considering applied search strategies and reviewing processes

2.4 Subdivision of Findings

Prevention measures aim to address intrinsic and extrinsic risk factors. Training programmes as well as medical and non-medical support are mainly concerned with intrinsic risk factors i.e. the predisposition of the athlete. By contrast protective equipment as well as technical and political strategies predominantly focus on extrinsic risk factors i.e. the general framework affecting basketball activities on all levels. For these reasons and for ways of easier categorisation, subdivisions have been defined allowing a first rough differentiation and allocation of all sources. Some findings relate to multiple subcategories, e.g. the combination of external ankle bracing (equipment) and ankle stabilisation training (training), recommendation of medical screenings (medical support) and their implementation within sports federations (political strategies).

Regarding the autonomous preventive recommendations, a subdivision into different fields of prevention was essential to finally allow a plain comparison of the presented preventive ideas.

The specific divisions of injury prevention as illustrated in Fig. 4 were defined as:

(1) Training & Physical Preparation
e.g. balancing exercises, stabilization, strengthening, agility, coordination, stretching

(2) Technical & Political Approaches
e.g. fairplay campaigns, coaches education, behaviour and rules modification, refereeing

(3) Equipment & Facilities
e.g. taping, orthoses, mouthguards, protectors, floor conditions, venues, shoes

(4) Medical & Non-medical Support
e.g. physiotherapy, pre-participation-examinations, medical screenings, massage, psychological support

(5) Multifaceted Approaches
Picking up aspects of at least two different subgroups that are mentioned above



Fig. 4. Fields of injury prevention

On the basis of the depicted preventive recommendation each of the 69 identified findings was allocated to one definite category. However, as multi-faceted approaches by definition pick up aspects of at least two categories, the overall number of single recommendations was in fact 108.

2.5 Structured Summaries of Findings

Due to copyright protection it was not possible to provide complete original and full-text references. Combined with the intention to condense the gathered information it seemed practicable to produce comprehensive summaries of all findings, giving a clear description of respective contents with special regard to the final preventive recommendation of each paper.

The present inventory report does not only focus on scientifically proven contents but also includes grey literature and expert recommendations that have not been tested anyway. Despite lower evidence levels these recommendations have a high relevance for prevention work in basketball and in addition, they represent the current knowledge of basketball experts. The validation levels that are depicted in the template substantially stick to evidence levels that have been defined by the CEBM (University of Oxford). Considering the above mentioned restrictions of the findings it was necessary to merge the high quality classification (level 1-3) to two comprehensive grades i.e. multiple scientific validation and single scientific validation. In return, the lower level of evidence has been differentiated more detailed. Fig. 5 shows the applied template structure with main issues and respective definitions and explanations.

<table>
<tr><th colspan="2">Title</th><th colspan="3">Author / Editor</th></tr>
<tr><td colspan="2">Original title</td><td colspan="3">First author</td></tr>
<tr><th colspan="2">English Title</th><th>Year</th><th>Country</th><th>Doc.No</th></tr>
<tr><td colspan="2">Original title in English</td><td>of publication</td><td>of origin</td><td>Internal coding</td></tr>
<tr><th>Source</th><th>Category</th><th colspan="3">Validation</th></tr>
<tr><td>Place of publication/finding

Form / Dissemination

Subject-matter + presentation and promotion</td><td>Main subject(s) of the final preventive recommendation:

<u>Training & Physical Preparation</u>
(e.g. proprioception, balance, agility, strength, flexibility)

<u>Technical & Political Approaches</u>
(e.g. Fair play campaigns, changes or modification of rules, refereeing and penalisation, psychological and behavioural aspects)

<u>Equipment & Facilities</u>
(e.g. orthoses, mouthguards, shoes, protectors, surface conditions, safety standards)

<u>Medical & Non-medical Support</u>
(e.g. PPE, medical screening, physiotherapy, return to play guidelines)

<u>Multifaceted Approaches</u>
(multisided recommendation referring to more than one of the above mentioned categories)</td><td colspan="3">Validity of the final preventive recommendation:

<u>Multiple scientific validation</u>
(e.g. review, meta-analysis)

<u>Single scientific validation</u>
(e.g. Single RCT, intervention study)

<u>Science-based</u>
(with reference to scientific data, studies)

<u>Multiple expert recommendation</u>
(by more than one expert from the fields of coaching, [sport] science, medicine, etc.)

<u>Single expert recommendation</u>
(from the fields of coaching, [sport] science, medicine, etc.)</td></tr>
<tr><th colspan="5">Description</th></tr>
<tr><th>Summary</th><td colspan="4">Brief summary of the context, contents, main findings and statements</td></tr>
<tr><th>Preventive recommendation</th><td colspan="4">Autonomous, comprehensive and conclusive statement(s) of the source towards prevention in basketball</td></tr>
</table>

Fig. 5. Structured template for comprehensive summaries of findings

3. Findings

Based on the methodology presented in the previous section, altogether 69 sources dealing with 108 preventive recommendations have been included in the inventory.

In addition to an overall description of the findings that is given below, a differentiated description within the predefined subdivisions (1) Training & Physical Preparation, (2) Technical & Political Approaches, (3) Equipment & Facilities, (4) Medical & Non-medical Support and (5) Multifaceted Approaches is presented as well.

As the reader may expect some of the sources within a different category (subdivision) and to avoid any duplication of combined measures which could also appear separately, a first alphabetical overview of the findings might be helpful (Tab. 7).

Tab. 7. *Alphabetical overview of the findings in injury prevention in basketball*

#	Author	Year	Country	Title
1	Aaltonen et al.	2007	Finland	Prevention of Sports Injuries - Systematic Review of Randomized Controlled Trials
2	American Academy of Orthopaedic Surgeons (AAOS)	2009	USA	Basketball Injury Prevention
3	Abernethy et al.	2007	Ireland	Strategies to prevent injury in adolescent sport: a systematic review
4	Agel et al.	2007	USA	Descriptive Epidemiology of Collegiate Women's Basketball Injuries: National Collegiate Athletic Association Injury Surveillance System, 1988–1989 Through 2003–2004
5	Allen et al.	1993	USA	The effect of preventative drills on stability of the knee in female basketball players
6	Amy, E	2004	Puerto Rico	Dental Injuries – Facial Injuries
7	Ardila et al.	2007	Colombia	Evidencia del trabajo propioceptivo utilizado en la prevención de lesiones deportivas
8	Badel et al.	2007	Croatia	Dental / orofacial trauma in contact sports and intraoral mouthguard programmes
9	Barret et al.	1993	USA	High- versus low-top shoes for the prevention of ankle sprains in basketball players : A prospective randomized study
10	Benazzo et al.	2008	Italy	La prevenzione della patologia di piede e caviglia nello sport
11	BCIRPU (The British Columbia Injury Research and Prevention Unit)	2000	Canada	Basketball Injuries
12	bfu Beratungsstelle für Unfallverhütung	2004	Switzerland	Unterrichtsblätter zur Sicherheitsförderung an Schulen - Ballspiele
13	Blunschi, B	2005	Switzerland	Dänk a Gläänk - Basketball-Manual für Trainerinnen und Trainer.
14	Callaghan, M	1997	Great Britain	Role of ankle taping and bracing in the athlete
15	Chappell et al.	2008	USA	Effect of a Neuromuscular Training Program on the Kinetics and Kinematics of Jumping Tasks
16	Emery et al.	2007	Canada	A Prevention Strategy to Reduce the Incidence of Injury in High School Basketball: A Cluster Randomized Controlled Trial
17	Cretu et al.	2005	Romania	Studiu privind aVantajele utilizarii stretchingului in prevenirea accidentelor la jucatorii de baschet
18	Cumps et al.	2007	Belgium	Efficacy of a sports specific balance training programme on the incidence of ankle sprains in basketball
19	Curtis et al.	2008	USA	The Role of Shoe Design in Ankle Sprain Rates Among Collegiate Basketball Players
20	Cuzzolin, F	2005	Italy	Injury Prevention: Drills on the Court
21	Deakin University	2002	Australia	Shooting for basketball injury prevention

22	Dick et al.	2007	USA	Descriptive Epidemiology of Collegiate Men's Basketball Injuries: National Collegiate Athletic Association Injury Surveillance System, 1988–1989 Through 2003–2004
23	Edwards, C	2005	Switzerland	Prevention is better than cure
24	Eils et al.	2006	Germany	Prävention von Sprunggelenksverletzungen beim Basketball
25	Faverio, D	2003	Italy	La Propriocettività e la Pallacanestro
26	Fröhlich et al.	2008	Germany	Prävention von Sprunggelenksverletzungen
27	Gollhofer et al.	2006	Germany	Bewegungskontrolle und Verletzungsprophylaxe
28	Graumann et al.	2007	Germany	Sportverletzungen der unteren Extremität im Basketball in Abhängigkeit der Torsionssteifigkeit des Sportschuhs
29	Hakizimana et al.	2005	South Africa	Epidemiology and Management of Basketball related injuries in Rwanda
30	Hatzimanouil et al.	2007	Greece	Πρόληψη Κακώσεων στα Ομαδικά Αθλήματα Επαφής της Ποδοσφαίρισης, της Καλαθοσφαίρισης, της Υδατοσφαίρισης και της Χειροσφαίρισης
31	Henke et al.	2008	Germany	Sports Injuries in Basketball – Epidemiology and Prevention Strategies
32	Hepp, F	2004	Hungary	Prevention of anterior cruciate ligament injuries
33	Hewett et al.	1999	USA	The Effect of Neuromuscular Training on the Incidence of Knee Injury in Female Athletes
34	Hewett et al.	2006	USA	Anterior Cruciate Ligament Injuries in Female Athletes - Part 2: A Meta-analysis of Neuromuscular Interventions Aimed at Injury Prevention
35	Hrysomallis et al.	2007	Australia	Relationship Between Balance Ability, Training and Sports Injury Risk
36	Huguet, J	2003	France	Ocular Traumas in Basketball
37	Iversen et al.	2009	USA	Pilot study of female high school basketball players' anterior cruciate ligament injury knowledge, attitudes, and practices
38	Jenkins et al.	2006	USA	Lower-Extremity Overuse Injury and Use of Foot Orthotic Devices in Women's Basketball
39	Junsten et al.	2008	Sweden	Vilka träningsmetoder förebygger skador i knä – och fotled inom idrott? – En litteraturstudie
40	Knapik et al.	2007	USA	Mouthguards in Sport Activities History, Physical Properties and Injury Prevention Effectiveness
41	Knobloch et al.	2005	Germany	Basketballverletzungen im Schulsport
42	Kofotolis et al.	2007	Germany	Ankle Sprain Injuries: A 2-Year Prospective Cohort Study in Female Greek Professional Basketball Players
43	Kreische, G	2007	Germany	Stabilisierung zur Verletzungsprävention am Sprunggelenk – eine Metaanalyse
44	Labella et al.	2002	USA	Effect of mouthguards on dental injuries and concussions in college basketball
45	Leetun et al.	2004	USA	Core Stability Measures as Risk Factors for Lower Extremity Injury in Athletes
46	Lieger et al.	2006	Switzerland	Orofacial/cerebral injuries and the use of mouthguards by professional athletes in Switzerland
47	Lim et al.	2009	Korea	Effects of Sports Injury Prevention Training on the Biomechanical Risk Factors of Anterior Cruciate Ligament Injury in High School Female Basketball Players
48	Major, N	2005	USA	Role of MRI in Prevention of Metatarsal Stress Fractures in Collegiate Basketball Players
49	McCormick, B	2005	USA	A Guide for Basketball Injury Prevention
50	McGuine et al.	2006	USA	The Effect of a Balance Training Program on the Risk of Ankle Sprains in High School Athletes
51	McKay et al.	2001	Australia	Ankle injuries in basketball: injury rate and risk factors
52	McLeod, T	2008	USA	The Effectiveness of Balance Training Programs on Reducing the Incidence of Ankle Sprains in Adolescent Athletes
53	Moiler et al.	2006	Australia	The Role of Fibular Tape in the Prevention of Ankle Injury in Basketball: A Pilot Study
54	Myrick, S	2007	USA	Injury Prevention and Performance Enhancement: A training program for basketball
55	Olsen et al.	2005	Norway	Exercises to prevent lower limb injuries in youth sports: cluster randomised controlled trial
56	Parkkari et al.	2001	Finland	Is it Possible to Prevent Sports Injuries? Review of Controlled Clinical Trials and Recommendations for Future Work
57	Petersen et al.	2003	Germany	Prävention von Rupturen des vorderen Kreuzbandes im Ballsport: eine Literaturübersicht

58	Petersen et al.	2005	Germany	Rupturen des vorderen Kreuzbandes bei weiblichen Athleten. Teil 1: Epidemiologie, Verletzungsmechanismen und Ursachen Teil 2: Präventionsstrategien und Präventionsprogramme
59	Renstrom et al	2008	Sweden	Non-contact ACL injuries in female athletes: an International Olympic Committee current concepts statement
60	Šarabon et al.	2004	Slovenia	Meaning of proprioceptive training in professional basketball
61	Scanlan et al.	2001	Canada	Sports and Recreation Injury Prevention Strategies: Systematic Review and Best Practices
62	Siebert et al.	2001	Germany	Orthopädische Checkliste: Basketball
63	Siebert, C	2009	Germany	Basketball
64	Silvers et al.	2007	USA	Prevention of anterior cruciate ligament injury in the female athlete
65	Sitler et al.	1994	USA	The Efficacy of a Semirigid Ankle Stabilizer to Reduce Acute Ankle Injuries in Basketball
66	Stein, A		USA	Keeping Your Basketball Players on the Court
67	Suva Accident Insurance Company		Switzerland	Basketball: SuvaLiv-Fairness-Preis
68	Svensk Basketballförbundet	2007	Sweden	knäkontroll förebygg skador - prestera bättre
69	Ward, T	2005	Australia	Reducing the risks of re-injury

The above-mentioned findings mainly derive from research in major scientific databases and internet sources as described in the section “Methods”. Taking a look on single category recommendations, Training & Physical Preparation is heading the number of findings (51 recommendations), followed by Equipment & Facilities (37 recommendations) and Technical & Political Approaches (14 recommendations). Medical & Non-medical Support is represented by 6 recommendations. Considering that 23 sources address two or more categories, all included 69 sources offer altogether 108 recommendations for preventing injuries in basketball. Only 58 out of 108 recommendations meet the requirements of strong scientific demands. Nevertheless the remaining recommendations are representing a lot of expert knowledge and have sports specific relevance and should not be neglected but appraised in a common framework (Tab. 8).

Tab. 8. *Distribution of preventive measures depending on category and validation level*

	Training & Physical Preparation	**Technical & Political Approaches**	**Equipment & Facilities**	**Medical & Non-medical Support**		**Multifaceted Approaches**
Multiple scientific validation	15	2	9	0	**26 (24%)**	6
Single scientific validation	15	3	11	3	**32 (30%)**	4
Science-based	9	6	9	2	**26 (24%)**	8
Multiple expert recommendation	4	2	4	1	**11 (10%)**	3
Single expert recommendation	8	1	4	0	**13 (12%)**	2
	51 (47%)	**14 (13%)**	**37 (34%)**	**6 (6%)**	**108**	**23**

As shown in Tab. 8, about 47 % of the preventive measures can be found in the category Training & Physical Preparation. More than half of these interventions (58 %) have been validated scientifically. Medical and non medical support is mostly mentioned as part of multifaceted approaches and can be found once as a unique source.

Tab. 9. *Distribution of preventive measures depending on category and country of origin*

Country	Training & Physical Preparation	Technical & Political Approaches	Equipment & Facilities	Medical & Non-medical Support	Multi-faceted Approaches	TOTAL
Australia	1				4	**5**
Belgium	1					**1**
Canada	1		1		1	**3**
Columbia	1					**1**
Croatia			1			**1**
Finland					2	**2**
France			1			**1**
Germany	4		1		6	**11**
Great Britain			1			**1**
Greece			1		1	**2**
Hungary	1					**1**
Ireland					1	**1**
Italy	3					**3**
Korea	1					**1**
Norway	1					**1**
Puerto Rico			1			**1**
Romania	1					**1**
Slovenia	1					**1**
South Africa					1	**1**
Sweden	3					**3**
Switzerland		1	1		3	**5**
USA	10	1	6	1	4	**22**
TOTAL	**29**	**2**	**14**	**1**	**23**	**69**

With regard to the origin of identified preventive ideas, it is conspicuous that most of them have been published in United States, followed by findings from Germany, Switzerland, Australia, representing regions where either basketball has great popularity or injury prevention in sports is an important topic (Tab. 8). The sources with preventive recommendations result from 22 countries, covering all continents. 15 of these countries are located in Europe.

In the following chapters, a more differentiated overview of the sources is given. The respective templates with the summaries can be found in the appendix.

3.1 Training & Physical Preparation

As probably expected and characteristically for team sports, the biggest group of findings is concerned with preventive training contents and programmes. Almost half of all findings (47 %) are addressing this area. This knowledge is laid down in 29 sources that are exclusively dealing with training. In addition 21 of the 23 multifaceted approaches also relate to training. Tab. 10 gives an alphabetical overview of this area.

Tab. 10. *Alphabetical overview of the findings in the subdivision "Training & Physical Preparation"*

Training				
#	**Author**	**Year**	**Country**	**Title**
1	Allen et al.	1993	USA	The effect of preventative drills on stability of the knee in female basketball players
2	Ardila et al.	2007	Colombia	Evidencia del trabajo propioceptivo utilizado en la prevención de lesiones deportivas
3	Benazzo et al.	2008	Italy	La prevenzione della patologia di piede e caviglia nello sport
4	Chappell et al.	2008	USA	Effect of a Neuromuscular Training Program on the Kinetics and Kinematics of Jumping Tasks
5	Emery et al.	2007	Canada	A Prevention Strategy to Reduce the Incidence of Injury in High School Basketball: A Cluster Randomized Controlled Trial
6	Cretu et al.	2005	Romania	Studiu privind aVantajele utilizarii stretchingului in prevenirea accidentelor la jucatorii de baschet
7	Cumps et al.	2007	Belgium	Efficacy of a sports specific balance training programme on the incidence of ankle sprains in basketball
8	Cuzzolin, F	2005	Italy	Injury Prevention: Drills on the Court
9	Faverio, D	2003	Italy	La Propriocettività e la Pallacanestro
10	Gollhofer et al.	2006	Germany	Bewegungskontrolle und Verletzungsprophylaxe
11	Henke et al.	2008	Germany	Sports Injuries in Basketball – Epidemiology and Prevention Strategies
12	Hepp, F	2004	Hungary	Prevention of anterior cruciate ligament injuries
13	Hewett et al.	1999	USA	The Effect of Neuromuscular Training on the Incidence of Knee Injury in Female Athletes
14	Hewett et al.	2006	USA	Anterior Cruciate Ligament Injuries in Female Athletes - Part 2: A Meta-analysis of Neuromuscular Interventions Aimed at Injury Prevention
15	Hrysomallis et al.	2007	Australia	Relationship Between Balance Ability, Training and Sports Injury Risk
16	Junsten et al.	2008	Sweden	Vilka träningsmetoder förebygger skador i knä – och fotled inom idrott? – En litteraturstudie
17	Leetun et al.	2004	USA	Core Stability Measures as Risk Factors for Lower Extremity Injury in Athletes
18	Lim et al.	2009	Korea	Effects of Sports Injury Prevention Training on the Biomechanical Risk Factors of Anterior Cruciate Ligament Injury in High School Female Basketball Players
19	McCormick, B	2005	USA	A Guide for Basketball Injury Prevention
20	McGuine et al.	2006	USA	The Effect of a Balance Training Program on the Risk of Ankle Sprains in High School Athletes
21	McLeod, T	2008	USA	The Effectiveness of Balance Training Programs on Reducing the Incidence of Ankle Sprains in Adolescent Athletes
22	Myrick, S	2007	USA	Injury Prevention and Performance Enhancement: A training program for basketball
23	Olsen et al.	2005	Norway	Exercises to prevent lower limb injuries in youth sports: cluster randomised controlled trial
24	Petersen et al.	2003	Germany	Prävention von Rupturen des vorderen Kreuzbandes im Ballsport: eine Literaturübersicht
25	Petersen et al.	2005	Germany	Rupturen des vorderen Kreuzbandes bei weiblichen Athleten. Teil 1: Epidemiologie, Verletzungsmechanismen und Ursachen Teil 2: Präventionsstrategien und Präventionsprogramme
26	Renstrom et al	2008	Sweden	Non-contact ACL injuries in female athletes: an International Olympic Committee current concepts statement
27	Šarabon et al.	2004	Slovenia	Meaning of proprioceptive training in professional basketball
28	Silvers et al.	2007	USA	Prevention of anterior cruciate ligament injury in the female athlete
29	Svensk Basketballförbundet	2007	Sweden	knäkontroll förebygg skador - prestera bättre

Most of these training programmes are either concerned with balance or coordination exercises for lower extremities, in particular with focus on ankle injuries or core strengthening exercises. Some findings mainly refer to the situation, that women are more vulnerable for knee injuries and suggest special training exercises. Preparation measures are either aimed at short-term preparation immediately before training or match, or at long-term preseason preparation. Few of the programmes are destined for season-attending application. No sources solely stick to upper extremities.

3.2 Technical & Political Approaches

There are only two preventive strategies that exclusively contain technical and/or political ideas. Based on epidemiological injury data, an educational module is presented, which increases the consciousness and knowledge about common injuries in women.

In addition, one initiative in Swiss elite basketball can be found aiming at reducing aggressive behaviour. This fair play campaign is promoted by the SUVA accident insurance and financially rewards respectful play.

Tab. 11. *Alphabetical overview of the findings in the subdivision "Technical & Political Approaches"*

Technical & Political Strategies				
#	Author	Year	Country	Title
1	Iversen et al.	2009	USA	Pilot study of female high school basketball players' anterior cruciate ligament injury knowledge, attitudes, and practices
2	Suva Accident Insurance Company		Switzerland	Basketball: SuvaLiv-Fairness-Preis

3.3 Equipment & Facilities

Most of the measures presented address either preferably custom made mouthguards or ankle injuries prevention via bracing/taping or high top shoes.

Tab. 12. *Alphabetical overview of the findings in the subdivision "Equipment & Facilities"*

#	Author	Year	Country	Title
1	Amy, E	2004	Puerto Rico	Dental Injuries – Facial Injuries
2	Badel et al.	2007	Croatia	Dental / orofacial trauma in contact sports and intraoral mouthguard programmes
3	Barret et al.	1993	USA	High- versus low-top shoes for the prevention of ankle sprains in basketball players : A prospective randomized study
4	Callaghan, M	1997	Great Britain	Role of ankle taping and bracing in the athlete
5	Curtis et al.	2008	USA	The Role of Shoe Design in Ankle Sprain Rates Among Collegiate Basketball Players
6	Edwards, C	2005	Switzerland	Prevention is better than cure
7	Graumann et al.	2007	Germany	Sportverletzungen der unteren Extremität im Basketball in Abhängigkeit der Torsionssteifigkeit des Sportschuhs
8	Huguet, J	2003	France	Ocular Traumas in Basketball
9	Jenkins et al.	2006	USA	Lower-Extremity Overuse Injury and Use of Foot Orthotic Devices in Women's Basketball

10	Knapik et al.	2007	USA	Mouthguards in Sport Activities History, Physical Properties and Injury Prevention Effectiveness
11	Kofotolis et al.	2007	Germany	Ankle Sprain Injuries: A 2-Year Prospective Cohort Study in Female Greek Professional Basketball Players
12	Labella et al.	2002	USA	Effect of mouthguards on dental injuries and concussions in college basketball
13	Scanlan et al.	2001	Canada	Sports and Recreation Injury Prevention Strategies: Systematic Review and Best Practices
14	Sitler et al.	1994	USA	The Efficacy of a Semirigid Ankle Stabilizer to Reduce Acute Ankle Injuries in Basketball

3.4 Medical & Non-medical Support

There is only one source that exclusively deals with medical support recommending prophylactic MRI (Magnetic Resonance Imaging) screenings in view of preventing stress fractures. Further advice relating to this category can be found as part of multifaceted approaches.

Tab. 13. *Alphabetical overview of the findings in the subdivision "Medical & Non-medical Support"*

#	Author	Year	Country	Title
1	Major, N	2005	USA	Role of MRI in Prevention of Metatarsal Stress Fractures in Collegiate Basketball Players

3.5 Multifaceted Approaches

Most of the multifaceted approaches contain a combination of training contents and either protective equipment or promotion of appropriate behaviour. Training measures are mainly focusing on balance and coordination exercises. Additional equipment advises favour the use of mouthguards and orthoses (ankle braces).

Recommendations on technical & political strategies predominantly refer to change of rules or behaviour and/or aspects of fair play. In addition, screening methods are discussed.

Tab. 14. *Alphabetical overview of the findings in the subdivision "Multifaceted Approaches"*

#	Author	Year	Country	Title
1	Aaltonen et al.	2007	Finland	Prevention of Sports Injuries - Systematic Review of Randomized Controlled Trials
2	American Academy of Orthopaedic Surgeons (AAOS)	2009	USA	Basketball Injury Prevention
3	Abernethy et al.	2007	Ireland	Strategies to prevent injury in adolescent sport: a systematic review
4	Agel et al.	2007	USA	Descriptive Epidemiology of Collegiate Women's Basketball Injuries: National Collegiate Athletic Association Injury Surveillance System, 1988–1989 Through 2003–2004
5	BCIRPU (The British Columbia Injury Research and Prevention Unit)	2000	Canada	Basketball Injuries
6	bfu Beratungsstelle für Unfallverhütung	2004	Switzerland	Unterrichtsblätter zur Sicherheitsförderung an Schulen - Ballspiele

7	Blunschi, B	2005	Switzerland	Dänk a Glänk - Basketball-Manual für Trainerinnen und Trainer.
8	Deakin University	2002	Australia	Shooting for basketball injury prevention
9	Dick et al.	2007	USA	Descriptive Epidemiology of Collegiate Men's Basketball Injuries: National Collegiate Athletic Association Injury Surveillance System, 1988–1989 Through 2003–2004
10	Eils et al.	2006	Germany	Prävention von Sprunggelenksverletzungen beim Basketball
11	Fröhlich et al.	2008	Germany	Prävention von Sprunggelenksverletzungen
12	Hakizimana et al.	2005	South Africa	Epidemiology and Management of Basketball related injuries in Rwanda
13	Hatzimanouil et al.	2007	Greece	Πρόληψη Κακώσεων στα Ομαδικά Αθλήματα Επαφής της Ποδοσφαίρισης, της Καλαθοσφαίρισης, της Υδατοσφαίρισης και της Χειροσφαίρισης
14	Knobloch et al.	2005	Germany	Basketballverletzungen im Schulsport
15	Kreische, G	2007	Germany	Stabilisierung zur Verletzungsprävention am Sprunggelenk – eine Metaanalyse
16	Lieger et al.	2006	Switzerland	Orofacial/cerebral injuries and the use of mouthguards by professional athletes in Switzerland
17	McKay et al.	2001	Australia	Ankle injuries in basketball: injury rate and risk factors
18	Moiler et al.	2006	Australia	The Role of Fibular Tape in the Prevention of Ankle Injury in Basketball: A Pilot Study
19	Parkkari et al.	2001	Finland	Is it Possible to Prevent Sports Injuries? Review of Controlled Clinical Trials and Recommendations for Future Work
20	Siebert et al.	2001	Germany	Orthopädische Checkliste: Basketball
21	Siebert, C	2009	Germany	Basketball
22	Stein, A		USA	Keeping Your Basketball Players on the Court
23	Ward, T	2005	Australia	Reducing the risks of re-injury

4. Synopsis and Conclusions

1.7 million European citizens play basketball in an organized manner and regularly participate in competition and training. This large community makes basketball one of the most popular team sports in the European area, although the roots of the game can be found in the US area. Basketball is practiced by men and women starting at the age of 5 to 6 years and ending in the forties. It is typically organised in sports clubs but recreational basketball and school basketball enjoy a large popularity. Thus, basketball has a large social value, in particular with regard to public health.

One has to expect 3-6 injuries per 1000 hours of basketball action. Most of the injuries happen during matches. There is a rough differentiation between contact and non-contact injuries. With regard to the topography of basketball injuries, lower extremities account for most of the injuries, followed by head and finger injuries. Sprains, strains and contusions are the predominantly injury types. More than 1/3 of all injuries affect the ankle joint, mainly deriving from landing on an opponent's foot when coming down from rebounds and jump shots. Considering the upper body regions, contact with opponents (head) and balls (fingers) appear to be the predominant mechanism. In general center players seem to be more prone to injuries compared to other player groups. The most severe injuries are knee injuries. Typical mechanisms are running with quick direction changes and sharp cutting maneuvers. It has been shown that women are clearly more vulnerable to knee injuries, in particular to ACL-ruptures.

With regard to the European area (not including recreational basketball and school sports) one can appraise that at least 720,000 injuries per year cause economic costs of approximately € 500 million. These facts accentuate the urgent need for preventive measures in basketball.

Compiling the state of the art in injury prevention in basketball showed that nearly half of identified countermeasures focus on training followed by protective equipment. A reduction of athletic deficits as well as improvements in balance, coordination and technique skills are typically recommended with respect to preventing injuries of the lower extremities. In addition, core stabilisation, flexibility and advanced elementary coordination and technique skills are claimed to protect the player. Passive protection is proposed in form of high-top shoes, mouthguards, taping, ankle braces and orthoses, in particular for athletes with history of injuries. There is a certain demand for medical check-ups and preventive screenings. In general, a noticeable call for fair play and sufficient regeneration is present.

The findings clearly reflect the differences in basketball's socio-cultural value. As expected, Northern America, as origin and clear core region of basketball, provides the largest amount of preventive approaches. With regard to the aetiology, one has to face the fact that modern basketball has evolved into a team sport with high physical contact. Thus, it is not surprising that the majority of findings somehow

address training and physical preparation. Improving players' general performance and thereby helping athletes to salutarily sustain the underlying physical demands seems to be a main goal in injury prevention in basketball.

Beside organized basketball in sports clubs there is a large population in Europe that plays basketball on a recreational level. Since "streetball" has emerged as serious recreational activity national and international basketball federations have increased their efforts to maintain and enlarge this movement. With respect to aspects of public health and well being, this population should also be considered when applying targeted prevention measures.

Injury surveillance should be enforced to supervise injury trends and to evaluate effects of preventive interventions. Compliance and acceptance are the sticking points for sustainable injury prevention in basketball. Therefore an interaction between science and practice on all levels is essential.

5. References

Aaltonen, S., et al. (2007). Prevention of Sports Injuries - Systematic Review of Randomized Controlled Trials. *Archives of Internal Medicine 167 (15),* 1585-1592.

American Academy of Orthopaedic Surgeons (2009). *Basketball Injury Prevention.* http://orthoinfo.aaos.org/topic.cfm?topic=A00177.

Abernethy, L.,et al. (2007). Strategies to Prevent Injury in Adolescent Sport: a Systematic Review*. British Journal of Sports Medicine, 41,* 627-638.

Agel, J., et al. (2005). Anterior cruciate ligament injury in National Collegiate Athletic Association basketball and soccer. *American Journal of Sports Medicine, 33,* 524- 530.

Agel, J., et al. (2007). Descriptive Epidemiology of Collegiate Women's Basketball Injuries:National Collegiate Athletic Association Injury Surveillance System, 1988–1989 Through 2003–2004. *Journal of Athletic Training, 42 (2),* 202-210.

Allen, G., et al. (1993). *The effect of preventative drills on stability of the knee in female basketball players*. http://w4.ub.uni-konstanz.de/cpa/article/viewFile/1704/1606.

Amy, E. (2004). *Dental Injuries*. http://www.fiba.com/asp_includes/download.asp?file_id=376.

Amy, E. (2004). *Facial Injuries*. http://www.fiba.com/asp_includes/download.asp?file_id=411.

Ardila, C., et al. (2007*). Evidencia del trabajo propioceptivo utilizado en la prevención de lesions deportivas.* Universidad de Antioquia, Colombia. http://viref.udea.edu.co/contenido/pdf/062/evidencia.pdf.

Arendt, E., et al. (1995). Knee Injury Patterns Among Men and Women in Collegiate Basketball and Soccer: NCAA Data and Review of Literature. *American Journal of Sports Medicine, 23,* 694-701.

Arendt, E., et al. (1999). Anterior Cruciate Ligament Injury Patterns Among Collegiate Men and Women. *Journal of Athletic Training, 34,* 86-92.

Badel, T., et al. (2007). Dental / Orofacial Trauma in Contact Sports and Intraoral Mouthguard programmes. *Kinesiology, 39 (1),* 97-105.

Bahr, R. (2009). No injuries, but plenty of pain? On the methodology for recording overuse symptoms in sports. *British Journal of Sports Medicine, 43,* 966-972.

Barret, J., et al. (1993). High- versus low-top shoes for the prevention of ankle sprains in basketball players : A prospective randomized study. *The American Journal of Sports Medicine, 21 (4),* 582-585.

Benazzo, F., et al. (2008). Prevention of sports-related foot and ankle injuries. *Medicina dello sport, 61(1),*1-9. The British Columbia Injury Research and Prevention Unit (2000). B*asketball Injuries*. www.injuryresearch.bc.ca.

bfu (2004). *Unterrichtsblätter zur Sicherheitsförderung an Schulen - Ballspiele.* http://www.bfu.ch/PDFLib/255_76.pdf.

Blunschi, B. (2005). *Dänk a Gläänk: Basketball-Manual für Trainerinnen und Trainer*. https://wwwsapp1.suva.ch/sap/public/bc/its/mimes/zwaswo/99/pdf/88137_d.pdf.

Borowski, L.A., et al. (2008). The Epidemiology of US High School Basketball Injuries, 2005-2007. *American Journal of Sports Medicine, 36 (12),* 2328-2335

Brooks, J. H., et al. (2006). The influence of methodological issues on the results and conclusions from epidemiological studies of sports injuries: illustrative examples. *Sports Medicine, 36 (6)*, 459-472.

Callaghan, M. (1997). Role of ankle taping and bracing in the athlete. *British Journal of Sports Medicine*, *31*, 102-108.

Chappell, J. D., et al. (2008). Effect of a Neuromuscular Training Program on the Kinetics and Kinematics of Jumping Tasks. *American Journal of Sports Medicine, 36 (6),* 1081-1086.

Comstock, R.D., et al. (2009). *National High School Sports-related injury surveillance study. 2008-2009 school year.* Center for Injury Research and Policy. Columbus, USA.

Cretu, A., et al. (2005). Studiu privind aVantajele utilizarii stretchingului in prevenirea accidentelor la jucatorii de baschet. *Revista Stiinta Sportului*, *47 (4).*

Cumps, E., et al. (2007). Efficacy of a sports specific balance training programme on the incidence of ankle sprains in basketball. *Journal of Sports Science and Medicine,* (6), 212-219.

Cumps, E., et al. (2008). Injury rate and socio-economic costs resulting from sports injuries in Flanders. Data derived from Sports Insurance Statistics 2003. *British Journal of Sports Medicine, 42,* 767-772.

Curtis, C., et al. (2008). The Role of Shoe Design in Ankle Sprain Rates Among Collegiate Basketball Players. *Journal of Athletic Training, 43(3),* 230-233.

Cuzzolin, F. (2005). Injury Prevention: Drills on the Court. *FIBA Assist Magazin, 15*, 59-62.

Deakin-University (2002). *Shooting for basketball injury prevention*. http://www.sport.vic.gov.au/web9/rwpgslib.nsf/GraphicFiles/ Shooting_for_basketball_injury_prevention.pdf/$file/ Shooting_for_basketball_injury_prevention.pdf.

Deitch, J. R., et al. (2006). Injury Risk in Professional Basketball Players: A Comparison of Women's National Basketball Association and National Basketball Association Athletes. *American Journal of Sports Medicine, 34,* 1077-1083.

De Loës, M., et al. (2000). A 7-year study on risks and costs of knee injuries in male and female youth participants in 12 sports. *Scandinavian Journal of Medicine & Science in Sports, 10,* 90-97.

Dick, R., et al. (2007). Descriptive Epidemiology of Collegiate Men's Basketball Injuries: National Collegiate Athletic Association Injury Surveillance System, 1988–1989 Through 2003–2004. *Journal of Athletic Training*, *42(2),*194-201.

Drakos, M., et al. (2010). Injury in the National Basketball Association: A 17-Year Overview. *Sports Health: A Multidisciplinary Approach. DOI:10.1177/1941738109357303* (online publication first)

Edwards, C. (2005). Prevention is better than cure. *FIBA Assisst Magazine*, *(13)*, 58-59.

Eils, E., et al. (2006). Prävention von Sprunggelenksverletzungen beim Basketball. *Sicherheit im Sport. Ein Leben mit Sport – aber sicher.,* 279-285.

Emery, C. (2007). A Prevention Strategy to Reduce the Incidence of Injury in High School Basketball: A Cluster Randomized Controlled Trial. *Clinical Journal of Sport Medicine*, *17,*17–24.

Faverio, D. (2003). *La Propriocettività e la Pallacanestro*. http://www.preparazioneatletica.it/prevenzione/prevenzione1.

FIBA (2008). Official Basketball Rules 2008. http://www.fiba.com/downloads/Rules/2008/OfficialBasketballRules2008.pdf

FIBA (2010). Inside FIBA. Quick facts. http://www.fiba.com/pages/eng/fc/FIBA/quicFact/p/openNodeIDs/962/selNodeID/962/quicFacts.html

FIBA (2010). Inside FIBA. FIBA History. http://www.fiba.com/pages/eng/fc/FIBA/fibaHist/p/openNodeIDs/987/selNodeID/987/bday.html

FIBA (2010). FIBA 33 Official Rules of the Game. http://www.fiba.com/downloads/Rules/FIBA33_Official_Rules_Scoresheet_2010.pdf

Frisch, A. et al. (2009). Injuries, risk factors and prevention initiatives in youth sport. *British Medical Bulletin, 24,* 1-27.

Fröhlich, V. (2008). *Prävention von Sprunggelenksverletzungen.* www.basketdocs.de.

Fuller, C. W., et al. (2006). Consensus statement on injury definitions and data collection procedures in studies of football injuries. *Scandinavian Journal of Medicine & Science in Sports, 16,* 83-92.

Fuller, C.W. (2007). Consensus statement on injury definitions and data collection procedures for studies of injuries in rugby union. *British Journal of Sports Medicine,41*, 328-331.

Gollhofer, A., et al. (2006). Bewegungskontrolle und Verletzungsprophylaxe. *Deutsche Zeitschrift für Sportmedizin, 57 (11/12),* 266-270.

Gomez, E., et al. (1996). Incidence of Injury in Texas Girls' High School Basketball. *American Journal of Sports Medicine, 24,* 684-687.

Graumann, L., et al. (2007). Sportverletzungen der unteren Extremität im Basketball in Abhängigkeit der Torsionssteifigkeit des Sportschuhs. *Sportorthopädie und Sporttraumatologie, 23,* 174-177.

Hakizimana, M. (2005). *Epidemiology and Management of Basketball related Injuries in Rwanda*. http://etd.uwc.ac.za/usrfiles/modules/etd/docs/etd_init_6540_1175070434.pdf.

Hatzimanouil, D., et al. (2007). Prevention of Injuries in Contact Sports Such as Soccer, Basketball, Water Polo and Team Handball. *Sport & Physical Education Volume, 1 (5),* 143-155.

Henke, T. (2003). *Gesundheitsbericht Nordrhein-Westfalen: Sportunfälle (Themenspezifische Reihe Band 1).* Düsseldorf: Ministerium für Gesundheit, Soziales, Frauen und Familie des Landes Nordrhein-Westfalen.

Henke, T. (2004). Sports Injuries in the EU countries in view of the 2004 Olympics: Harvesting the information from existing databases. In Pedridou, E. (Ed.) *Germany – National Report* (pp. 214-240). http://ec.europa.eu/health/ph_projects/1999/injury/fp_injury_1999_frep_20_en.pdf.

Henke, T., et al. (2008). Sports Injuries in Basketball – Epidemiology and Prevention Strategies. *13th Annual Congress of the European College of Sports Science, Portugal: Estoril.* Book of abstract, 475

Hepp, F. (2004). Prevention of anterior cruciate ligament injuries. *Fiba Assisst Magazine*, *(11),* 57-58.

Hewett, T., et al. (1999). The Effect of Neuromuscular Training on the Incidence of Knee Injury in Female Athletes. *American Journal of Sports Medicine, 27 (6)*, 699-706.

Hewett, T. E., et al. (2006). Anterior Cruciate Ligament Injuries in Female Athletes. *American Journal of Sports Medicine, 34,* 490.

Hickey, G., et al. (1997). WA: Injuries to young elite basketball players over a six-year period. *Clinical Journal of Sports Medicine, 7,* 252-256.

Hrysomallis, C. (2007). Relationship between Balance Ability, Training and Sports Injury Risk. *Sports Medicine, 37 (6),* 547-556.

Huguet, J. (2003). Ocular traumas in basketball. *Fiba Asisst Magazine, (1)*, 57-58.

Iversen, M., et al. (2009). Pilot study of female high school basketball players' anterior cruciate ligament injury knowledge, attitudes, and practices. *Scandinavian Journal of Medicine & Science in Sports, 19(4),* 595-602.

Janeira, M., et al. (1998). Game intensity in basketball. An interactionist view linking time-motion analysis, lactate concentration and heart rate. *Coaching & Sport Science Journal, 3 (2)*, 26-30.

Jenkins, W., et al. (2006). Lower-Extremity Overuse Injury and Use of Foot Orthotic Devices in Women's Basketball. *Journal of the American Podiatric Medical Associatio, 96(5),* 408-412.

Junsten, E., et al. (2008). *Vilka träningsmetoder förebygger skador i knä – och fotled inom idrott? .* Instituionen för hälsovetenskap, Lulea Tekniska Universitet. http://epubl.ltu.se/1402-1773/2008/332/LTU-CUPP-08332-SE.pdf.

Knapik, J. J., et al. (2007). Mouthguards in Sport Activities History, Physical Properties and Injury Prevention Effectiveness. *Sports Medicine, 37 (2),* 117-144.

Knobloch, K., et al. (2005). Basketballverletzungen im Schulsport. *Deutsche Zeitschrift für Sportmedizin, 56(4),* 96-99.

Kofotolis, N., et al. (2007). Ankle Sprain Injuries: A 2-Year Prospective Cohort Study in Female Greek Professional Basketball Players. *Journal of Athletic Training, 42(3),* 388-394.

Kreische, G. (2007). *Stabilisierung zur Verletzungsprävention am Sprunggelenk – eine Metaanalyse.* Medizinische Fakultät, Universität Würzburg.

*Krosshaug, T., et al. (2007).*Mechanisms of anterior cruciate ligament injury in basketball. Video analysis of 39 cases*. American Journal of Sports Medicine, 35,* 359-367.

Labella, C., et al. (2002). Effect of mouthguards on dental injuries and concussions in college basketball. *Medicine & Science in Sports & Exercise*, 41-44.

Lanese, R.R., et al. (1990). Injury and Disability in Matched Men's and Women's Intercollegiate Sports. *American Journal of Public Health, 12,* 1459-1462.

Leetun, D., et al. (2004). Core Stability Measures as Risk Factors for Lower Extremity Injury In Athletes. *Medicine & Science in Sports & Exercise*, 926-934.

Lian, O., et al. (2005). Prevalence of jumper's knee among elite athletes from different sports. *American Journal of Sports Medicine, 33,* 561-567.

Lieger, O., et al. (2006). Orofacial/Cerebral Injuries and the Use of Mouthguards by Professional Athletes in Switzerland. *Dental Traumatology, 22,* 1–6.

Lim, B., et al. (2009). Effects of Sports Injury Prevention Training on the Biomechanical Risk Factors of Anterior Cruciate Ligament Injury in High School Female Basketball Players. *American Journal of Sports Medicine, 37(9),* 1728-1734.

Major, N. M. (2005). Role of MRI in Prevention of Metatarsal Stress Fractures in Collegiate Basketball Players. *American Journal of Roentgenology* ,*186*, 255-258.

McCormick, B. (2005). *A Guide for Basketball Injury Prevention.* http://www.associatedcontent.com.

McGuine, T., et al. (2006). The Effect of a Balance Training Program on the Risk of Ankle Sprains in High School Athletes. *American Journal of Sports Medicine, 34(7),* 1103-1111.

McInnes, S., et al. (1995). The physiological load imposed on basketball players during competition. *Journal of Sports Science, 13 (5),* 387-397.

McKay, G., et al. (2001). Ankle injuries in basketball: injury rate and risk factors. *British Journal of Sports Medicine, 35*, 103–108.

McKay, G., et al. (2001). A prospective study of injuries in basketball: a total profile and comparison by gender and standard of competition. Journal of Science and Medicine in Sport 4, 196-211.

McKay, G. et al. (2010). Basketball. In D. J. Caine, P. A. Harmer & M. A. Schiff (Eds.) *Epidemiology of Injury in Olympic Sports (S. 78-91).* Chichester, UK: Wiley-Blackwell.

McLeod, T. (2008). The Effectiveness of Balance Training Programs on Reducing the incidence of Ankle Sprains in Adolescent Athletes. *Journal of Sport Rehabilitation, 17,* 316-323.

Messina, D. F., et al. (1999). The Incidence of Injury in Texas High School Basketball: A Prospective Study Among Male and Female Athletes. *American Journal of Sports Medicine, 27,* 294-299.

Meeuwisse, W. H., et al. (2003). Rates and Risks of Injury during Intercollegiate Basketball. *American Journal of Sports Medicine, 31,* 379-385.

Moiler, K., et al. (2006). The Role of Fibular Tape in the Prevention of Ankle Injury in Basketball: A Pilot Study. *Journal of Orthopaedic & Sports Physical Therapy, 36(9),* 661-668.

Moreno, J., (1988). Basket: Preparation physique specifique du joueur. *Education physique et sport, Bd. 211*, 17-19.

Myrick, S., (2007). Injury Prevention and Performance Enhancement: A training program for basketball. *Connecticut Medicine, 71(1),* 5-8.

National Collegiate Athletic Association NCAA (1998). NCAA Injury Surveillance System for All Sports. NCAA, Overland Park, USA

Olsen, O.E., et al. (2005). Exercises to prevent lower limb injuries in youth sports: cluster randomised controlled trial. *British Medical Journal, 330,* 449.

Parkkari, J., et al. (2001). Is it Possible to Prevent Sports Injuries? Review of Controlled Clinical Trials and Recommendations for Future Work. *Sports Medicine, 31(14),* 985-995.

Petersen, W., et al. (2003). Prävention von Rupturen des vorderen Kreuzbandes im Ballsport: eine Literaturübersicht. *Sportorthopädie – Sporttraumatologie, 19,* 105-109.

Petersen, W., et al. (2005). Rupturen des vorderen Kreuzbandes bei weiblichen Athleten. Teil 1: Epidemiologie, Verletzungsmechanismen und Ursachen. *Deutsche Zeitschrift für Sportmedizin, 56 (6),* 150-164.

Piasecki, D., et al. (2003). RD: Intraarticular injuries associated with anterior cruciate ligament tear: Findings at ligament reconstruction in high school and recreational athletes. *American Journal of Sports Medicine, 31,* 601-601.

Powell, J., et al. (1999). Traumatic brain injury in high school athletes. *Journal of the American Medical Association, 282,* 958-963.

Powell, J., et al. (2000). Sex-related injury patterns among selected high school sports. *American Journal of Sports Medicine*, *28 (3),* 385-391.

Renstrom, P., et al. (2008). Non-contact ACL Injuries in Female Athletes: An International Olympic Committee Current Concepts Statement. *British Journal of Sports Medicine, 42,* 394-412.

Šarabon, N., et al. (2004). *Meaning of proprioceptive training in professional basketball.* http://www.tone-si.com/clanki/sportEN.pdf.

Scanlan, A., et al. (2001). *Sports and Recreation Injury Prevention Strategies: Systematic Review and Best Practices*. http://www.injuryresearch.bc.ca.

Schmidt, G., et al. (2003). Zur Lauf- und Sprungbelastung im Basketball. *Leistungssport, 33(1),* 41-48.

Siebert, C. H., et al. (1997). Verletzungsmuster im deutschen Basketball. *Sportorthopädie – Sporttraumatologie, 13,* 168-172.

Siebert, C., et al. (2001). Orthopädische Checkliste: Basketball. *Sportorthopädie und Sporttraumatologie, 17*, 262-263.

Silvers, H. J., et al. (2007). Prevention of Anterior Cruciate Ligament Injury in the Female Athlete. *British Journal of Sports Medicine, 41,* 52-59.

Sitler, M., et al. (1994). The Efficacy of a Semirigid Ankle Stabilizer to Reduce Acute Ankle Injuries in Basketball. *The American Journal of Sports Medicine, 22(4),* 454-461.

Stein, A. *Keeping Your Basketball Players on the Court.* http://www.coachlikeapro.com/injuryprevention.html.

Sugiyama, K., et al. (1999). Development of a treadmill running test to simulate heart rate response during a basketball game. *Research in sports medicine – An international journal, 9 (2),* 141-152.

Suva. (n/a). *Basketball*: *SuvaLiv-Fairness-Preis*. http://www.suva.ch/home/suvaliv/kampagnen/kampagne_daenk_glaenk/basketballfairnesspreis.htm.

Svensk Basketballförbundet (2007). *knäkontroll förebygg skador - prestera batter*. www.basket.se.

Ward, T. (2005). Reducing the risks of re-injury. *FIBA Assist Magazin, (12),* 62-63.

Weir, M.A., et al. (1996). A twelve month study of sports injuries in one Irish school. *Irish Journal of Medical Sciences, 165*, 165-169

Yde, J. et al. (1990). Sports injuries in adolescents‘ ball games: soccer, handball and basketball. *British Journal of Sports Medicine, 24*, 51-54

Zimmermann, M., et al. (2006). Energetische Beanspruchung im Basketball in Wettkampf und Training. In K. Weber, D. Augustin, P. Maier, K. Roth (Eds.). W*issenschaftlicher Transfer für die Praxis der Sportspiele (S. 292-296).* Köln: Strauß.

Appendix

A. Training & Physical Preparation

Title	Author / Editor
The effect of preventative drills on stability of the knee in female basketball players	Allen et al.

English Title	Year	Country	Doc.No
The effect of preventative drills on stability of the knee in female basketball players	1993	USA	098

Source	Category	Validation
SBS - Conference Proceedings Archive, 11th International Symposium on Biomechanics in Sports (1993) http://w4.ub.uni-konstanz.de/cpa/article/viewFile/1704/1606	☒ Training & Physical Preparation ☐ Technical & Political Approaches ☐ Equipment & Facilities ☐ Medical & Non-medical Support ☐ Multifaceted Approaches	☐ Multiple scientific validation ☒ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
Study Online + print congress paper		

Description

Summary	Prevention of ACL tears is a relatively new concept in sports science, however. In the past, science has placed the emphasis on rehabilitation of ACL tears rather than on prevention of the injury. Henning et al. (1985; 1989) suggest three injury prevention techniques in combination with improved strength relationships of the hamstrings and quadriceps to reduce risk of ACL tears. The three preventative techniques are: a) bent knee landings; b) rounded accelerated turns; and c) two/three step stops. The purpose of this investigation, therefore, was to study the effect of incorporating three preventative techniques into the practice sessions of an eighth grade girls' basketball team over the duration of one season on the players' knee stability. Knee stability was defined as: a) range of motion in extension and flexion; b) comparative strength of the hamstrings and quadriceps muscles; and c) joint laxity as an indicator of ACL strength. It was concluded that inclusion of the three preventative mechanical principles into practice sessions of eighth grade female basketball players improved flexion/extension ratios and peak torque values.
Preventive recommendation	Learning the preventative mechanical principles for landing, pivoting, and stopping skills may increase knee stability and reduce female basketball players' predisposition for knee injuries.

Title	Author / Editor		
Evidencia del trabajo propioceptivo utilizado en la prevención de lesiones deportivas	Ardila et al.		
English Title	**Year**	**Country**	**Doc.No**
Evidence of proprioceptive exercises in the prevention of sports injuries	2007	Colombia	007

Source	Category	Validation
Universidad de Antioquia, Colombia: 2007. http://viref.udea.edu.co/contenido/pdf/062-evidencia.pdf	☒ Training & Physical Preparation	☐ Multiple scientific validation
	☐ Technical & Political Approaches	☐ Single scientific validation
Form / Dissemination	☐ Equipment & Facilities	☒ Science-based
Thesis Online publication	☐ Medical & Non-medical Support	☐ Multiple expert recommendation
	☐ Multifaceted Approaches	☐ Single expert recommendation

Description

Summary	Thesis in the field of sports science giving an overview of anatomic and physiological background of proprioception as well as a review of relevant studies which have validated the effects of proprioceptive training with regard to a reduction of sports injuries. Taking the discussed literature into consideration the authors developed a three-way training programme for improving the proprioception; aiming at the prevention of, firstly, foot and ankle injuries, secondly, knee injuries and thirdly, hamstring and hip injuries.
Preventive recommendation	Functional flexibility and strength training of the lower limb, sensorimotor, neuromuscular and proprioceptive exercises, at least twice a week for a minimum of 15 minutes. For proper execution, supervision of the programme by physiotherapists is recommended.









Title	Author / Editor
La prevenzione della patologia di piede e caviglia nello sport	Benazzo et al.

English Title	Year	Country	Doc.No
Prevention of sports-related foot and ankle injuries	2008	Italy	093

Source	Category	Validation
Medicina dello sport 61, (1) 2008: 1-9 http://www.minervamedica.it/en/journals/medicina-dello-sport/index.php	☒ Training & Physical Preparation	☐ Multiple scientific validation
	☐ Technical & Political Approaches	☐ Single scientific validation
Form / Dissemination	☐ Equipment & Facilities	☐ Science-based
Information Online + print journal article	☐ Medical & Non-medical Support	☐ Multiple expert recommendation
	☐ Multifaceted Approaches	☒ Single expert recommendation

Description

Summary	Sports-related foot and ankle injuries are increasingly common among professional and recreational athletes and are often the cause of temporary elimination from active participation in sports or may even result in permanent structural damage to the lower limbs. The present article examines the causes of common foot and ankle injuries and discusses how they can be prevented. In popular team sports such as basketball the basic techniques are running and jumping. Thus, the prevention of functional overload is the key. From an analysis of an athlete's anatomic characteristics, predisposing factors, and specific sport techniques, adequate prevention measures against stress fractures or tendinopathies can be planned. Prevention methods include accurate analysis of the sports technique, assessment of requirements of the muscle conditioning exercises drilled by coaches, evaluation of the individual athlete's predisposing anatomic situations by the medical staff.
Preventive recommendation	Dynamic proprioception programmes. Highly useful are dynamic proprioception drills conducted on sand, which stimulates the elastic energy storage capacity of muscle tissue and works as a highly shock absorber of joint impact. This strategy, besides being useful in recovery programmes of the injured athlete, is particularly indicated in the prevention of tendinopathies.

Title	Author / Editor
Effect of a Neuromuscular Training Program on the Kinetics and Kinematics of Jumping Tasks	Chappell et al.

English Title	Year	Country	Doc.No
Effect of a Neuromuscular Training Program on the Kinetics and Kinematics of Jumping Tasks	2008	USA	015

Source	Category	Validation
American Journal of Sports Medicine 2008, 36: 1081 http://ajs.sagepub.com/	☒ Training & Physical Preparation ☐ Technical & Political Approaches ☐ Equipment & Facilities ☐ Medical & Non-medical Support ☐ Multifaceted Approaches	☐ Multiple scientific validation ☒ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
Intervention study Online + print journal article		

Description

Summary	Controlled laboratory study evaluating the effect of a neuromuscular training programme on the biomechanics of selected jumping tasks in female collegiate athletes (basketball and football). Thirty female National Collegiate Athletic Association Division I soccer and basketball players performed vertical jump, hopping tests, drop and stop jumps as pre- and post tests. All subjects completed a six week injury prevention programme combining core strengthening exercises, dynamic joint stability and balance training, jump training, and plyometric exercises. The programme consists of 10 exercises and was designed to be performed daily during a 10- to 15-minute period. After completion of the programme athletes showed changed movement patterns and improved performance in above-mentioned jumping tasks.
Preventive recommendation	Implementing a neuromuscular training programme can alter motor control strategies in females, improve performance and thus potentially lower an athlete's risk of injury.

TABLE 1
Kerlan-Jobe Orthopaedic Clinic Modified Neuromuscular Training Program

Exercise	Amount
Abdominal crunches	20 repetitions
Cross crunches	20 repetitions
The plank	Hold for 60 seconds
Lunges	20 total
Single-leg chest pass	20 passes each side
Single-leg, forward-bend pass	20 passes each side
Single-leg figure of 8	20 repetitions each leg
Line jumps	20 repetitions
Lateral shuffle	20 slides to each side
Bounding	20 jumps

Title	Author / Editor
Studiu privind aVantajele utilizarii stretchingului in prevenirea accidentelor la jucatorii de baschet	Cretu et al.

English Title	Year	Country	Doc.No
Use of stretching and its advantages for the injury prevention of basketball players	2005	Romania	019

Source	Category	Validation
Revista Stiinta Sportului (4) 47, 2005 http://www.sportscience.ro/html/revista.html	☒ Training & Physical Preparation	☐ Multiple scientific validation
	☐ Technical & Political Approaches	☒ Single scientific validation
Form / Dissemination	☐ Equipment & Facilities	☐ Science-based
Study Online journal article	☐ Medical & Non-medical Support	☐ Multiple expert recommendation
	☐ Multifaceted Approaches	☐ Single expert recommendation

Description

Summary	The present study was conducted on the Steaua Bucharest basketball team. From August 2004 to January 2005 a group of 12 sportsmen (aged 18 to 30 years) performed a systematic warm-up routine with dynamic stretching prior to each practice session and a systematic cool down routine with static stretching after each session. Occurrence of acute traumatic injuries was measured using questionnaires. Compared to the same period of the previous year results showed that the number of traumatic injuries declined in the period when stretching exercises were systematically done. It is assumed that during warm-up stretching ensures optimal condition for sports performance, whereas during cool down it has the role of improving muscular elasticity and accelerating decomposition of toxic substances from the organism.
Preventive recommendation	Stretching should be an integral part of warm-up and cool down routines prior and after each practice session.

Title	Author / Editor
Efficacy of a sports specific balance training programme on the incidence of ankle sprains in basketball	Cumps et al.

English Title	Year	Country	Doc.No
Efficacy of a sports specific balance training programme on the incidence of ankle sprains in basketball	2007	Belgium	020

Source	Category	Validation
Journal of Sports Science and Medicine (2007) 6, 212-219 http://www.jssm.org	☒ Training & Physical Preparation ☐ Technical & Political Approaches ☐ Equipment & Facilities ☐ Medical & Non-medical Support ☐ Multifaceted Approaches	☐ Multiple scientific validation ☒ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
Intervention study Online + print journal article		

Description

Summary	The purpose of the study was to determine the efficacy of basketball specific balance training programme on the incidence of lateral ankle sprains in male and female basketball players (N=54). The intervention group (N=29) performed balance exercises using balance semi-globes on top of their normal training routine. The programme lasted 22 weeks and was performed three times a week for 5 to 10 minutes. All skills performed during the intervention programme were basketball specific: each session consisted of a stance exercise, an Aberdeen (ball handling without dribbling), a dribbling and a passing drill. The intervention programme was gradually increased with respect to difficulty and safety of the balance skill. Results showed a lower risk of lateral ankle sprains in the intervention group.
Preventive recommendation	The use of balance training is recommended as a routine during basketball activities for the prevention of ankle sprains.

			Session 1 Eyes open focused on ball	Session 2 Eyes open not focused on ball	Session 3 Eyes closed
Phase 1: WITHOUT SG	Week 1		**Basketball position: feet next to each other shoulder width**[1]		
		Stance	*Sweeps (= keeping the ball alive)*		
		Dribbling	*Push & Pull dribble (= forward – backward next to feet)*		
		Aberdeen	*Turn ball around head, trunk and legs (figure 8)*		
		Passing[1]	*Hands up: straight and diagonal passing*		
	Week 2		**Tandem stance: one foot behind the other on a straight line** [1]		
		Stance	*Sweeps*		
		Dribbling	*Power dribble high and low and changing hand between the legs*		
		Aberdeen	*Turn ball around head, trunk and legs (figure 8)*		
		Passing[1]	*Hands up: with 2 balls straight passing*		
	Week 3		**One leg stance**		
		Stance	*Sweeps*		
		Dribbling	*Push & Pull dribble*		
		Aberdeen	*Figure 8 between the legs*		
		Passing[1]	*Bad passing with tennis ball*		
	Week 4		**Jumping tasks** [2, 3]		
		Stance	*Mirror the teammate*		
		Dribbling	*Push & Pull dribble + jump into pass*		
		Aberdeen	*Figure 8 between the legs + jump (= scissors)*		
		Passing[1]	*Jump to bad pass with tennis ball*		
Phase 2: SG FLAT SIDE DOWN	Week 5/6/7/8		**Basketball position: feet next to each other shoulder width** [1]		
		Stance	*Stance / Sweeps / Sweeps + Mirror the ball*[2] */ Ball fight*		
		Dribbling	*Power dribble high & low / Push & Pull dribble / Hockey dribble / L-dribble*		
		Aberdeen	*Around trunk / Figure 8 between legs / Head-trunk-figure 8 / Scissors*		
		Passing[1]	*Chest pass / Week 1 / Week 2 / Week 3*		
	Week 9/10/11/12		**Tandem stance: one foot behind the other on a straight line** [1]		
		Stance	*Stance / Sweeps / Sweeps + Mirror the ball*[2] */ Ball fight*		
		Dribbling	*Power dribble high & low / Push & Pull dribble / Hockey dribble / L-dribble*		
		Aberdeen	*Around trunk / Figure 8 between legs / Head-trunk-figure 8 / Scissors*		
		Passing[1]	*Chest pass / Week 1 / Week 2 / Week 3*		
	Week 13/14/15/1		**One leg stance**		
		Stance	*Stance / Sweeps / Sweeps + Mirror the ball*[2] */ Ball fight*		
		Dribbling	*Power dribble high & low / Push & Pull dribble / Hockey dribble / L-dribble*		
		Aberdeen	*Around trunk / Figure 8 between legs / Head-trunk-figure 8 / Scissors*		
		Passing[1]	*Chest pass / Week 1 / Week 2 / Week 3*		
Phase 3: SG GLOBE SIDE DOWN	Week 17/18		**Basketball position: feet next to each other shoulder width** [1]		
		Stance	*Stance / Sweeps*		
		Dribbling	*Push & Pull dribble / Power dribble high & low*		
		Aberdeen	*Around trunk / Figure 8 between legs*		
		Passing[1]	*Chest pass / Week 1*		
	Week 19/20		**One leg stance**		
		Stance	*Stance / Sweeps*		
		Dribbling	*Push & Pull dribble / Power dribble high & low*		
		Aberdeen	*Around trunk / Figure 8 between legs*		
		Passing[1]	*Chest pass / Week 1*		
Phase 4: SG FLAT SIDE DOWN	Week 21		**Dynamic exercises** [2]		
		Stance	*Walk on 10 SG*		
		Dribbling	*Walk on 10 SG and Power dribble high & low*		
		Aberdeen	*Walk on 10 SG and turn ball around trunk*		
		Passing[1]	*Walk on 10 SG and chest pass*		
	Week 22		**Dynamic exercises** [2]		
		Stance	*Walk on 10 SG + Shot*		
		Dribbling	*Walk on 10 SG and Power dribble high & low + Shot*		
		Aberdeen	*Walk on 10 SG and turn ball around trunk + Shot*		
		Passing[1]	*Walk on 10 SG and chest pass + Shot*		



Title	Author / Editor
Injury Prevention: Drills on the Court	Cuzzolin, F

English Title	Year	Country	Doc.No
Injury Prevention: Drills on the Court	2005	Italy	023

Source	Category	Validation
FIBA Assist Magazin, 15, 2005: 59-62 www.fiba.com	☒ Training & Physical Preparation	☐ Multiple scientific validation
	☐ Technical & Political Approaches	☐ Single scientific validation
Form / Dissemination	☐ Equipment & Facilities	☐ Science-based
Coaches‘ Education and information Online magazine article	☐ Medical & Non-medical Support	☐ Multiple expert recommendation
	☐ Multifaceted Approaches	☒ Single expert recommendation

Description

Summary	The technical and physical evolution of basketball over the past few years has helped athletes reach newer performance plateaus, but it has also made athletes bear even greater physical stress. However, the role of the conditioning coach has become more important, in particular with regard to maintain and increase health and performance of the athletes. Understanding (1.) Structural issues (i.e. level of musculoskeletal functionality of the athletes in relation to their age, postural balance, history of past injuries and level of recovery) (2.) Methodological issues (i.e. level of conditioning of the athlete in proportion to the workload he will undertake, habits and methods used by the athlete and his coach in the past) (3.) Behavioral issues (i.e. lifestyle of the athletes, psycho-emotional status in relation to the family situation, contract status and future perspectives) (4.) Technical issues (i.e. type of preparation used in training for games, and the stressful and regenerating drills, synergistic planning between the work of the therapist, conditioning coach and head coach, management of situations with high risk that can occur on the court) an individualized prevention programme can be planned. On the basis of typical injury situations and basketball-specific movement patterns the author presents some preventive drills to be included into conditioning practice.
Preventive recommendation	Individualized season-attending athletic conditioning with regard to basic basketball-specific movement patterns.

Substantially the athlete, to move, alternates a sequence of standing only on one foot in different directions, with different width and quickness. To simplify, the drills will be executed in six ways:

1. Going forward;
2. Going back;
3. Laterally;
4. Going forward, diagonally, with an angle of 45°;
5. Going back, diagonally, with an angle of 45°;
6. Crossing forward.

In all of these actions, the joints' involvement is in charge of the joints of the ankle, of the knee and the hip.

In a first phase, pass from a dynamic situation, made by little jumps, fast walk, jogging or running, to a static situation, standing only in one foot, trying to stop the inertia of the body, with the knee bent, and maintaining the balance for two or three seconds. Then, continue executing the same movement with the other limb.

In a second phase, pass from a dynamic situation to a static one, to introduce, later, an hop in the same or another direction, to stop, then, standing only on one foot, maintaining the balance for two or three seconds.

Planning the practices, we want to gradually increase the difficulty in stabilizing the articulations, maintaining the balance, as the following the progression:

1. Increase the load: we can work on the distance between the steps, we can decrease the articular angles, or increase the weight of the athlete (barbells, medicine balls, etc.);
2. Increase the instability: we can propose movements of the head, or we use some wobble boards, dyna disc, airex pad, bosu, etc.;
3. Increase the difficulty, adding or mixing up the previous points, or introducing some rotatory movements;
4. Increase the specificity, introducing the ball.

STEP AND STICK

1. Make three steps going forward. At the third step; stopping rolling from the heel to the forefoot, stop with the knee bent for two or three seconds, maintaining the balance. Repeat the drill on the opposite side. In the other half court, execute a allow skip or a hopping steps. Execute a round trip.
2. Like the previous drill, but going back, in the other half court, run or jump back.
3. Go forward with a sliding step diagonally, with an angle of 45°; at the third step, stop with the knee bent. Repeat the drill on the opposite side. On the other half-court, slide diagonally, changing the side every three steps.
4. Go forward with a sliding step; at the third step, stop with the knee bent. Repeat the drill on the opposite side. On the other half-court, slide laterally.
5. Go back with a sliding step diagonally, with an angle of 45°; at the third step, stop with the knee bent. Repeat the drill on the opposite side. On the other half-court, slide back diagonally, changing the side every three steps.
6. Go forward laterally, crossing the first step behind the body, with the left leg if going on the right; execute a lateral step with the right leg, then cross forward with the left one, stopping as explained before. Repeat the same movement on the same side until the half-court, changing the side when executing the return. After the half-court, execute a carioca run.

STEP, JUMP AND STICK

The same sequence of drills proposed before can be executed also making the athlete do, after a first stop, a hop, before a second stop. The first stop is usually short, one or two seconds maximum; the second one is two or three seconds maximum long. The hop will be executed at the beginning, at the same direction of the first stop, skimming the court and close. Later, when the athlete will be fit to the stimulus, you can vary all of the parameters.

STEP, SPIN AND STICK

This drill is extremely difficult, also because of a high stimulation of the vestibular apparatus. The drill is executed exclusively with movements to go forward and back. Talking of rotation, I mean starting with a step forward, rotate with three steps of 180°, and stop with a step back. Then, start with a step back, rotate with three steps of 180°, and stop with a step forward. There is also the possibility to rotate of 360°.

STEP, BACK AN STICK

The same sequence of drills proposed before can be executed also making the athlete do, after a first stop, a hop in a direction opposite to the previous one, before a second stop. The first stop is usually very short, just to change direction; the second one is long two or three second maximum. The same exercise can be executed on the baseline, or on the half-court, alternating three steps in place, a hop in various directions and, after having load the limb, push for going back at the starting position. This exercise is very effective, but it must be used with caution, with athlete who are healthy and that already have a good knowledge of the exercise proposed, because of his high eccentric component.

Title	Author / Editor
A Prevention Strategy to Reduce the Incidence of Injury in High School Basketball: A Cluster Randomized Controlled Trial	Emery et al.

English Title	Year	Country	Doc.No
A Prevention Strategy to Reduce the Incidence of Injury in High School Basketball: A Cluster Randomized Controlled Trial	2007	Canada	016

Source	Category	Validation
Clinical Journal of Sport Medicine 2007, 17:17–24 http://www.cjsportsmed.com	☒ Training & Physical Preparation ☐ Technical & Political Approaches ☐ Equipment & Facilities ☐ Medical & Non-medical Support ☐ Multifaceted Approaches	☐ Multiple scientific validation ☒ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
RCT Online + print journal article		

Description

Summary	Cluster randomized controlled trial examining the effectiveness of a sport-specific balance training programme in reducing injuries in basketball. During one single season (18 weeks) and prior to each practice session (approx. 5 per week) control (n = 426) and training group (n = 494) performed a ten minute warm-up routine that included aerobic, static stretch and dynamic stretch components. In addition, the training group received an additional five minute sport-specific balance training warm-up component for practice sessions and a 20 minute home exercise programme using a wobble board. A significant protective effect of a basketball-specific balance training programme in reducing acute-onset injuries in high school basketball was found. A clinically relevant trend, which has to be handled with care, was also found with respect to all injury, lower-extremity injury, and ankle sprain injury.
Preventive recommendation	A wobble board balance training programme may protect athletes against suffering injuries.

Title	Author / Editor
La Propriocettività e la Pallacanestro	Faverio, D

English Title	Year	Country	Doc.No
Proprioception and basketball	2003	Italy	030

Source	Category	Validation
Associazione Preparatori Fisici Italiani Pallacanestro http://www.preparazioneatletica.it/prevenzione/prevenzione1	☒ Training & Physical Preparation ☐ Technical & Political Approaches ☐ Equipment & Facilities ☐ Medical & Non-medical Support ☐ Multifaceted Approaches	☐ Multiple scientific validation ☐ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☒ Single expert recommendation
Form / Dissemination		
Coaches' information and education Online publication		

Description

Summary	Balance and body control are essential elements of basketball. The present article informs about proprioceptive mechanisms and the application of proprioceptive exercises in rehabilitation and prevention of lower limb injuries in basketball. The author stresses the importance of improving basketball-specific motor patterns that commonly lead to injuries (e.g. landing after rebound). Main purpose of the finally presented training programme is to increase the capability to regain balance when executing crucial basketball movements. Exercises include single and two-leg balancing with/without disturbance, with/without ball on increasingly instable devices. Programme is intended to be an integral part of daily training routine either in the warm-up or in the cool down part (15 minutes).
Preventive recommendation	Improving proprioception through balance exercises. Balance exercises should be integral part of regular training routine.











Title		Author / Editor		
Bewegungskontrolle und Verletzungsprophylaxe		Gollhofer et al.		
English Title		**Year**	**Country**	**Doc.No**
Motor control and injury prevention		2006	Germany	032
Source	**Category**	**Validation**		
Deutsche Zeitschrift für Sportmedizin 57, 2006 (11/12): 266-270 www.zeitschrift-sportmedizin.de	☒ Training & Physical Preparation ☐ Technical & Political Approaches ☐ Equipment & Facilities ☐ Medical & Non-medical Support ☐ Multifaceted Approaches	☒ Multiple scientific validation ☐ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation		
Form / Dissemination				
Review Online + print journal Article				

Description

Summary	The review discusses the complexity of the mechanisms of sports-related injuries of the lower extremities which has been addressed in several studies. Extrinsic and intrinsic factors have been identified to determine the actual cause of sports injuries. The paper is focused on the interaction of motor control and coordinative function in sports. It has been shown that the adaptations of the neuromuscular system following sensorimotor training are highly specific and closely associated with alterations in motor control of the lower limb muscles. Evidence is provided from recent studies demonstrating that sensorimotor training interventions are highly effective in the reduction of injury incidence.
Preventive recommendation	Sensorimotor training interventions increase proprioceptive capabilities in particular after receiving an injury and thus are highly effective in the reduction of recurring injuries.

Title	Author / Editor
Sports Injuries in Basketball – Epidemiology and Prevention Strategies	Henke et al.

English Title	Year	Country	Doc.No
Sports Injuries in Basketball – Epidemiology and Prevention Strategies	2008	Germany	038

Source	Category	Validation
Poster presentation at 13th annual Congress of the ECSS "Sport Science by the Sea", 09.-12.07.2008, Estoril - Portugal	☒ Training & Physical Preparation	☐ Multiple scientific validation
	☐ Technical & Political Approaches	☐ Single scientific validation
Form / Dissemination	☐ Equipment & Facilities	☐ Science-based
Coaches‘ information and education Print publication	☐ Medical & Non-medical Support	☒ Multiple expert recommendation
	☐ Multifaceted Approaches	☐ Single expert recommendation

Description

Summary	Due to the fact that basketball injuries are ranking within the top ten of sports injury statistics in nearly every European country, it seems to be necessary to develop sports specific prevention measures for basketball. Based on the injury data of 5090 basketball injuries and in view of current research, training recommendations are presented focusing on basketball-specific injury mechanisms and situations. As ankle and knee injuries appear to be most frequently affected, recommendations primarily stick to the lower body regions.
Preventive recommendation	Exercises to improve catching technique and finger strength, agility training as sport-specific warm-up focusing on speed, strength and coordination, stability training (basic and sport-specific) and plyometric drills (e.g. squats and front squats holding the ball above the head), coordination and neuromuscular motor training (e.g. basic neuromuscular exercises usually including the ball and quickly getting sport-specific), proper landing and cutting techniques (e.g. reducing valgus movement, activating the hamstrings, enlarging knee and hip flexion and focusing on the knee-over-toe position)

Title	Author / Editor
Prevention of anterior cruciate ligament injuries	Hepp, F

English Title	Year	Country	Doc.No
Prevention of anterior cruciate ligament injuries	2004	Hungary	039

Source	Category	Validation
Fiba Assisst Magazine, (11) 2004: 57-58 http://www.fiba.com/	☒ Training & Physical Preparation ☐ Technical & Political Approaches ☐ Equipment & Facilities ☐ Medical & Non-medical Support ☐ Multifaceted Approaches	☐ Multiple scientific validation ☐ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☒ Single expert recommendation
Form / Dissemination		
Information Online + print magazine article		

Description

Summary	About 60 to 80% of all sports injuries occur in the lower extremities. Among these, knee problems are the most frequent, followed by injuries of the ankle joint. In particular ACL injuries are of great concern. The present article highlights mechanisms, diagnostics and risk factors of ACL injuries. In basketball players, the ACL injury rate is particularly high, especially for females, where the female-to-male ratio is 4:1; the game-to-training ratio is 3:1. Efforts to prevent or at least decrease the rate of occurrence of these injuries seem wise. General advices and few basic examples of training exercises aimed at preventing ACL injuries are given.
Preventive recommendation	Prevention programmes designed to increase neuromuscular control, improve balance, and teach avoidance strategies appear to be effective in decreasing ACL injury rates. These programmes should include standing on one leg on flat surface, as well as on a tilting plateau, stepping up, and down from a globe-based plateau. Proprioceptive training should be started 30 days before the competitive season begins. During the competitive season, preventive programmes should be integral part (20 Minutes) of the training routine for at least three times a week.

Title	Author / Editor
The Effect of Neuromuscular Training on the Incidence of Knee Injury in Female Athletes	Hewett et al.

English Title	Year	Country	Doc.No
The Effect of Neuromuscular Training on the Incidence of Knee Injury in Female Athletes	1999	USA	100

Source	Category	Validation
American Journal of Sports Medicine 27, (6)1999: 699-706 www.ajs.sagepub.com	☒ Training & Physical Preparation	☐ Multiple scientific validation
	☐ Technical & Political Approaches	☒ Single scientific validation
Form / Dissemination	☐ Equipment & Facilities	☐ Science-based
Study Online + print publication	☐ Medical & Non-medical Support	☐ Multiple expert recommendation
	☐ Multifaceted Approaches	☐ Single expert recommendation

Description

Summary	The present study evaluated the effect of neuromuscular training on the incidence of knee injury in female athletes. 43 high school sports teams (n=1263) participated in the study. Soccer, volleyball, and basketball were selected for monitoring because of the high level of jumping and cutting activity in these sports. Coaches were instructed by means of video and training manual demonstrating a 6-week preseason neuromuscular training programme that incorporated flexibility, plyometrics and weight training to increase muscle strength and decrease landing forces. Untrained female athletes had a 3.6 times higher incidence of knee injury than trained female athletes and 4.8 times higher than male athletes (control group). Thus, this prospective study demonstrated a decreased incidence of knee injury in female athletes after a specific plyometric training programme.
Preventive recommendation	It is recommended that young female athletes in sports that entail jumping, pivoting, and cutting, such as basketball should participate in an effective preseason jump training programme that includes progressive resistance weight training for the lower extremities.

Appendix 1. Jump Training Program

Exercise	Duration or Repetitions by Week	
Phase I: Technique	**Week 1**	**Week 2**
1. Wall jumps	20 sec	25 sec
2. Tuck jumps*	20 sec	25 sec
3. Broad jumps stick (hold) landing	5 reps	10 reps
4. Squat jumps*	10 sec	15 sec
5. Double-legged cone jumps*	30 sec/30 sec	30 sec/30 sec (side-to-side and back-to-front)
6. 180° jumps	20 sec	25 sec
7. Bounding in place	20 sec	25 sec
Phase II: Fundamentals	**Week 3**	**Week 4**
1. Wall jumps	30 sec	30 sec
2. Tuck jumps*	30 sec	30 sec
4. Jump, jump, jump, vertical jump	5 reps	8 reps
5. Squat jumps*	20 sec	20 sec
6. Bounding for distance	1 run	2 runs
7. Double-legged cone jumps*	30 sec/30 sec	30 sec/30 sec (side-to-side and back-to-front)
8. Scissors jump	30 sec	30 sec
9. Hop, hop, stick landing*	5 reps/leg	5 reps/leg
Phase III: Performance	**Week 5**	**Week 6**
1. Wall jumps	30 sec	30 sec
2. Step, jump up, down, vertical	5 reps	10 reps
3. Mattress jumps	30 sec/30 sec	30 sec/30 sec (side-to-side and back-to-front)
4. Single-legged jumps distance*	5 reps/leg	5 reps/leg
5. Squat jumps*	25 sec	25 sec
6. Jump into bounding*	3 runs	4 runs
7. Hop, hop, stick landing	5 reps/leg	5 reps/leg

Before jumping exercises: Stretching (15-20 minutes), skipping (2 laps), side shuffle (2 laps).
Posttraining: Cool-down walk (2 minutes), stretching (5 minutes).
*These jumps performed on mats.
Note: Each jump exercise is followed by a 30-second rest period.

Appendix 2. Glossary of Jump Training Exercises

1. **180° Jumps:** Two-footed jump. Rotate 180° in mid-air. Hold landing for 2 seconds and then repeat in reverse direction.
2. **Bounding for Distance:** Start bounding in place and slowly increase distance with each step, keeping knees high.
3. **Bounding in Place:** Jump from one leg to the other straight up and down, progressively increasing rhythm and height.
4. **Broad Jumps-Stick (hold) Landing:** Two-footed jump as far as possible. Hold landing for 5 seconds.
5. **Cone Jumps:** Double-legged jump with feet together. Jump side-to-side over cones quickly. Repeat forward and backward.
6. **Hop, Hop Stick:** Single-legged hop. Stick second landing for 5 seconds. Increase distance of hop as technique improves.
7. **Jump into Bounding:** Two-footed broad jump. Land on single leg, then progress into bounding for distance.
8. **Jump, Jump, Jump, Vertical:** Three broad jumps with vertical jump immediately after landing the third broad jump.
9. **Mattress Jumps:** Two-footed jump on mattress, tramp, or other easily compressed device. Perform side-to-side and back-to front.
10. **Scissors Jump:** Start in stride position with one foot well in front of other. Jump up, alternating foot positions in mid-air.
11. **Single-Legged Jumps, Distance:** Single-legged hop for distance. Hold landing (knees bent) for 5 seconds.
12. **Squat Jumps:** Standing jump raising both arms overhead, land in squatting position touching both hands to floor.
13. **Step, Jump Up, Down, Vertical:** Two-footed jump onto 6- to 8-inch step. Jump off step with two feet, then vertical jump.
14. **Tuck Jumps:** From standing position jump, and bring both knees up to chest as high as possible. Repeat quickly.
15. **Wall Jumps (Ankle Bounces):** With knees slightly bent and arms raised overhead, bounce up and down off toes.

Appendix 3. Stretching and Weight Training Program

Stretches[a]	Weight-training exercises[b]
1. Calf stretch 1	1. Abdominal curl
2. Calf stretch 2: soleus	2. Back hyperextension
3. Quadriceps	3. Leg press
4. Hamstring	4. Calf raise
5. Hip flexors	5. Pullover
6. Iliotibial band/lower back	6. Bench press
7. Posterior deltoids	7. Latissimus dorsi pulldown
8. Latissimus dorsi	8. Forearm curl
9. Pectorals/biceps	9. Warm-down/short stretch

[a] Stretching consists of 3 sets of 30 seconds each.
[b] Weight training consists of 1 set of each exercise, generally 12 repetitions for upper body exercises and 15 repetitions for the trunk and lower body exercise.

Title	Author / Editor
Anterior Cruciate Ligament Injuries in Female Athletes - Part 2: A Meta-analysis of Neuromuscular Interventions Aimed at Injury Prevention	Hewett et al.

English Title	Year	Country	Doc.No
Anterior Cruciate Ligament Injuries in Female Athletes - Part 2: A Meta-analysis of Neuromuscular Interventions Aimed at Injury Prevention	2006	USA	040

Source	Category	Validation
American Journal of Sports Medicine 2006 34: 490 http://ajs.sagepub.com	☒ Training & Physical Preparation ☐ Technical & Political Approaches ☐ Equipment & Facilities ☐ Medical & Non-medical Support ☐ Multifaceted Approaches	☒ Multiple scientific validation ☐ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
Meta-analysis Online + print journal article		

Description

Summary	Meta-analysis of six neuromuscular training interventions in major team sports (e.g. football, basketball, volleyball and handball). The purpose of this "Current Concepts" review is to highlight the relative effectiveness of these interventions in reducing anterior cruciate ligament injury rates and to evaluate the common training components between the training studies. In addition, the level of rigor of these interventions, the costs and the difficulty of implementation, the compliance with these interventions, and the performance benefits are discussed. This review summarizes conclusions based on evidence from the common components of the various interventions to discuss their potential to reduce anterior cruciate ligament injury risk and assess their potential for combined use in more effective and efficient intervention protocols. All 3 studies that incorporated high-intensity plyometrics reduced ACL risk, whereas the studies that did not incorporate high-intensity plyometrics did not reduce ACL injury risk. The plyometric component of these interventions, which trains the muscles, connective tissue, and nervous system to effectively carry out the stretch-shortening cycle and that focuses on proper technique and body mechanics, appears to reduce ACL injuries.
Preventive recommendation	Neuromuscular training may assist in the reduction of ACL injuries in females athletes if 1. plyometrics, balance, and strengthening exercises are incorporated into a comprehensive training protocol; 2. the training sessions are performed more than 1 time per week; 3. the duration of the training programme is a minimum of 6 weeks in length.

Title	Author / Editor
Relationship Between Balance Ability, Training and Sports Injury Risk	Hrysomallis et al.

English Title	Year	Country	Doc.No
Relationship Between Balance Ability, Training and Sports Injury Risk	2007	Australia	097

Source	Category	Validation
Sports Medicine 2007; 37 (6): 547-556 http://www.ingentaconnect.com/content/adis/smd	☒ Training & Physical Preparation ☐ Technical & Political Approaches ☐ Equipment & Facilities ☐ Medical & Non-medical Support ☐ Multifaceted Approaches	☒ Multiple scientific validation ☐ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
Review Online + print journal article		

Description

Summary	Traditionally, balance training has been used as part of the rehabilitation programme for ankle injuries. More recently, balance training has been adopted to try and prevent injuries to the ankle and knee joints during sport. The purpose of this review is to synthesise current knowledge in the area of balance ability, training and injury risk, highlight the findings and identify any future research needs. Poor balance ability has been significantly associated with an increased risk of ankle injuries in multiple sports. Multifaceted intervention studies that have included balance training along with jumping, landing and agility exercises have resulted in a significant decrease in ankle or knee injuries. However, it is unknown which component of the multifaceted intervention was most effective and whether the effects are additive. As a single intervention, balance training has been shown to significantly reduce the recurrence of ankle ligament injuries. Future research should be directed at determining the relative contribution of balance training to a multifaceted intervention.
Preventive recommendation	It appears that balance training, as a single intervention, is probably not as effective for injury prevention as when it is part of a multifaceted intervention.

Title	Author / Editor
Vilka träningsmetoder förebygger skador i knä – och fotled inom idrott? – En litteraturstudie	Junsten et al.

English Title	Year	Country	Doc.No
Which training measures will prevent knee and ankle injuries? – A review	2008	Sweden	045

Source	Category	Validation
Lulea University of Technology, Sweden http://epubl.ltu.se/1402-1773/2008/332/LTU-CUPP-08332-SE.pdf	☒ Training & Physical Preparation ☐ Technical & Political Approaches ☐ Equipment & Facilities ☐ Medical & Non-medical Support ☐ Multifaceted Approaches	☒ Multiple scientific validation ☐ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
Review Online publication		

Description

Summary	Based on a database literature research (Pubmed, Amed , CINAHL) the review considers 26 intervention programmes (CTs, RCTs) for the prevention of knee and ankle injuries in all sports. Interventions are subdivided into two groups each: balance training/proprioceptive training and combined Training & Physical Preparation. Interventions focusing on balancing exercises, either as single-intervention programme or in combination with other training contents (e.g. core training) seem to be most commonly used. Isolated balance training is primarily aiming at the prevention of ankle injuries, in particular of recurring ankle injuries, while the combined programmes tend to focus on knee injuries, in particular among female athletes. However, heterogeneous methods and the lack of blinding and compliance impede stating a precise conclusion regarding general preventive recommendations. In view of knee injuries, there is contradictory scientific evidence concerning combined Training & Physical Preparation. Thus more high-quality RCTs are required.
Preventive recommendation	Balance training is most effective in preventing recurring ankle injuries among athletes with previous ankle injuries.

Title	Author / Editor
Core Stability Measures as Risk Factors for Lower Extremity Injury in Athletes	Leetun et al.

English Title	Year	Country	Doc.No
Core Stability Measures as Risk Factors for Lower Extremity Injury in Athletes	2004	USA	104

Source	Category	Validation
Medicine & Science in Sports & Exercise 2004: 926-934 http://www.acsm-msse.org	☒ Training & Physical Preparation ☐ Technical & Political Approaches ☐ Equipment & Facilities ☐ Medical & Non-medical Support ☐ Multifaceted Approaches	☐ Multiple scientific validation ☒ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
Study Online + print journal article		

Description

Summary	Decreased core stability has been suggested to contribute to the etiology of lower extremity injuries, particularly in female athletes. Before their season, 80 female and 60 male intercollegiate basketball and track athletes were studied. Hip abduction and external rotation strength, abdominal muscle function, and back extensor and quadrates lumborum endurance was tested for each athlete. The head athletic trainers for each of the teams participating in the study recorded all back and lower extremity injuries that occurred during organized practices or games throughout the control season. Results showed that athletes who did not sustain an injury were significantly stronger in hip abduction and external rotation. In general, athletes who experienced an injury over the course of the season generally demonstrated lower core stability measures than those who did not.
Preventive recommendation	Core stability has an important role in injury prevention. Proximal stabilization is recommended for the prevention of injuries of the lower limbs.

Title	Author / Editor
Effects of Sports Injury Prevention Training on the Biomechanical Risk Factors of Anterior Cruciate Ligament Injury in High School Female Basketball Players	Lim et al.

English Title	Year	Country	Doc.No
Effects of Sports Injury Prevention Training on the Biomechanical Risk Factors of Anterior Cruciate Ligament Injury in High School Female Basketball Players	2009	Korea	055

Source	Category	Validation
The American Journal of Sports Medicine 37, (9) 2009: 1728-1734 www.ajs.sagepub.com	☒ Training & Physical Preparation ☐ Technical & Political Approaches ☐ Equipment & Facilities ☐ Medical & Non-medical Support ☐ Multifaceted Approaches	☐ Multiple scientific validation ☒ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
Study Online + print journal article		

Description

Summary	Female athletes have a higher risk of anterior cruciate ligament injury than their male counterparts who play at similar levels in sports involving pivoting and landing. The present study hypothesizes that competitive female basketball players who participate in a sports injury prevention training programme would show better muscle strength and flexibility and improved biomechanical properties. 22 high school female basketball players were recruited and randomly divided into 2 groups (the experimental group and the control group, 11 participants each). The experimental group was instructed in the sports injury prevention training programme and performed it during the first 20 minutes of team practice for the next 8 weeks, while the control group performed their regular training programme. Both groups were tested with a rebound-jump task before and after the 8-week period. The sports injury prevention training programme improved the strength and flexibility of the competitive female basketball players tested and biomechanical properties associated with anterior cruciate ligament injury as compared with pretraining parameters and with posttraining parameters in the control group.
Preventive recommendation	A 20 minutes prevention programme including warm up, stretching, strengthening, plyometrics, agility drills and cool down can improve flexibility, strength and biomechanical properties that are associated with ACL injuries. Thus it may support in preventing ACL injuries.

TABLE 1
Sports Injury Prevention Training Program (SIPTP)

Exercise	Distance	Repetitions/Cumulative Time
1. Warm-up		
Jog line to line	100 yd	0-1 min
Shuttle run (side to side)	100 yd	1-2 min
Backward running	100 yd	2-3 min
2. Stretching		
Calf stretch		30 sec × 2 reps (3-4 min)
Quadriceps stretch		30 sec × 2 reps (4-5 min)
Hamstring stretch		30 sec × 2 reps (5-6 min)
Inner thigh stretch		20 sec × 3 reps (6-7 min)
Hip flexor stretch		30 sec × 2 reps (7-8 min)
3. Strengthening		
Walking lunges		3 sets × 10 reps (8-9 min)
Russian hamstring		3 sets × 10 reps (9-10 min)
Single toe raises		2 sets × 30 reps (10-11 min)
4. Plyometrics		
Lateral hops over cone		20 reps (11-11.5 min)
Forward/backward hops over cone		20 reps (11.5-12 min)
Single-leg hops over cone		20 reps (12-12.5 min)
Vertical jumps with headers		20 reps (12.5-13 min)
Scissors jump		20 reps (13-13.5 min)
5. Agilities		
Shuttle run with forward/backward running	50 yd	13.5-14 min
Diagonal runs	50 yd (3 passes)	14-14.5 min
Bounding runs	50 yd	14.5-15 min
6. Alternative exercise–warm down		
Bridging with alternating hip flexion		30 reps (15-16 min)
Abdominal crunches		30 sec × 2 reps (16-17 min)
Single and double knee to chest (supine)		30 sec × 2 reps (17-18 min)
Piriformis stretch–supine		30 sec × 2 reps (18-19 min)
Seated butterfly stretch–seated		30 sec × 2 reps (19-20 min)

Title	Author / Editor
A Guide for Basketball Injury Prevention	McCormick, B

English Title	Year	Country	Doc.No
A Guide for Basketball Injury Prevention	2005	USA	058

Source	Category	Validation
http://www.associatedcontent.com	☒ Training & Physical Preparation ☐ Technical & Political Approaches ☐ Equipment & Facilities ☐ Medical & Non-medical Support ☐ Multifaceted Approaches	☐ Multiple scientific validation ☐ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☒ Single expert recommendation
Form / Dissemination Coaches' information and education Online publication		

Description

Summary	Two-paged factsheet giving advices on preventive training contents. Regardless of responsibility, every year, an injury ends numerous teams' seasons prematurely. However, many injuries are preventable through training and off-season strength and conditioning work. Common ankle or knee injuries occur because basketball places tremendous force on these joints, the tendons and ligaments which stabilize the joints and the muscles which move the joints. The constant landing from jumps, stops and starts and quick changes of direction compromise the muscles, especially when fatigued, which leads to injury. Coaches must be aware of their role in developing traits and habits in female players that will reduce the likelihood of ACL tears. This means incorporating movement training into practices, especially for younger players. Young players who develop good habits are less likely to suffer an injury later; however, if young players fail to develop good habits, they may never learn to move properly and will be susceptible to injury throughout their career. Learning to jump and land is one effective way to prevent a season-ending injury. In addition, a daily dynamic warm-up is good to prepare muscles for basketball actions and movements.
Preventive recommendation	Proper dynamic warm-up routine (including jogging, skipping, running backward, high knees, butt kicks, carioca, multidirectional lunges, ankle walks, heel walks, heel-to-toe walks, shuffles, marches, etc.) prior to playing basketball, plyometric exercises such as depth jumps, lateral hops (ice skater), lateral slides with resistance bands, wobble board squats or squats on other instable devices to improve proprioception.

Title	Author / Editor
The Effect of a Balance Training Program on the Risk of Ankle Sprains in High School Athletes	McGuine et al.

English Title	Year	Country	Doc.No
The Effect of a Balance Training Program on the Risk of Ankle Sprains in High School Athletes	2006	USA	059

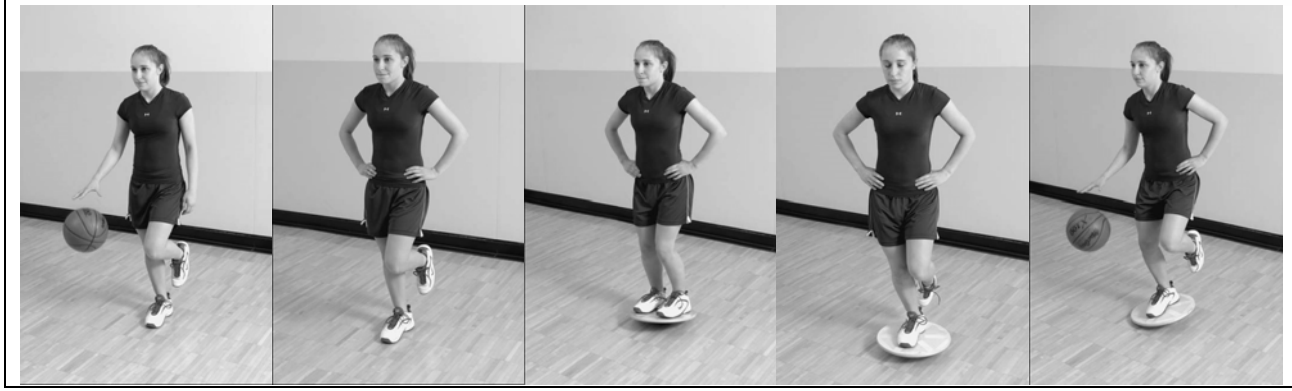
Source	Category	Validation
The American Journal of Sports Medicine, 34, 2006: 1103-1111 www.ajs.sagepub.com	☒ Training & Physical Preparation ☐ Technical & Political Approaches ☐ Equipment & Facilities ☐ Medical & Non-medical Support ☐ Multifaceted Approaches	☐ Multiple scientific validation ☒ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
Study Online + print journal article		

Description

Summary	Ankle sprains are the most common musculoskeletal injuries that occur in athletes and they have a profound impact on health care costs and resources. The present randomized controll trial examines the effectivity of a balance training programme with regard to preventing ankle sprains injuries in high school athletes. 765 high school soccer and basketball players (523 girls and 242 boys) were randomly assigned to either an intervention group (27 teams, 373 subjects) that participated in a balance training programme or to a control group (28 teams, 392 subjects) that performed only standard conditioning exercises. On-site athletic trainers recorded athlete exposures and sprains. The programme included exercises such as (1) maintaining a single leg stance on a flat surface with eyes open and closed; (2) performing functional sport activities such as throwing, catching, and dribbling on 1 leg; (3) maintaining double-leg stance while rotating the balance board; (4) maintaining a single-leg stance on the balance board with eyes open and closed; and (5) performing functional sport activities while in single-leg stance on the board. The programme was performed five times a week during the first four weeks and was continued three times a week afterwards. The rate of ankle sprains was significantly lower for subjects in the intervention group. Athletes who performed the intervention programme decreased their risk of a sprain by one half.
Preventive recommendation	Season attending balance training reduces the rate of ankle injuries.

The Balance Training Program[a]

Phase	Surface	Eyes	Exercise
I	Floor	Open	Single-leg stance
Week 1		Open	Single-leg stance while swinging the raised leg
		Open	Single-leg squat (30°-45°)
		Open	Single-leg stance while performing functional activities (dribbling, catching, kicking)
II	Floor	Closed	Single-leg stance
Week 2		Closed	Swinging the raised leg
		Closed	Single-leg squat (30°-45°)
III	Board	Open	Single-leg stance
Week 3		Open	Swinging the raised leg
		Open	Single-leg squat (30°-45°)
		Open	Double-leg stance while rotating the board
IV	Board	Closed	Single-leg stance
Week 4		Open	Swinging the raised leg
		Open	Single-leg squat (30°-45°)
		Open	Single-leg stance while rotating the board
V	Board	Closed	Single-leg stance
Week 5+		Open	Single-leg squat (30°-45°)
		Open	Single-leg stance while rotating the board
		Open	Single-leg stance while performing functional activities (dribbling, catching, kicking)



Title	Author / Editor
The Effectiveness of Balance Training Programs on Reducing the Incidence of Ankle Sprains in Adolescent Athletes	McLeod, T

English Title	Year	Country	Doc.No
The Effectiveness of Balance Training Programs on Reducing the Incidence of Ankle Sprains in Adolescent Athletes	2008	USA	062

Source	Category	Validation
Journal of Sport Rehabilitation, 2008, 17, 316-323 www.humankinetics.com/JSR	☒ Training & Physical Preparation	☒ Multiple scientific validation
	☐ Technical & Political Approaches	☐ Single scientific validation
Form / Dissemination	☐ Equipment & Facilities	☐ Science-based
Review Online + print journal article	☐ Medical & Non-medical Support	☐ Multiple expert recommendation
	☐ Multifaceted Approaches	☐ Single expert recommendation

Description

Summary	Ankle sprains are one of the most common sport-related injuries treated by rehabilitation professionals. These injuries often result in lost participation and can lead to subsequent injury episodes. Therefore, it is important to determine appropriate means of preventing these injuries. This review assessed the effectivity of balance Training & Physical Preparation with regard to preventing ankle injuries. Four relevant studies were included (2 RCTs and 2 cohort studies). Findings indicate that in general, balance Training & Physical Preparation are moderately effective in reducing the risk of ankle sprains in adolescent athletes. There were some important differences in the design of the balance Training & Physical Preparation that may have resulted in the aforementioned findings, including the timing of program implementation and subject compliance in completing the required training sessions.
Preventive recommendation	Evidence exists that supervised preseason and in-season balance Training & Physical Preparation are effective in reducing the rate of ankle sprains in adolescent athletes. Difficulty of applied balance exercises should increase progressively from basic balance exercises (e.g. eyes open, firm surface) to more challenging exercises (eyes closed, uneven support surfaces, sport-specific drills).

Title	Author / Editor
Injury Prevention and Performance Enhancement: A training program for basketball	Myrick, S

English Title	Year	Country	Doc.No
Injury Prevention and Performance Enhancement: A training program for basketball	2007	USA	066

Source	Category	Validation
Connecticut Medicine 71,(1) 2007: 5-8 https://www.csms.org	☒ Training & Physical Preparation	☐ Multiple scientific validation
	☐ Technical & Political Approaches	☒ Single scientific validation
Form / Dissemination	☐ Equipment & Facilities	☐ Science-based
Study Print journal article	☐ Medical & Non-medical Support	☐ Multiple expert recommendation
	☐ Multifaceted Approaches	☐ Single expert recommendation

Description

Summary	The purpose of the present study was to examine the effectivity of a training programme, focusing on agilty and plyometric exercises in basketball. In this case effectivity was determined as the programme's abilty in decreasing injuries and enhancing the player's performance in terms of quickness, speed, strength and explosive power. Ten athletes (5 male, 5 female) were included in this study. The training programme took 8 weeks and was intended to be a pres-season conditioning programme as it ended immediately prior to start of high school basketball season. Each week consisted of three sessions (90 minutes) that contained a dynamic warm-up, agility/quickness drills, basketball-specific plyometrics, functional weight training, core training and a cool-down with static stretching. Results showed that on average players improved in all test categories (t-test, shuttle run, cone touches defensive slide, wall-sit, vertical jump, standing long jump, push-ups). For the following seaon including play-offs no injuries were reported to players that participated in this programme.
Preventive recommendation	With regard to decreasing injury chances and enhancing performance both male and female athletes playing a predominantely jumping sport such as basketball can benefit from a supervised athletic conditioning programme that includes dynamic warm-up, agility/quickness drills, sport-specific plyometrics, functional weight training, core training and an appropriate cool down with static stretching.

Title	Author / Editor
Exercises to prevent lower limb injuries in youth sports: cluster randomised controlled trial	Olsen et al.

English Title	Year	Country	Doc.No
Exercises to prevent lower limb injuries in youth sports: cluster randomised controlled trial	2005	Norway	068

Source	Category	Validation
British Medical Journal 2005;330;449 http://bmj.com	☒ Training & Physical Preparation	☐ Multiple scientific validation
	☐ Technical & Political Approaches	☒ Single scientific validation
Form / Dissemination	☐ Equipment & Facilities	☐ Science-based
RCT Online + print journal article	☐ Medical & Non-medical Support	☐ Multiple expert recommendation
	☐ Multifaceted Approacheses	☐ Single expert recommendation

Description

Summary	Cluster randomised controlled trial investigating the effect of a prevention programme designed to reduce the incidence of knee and ankle injuries in young people participating in sports. The exercises used in the programme were developed on the basis of previous intervention studies in team handball, volleyball and football, considering agility, balance, strength, awareness of vulnerable positions of the knee and ankle and playing technique. Thus, it is not possible to determine exactly which part of the programme may be effective in preventing injuries. During the monitored eight month season, 262 (14%) of the 1837 players who were included in the study contracted a total of 298 injuries. Of these, 241 (81%) were acute injuries and 57 (19%) were overuse injuries. Significantly fewer injured players were observed in the intervention group than in the control group for injuries overall, lower limb injuries, acute knee or ankle injuries, and acute knee and upper limb injuries.
Preventive recommendation	A structured warm-up programme containing agility, balance, strength and playing technique exercises, designed to improve awareness and knee and ankle control during landing and pivoting movements prevents knee and ankle injuries among youth athletes. It is suggested that programmes focusing on technique (cutting and landing movements) and balance training (on wobble boards, mats or similar equipments) should already be implemented in players aged 10-12 years. Furthermore, preventive training should also be routine in Training & Physical Preparation for adolescents.







Warm-up exercises
Jogging end to end
Backward running with sidesteps
Forward running with knee lifts and heel kicks
Sideways running with crossovers
Sideways running with arms lifted
Forward running with trunk rotations
Forward running with intermittent stops
Speed run

Technique
Planting and cutting movements
Jump shot landings

Balance
(On a balance mat or wobble board, one exercise during each training session; 4 minutes and 2×90 seconds each)
Passing the ball (two leg stance)
Squats (one or two leg stance)
Passing the ball (one leg stance)
Bouncing the ball with eyes closed
Pushing each other off balance

Strength and power
(2 minutes and 3×10 repetitions each)
One quadriceps exercise:
Squats to 80° of knee flexion
Bounding strides
Forward jumps
Jump shot—two legged landing
“Nordic hamstring lowers

Title	Author / Editor
Prävention von Rupturen des vorderen Kreuzbandes im Ballsport: eine Literaturübersicht	Petersen et al.

English Title	Year	Country	Doc.No
Prevention of ACL ruptures in pivoting sports: A review of literature	2003	Germany	071

Source	Category	Validation
Sportorthopädie / Sporttraumatologie 19, 105–109 (2003) http://www.sciencedirect.com/science/journal/0949328X	☒ Training & Physical Preparation ☐ Technical & Political Approaches ☐ Equipment & Facilities ☐ Medical & Non-medical Support ☐ Multifaceted Approaches	☒ Multiple scientific validation ☐ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
Review Online + print journal article		

Description

Summary	A number of epidemiological studies have shown that the rate of ACL ruptures in female athletes is 2.4 to 9.5 times higher than in male athletes. Approximately 70% of these injuries occur without direct contact to another player. Most frequent situations are jump shot landing, stopping and planting/cutting manoeuvres. However, there is evidence that gender specific differences in coordination and neuromuscular control may be an explanation for the high incidence of ACL injuries in female athletes. In the following four different prevention programmes are summarized by sport, aims, contents and effects. These studies show that a reduction of ACL injuries in female team sport is possible. Thus, observed differences and similarities are discussed and lead to general recommendations for preventive programmes. It is assumed that a Multifaceted Approaches combining elements from all programmes may be most effective.
Preventive recommendation	A combined prevention programme in ball sports should provide information on typical sport-specific injury mechanisms and training principles. Furthermore, static and dynamic balance exercises and muscle strengthening should be included. The integration of the preventive programme into training routine should be easy-to-handle and time-saving to increase compliance among coaches.

Title	Author / Editor
Rupturen des vorderen Kreuzbandes bei weiblichen Athleten. Teil 1: Epidemiologie, Verletzungsmechanismen und Ursachen Teil 2: Präventionsstrategien und Präventionsprogramme	Petersen et al.

English Title	Year	Country	Doc.No
Anterior Cruciate Ligament Ruptures in Female Athletes. Part 1: Epidemiology, Injury Mechanisms, and Causes Part 2: Prevention Strategies and Prevention Programs	2005	Germany	072

Source	Category	Validation
Deutsche Zeitschrift für Sportmedizin 56, 6 (2005): 150-164 http://www.zeitschrift-sportmedizin.de/	☒ Training & Physical Preparation ☐ Technical & Political Approaches ☐ Equipment & Facilities ☐ Medical & Non-medical Support ☐ Multifaceted Approaches	☒ Multiple scientific validation ☐ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
Review Online + print journal article		

Description

Summary	In the first part the review discusses the current epidemiological literature, summarizing incidences, mechanism and possible predispositions of ACL ruptures in female athletes. There is a consensus that female athletes have a 2.4 to 9.5 times higher risk to suffer an ACL rupture compared to male athletes. ACL ruptures occur predominantly in non-contact situations during jump shot landing, stopping and planting/cutting manoeuvres. It is unclear if hormonal or anatomical differences between males and females contribute to the different rate of ACL injuries but there is evidence that gender specific differences in coordination and neuromuscular control may be an explanation for the high incidence of ACL injuries in female athletes. Various studies, which are discussed in the second part of this article, have shown that specific Training & Physical Preparation can significantly reduce the incidence of ACL injuries. A universal prevention strategy has not been tested so far, but there is evidence that a combination of different strategies may maximize the preventive effect.
Preventive recommendation	A prevention programme should consider information on sport-specific injury mechanisms, proprioceptive exercises, jump exercises to improve technique of typical motor patterns, strengthening. Furthermore, these contents should be integrated into regular warm-up routine. A sport-specific adaptation can increase compliance among athletes and coaches.

Title	Author / Editor
Non-contact ACL injuries in female athletes: an International Olympic Committee current concepts statement	Renstrom et al

English Title	Year	Country	Doc.No
Non-contact ACL injuries in female athletes: an International Olympic Committee current concepts statement	2008	Sweden	102

Source	Category	Validation
British Journal of Sports Medicine 2008; 42: 394–412 http://bjsm.bmj.com	☒ Training & Physical Preparation	☒ Multiple scientific validation
	☐ Technical & Political Approaches	☐ Single scientific validation
Form / Dissemination	☐ Equipment & Facilities	☐ Science-based
Review, Consensus statement Online + print journal article	☐ Medical & Non-medical Support	☐ Multiple expert recommendation
	☐ Multifaceted Approaches	☐ Single expert recommendation

Description

Summary	According to current research the incidence of anterior cruciate ligament injury remains high in young athletes despite the fact that some successful prevention programmes have been introduced. Female athletes have a higher incidence of ACL injuries in team sports such as basketball and team handball compared to male athletes: Thus, the IOC Medical Commission invited a multidisciplinary group of ACL expert clinicians and scientists to (1) review current evidence (2) critically evaluate high quality studies of injury mechanics; (3) consider the key elements of successful prevention programmes; (4) summarise clinical management including surgery and conservative management; and (5) identify areas for further research. The risk factors for ACL injury have been considered as either internal or external to an individual. External risk factors include type of competition, footwear and surface, and environmental conditions. Internal risk factors include anatomical, hormonal and neuromuscular risk factors. Well-designed injury prevention programmes reduce the risk of ACL injuries for athletes, in particular for young female athletes.
Preventive recommendation	Preventive Training & Physical Preparation should include strength and power exercises, neuromuscular training, plyometrics and agility exercises: They should be integrated into warm-up routine of the regular training. When properly executed they can serve to enhance performance and prevent injuries. Focus should be on performance of the hip-knee-foot line and ‘‘kissing knees’’ should be avoided. Sustainability and compliance (e.g. acceptance among athletes and coaches) are essential criteria for a successful programme. Ideally, these prevention programmes should be introduced as early as possible in the training period. In some sports this would be at the age of 6–10 years.

Title	Author / Editor
Meaning of proprioceptive training in professional basketball	Šarabon et al.

English Title	Year	Country	Doc.No
Meaning of proprioceptive training in professional basketball	2004	Slovenia	078

Source	Category	Validation
University of Ljubljana, Faculty of Sports, Slovenia http://www.tone-si.com/clanki/sportEN.pdf	☒ Training & Physical Preparation ☐ Technical & Political Approaches ☐ Equipment & Facilities ☐ Medical & Non-medical Support ☐ Multifaceted Approaches	☐ Multiple scientific validation ☒ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
Study Online article		

Description

Summary	The purpose of this descriptive study was to determine the effects of a systematic and progressive proprioceptive training on injury prevention in a professional basketball team during one single test season. Occurrence of injuries was described in comparison to the two preceding seasons, where proprioception training was not part of the training routine. The programme consisted of selected balance exercises with or without balance boards. In every analyzed season the senior basketball team had 15 players. During the test season the number of players with health problems decreased by half in comparison to the previous seasons. The most obvious improvement was a fundamental decrease of knee joint and Achilles tendon problems.
Preventive recommendation	Health prevention contents like stretching and proprioception training should be a part of every conditioning programme in basketball.


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Title	Author / Editor
Prevention of anterior cruciate ligament injury in the female athlete	Silvers et al.

English Title	Year	Country	Doc.No
Prevention of anterior cruciate ligament injury in the female athlete	2007	USA	103

Source	Category	Validation
British Journal of Sports Medicine 2007; 41; i52-i59 http://bjsm.bmj.com	☒ Training & Physical Preparation	☒ Multiple scientific validation
	☐ Technical & Political Approaches	☐ Single scientific validation
Form / Dissemination	☐ Equipment & Facilities	☐ Science-based
Review Online + print journal article	☐ Medical & Non-medical Support	☐ Multiple expert recommendation
	☐ Multifaceted Approaches	☐ Single expert recommendation

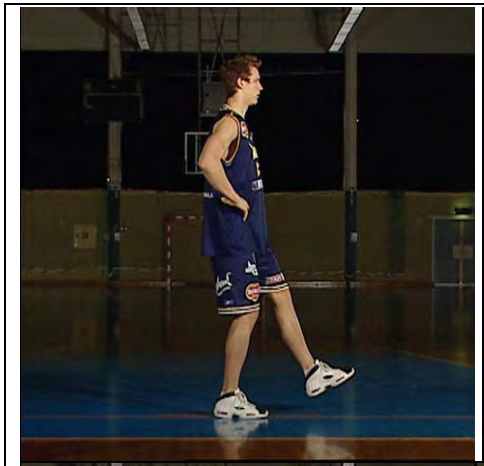
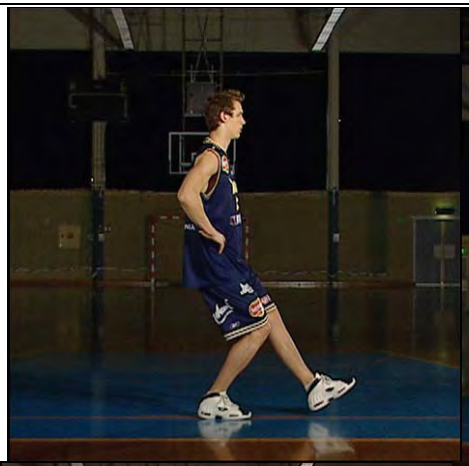
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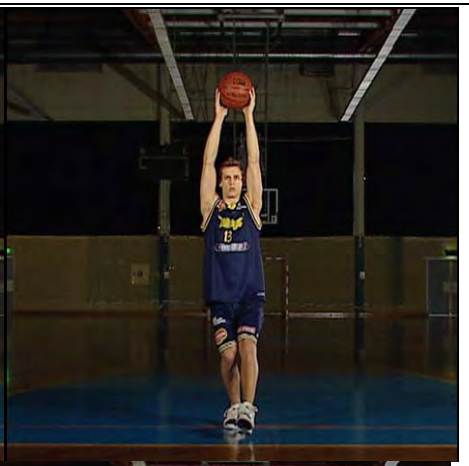
Summary	The relationships of gender, age and training to the incidence of anterior cruciate ligament injury are pivotal to developing a comprehensive neuromuscular and proprioceptive training programme to decrease ACL injuries in female athletes. The mechanisms of ACL injuries have been described recently. There are two types: contact and non-contact. Approximately 70% of all reported ACL injuries are non-contact in origin, the remainder involving contact from an outside force such as an opposing player. The mechanism of non-contact ACL injury in team sports commonly involves a one-step/stop deceleration, cutting movements, sudden change of direction, landing from a jump with inadequate knee and hip flexion. 12 ACL prevention protocols from team sports are summarized and discussed to find mutual elements and inherent activities that may be considered essential.
Preventive recommendation	A prophylactic neuromuscular and proprioceptive training programme may have direct benefit in decreasing the number of ACL injuries in female athletes when emphasizing proper landing technique. Landing softly on the forefoot and rolling back to the rear foot, engaging knee and hip flexion on landing and with lateral (cutting) manoeuvres, avoiding excessive genu valgum at the knee on landing and squatting, strengthening of the core, hamstrings, gluteus medialis and hip abductor, increasing dynamic balance ability and addressing proper deceleration techniques by the means of agility drills.

Title		Author / Editor		
knäkontroll förebygg skador - prestera bättre		Svensk Basketballförbundet		
English Title		**Year**	**Country**	**Doc.No**
Knee control – preventiging injuries – do it better		2007	Sweden	090
Source	**Category**	**Validation**		
Svensk Basketballförbundet www.basket.se	☒ Training & Physical Preparation ☐ Technical & Political Approaches ☐ Equipment & Facilities ☐ Medical & Non-medical Support ☐ Multifaceted Approaches	☐ Multiple scientific validation ☐ Single scientific validation ☒ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation		
Form / Dissemination				
Coaches' education CD-Rom / DVD				

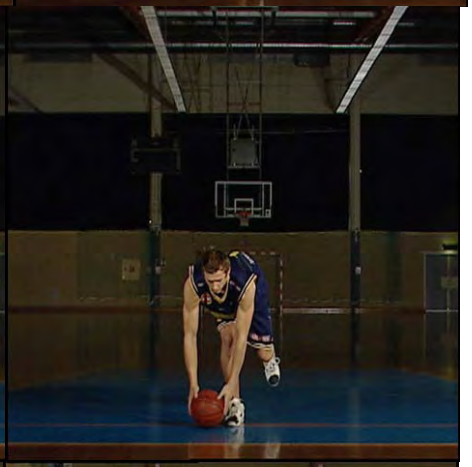
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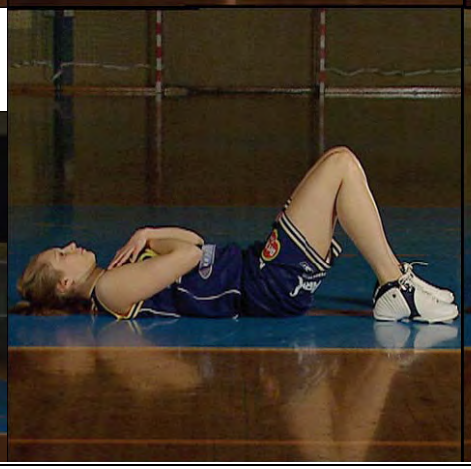
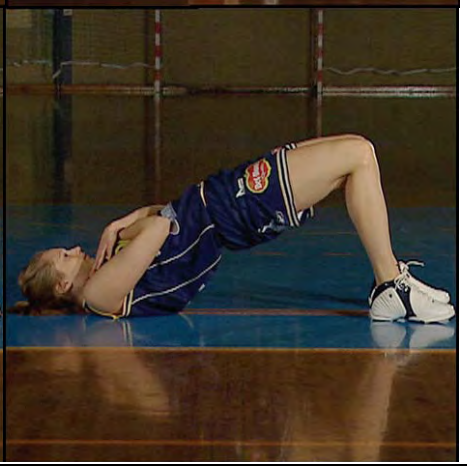
Summary	Current literature on epidemiology, injury situations and mechanisms in handball shows that there is an urgent need to protect basketball players from injuries, in particular knee injuries. On the basis of scientific proved prevention measures the Swedish basketball federation developed an exercise programme for the prevention of knee and shoulder injuries, focusing on a better athletic preparation of handball players. The present CD is mainly dedicated to youth coaches. The programme is designed be an integral part of the regular warm-up routine during handball training and should already start in young players aged 10-12 years. For older athletes, which are familiar with correct technique, exercises can be intensified e.g. by additional weights.
Preventive recommendation	Training programme consisting of 6 basic exercises dealing with stabilisation of the core, balancing and coordination practices and proper jumping and landing technique. Exercises are intended to be integral parts of the warm-up routine (10-15 min). Progressive intensification of exercises according to age and performance level. During pre-season the programme should be included in each session, during regular season twice a week.

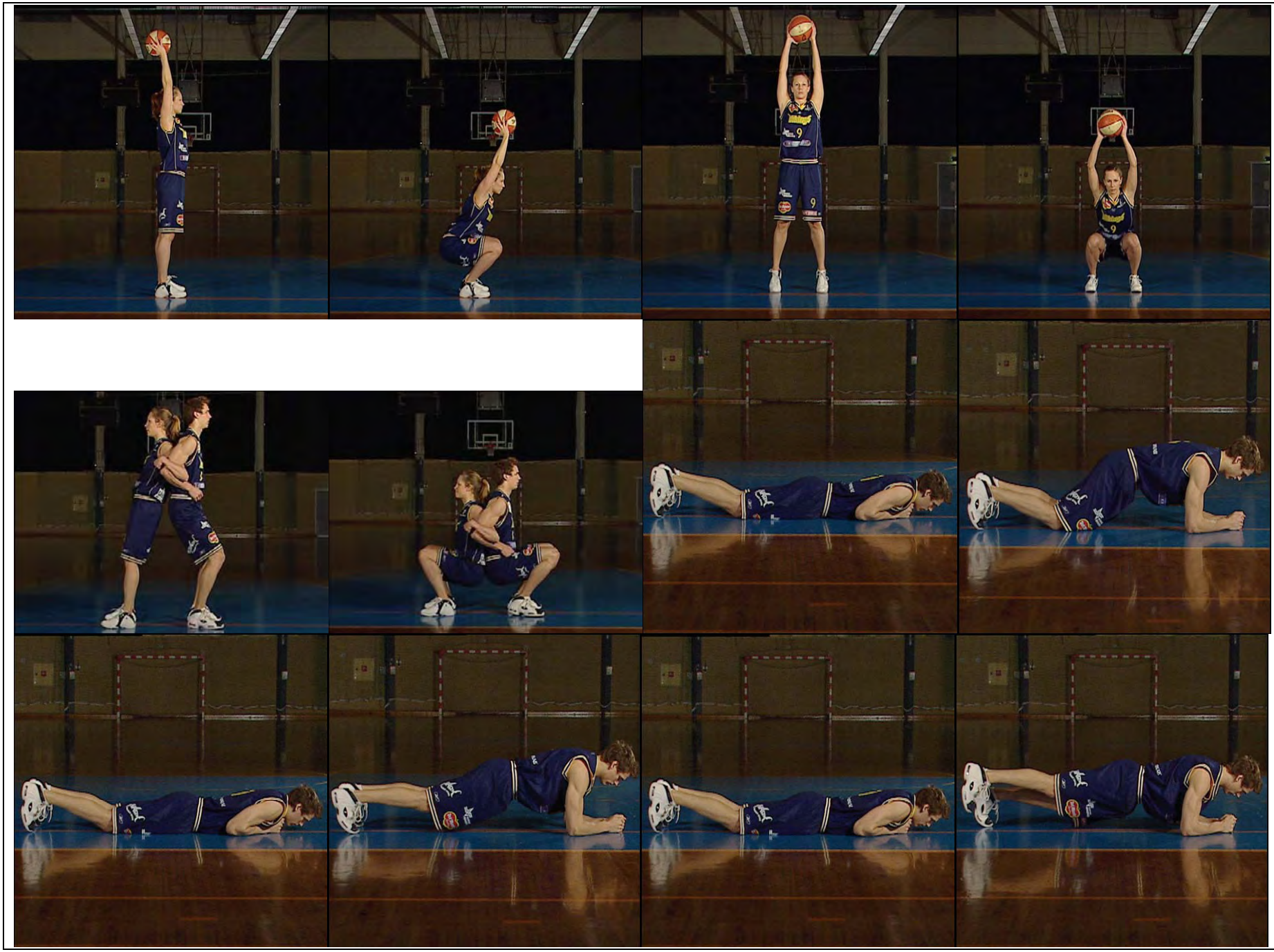


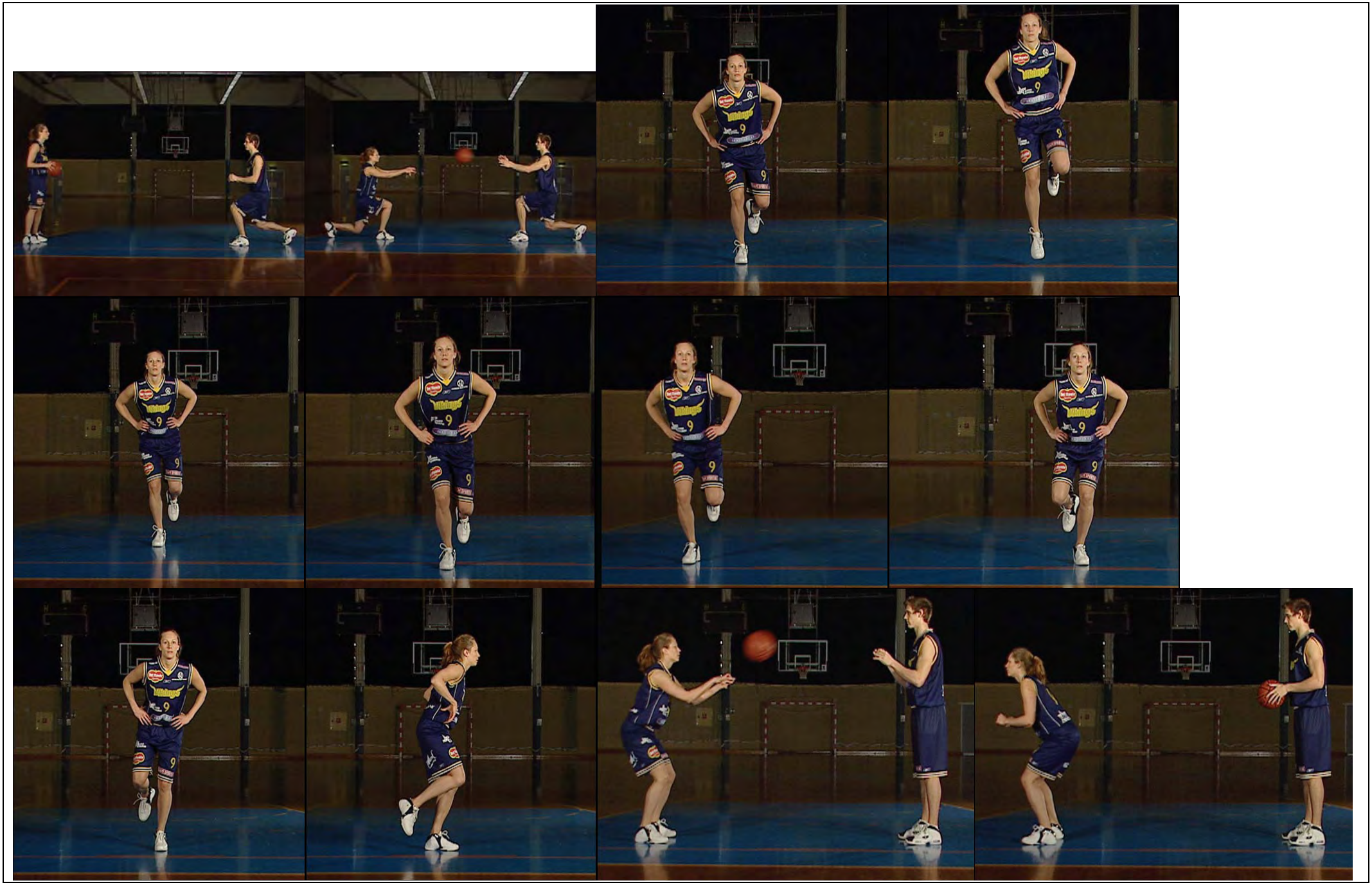










B. Technical & Political Approaches

Title	Author / Editor
Pilot study of female high school basketball players' anterior cruciate ligament injury knowledge, attitudes, and practices	Iversen et al.

English Title	Year	Country	Doc.No
Pilot study of female high school basketball players' anterior cruciate ligament injury knowledge, attitudes, and practices	2009	USA	042

Source	Category	Validation
Scandinavian Journal of Medicine & Science in Sports, 2009,19(4): 595-602 http://www3.interscience.wiley.com/journal/118521374/home	☐ Training & Physical Preparation ☒ Technical & Political Approaches ☐ Equipment & Facilities ☐ Medical & Non-medical Support ☐ Multifaceted Approaches	☐ Multiple scientific validation ☒ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination Study Online + print journal article		

Description

Summary	Research shows that non-contact knee injuries in quick stopping, jumping and cutting sports such as soccer, basketball, volleyball and handball are common, with a higher incidence in female athletes. The specific purposes of this study were (a) to characterize female high school basketball players' and coaches' knowledge, attitudes, and beliefs regarding ACL injury risks and injury prevention practices (b) to examine the effectiveness of an educational programme on players' and coaches' knowledge about the role of the ACL and ACL injury risk, attitudes toward ACL injury prevention and use of injury prevention practices. Hence, 113 female high school varsity and junior varsity basketball players and 12 coaches participated in an 8-week educational and skills programme. Demographic and injury history data were collected. At pre-intervention and at the end of season, knowledge, attitudes, and practices about ACL risk and injury prevention were assessed via questionnaires, and frequency of two-footed landings were videotaped during games. Results showed that the applied programme increased knowledge about ACL injury risk and improved player's landing skills.
Preventive recommendation	A simple 45-min low-cost educational session provided to players and their coaches can help increase knowledge and improve performance of two-footed landings.

Title		Author / Editor		
Basketball: SuvaLiv-Fairness-Preis		Suva Accident Insurance Company		
English Title		**Year**	**Country**	**Doc.No**
Basketball: SuvaLiv-Fairness award			Switzerland	089
Source	**Category**	**Validation**		
Suva – Swiss accident insurer http://www.suva.ch/home/suvaliv/kampagnen/kampagne_daenk_glaenk/basketball-fairness-preis.htm	☐ Training & Physical Preparation ☒ Technical & Political Approaches ☐ Equipment & Facilities ☐ Medical & Non-medical Support ☐ Multifaceted Approaches	☐ Multiple scientific validation ☐ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☒ Single expert recommendation		
Form / Dissemination				
Education and information Online, print/poster publication				

Description

Summary	Team sports bear a certain risk of sports injuries, in particular team sports such as basketball that are characterized by intensive physical contact with opponents. Providing a respectful way of play can help to reduce the risk of getting injured in contact situations by unfair play. A Swiss accident insurer that is collaborating with the Swiss Basketball Federation annually advertises a fairness-award for men's and women's elite basketball teams in the Swiss 'Nationalliga'. The first two teams of the respective fairplay table are financially rewarded. Personal fouls, technical fouls and flagrant fouls during competitive games are considered for the calculation of the ranking.
Preventive recommendation	Rewarding fairplay and educating a respectful way of play.

C. Equipment & Facilities

Title	Author / Editor
Dental Injuries Facial Injuries	Amy, E

English Title	Year	Country	Doc.No
Dental Injuries Facial Injuries	2004	Puerto Rico	005

Source	Category	Validation
FIBA Assisst Magazine http://www.fiba.com/asp_includes/download.asp?file_id=376 http://www.fiba.com/asp_includes/download.asp?file_id=411	☐ Training & Physical Preparation ☐ Technical & Political Approaches ☒ Equipment & Facilities ☐ Medical & Non-medical Support ☐ Multifaceted Approaches	☐ Multiple scientific validation ☐ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☒ Single expert recommendation
Form / Dissemination		
Information Online magazine article		

Description

Summary	This article highlights dental and facial injuries in detail and makes recommendations for diagnosis and first treatment. In addition, consequences of suffered dental and facial injuries are pointed out. Furthermore, essential properties of appropriate mouth protection by means of different mouth guards are listed up. The main functions of mouth protectors are: Protection of soft tissue and lips from lacerations caused by teeth in times of contact, cushioning and distribution of direct punches to the jaw, reducing the incidence of fractures, providing support to the jaw, absorbing the punch, and minimizing the possibility of a fracture to the condyles. A mouth protector should have the following properties: Custom-made for a specific patient, fine and smooth edges, enough retention to avoid coming out of place during competition, strong enough so that teeth cannot penetrate it, lasting approximately two years, thermal resistant so that it can be sterilized, no smell or flavor, reasonable costs.
Preventive recommendation	Mouth protectors are essential for athletes involved in contact sports. Custom-built protectors are the only ones that really guarantee maximal protection. They are more adaptable to the oral tissues, comfortable, and interfere less with breathing and speech.

Title	Author / Editor
Dental / orofacial trauma in contact sports and intraoral mouthguard programmes	Badel et al.

English Title	Year	Country	Doc.No
Dental / orofacial trauma in contact sports and intraoral mouthguard programmes	2007	Croatia	008

Source	Category	Validation
Kinesiology 39 (2007) 1:97-105 http://hrcak.srce.hr/kineziologija	☐ Training & Physical Preparation ☐ Technical & Political Approaches ☒ Equipment & Facilities ☐ Medical & Non-medical Support ☐ Multifaceted Approaches	☐ Multiple scientific validation ☐ Single scientific validation ☒ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
Review Online + print journal article		

Description

Summary	Review of mouthguard programmes with the aim of raising awareness of the need for protective mouthguards. Starting with an epidemiological description of oral and dental injuries in American football, baseball, basketball, boxing, and other combat sports, ice-hockey, field-hockey, football, gymnastics, inline skating, biking, mountain biking, horseback riding, rugby, skateboarding and water polo. The incidence of dental/orofacial injuries among basketball players varies between 5.2 and 69.4% but only a half of the professional Croatian basketball players interviewed wear mouthguards. Three types of mouthguards can be differentiated: prefabricated, self-adapting and custom-made mouthguards. In general, all mouthguards worn during sports participation have proved to provide effective protection against dental and orofacial injuries. However, only the custom-made mouthguard has proved to be the most effective means in the prevention against injuries to the orofacial system. In addition, athletes clearly show a preference for custom-made mouthguards as they provide the best comfort during practice sessions and competitions.
Preventive recommendation	Intraoral moutguards, in particular custom-made mouthguards, are recommended as an indispensable part of dental care dedicated to both levels of sports involvement - the professional and the recreational alike.

Title	Author / Editor
High- versus low-top shoes for the prevention of ankle sprains in basketball players : A prospective randomized study	Barret et al.

English Title	Year	Country	Doc.No
High- versus low-top shoes for the prevention of ankle sprains in basketball players : A prospective randomized study	1993	USA	109

Source	Category	Validation
The American Journal of Sports Medicine 21, (4)1993: 582-585 www.ajs.sagepub.com	☐ Training & Physical Preparation ☐ Technical & Political Approaches ☒ Equipment & Facilities ☐ Medical & Non-medical Support ☐ Multifaceted Approaches	☐ Multiple scientific validation ☒ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
Study Online + print journal article		

Description

Summary	In this study it was hypothesized that wearing high-top shoes results in fewer ankle sprains compared with wearing low-top shoes. 622 college basketball players participated in this study for one single season. Subjects were subdivided by previous history of ankle sprains (frequent sprains, occasional sprains and no sprains) and then randomized to three study groups: (1) low-top shoes (2) high-top shoes or (3) high-top shoes with inflatable air chambers. All participants were provided and fitted with a new pair of basketball shoes. Results showed that there was no difference between high- and low-top basketball shoes in the prevention of ankle sprains.
Preventive recommendation	New shoes provide good lateral support to the ankle and may help prevent sprains.

Title	Author / Editor
Role of ankle taping and bracing in the athlete	Callaghan, M

English Title	Year	Country	Doc.No
Role of ankle taping and bracing in the athlete	1997	Great Britain	110

Source	Category	Validation
British Journal of Sports Medicine 1997, 31: 102-108 http://bjsm.bmj.com/	☐ Training & Physical Preparation ☐ Technical & Political Approaches ☒ Equipment & Facilities ☐ Medical & Non-medical Support ☐ Multifaceted Approaches	☒ Multiple scientific validation ☐ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
Review Online + print journal article		

Description

Summary	As ankle sprains are a major cause of an athlete's disability and time off sport, the choice of the method of support should be more scientifically reasoned. This paper reviewed the literature concerning the effects of various methods of ankle support on swelling, stability, range of movement, proprioception, muscle function, gait, and performance tests. Computerized searches were performed using Medline, Excerpta Medica, and CINAHL for studies published between 1966 and 1996.
Preventive recommendation	Both taping and braces have been shown to prevent ankle sprains in basketball. Ankle braces are more convenient and cost effective than tape. Furthermore, they retain their restrictive properties for longer periods after exercise, but have also been shown to have a proprioceptive role.

Title	Author / Editor
The Role of Shoe Design in Ankle Sprain Rates Among Collegiate Basketball Players	Curtis et al.

English Title	Year	Country	Doc.No
The Role of Shoe Design in Ankle Sprain Rates Among Collegiate Basketball Players	2008	USA	022

Source	Category	Validation
Journal of Athletic Training 2008, 43(3): 230–233 www.journalofathletictraining.org	☐ Training & Physical Preparation ☐ Technical & Political Approaches ☒ Equipment & Facilities ☐ Medical & Non-medical Support ☐ Multifaceted Approaches	☐ Multiple scientific validation ☒ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
Study Online + print journal article		

Description

Summary	Basketball players frequently land on another competitor's foot, causing an awkward, plantar-flexed inversion moment and stretching the lateral ankle ligaments beyond their capacity, resulting in an ankle sprain. The present study examined the incidence of lateral ankle sprains in collegiate basketball players with regard to shoe design, hypothesizing that cushioned column system shoes reduce the amount of lateral stability in the ankle joint as a result of a perceived increase in ankle plantar flexion. During one single season type of shoe, practice and game exposures, and lateral ankle injuries for were recorded 141 male and 89 female collegiate basketball players between the ages of 18 years and 24 years. Results showed no differences in incidences of lateral ankle sprains between collegiate basketball players wearing cushion columned and those wearing non-cushioned column shoes.
Preventive recommendation	Cushioned column shoes do not increase the risk of ankle injury in collegiate basketball players. In addition, a significant percentage of collegiate basketball players wore prophylactic ankle supports while participating which lead to a decrease in ankle injuries.

Title	Author / Editor
Prevention is better than cure	Edwards, C

English Title	Year	Country	Doc.No
Prevention is better than cure	2005	Switzerland	028

Source	Category	Validation
FIBA Assisst Magazine (13) 2005: 58-59 http://www.fiba.com/	☐ Training & Physical Preparation ☐ Technical & Political Approaches ☒ Equipment & Facilities ☐ Medical & Non-medical Support ☐ Multifaceted Approaches	☐ Multiple scientific validation ☐ Single scientific validation ☐ Science-based ☒ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
Information Online magazine article		

Description

Summary	Dento-facial traumas represent 10% of the lesions in sports activities, it is the third most affected zone after the lesions of superior and inferior limbs. Basketball shows a high risk for suffering orofacial injuries. In particular, physical contact (e.g. blows struck with the head or elbows) is a hardly avoidable part of the game. The dental rehabilitation of such injuries costs 400$ to 2000$. The athlete often has insufficient insurance cover. However, more important than the monetary factor is the fact that the rehabilitation cannot guarantee reconstructing the dental health or the initial solidity.
Preventive recommendation	Custom-fabricated mouthguards are essential in the prevention of basketball maxillo-facial injuries. For basketball a custom-made multiple layered mouthguard is recommended. A minimum of two laminated layers (2/4mm) is necessary.

Title		Author / Editor		
Sportverletzungen der unteren Extremität im Basketball in Abhängigkeit der Torsionssteifigkeit des Sportschuhs		Graumann et al.		
English Title		**Year**	**Country**	**Doc.No**
The influence of sports-shoes mechanical properties on the frequency of lower-extremity athletic injuries		2007	Germany	034
Source	**Category**	**Validation**		
Sportorthopädie & Sporttraumatologie 23, 174–177 (2007) http://elsevier.isoftmedia.de/index.php?lan=ger&site=journalo&journal=1	☐ Training & Physical Preparation ☐ Technical & Political Approaches	☐ Multiple scientific validation ☒ Single scientific validation		
Form / Dissemination	☒ Equipment & Facilities	☐ Science-based		
Study Online + print journal article	☐ Medical & Non-medical Support ☐ Multifaceted Approaches	☐ Multiple expert recommendation ☐ Single expert recommendation		

Description

Summary	The present study examines the influence of basketball shoes (i.e. torsional stiffnes of the shoe) on the occurrence of lower limb injuries in basketball. Four groups, each consisting of 40 semi-professional basketball players, tested four identically looking basketball shoes that had a different torsional stiffness respectively. Results showed a correlation of body weight, stiffness and instability within the four groups. Subjects with a higher body weight (>85 kg) had a benefit in a higher stiffness and subjects with lower body weight (<85 kg) vice-versa ($p < .05$). Thus, this study shows that the risk of supination trauma increases with a non-bodyweight adapted torsional stiffness of basketball shoes.
Preventive recommendation	A bodyweight adapted (for heavier >85kg and lighter <85kg athletes) shoe-stiffness may maximize stability and comfort and thus support in preventing injuries of the lower limbs.

Title	Author / Editor
Ocular Traumas in Basketball	Huguet, J

English Title	Year	Country	Doc.No
Ocular Traumas in Basketball	2003	France	041

Source	Category	Validation
Fiba Asisst Magazine, (1) 2003: 57-58 http://www.fiba.com/	☐ Training & Physical Preparation ☐ Technical & Political Approaches ☒ Equipment & Facilities ☐ Medical & Non-medical Support ☐ Multifaceted Approaches	☐ Multiple scientific validation ☐ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☒ Single expert recommendation
Form / Dissemination		
Information Online magazine article		

Description

Summary	Any sport that involves a ball or other projectile, a stick or a racket presents a risk of serious eye injury. The nature and severity of an impact injury to the eye depends mainly on the impacting object's mass, speed, hardness, size and sharpness. Although there are no accurate figures available for the number of sports-related eye injuries, they remain a significant problem. In general, eye injuries account for 0.5 to 2% of all basketball-related injuries. The cornea was the most injured region part of the eye. Typically, flying elbows and errant fingers cause occular traumas. However, eye injuries are not an inevitable part of basketball and can easily be prevented with proper eyewear. Only 3.4% of the players wear protective glasses.
Preventive recommendation	If a basketball player is concerned about the risk of eye injury, protective eyewear should definitely be worn. For some, protective eyewear is not an option, but a necessity. Athletes who are functionally one-eyed due to injury or illness and have vision of 20/40 or worse in one eye, should not play basketball without protective polycarbonate eye wear.

Title	Author / Editor
Lower-Extremity Overuse Injury and Use of Foot Orthotic Devices in Women's Basketball	Jenkins et al.

English Title	Year	Country	Doc.No
Lower-Extremity Overuse Injury and Use of Foot Orthotic Devices in Women's Basketball	2006	USA	043

Source	Category	Validation
Journal of the American Podiatric Medical Association, 96 (5) 2006: 408-412 www.japmaonline.org/	☐ Training & Physical Preparation ☐ Technical & Political Approaches ☒ Equipment & Facilities ☐ Medical & Non-medical Support ☐ Multifaceted Approaches	☐ Multiple scientific validation ☒ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
Study Online + print journal article		

Description

Summary	Lower-extremity overuse injuries are prevalent in female athletes. Non-traumatic injuries of the knee extensor mechanism, stress fractures of the lower leg and foot and medial tibial stress syndrome are especially frequent overuse injuries in female athletes, including female basketball players. The purpose of the present study was to determine whether the use of foot orthotic devices (insoles) affects the incidence of lower-extremity overuse injury in a group of intercollegiate female basketball players. 132 female basketball players were observed for lower-extremity overuse injury between 1993 and 2004. Athletes studied between 1993 and 1996 did not receive foot orthotic devices and composed the control group (n=36). The treatment group (n=96) comprised athletes studied between 1996 and 2004. The foot orthotic device consisted of a mediumdensity (35-durometer) ethyl vinyl acetate shoe insert, given to each player of the treatment group according to their foot size in the preseason each year. Each player was asked to wear the foot orthotic device during all basketball activities. Results showed that athletes who wore foot orthotic devices were no less likely to sustain an injury to the foot, lower leg or knee extensor mechanism than those who did not wear a foot orthotic device.
Preventive recommendation	This study does not support the use of accommodative foot orthotic devices (insoles) to reduce lower-extremity overuse injury rates in female basketball players.

Title	Author / Editor
Mouthguards in Sport Activities History, Physical Properties and Injury Prevention Effectiveness	Knapik et al.

English Title	Year	Country	Doc.No
Mouthguards in Sport Activities History, Physical Properties and Injury Prevention Effectiveness	2007	USA	047

Source	Category	Validation
Sports Medicine 2007; 37 (2): 117-144 http://www.ingentaconnect.com/content/adis/smd	☐ Training & Physical Preparation ☐ Technical & Political Approaches ☒ Equipment & Facilities ☐ Medical and non-medical support ☐ Multifaceted Approaches	☒ Multiple scientific validation ☐ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
Review Online + print journal article		

Description

Summary	Three systematic reviews were conducted on the history of mouth guard use in sports, mouthguard material and construction and the effectiveness of mouth guards in preventing orofacial injuries and concussions. Among modern materials, none seems to stand out as superior to another since the characteristics of all the modern materials can be manipulated to provide a range of favorable characteristics. Impact studies have shown that compared with no mouthguard, mouthguards composed of many types of materials reduce the number of fractured teeth and head acceleration. Meta-analyses indicated that the risk of an orofacial sports injury was 1.6–1.9 times higher when a mouthguard was not worn. However, the evidence that mouthguards protect against concussion was inconsistent, and no conclusion regarding the effectiveness of mouthguards in preventing concussion can be drawn at present.
Preventive recommendation	Mouthguard use should be promoted in sports activities where there is a significant risk of orofacial injury.

Title	Author / Editor
Ankle Sprain Injuries: A 2-Year Prospective Cohort Study in Female Greek Professional Basketball Players	Kofotolis et al.

English Title	Year	Country	Doc.No
Ankle Sprain Injuries: A 2-Year Prospective Cohort Study in Female Greek Professional Basketball Players	2007	Greece	051

Source	Category	Validation
Journal of Athletic Training, 42(3) 2007: 388-394 http://www.nata.org/jat/readers/archives	☐ Training & Physical Preparation ☐ Technical & Political Approaches ☒ Equipment & Facilities ☐ Medical & Non-medical Support ☐ Multifaceted Approaches	☐ Multiple scientific validation ☒ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
Study Online + print journal article		

Description

Summary	Ankle sprains are a common basketball injury. Therefore, examination of risk factors for injury in female professional basketball players is worthwhile. The present study assessed rates of ankle sprains, associated time missed from participation, and risk factors for injury observing 204 players from 18 female professional basketball teams for 2 consecutive seasons during a 2-year period. Results showed that female professional basketball athletes who did not wear an external ankle support, who played in the key area or who functioned as centers had a higher risk for ankle sprain than did other players.
Preventive recommendation	Injury prevention strategies in female basketball players should focus on the use of external ankle supports (bracing), especially during games. This strategy applies in particular to those athletes who play in the key area of the court, mostly centers, and to those athletes who have experienced an ankle sprain.

Title	Author / Editor
Effect of mouthguards on dental injuries and concussions in college basketball	Labella et al.

English Title	Year	Country	Doc.No
Effect of mouthguards on dental injuries and concussions in college basketball	2002	USA	107

Source	Category	Validation
Medicine & Science in Sports & Exercise 2002: 41-44 http://www.acsm-msse.org	☐ Training & Physical Preparation ☐ Technical & Political Approaches ☒ Equipment & Facilities ☐ Medical & Non-medical Support ☐ Multifaceted Approaches	☐ Multiple scientific validation ☒ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
Study Online + print journal article		

Description

Summary	This study prospectively recorded dental injuries and concussions among 50 men's college basketball teams during one competitive season, comparing injury rates between mouthguard users and nonusers. During the 1999 to 2000 basketball season, athletic trainers from included college basketball programmes used an internet website to submit weekly reports of the number of athlete exposures, mouthguard users, concussions, oral soft tissue injuries, dental injuries, and dentist referrals. Results showed that mouthguard users had significantly lower rates of dental injuries and dentist referrals but there were no significant differences with regard to rates of concussions and oral soft tissue injuries.
Preventive recommendation	Custom-fitted mouthguards reduce the morbidity and expense resulting from dental injuries.

Title	Author / Editor
Sports and Recreation Injury Prevention Strategies: Systematic Review and Best Practices	Scanlan et al.

English Title	Year	Country	Doc.No
Sports and Recreation Injury Prevention Strategies: Systematic Review and Best Practices	2001	Canada	079

Source	Category	Validation
The British Columbia Injury Research and Prevention Unit http://www.injuryresearch.bc.ca	☐ Training & Physical Preparation ☐ Technical & Political Approaches ☒ Equipment & Facilities ☐ Medical & Non-medical Support ☐ Multifaceted Approaches	☒ Multiple scientific validation ☐ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
Review Online report		

Description

Summary	Basketball is the highest contributor to sport and recreation-related injuries in Canada. Upon a search of computerized databases, fourteen potentially relevant articles were identified. Three met the inclusion criteria and were included in the present review. All of the studies examined equipment-related interventions designed to reduce injury to the ankle (shoes, tape, ankle braces). Results are discussed in the light of current literature. In addition, general recommendations for practice and for further research are given.
Preventive recommendation	The use of ankle stabilizers, high-top shoes and ankle taping can reduce the incidence of ankle injuries in basketball players; Encourage pre-season conditioning to prepare the athlete for competition and reduce the possibility of injury; Playing surfaces must be well-maintained and kept clear of debris or obstructions and conditions should be monitored; Ensure that the design, development and maintenance of sports and recreation equipment and facilities meet recognized safety standards and monitor the effects on injury reduction.

Title	Author / Editor
The Efficacy of a Semirigid Ankle Stabilizer to Reduce Acute Ankle Injuries in Basketball	Sitler et al.

English Title	Year	Country	Doc.No
The Efficacy of a Semirigid Ankle Stabilizer to Reduce Acute Ankle Injuries in Basketball	1994	USA	108

Source	Category	Validation
The American Journal of Sports Medicine 22, (4)1994: 454-461 www.ajs.sagepub.com	☐ Training & Physical Preparation ☐ Technical & Political Approaches ☒ Equipment & Facilities ☐ Medical & Non-medical Support ☐ Multifaceted Approaches	☐ Multiple scientific validation ☒ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
RCT Online + print journal article		

Description

Summary	The present randomized clinical study was designed to prospectively determine the efficacy of a semi-rigid ankle stabilizer in reducing the frequency and severity of acute ankle injuries in basketball. 1601 United States Military Academy cadets with no pre-participation, clinical, functional, or radiographic evidence of ankle instability participated in the study over a period of two consecutive seasons. All practices and games were conducted on hardwood floors, and the same type of high-top basketball shoe was worn by all subjects. During the 2 years of the study, 812 subjects served as non-braced controls (722 non-injured, 90 previously injured) and 789 subjects wore ankle stabilizers (702 non-injured, 87 previously injured). Use of ankle stabilizers significantly reduced the frequency of ankle injuries. However, injury severity was not reduced. Wearing the ankle stabilizer did not affect the frequency of knee injuries.
Preventive recommendation	Semi-rigid ankle stabilizers significantly reduce the frequency of ankle injuries.

D. Medical & Non-medical Support

Title	Author / Editor
Role of MRI in Prevention of Metatarsal Stress Fractures in Collegiate Basketball Players	Major, N

English Title	Year	Country	Doc.No
Role of MRI in Prevention of Metatarsal Stress Fractures in Collegiate Basketball Players	2005	USA	057

Source	Category	Validation
American Journal of Roentgenology 186, 2006: 255-258 http://www.ajronline.org	☐ Training & Physical Preparation ☐ Technical & Political Approaches ☐ Equipment & Facilities ☒ Medical & Non-medical Support ☐ Multifaceted Approaches	☐ Multiple scientific validation ☒ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
Study Online + print journal article		

Description

Summary	Metatarsal stress fractures are common and represent debilitating and potentially season-ending injuries for basketball players. The injury results from an increase in vertical load distributed over the metatarsal. Bone marrow edema is readily visualized on MRI and can be a sign of stress changes. Twenty-six asymptomatic male National Collegiate Athletic Association basketball players were imaged before the 2003–2004 season and 14 players were reimaged after the conclusion of the season. The present study hypothesizes that if this abnormality could be diagnosed early, preventive measures could be instituted to decrease or eliminate the time away from this sport. Although the numbers in this evaluation were small, it revealed that MRI has a role in identifying stress changes in the metatarsals, as shown in three of the 26 players and that early diagnosis can alter treatment and outcome, as shown in two players. A third player did not receive treatment and sustained a stress fracture.
Preventive recommendation	MRI (of foot and ankle region) should be used to identify stress changes by showing prominent bone marrow signal alterations, allowing early treatment to prevent the development of stress fractures.

E. Multifaceted Approaches

Title	Author / Editor		
Prevention of Sports Injuries - Systematic Review of Randomized Controlled Trials	Aaltonen et al.		
English Title	**Year**	**Country**	**Doc.No**
Prevention of Sports Injuries - Systematic Review of Randomized Controlled Trials	2007	Finland	001

Source	Category	Validation
Archive of Internal Medicine 15 (167), 1585-1592 www.archinternmed.com	☒ Training & Physical Preparation ☐ Technical & Political Approaches ☒ Equipment & Facilities ☐ Medical & Non-medical Support ☒ Multifaceted Approaches	☒ Multiple scientific validation ☐ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
Review Online journal article		

Description

Summary	Systematic review of 32 randomized controlled trials with altogether 24931 participants. Kinds of sports covered: basketball, handball, football, volleyball, recreational sports, college sports, parachuting and alpine skiing. The review considers studies on prevention measures with regard to insoles, external joint supports, single balance board Training & Physical Preparation, multi-intervention Training & Physical Preparation including balance boards, other multi-intervention Training & Physical Preparation, stretching and warm-up programmes, mouthguards, modified shoes and videos. Evidence of preventive effect was found for three types of injury prevention interventions: insoles, external joint supports, multi-intervention Training & Physical Preparation. Mouthguards and single balance board Training & Physical Preparation deliver no homogenous results in preventing injuries. Shoes, warm-up, videos and stretching do not show evidence in reducing injuries. Common methodical problems of the reviewed investigations are the difficulties of blinding and controlling of confounding variables. Especially in all multi-intervention Training & Physical Preparation, it is almost impossible to clarify which component is most effective or effective at all.
Preventive recommendation	In general, custom-made and prefabricated insoles, ankle orthoses, ankle stabilizers, outside-the-boot braces and multi-intervention Training & Physical Preparation with or without balance board training seem to be most promising.

Title	Author / Editor
Basketball Injury Prevention	American Academy of Orthopaedic Surgeons (AAOS)

English Title	Year	Country	Doc.No
Basketball Injury Prevention	2009	USA	002

Source	Category	Validation
American Academy of Orthopaedic Surgeons http://orthoinfo.aaos.org/topic.cfm?topic=A00177	☒ Training & Physical Preparation ☐ Technical & Political Approaches ☒ Equipment & Facilities ☒ Medical & Non-medical Support ☒ Multifaceted Approaches	☐ Multiple scientific validation ☐ Single scientific validation ☐ Science-based ☒ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
Information Online publication		

Description

Summary	In view of approximately 481,000 basketball related injuries, that have been treated in the US in 2007, the American Academy of Orthopaedic Surgeons gives recommendations for safer basketball, whether recreational or organized basketball, by means of a two-sided factsheet. The present advises are of general nature referring to playground properties, match preparation, appropriate equipment and technique.
Preventive recommendation	Safe playground, preparation for first aid and emergency cases, appropriate warm up with jumping jacks, stationary cycling, running or walking in place for 3 to 5 minutes, mouthguards, knee and elbow pads, external ankle support and appropriate shoes. Development of proper passing and scoring technique, avoid hard contact and collisions, stick to rules.

Title	Author / Editor
Strategies to prevent injury in adolescent sport: a systematic review	Abernethy et al.

English Title	Year	Country	Doc.No
Strategies to prevent injury in adolescent sport: a systematic review	2007	Ireland	003

Source	Category	Validation
British Journal of Sports Medicine, 41, 627-638 www.bjsportmed.com	☒ Training & Physical Preparation ☒ Technical & Political Approaches ☒ Equipment & Facilities ☐ Medical & Non-medical Support ☒ Multifaceted Approaches	☒ Multiple scientific validation ☐ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
Review Online journal article		

Description

Summary	This systematic review aimed to identify randomised controlled trials and controlled intervention studies that evaluated the effectiveness of preventive strategies in adolescent sport. Therefore twelve studies covering sports in Ireland (basketball, handball, athletics, hockey, rugby, football, swimming, tennis, squash, badminton, netball, gaelic football, camogie, hurling and lacrosse) have been included, examining the effect of any preventive intervention e.g. protective equipment, specialist coaching, conditioning or neuromuscular training. It can be concluded that injury prevention strategies that focus on preseason conditioning, functional training, education, balance and sport-specific skills, which should be continued throughout the sporting season, are effective. However, the evidence for the effectiveness of protective equipment in injury prevention is inconclusive and requires further assessment.
Preventive recommendation	In general, injury prevention strategies combining (preseason and season attending) functional flexibility and strength training, proprioceptive balance training, structured warm-up, sport-specific fitness and technique training show significant effectivity in reducing injuries - especially if educational forms are added.

Title	Author / Editor
Descriptive Epidemiology of Collegiate Women's Basketball Injuries: National Collegiate Athletic Association Injury Surveillance System, 1988–1989 Through 2003–2004	Agel et al.

English Title	Year	Country	Doc.No
Descriptive Epidemiology of Collegiate Women's Basketball Injuries: National Collegiate Athletic Association Injury Surveillance System, 1988–1989 Through 2003–2004	2007	USA	004

Source	Category	Validation
Journal of Athletic Training 42(2): 202-210 http://www.journalofathletictraining.org	☒ Training & Physical Preparation ☒ Technical & Political Approaches ☒ Equipment & Facilities ☐ Medical & Non-medical Support ☒ Multifaceted Approaches	☐ Multiple scientific validation ☐ Single scientific validation ☒ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
Epidemiologic study Print + online journal article		

Description

Summary	The present study reports on epidemiology of female collegiate basketball players over a 16 year period from 1988 to 2004. Data derive from NCAA Injury Surveillance System (ISS). During this time, 3556 injuries from more than 45,000 games and 6665 injuries from more than 134,000 practices were reported. Game and practice injury rates exhibited significant decreases over the study period. The injury rate in game situations was almost twice as high as in practice. Preseason-practice injury rates were more than twice as high as regular-season practice injury rates. Efforts to improve conditioning, training and rule changes designed to decrease the risk of specific injuries have not shown the intended change.
Preventive recommendation	Strength, agility, and flexibility should be trained in preseason and regular season, with stretching and warm-ups preceding practices and games. Injury prevention should be applied by coaches as frequent as training of individual and team skills. Neuromuscular control and balance training may reduce the frequency of lower extremity injuries. A combination of rule, training and equipment changes may be more likely than a single specific rule change or training improvement.

Title		Author / Editor		
Basketball Injuries		The British Columbia Injury Research and Prevention Unit (BCIRPU)		
English Title		**Year**	**Country**	**Doc.No**
Basketball Injuries		2000	Canada	010
Source	**Category**	**Validation**		
The British Columbia Injury Research and Prevention Unit www.injuryresearch.bc.ca	☒ Training & Physical Preparation ☒ Technical & Political Approaches ☒ Equipment & Facilities ☐ Medical & Non-medical Support ☒ Multifaceted Approaches	☐ Multiple scientific validation ☐ Single scientific validation ☒ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation		
Form / Dissemination				
Information Online publication				

Description

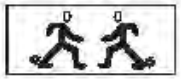
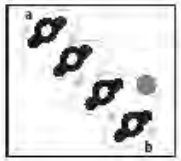
Summary	Basketball is a popular sport for all ages but each year, more than 1.6 million basketball-related injuries are treated in hospitals, doctor's offices and emergency rooms in North America. Of those injuries 574,000 involve children aged 5-14 years. Athletes are predominantly at risk for acute injuries as a result of traumas from collisions and falls and motions such as sudden accelerations, decelerations, pivoting, and explosive movements. The majority of basketball injuries are sprains and strains. Approximately half of all injuries result from body contact. At the high school and recreation levels, the majority of injuries are sustained during practice, specifically during rebounding. At college and professional levels, the majority of injuries occur during competition rather than during practice. The overall injury rate is slightly higher for females than for males, with females having more severe injuries and more injuries requiring surgery. Ankle and knee are most commonly affected and rank highest for injury severity and lost playing time. Following the detailed description of basketball epidemiology in view of age, performance level and gender this four-sided factsheet outlines general injury prevention tips in the fields of players, equipment, facilities and coaches.
Preventive recommendation	Preseason and season-attending conditioning that includes strength, agility and endurance training. Thorough warm-up and stretching before practices and games. Prophylactic taping, high-top shoes, ankle stabilizers and mouthguards. Proper and well maintained playgrounds. Educated coaches and sportsmanship.

Title		Author / Editor		
Unterrichtsblätter zur Sicherheitsförderung an Schulen - Ballspiele		bfu		
English Title		**Year**	**Country**	**Doc.No**
Safety tool for safety promotion in schools – ball games		2004	Switzerland	011
Source	**Category**	**Validation**		
bfu – Beratungsstelle für Unfallverhütung http://www.bfu.ch/PDFLib/255_76.pdf	☒ Training & Physical Preparation ☒ Technical & Political Approaches ☒ Equipment & Facilities ☐ Medical & Non-medical Support ☒ Multifaceted Approaches	☐ Multiple scientific validation ☐ Single scientific validation ☐ Science-based ☒ Multiple expert recommendation ☐ Single expert recommendation		
Form / Dissemination				
Education and information Online publication				

Description

Summary	13-page brochure covering the four most popular ball games in schools: basketball, football, volleyball and handball. The brochure is likewise addressed to pupils (aged 11-18) and teachers. It is divided into two main parts. The first part deals with general information on injury prevention and safety management in ball games, the teacher's role, injury awareness, emphasising the game character, appropriate balls and materials, basics of ball games including fairplay. The second part includes eight sheets of exercises for self-guided learning. One of them directly concerned with basketball. Finally, a checklist for controlling the basic environment in ball games in school sports is promoted.
Preventive recommendation	Correct education of basic technical skills e.g. catching, throwing, dribbling, and jumping; rising awareness of injury risks and their reduction; promotion of fairplay.

Lektionsvorschlag Basketball

		Inhalt	Zeit	Bemerkungen
1.		Ihr dribbelt zu dritt im Raum. Dabei ist es das Ziel von A sich stets auf der imaginären Linie zwischen B und C zu bewegen.	5'	Ziel: Erwerben von Übersicht und Orientierung! ➔ Raum öffnen (Basic 3) Für Geübte: Haltet euch genau in der Mitte der Linie oder haltet euch näher bei B oder C.
2.	 	Funktionsgymnastik Du bewegst den Ball mit ausgestreckten Armen mit den Fingerspitzen möglichst schnell von Hand zu Hand. Du beugst das vordere Bein so weit, dass die Ferse des hinteren gestreckten Beines gerade noch auf dem Boden bleibt. Nun strecke es wieder. Wiederhole das Ganze 5x.	3'	Ziel: Kräftigung der Arm-, Hand- und Fingermuskulatur! Dynamische Dehnung der Wadenmuskulatur!
3.		Ihr passt euch zu zweit einen Ball zu und löst die folgenden Bewegungsaufgaben: Annahme des Balles möglichst früh, weich, ohne Berührung der Fingerspitzen, ohne Durchrutschen durch die Hände. Entwickelt einen Vorschlag, der alle Optionen enthält und diskutiert anschliessend in der Klasse die Lösungsvorschläge.	2'	Ziel: Erwerben einer sicheren Fangtechnik! Einsatz Arbeitsblatt 6.
4.		4er-Teams: Ihr passt euch innerhalb der Gruppe den Ball um die Wette zu von a nach b und zurück.	5'	Ziel: Anwenden einer sicheren Ballannahme und -abgabe! ✖ Orientierung des Körpers zum Ball (Basic 4)
5.		Ihr steht zu fünft in je einer Feldhälfte mit einem Ball. Ein Angreifer versucht durch Blickkontakt und Ball fordern (Ausstrecken der Arme Richtung Ball) möglichst viele Doppelpässe zu spielen. Zwei Verteidiger versuchen dies zu verhindern.	5'	Ziel: Technik anwenden, wie man einen Ball fordert! Passen, nur wenn der Ball gefordert wird und Blickkontakt besteht. ● Blickkontakt (Basic 2) Ruhig spielen.
6.		Ihr spielt nun Basketball mit individueller Deckung. Wer seinen direkten Gegenspieler in Ballnähe berührt, meldet das selbständig und läuft sofort eine Runde um das Spielfeld.	10'	Ziel: Aufmerksamkeit auf den Gegenspieler lenken! ❤ Fairplay (Basic 5) Ruhig spielen.

Title	Author / Editor
Dänk a Gläänk - Basketball-Manual für Trainerinnen und Trainer.	Blunschi, B

English Title	Year	Country	Doc.No
Mind your joints – Basketball manual for coaches	2005	Switzerland	012

Source	Category	Validation
Suva - Schweizerische Unfallversicherungsanstalt https://wwwsapp1.suva.ch/sap/public/bc/its/mimes/zwaswo/99/pdf/88137_d.pdf	☒ Training & Physical Preparation ☒ Technical & Political Approaches ☒ Equipment & Facilities ☐ Medical & Non-medical Support ☒ Multifaceted Approaches	☐ Multiple scientific validation ☐ Single scientific validation ☐ Science-based ☒ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
Coaches‘ education Online publication		

Description

Summary	Injuries in basketball mainly affect the joints. Therefore, the author developed (in collaboration with Swiss Basketball Federation and Suva Accident Insurance) this coaching manual consisting of general advices for safety management regarding appropriate equipment and behaviour. Additionally, education of fairplay is promoted. Furthermore, the author presents a number of basic exercises, in the fields of warming-up, stretching / mobilisation, strengthening, jump training, and some basketball-specific drills (e.g. 1:1, rebounding), aimed at preventing joint injuries.
Preventive recommendation	Structured warm-up and cool-down, pre (10s) and post (20-30s) practice stretching and mobilisation, core stabilisation, plyometric / jump training, in general athletic conditioning with regard to agility, strength and endurance training, appropriate high top indoor shoes, optimisation of training organisation e.g. avoiding unattended balls, sufficient regeneration, educated coaches, clear behaviour code and fair play.



Title	Author / Editor
Shooting for basketball injury prevention	Deakin University

English Title	Year	Country	Doc.No
Shooting for basketball injury prevention	2002	Australia	025

Source	Category	Validation
Deakin University, Victoria, Autralia http://www.sport.vic.gov.au/web9/rwpgslib.nsf/GraphicFiles/Shooting_for_basketball_injury_prevention.pdf/$file/Shooting_for_basketball_injury_prevention.pdf	☒ Training & Physical Preparation ☒ Technical & Political Approaches ☒ Equipment & Facilities ☒ Medical & Non-medical Support ☒ Multifaceted Approaches	☐ Multiple scientific validation ☐ Single scientific validation ☒ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
Information Online + print report		

Description

Summary	Prevention of injuries in basketball involves a number of factors. Following a description of the epidemiology of basketball injuries, this comprehensive report (139 pages) provides information on preventive countermeasures and opportunities in multiple fields covering conditioning and fitness programmes, pre-participation screening, warm-up and cool-down routines, psychological factors, environmental factors (e.g. court surfaces, game surrounds, playing equipment), rules and regulations, coach and player education, protective equipment (e.g. ankle taping and bracing, mouth guards, eye protection) and first aid, medical staff and rehabilitation. Recommendations which are presented in a quite general and unspecific manner are partly based on existing literature and research, and on expert experience and opinion.
Preventive recommendation	Individualized preseason and seasonal conditioning programme concentrating on cardiovascular fitness, muscular strength, endurance and flexibility, pre-participation examination including general physical and basketball-specific assessments, 10-20 minutes warm-up prior to and cool-down activity immediately after training and competition, reduction of excessive stress, proper and well maintained facilities and playgrounds, modified rules for children's basketball (e.g. oz-ball, mini basketball and 'fast break'), fair play and behavior code, safety instructions for players, coaches and referees, preparation for emergency and first aid cases, external ankle support (e.g. taping, bracing) for athletes with previous injuries, appropriate footwear, custom-made mouthguards, appropriate protective eyewear if necessary, return to play guidelines, educated coaches and officials.

Title	Author / Editor
Descriptive Epidemiology of Collegiate Men's Basketball Injuries: National Collegiate Athletic Association Injury Surveillance System, 1988–1989 Through 2003–2004	Dick et al.

English Title	Year	Country	Doc.No
Descriptive Epidemiology of Collegiate Men's Basketball Injuries: National Collegiate Athletic Association Injury Surveillance System, 1988–1989 Through 2003–2004	2007	USA	027

Source	Category	Validation
Journal of Athletic Training 2007, 42(2): 194–201 www.journalofathletictraining.org	☒ Training & Physical Preparation ☒ Technical & Political Approaches ☒ Equipment & Facilities ☐ Medical & Non-medical Support ☒ Multifaceted Approaches	☐ Multiple scientific validation ☐ Single scientific validation ☒ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
Study Online + print journal article		

Description

Summary	Retrospective study on epidemiology of NCAA basketball injuries covering a period of 16 years aimed at identifying potential fields of injury prevention. The overall rate of injury was 9.9 per 1000 athlete-exposures for games and 4.3 per 1000 athlete-exposures for practices. Approximately 60% of all injuries were to the lower extremity, with ankle ligament sprains being the most common injury overall and knee internal derangements being the most common injury causing athletes to miss more than 10 days of participation. A trend of increasing incidence of injuries to the head and face was noted over the 16-year span of the study, which may be related to an observed increase in physical contact in men's basketball over the past 2 decades. Randomized controlled trials assessing the efficacy of preventive measures among NCAA collegiate men's basketball players are clearly lacking.
Preventive recommendation	Ankle ligament sprains and knee internal derangements may be at least partially preventable with interventions such as taping, bracing and neuromuscular training. Officials need to assess the increased tolerance for physical contact in men's basketball seen over the past 2 decades.

Title	Author / Editor
Prävention von Sprunggelenksverletzungen beim Basketball	Eils et al.

English Title	Year	Country	Doc.No
Prevention of ankle joint injuries in basketball	2006	Germany	029

Source	Category	Validation
Sicherheit im Sport. Ein Leben mit Sport – aber sicher., Köln 2006, 279-285	☒ Training & Physical Preparation ☐ Technical & Political Approaches ☒ Equipment & Facilities ☐ Medical & Non-medical Support ☒ Multifaceted Approaches	☐ Multiple scientific validation ☒ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
RCT Print article in edited volume		

Description

Summary	Ankle injuries occur frequently in sports with a lot of jumping and landing, and quick direction changes during running. In basketball every other injury affects the ankle. For one thing the present study examines the effect of external ankle stabilization (i.e. orthoses), for another thing the effect of a basketball-specific proprioception training, both in view of reducing the number of ankle injuries. 35 teams participating in this study have been (cluster) randomized to control group (n=125), proprioception group (n=116) or orthoses group (n=93). The proprioceptive training programme consisted of six exercises (i.e. balance and coordination exercises focusing on knee-over-toe position) intended to be integrated into regular warm-up routine. Proper execution (once a week) was supervised by physiotherapists. Results showed that orthoses as well as the basketball-specific proprioception programme were effective in reducing ankle injuries compared to the control group. However, orthoses were more effective (p=.042) in preventing ankle injuries than the multi-station training programme (p=.106), which showed no significant results. Nevertheless, both interventions are clearly recommended.
Preventive recommendation	Ankle orthoses and/or basketball-specific proprioception training.

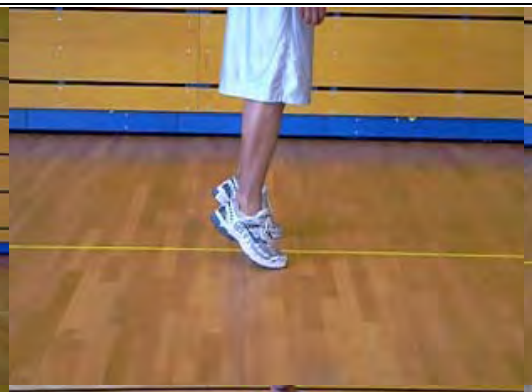
Title	Author / Editor
Prävention von Sprunggelenksverletzungen	Fröhlich et al.

English Title	Year	Country	Doc.No
Prevention of ankle joint injuries	2008	Germany	009

Source	Category	Validation
Deutsche Basketballärzte e.V. www.basketdocs.de	☒ Training & Physical Preparation ☐ Technical & Political Approaches ☒ Equipment & Facilities ☐ Medical & Non-medical Support ☒ Multifaceted Approaches	☐ Multiple scientific validation ☐ Single scientific validation ☒ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
Information for medical staff Online presentation + workshop		

Description

Summary	Presentation on epidemiology, diagnostics, therapy and prevention of ankle injuries in basketball. Ankle injuries are the most common acute injuries among basketball players, typically deriving from landing on an opponent's foot. Based on current knowledge examples are given on general and basketball-specific preventive training measures focusing on improvement of sensorimotor abilities.
Preventive recommendation	External ankle support (e.g. orthoses, tape, high- top shoes), in particular for the prevention of recurring injuries; stabilisation training; sensorimotor training (e.g. balancing, jumping, landing on one or two legs with, with or without unstable devices, with or without ball and partner.)














BENZ
BENZ

Title	Author / Editor
Epidemiology and Management of Basketball related injuries in Rwanda	Hakizimana et al.

English Title	Year	Country	Doc.No
Epidemiology and Management of Basketball related injuries in Rwanda	2005	South Africa	035

Source	Category	Validation
Department of Physiotherapy, Faculty of Community and Health Sciences, University of the Western Cape, South Africa http://etd.uwc.ac.za/usrfiles/modules/etd/docs/etd_init_6540_1175070434.pdf	☒ Training & Physical Preparation ☒ Technical & Political Approaches ☒ Equipment & Facilities ☒ Medical & Non-medical Support ☒ Multifaceted Approaches	☐ Multiple scientific validation ☐ Single scientific validation ☒ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
Thesis Online publication		

Description

Summary	The aim of this thesis was to investigate the prevalence, mechanisms, nature and management of basketball-related injuries in Rwanda. Results show that the injury prevalence among Rwandan basketball players is high. Treatment and rehabilitation after injury of basketball players was found to be very poor. Education to raise coaches', players' and managers' awareness of epidemiology and adequate management is needed in order to prevent basketball injuries and to promote players' faster recovery and hence maintain players' performance. Well-planned strategies to prevent common basketball injuries are also urgently required. With regard to the results and based on current literature the author gives general recommendations for the prevention of basketball in injuries in the fields of training, equipment and environment.
Preventive recommendation	Pre-season screening, appropriate conditioning focusing on cardiovascular fitness, strength, flexibility and neuromuscular control, appropriate warm-up, education of basic technique (e.g. passing, catching, jumping, landing, shooting), medium-top shoes that go above malleolli level and enable free ankle-joint movement, mouthguards, external ankle, wrist and elbow support, safe playgrounds, proper hydration, strict officiating, qualified coaches and physiotherapy support.

Title	Author / Editor
Πρόληψη Κακώσεων στα Ομαδικά Αθλήματα Επαφής της Ποδοσφαίρισης, της Καλαθοσφαίρισης, της Υδατοσφαίρισης και της Χειροσφαίρισης	Hatzimanouil et al.

English Title	Year	Country	Doc.No
Prevention of Injuries in Contact Sports Such as Soccer, Basketball, Water Polo and Team Handball	2007	Greece	037

Source	Category	Validation
Inquiries in Sport & Physical Education Volume 5 (1), 143 – 155 http://www.hape.gr/emag/vol5_1/hape172.pdf	☒ Training & Physical Preparation ☐ Technical & Political Approaches ☒ Equipment & Facilities ☐ Medical & Non-medical Support ☒ Multifaceted Approaches	☒ Multiple scientific validation ☐ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
Review Online + print journal article		

Description

Summary	The prevention of sports injuries is an important issue in the public health management. The present review discusses literature focusing on the prevention of injuries in popular team-sport (i.e. football, basketball, water polo and handball). Furthermore, it is intended to determine similarities and differences among applied sport-specific prevention measures. Football, basketball and handball show similar approaches in injury prevention reflecting, mutual movement patterns (e.g. jumping/landing, planting/cutting, running) while water polo because of its unique features and environment presents a different prevention model. Sport-specific prevention should consider typical epidemiology, injury mechanisms and movement patterns of the respective to become effective. Basketball players most frequently suffer ankle injuries due to inadequate landing, followed by knee injuries.
Preventive recommendation	In basketball prevention should primarily focus on neuromuscular training, strengthening, balancing exercises and technique training, in particular proper jump and landing technique. Additionally, orthoses may support in preventing ankle injuries, especially in players with previous injuries.

Title		Author / Editor		
Basketballverletzungen im Schulsport		Knobloch et al.		
English Title		**Year**	**Country**	**Doc.No**
Injuries during school basketball		2005	Germany	048
Source	**Category**	**Validation**		
Deutsche Zeitschrift für Sportmedizin 56, (4) 2005: 96-99 www.zeitschrift-sportmedizin.de	☒ Training & Physical Preparation ☐ Technical & Political Approaches ☒ Equipment & Facilities ☐ Medical & Non-medical Support ☒ Multifaceted Approaches	☐ Multiple scientific validation ☐ Single scientific validation ☒ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation		
Form / Dissemination				
Study Online + print journal article				

Description

Summary	Retrospective study analyzing the epidemiology of 2234 reported school sport injuries during one school year. The results show that ball sports (e.g. football, handball, volleyball and hockey) account for a very high number of school sport injuries. Regarding the non-gender-specific distribution of the ball sport disciplines, basketball leads with 32.4 %. In the analysis of the distribution of injury during basketball accidents, upper extremity injuries (65.6 %) dominate followed by lower extremity injuries (28.2 %) and head injuries (5.4 %). The type of injury during basketball injuries at school were predominantly sprains (27 %), ligament distensions and ruptures (23 %), fractures (21 %), and capsular injuries (9 %). In particular ankle and finger injuries occur frequently which may be due to low technical skills and deficits in finger and ankle proprioception. General advices for the prevention of above-mentioned injuries during school sport activities are given.
Preventive recommendation	Education of basic basketball technique skills, keep up concentration during school sport lessons, proprioceptive training focusing on finger and ankle proprioception should be integral part of school sport lessons e.g. 5-10 minutes during warm-up, twice a week, preventive application of finger tape may assisst in reducing finger injuries.

Title	Author / Editor
Stabilisierung zur Verletzungsprävention am Sprunggelenk – eine Metaanalyse	Kreische, G

English Title	Year	Country	Doc.No
Stabilization to prevent ankle injures – a meta-analysis	2007	Deutschland	052

Source	Category	Validation
University of Würzburg Department of Orthopaedy	☒ Training & Physical Preparation	☒ Multiple scientific validation
	☐ Technical & Political Approaches	☐ Single scientific validation
Form / Dissemination	☒ Equipment & Facilities	☐ Science-based
Meta-Analysis, thesis Print publication	☐ Medical & Non-medical Support	☐ Multiple expert recommendation
	☒ Multifaceted Approaches	☐ Single expert recommendation

Description

Summary	Ankle injuries are very common in sports and leisure activities. They occur more frequently in sports which are characterized by quick direction changes and numerous jumping and landing actions e.g. handball, basketball, football and volleyball. Based on a literature research (Pubmed, Medline) this thesis considers 44 studies on ankle stabilizing measures e.g. orthoses, taping, shoes and proprioceptive training for a meta-analysis. Although one cannot exclude all possibility of a decrease in proprioceptive motor skills, external ankle stabilization in terms of ankle braces, orthoses and taping may assist in preventing ankle injuries, in particular in athletes with previous ankle injuries. However, proprioception and coordination training (e.g. balancing exercises on unstable devices) tend to become more popular in sports injury prevention and provide scientific evidence in reducing ankle injuries even though heterogeneous study designs and the lack of blinding and compliance impede general conclusions.
Preventive recommendation	Combined ankle injury prevention strategy, composed of (soft) ankle bracing and additional stabilization and proprioception training.

Title	Author / Editor
Orofacial/cerebral injuries and the use of mouthguards by professional athletes in Switzerland	Lieger et al.

English Title	Year	Country	Doc.No
Orofacial/cerebral injuries and the use of mouthguards by professional athletes in Switzerland	2006	Switzerland	054

Source	Category	Validation
Dental Traumatology 2006; 22: 1–6 http://www3.interscience.wiley.com/journal/118537215/home	☐ Training & Physical Preparation ☒ Technical & Political Approaches ☒ Equipment & Facilities ☐ Medical & Non-medical Support ☒ Multifaceted Approaches	☐ Multiple scientific validation ☐ Single scientific validation ☒ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
Study Online + print journal article		

Description

Summary	As sporting accidents are one of the most common causes of facial injuries, the objective of this questionnaire based study was to measure the occurrence of orofacial and cerebral injuries in different sports (i.e. handball, ice hockey, basketball and football) and to survey the awareness of athletes and officials concerning the use of mouth guards during sport activities. In basketball, there was no need to use a mouth guard according to the interviewed players, despite high injury rates (45%). The large discrepancy between the acceptance of the mouth guard by officials and athletes and its use in sports demonstrates that a commitment by team dentists and officials is required.
Preventive recommendation	Athletes as well as coaches should be informed about the high risk of oral injuries when performing contact sports. Therefore, the initiation of a mouth-protection plan for handball players of all ages appears to be an appropriate goal to achieve. Mouthguards.

Title	Author / Editor
Ankle injuries in basketball: injury rate and risk factors	McKay et al.

English Title	Year	Country	Doc.No
Ankle injuries in basketball: injury rate and risk factors	2001	Australia	060

Source	Category	Validation
British Journal of Sports Medicine 35, 2001: 103–108 http://bjsm.bmj.com	☒ Training & Physical Preparation ☒ Technical & Political Approaches ☒ Equipment & Facilities ☐ Medical & Non-medical Support ☒ Multifaceted Approaches	☐ Multiple scientific validation ☒ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
Study Online and print journal article		

Description

Summary	In basketball, ankle injuries are among the most common injuries sustained and they are also amongst the most severe. The present study examined rate and risk factors of ankle injuries among mainly recreational basketball players. Injury observers sat courtside to determine the occurrence of ankle injuries. Ankle injured players (n=40) and a group of non-injured basketball players (n = 360) completed a questionnaire. The rate of ankle injury was 3.85 per 1000 participations, with almost half missing one week or more of competition and the most common mechanism being landing (45%). Basketball players who had previously injured their ankle were almost five times more likely to injure an ankle than their previously uninjured counterparts. Players wearing shoes with air cells being 4.3 times more likely to injure an ankle than those wearing shoes without air cells. Players who did not complete a general stretching programme as part of their warm-up routine were 2.6 times more likely to injure an ankle than players who stretched. These three identified risk factors and landing, should all be considered when preventive strategies for ankle injuries in basketball are being formulated.
Preventive recommendation	Ankle injured players need to be made aware of the increased risk of injury after the initial injury and pursue preventive strategies. Appropriate stretching programmes need to be taught to basketball players, particularly those with a history of ankle injuries. Shoes with air cells may decrease rear foot stability and consequently increase the risk of ankle injury. This needs further research.

Title	Author / Editor
The Role of Fibular Tape in the Prevention of Ankle Injury in Basketball: A Pilot Study	Moiler et al.

English Title	Year	Country	Doc.No
The Role of Fibular Tape in the Prevention of Ankle Injury in Basketball: A Pilot Study	2006	Australia	064

Source	Category	Validation
Journal of Orthopadic & Sports Physical Therapy 36, (9)2006: 661-668 www.jospt.org	☐ Training & Physical Preparation ☐ Technical & Political Approaches ☒ Equipment & Facilities ☒ Medical & Non-medical Support ☒ Multifaceted Approaches	☐ Multiple scientific validation ☒ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
Study Online + print journal article		

Description

Summary	Lateral ankle sprain is the most common injury in basketball. A novel method of taping, FRT (fibular repositioning tape), which has been described to prevent ankle sprain, requires less tape than traditional methods and is easier to apply. The objective of the present study was to determine the effect of FRT on the incidence and severity of ankle injury in basketball. Therefore, 125 male basketball players aged between 13 and 23 years were included as subjects in this study. Subjects were measured during 433 basketball exposures (control group n=209, FRT group n=224). Control participants had the choice on the use and type of prophylaxis, excluding FRT. Results showed that significantly less ankle injuries were sustained by members of the FRT condition, compared to members of the control condition. Strikingly, all injured participants reported a previous history of ankle injury.
Preventive recommendation	FRT (fibular repositioning tape) can provide prophylactic effects in preventing ankle injuries in male basketball players.





Title	Author / Editor
Is it Possible to Prevent Sports Injuries? Review of Controlled Clinical Trials and Recommendations for Future Work	Parkkari et al.

English Title	Year	Country	Doc.No
Is it Possible to Prevent Sports Injuries? Review of Controlled Clinical Trials and Recommendations for Future Work	2001	Finland	069

Source	Category	Validation
Sports Medicine 2001; 31 (14): 985-995 http://www.ingentaconnect.com/content/adis/smd	☒ Training & Physical Preparation ☒ Technical & Political Approaches ☒ Equipment & Facilities ☐ Medical & Non-medical Support ☒ Multifaceted Approaches	☒ Multiple scientific validation ☐ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
Review Online + print journal article		

Description

Summary	The aim of this article is to review the controlled trials on prevention of sports injuries and describe the most important aspects associated with injury surveillance and successful injury prevention. On the basis of a database research (Medline, Cochrane and Sport databases) 16 RCTs were taken into consideration. Along with the most important nonrandomised controlled studies these identified RCTs have been summarized by sports, anatomic region and type of prevention. The review has revealed that strategies designed to prevent sports injuries can be effective (e.g. multifaceted injury prevention programme in football; ankle disk training, combined with a thorough warm-up, in handball; ankle supports in basketball) although there is a continuous need for further well-designed randomised studies on preventive actions and devices that are in common use, such as preseason medical screenings, warming up, proprioceptive training, stretching, muscle strengthening, taping, protective equipment, rehabilitation programmes and education interventions. The most urgent needs are in commonly practised or high-risk sports e.g. handball, football, basketball (…).
Preventive recommendation	Existing data on sport-specific injury profiles and injury mechanisms could be used to educate participants, since a sound knowledge of risks is likely to have a preventive effect. To avoid injuries, the preventive measures proven to be effective should already be taught to young athletes. Measures, such as improved game rules supported by strict officiating, should always be incorporated with the aim of decreasing the number of violent contacts between participants. To reduce ankle injuries ankle disk training, taping and bracing may be options.

Title	Author / Editor
Orthopädische Checkliste: Basketball	Siebert et al.

English Title	Year	Country	Doc.No
Orthopaedic checklist: basketball	2001	Germany	082

Source	Category	Validation
Sportorthopädie · Sporttraumatologie 17, 2001: 262–263 http://elsevier.isoftmedia.de/index.php?lan=ger&site=journalo&journal=1	☒ Training & Physical Preparation ☐ Technical & Political Approaches ☒ Equipment & Facilities ☐ Medical & Non-medical Support ☒ Multifaceted Approaches	☐ Multiple scientific validation ☐ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☒ Single expert recommendation
Form / Dissemination		
Information Online + print journal article		

Description

Summary	The present two-paged fact sheet provides general information on basketball injuries. The ankle joint is injured most frequently, commonly during landing after rebounding. Thus forwards and center players are more vulnerable to suffer an acute injury. Following a description of typical injury types and mechanisms, some prophylactic countermeasures are given in bullet point form.
Preventive recommendation	Warm-up, cool-down, stretching (in particular m.rectus femoris), improving proprioceptive and coordination skills (soft mats, wobble boards), strengthening of peroneal muscles, external ankle support (tape, orthoses, high top shoes), mouthguards.

Title	Author / Editor
Basketball	Siebert, C

English Title	Year	Country	Doc.No
Basketball	2009	Germany	111

Source	Category	Validation
Basketball. In: Engelhardt (ed.) *Sportverletzungen* (515-522). München: Urban & Fischer.	☒ Training & Physical Preparation	☒ Multiple scientific validation
	☐ Technical & Political Approaches	☐ Single scientific validation
Form / Dissemination	☒ Equipment & Facilities	☐ Science-based
Review Print book chapter in collector's edition	☐ Medical & Non-medical Support	☐ Multiple expert recommendation
	☒ Multifaceted Approaches	☐ Single expert recommendation

Description

Summary	In view of injury patterns in basketball the author compares 11 different studies over a period from 1965 to 2007. Results of the 11 named studies show the incidence of injuries in lower extremities is mostly higher than in upper extremities. Main cause for such a high injury rate is the body contact to an opponent player, particularly during a rebounding situation in the paint or key area. This explains the high injury rate of centre players compared to other players. The majority of injuries are ligament sprains and distortions and mostly affect the ankle joint. Overuse injuries such as "Jumper's Knee" are mostly found in the knee joint. Female players are 25-60% higher affected by injuries than male players.
Preventive recommendation	Improvement of muscular stabilization in terms of taping; proprioceptive training; improvement of court floor; sufficient practice time; warm-up and cool-down; adherence of safety distance (e.g. spectators, banner advertisement etc.); mouthguard; safety glasses; orthoses and appropriate basketball shoes.

Title	Author / Editor
Keeping Your Basketball Players on the Court	Stein, A

English Title	Year	Country	Doc.No
Keeping Your Basketball Players on the Court		USA	085

Source	Category	Validation
Coach like a pro http://www.coachlikeapro.com/injury-prevention.html	☒ Training & Physical Preparation ☐ Technical & Political Approaches ☒ Equipment & Facilities ☐ Medical & Non-medical Support ☒ Multifaceted Approaches	☐ Multiple scientific validation ☐ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☒ Single expert recommendation
Form / Dissemination		
Coaches' information Online article		

Description

Summary	The present two-sided fact sheets claims the importance of year round conditioning. The central purpose of a year round training programme is to decrease the occasion for injury. Basketball is very demanding physically. Making the muscles, ligaments, and tendons of the body stronger will lessen the chance and/or severity of an injury, and keep players on the court. Thus, players need to warm-up properly for all workouts and practices as well as perform strength training and pre-hab exercises on a year round basis.
Preventive recommendation	In order to reduce the occurrence of injury players should participate in a comprehensive year round training programme. This includes having them warm up (e.g. light sprinting, back pedaling, defensive sliding, jumping, line jumps and quick feet) before every workout followed by dynamic flexibility exercises, perform strength training and pre-hab exercises (e.g. balancing on instable devices), limit the overuse of plyometrics, ankle tape or braces, sufficient recovery.

Title	Author / Editor
Reducing the risks of re-injury	Ward, T

English Title	Year	Country	Doc.No
Reducing the risks of re-injury	2005	Australia	091

Source	Category	Validation
FIBA Assist Magazin (12) 2005: 62-63 www.fiba.com	☒ Training & Physical Preparation ☒ Technical & Political Approaches ☒ Equipment & Facilities ☒ Medical & Non-medical Support ☒ Multifaceted Approaches	☐ Multiple scientific validation ☒ Single scientific validation ☐ Science-based ☐ Multiple expert recommendation ☐ Single expert recommendation
Form / Dissemination		
Study Online + print magazine article		

Description

Summary	The incidence of ankle injuries is stated to be around 25% of all basketball injuries arriving for treatment at sports injury clinics. Although they do not account for the greatest days missed from the court per injury (knee injuries being the highest), their prevalence in basketball accounts for a significant time in total athlete days spent out of team training. Literature on ankle injury rates has stated that the biggest predictor of ankle injuries is in fact previous ankle injury. The Australian Institute of Sports implemented an ankle prevention programme in their men's basketball team, consisting of (1) team and athlete education, (2) a balance control programme and (3) and a full rehabilitation programme. A significant decrease in ankle injuries and re-injuries was observed. Following these efforts general advices for ankle prevention with special regard to preventing re-injuries are given.
Preventive recommendation	Prevention of ankle (re-) injuries should include: 1. Appropriate taping for games and training 2. Regular preventative team balance training including exercises on wobble boards, minitramps and balance beams (3. Appropriate acute injury management) (4. Full completion of a 21-day rehabilitation programm post injury)