STRENGTH TRAINING FOR INJURY PREVENTION IN TEAM SPORTS

ABSTRACT

Playing team sports is associated with a high risk of injuries. One of the most effective injury-preventing modalities is regular strength training. In this paper, you will gain insight into the injury incidence in some of the most popular team sports, common injuries incurred, what strength training can do for team sport athletes´ from an injury preventive perspective, and simple recommendations. Let's prevent some injuries!

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INJURY INCIDENCE AND COMMON INJURIES IN TEAM SPORTS

Participation in team sports is associated with a high risk of sustaining injuries. According to Hootman et al., (2007), the risk of injury is higher during matchplay (13.8 injuries/games played) than during practice (4.0 injuries/practice) across different team sports, such as soccer, basketball, American football, ice hockey, and more. In the same article, the results show that the risk of injury is higher if the level of sport is professional in comparison to when adolescents are playing, and that the pre-season is associated with more injuries, than the competitive season.

other hand, has almost a twofold injury incidence in comparison to basketball. It is also clear that the lower body generally seems to be the most exposed location for injuries across different team sports. As a result, we will shift our focus towards lower-body injuries.

Injuries can broadly be divided into two facets. One facet is acute injuries. Acute injuries have been defined as: "injuries that occur due to sudden trauma to the tissue, with the symptoms presenting themselves almost immediately" (O'Reilly, et al., 2010). According to the same source, acute injuries can further be categorized into either contact injuries, as in a collision with an opponent or

INJURY RISKS ASSOCIATED WITH DIFFERENT TEAM SPORTS

	SOCCER	BASKETBALL	AMERICAN FOOTBALL	ICE HOCKEY
INJURY INCIDENCE (per 1000 games) Hootman et al., 2007	18.8	9.9	35.9	16.3
MOST COMMON INJURY LOCATIONS	Lower body 70% Trunk 13% Head 9%	Lower body 62% Upper body 15% Trunk 13%	Lower body 50% Upper body 17% Trunk 12%	Head (face) 40% Lower body 31% Upper body 22%
MOST COMMON LOWER BODY INJURIES	1. Thigh 2. Knee 3. Ankle Ekstrand et al., 2009	1. Knee (patella) 2. Ankle 3. Foot Drakos et al., 2010	1. Knee 2. Ankle 3. Thigh Mack et al., 2020	1. Knee 2. Ankle 3. Thigh Tuominen et al., 2014

Table 1: Injury incidence and injury distribution in team sports

When looking at some of the world's most popular team sports, the injury incidence and distribution of injuries differ. In Table 1, we can see how the injury incidence in American football is almost double the incidence in soccer, and that soccer, on the

implement (e.g., ball), or non-contact injuries, as in a muscle strain or ligament sprain (e.g., caused by exceeding tissue tolerance).

The other facet of injury is chronic, or overuse, injuries. In a systematic review, Cheéron et al., (2017) compiled several definitions of overuse

injuries used from different articles and found the following definitions to be one´s most frequently used:

1. "Absence of a single, identifiable (traumatic) cause"
2. "Gradual onset"
3. "Repeated microtrauma"

Therefore, an overuse injury could be thought of as an injury with it´s associated symptoms gradually increased over time when the body is repeatedly exposed to training stimuli (microtrauma).

EFFECT OF INJURIES ON TEAMS AND INDIVIDUALS

Injuries can often be a challenging time for an individual player. There are numerous challenges ahead during a rehabilitation period. One of them is not to rush back to full participation too soon. This is because the risk of injury is higher in the lower extremities when an athlete has had a past injury in the same muscle region (Fulton et al., 2014).

In some cases, the risk for sustaining different injuries is thought to be higher when an athlete has had a past injury. Fulton et al., (2014) demonstrated that a previous hamstring strain is associated with a higher risk for sustaining knee injuries. The authors describe how the risk of sustaining another injury could possibly be explained by reduced proprioception, strength, and motor control associated with the past injury. As an example, it can take professional soccer players up to 12 months, post anterior cruciate ligament (ACL) reconstruction, before the rate of force development (RFD) returns to baseline values (Angelozzi et al., 2012).

This exemplifies how critical a full rehabilitation process is both from a time- and training perspective, before training and competing on normal premises. This is especially true if the intentions are long term, and with the longevity and athlete´s health in mind.

Potentially more challenging is the psychological aspects of an injury. It is common for elite athletes to experience negative emotions, such as anxiety and depression, during periods of injury (Wiese-Bjornstal, 2010). Souter et al., (2018) explain how injuries are related to developing depression. For a coaching staff or sporting organization, it is important to understand the challenges and importance associated with an injury to avoid making bad decisions.

Teams and organizations possibly add more pressure to the injured athlete. From a team or organizational perspective, this is sometimes understandable but may not be wise. For the 2019/20 season, the average yearly salary for an English Premier League (EPL) team was: 3.97 million US dollars (English Premier League Salary 2018/19, 2019), or 2.70 million US dollars for the average National Hockey League (NHL) team (Average NHL Salary by Team 2019/20, 2019). Bottom line, injured players are a big financial loss for organizations.

Eliakim et al., (2020) analyzed injury statistics for the EPL between 2012-2017 and found that teams on average lost 57 million US dollars per annum, due to injuries. The authors also presented a moderate relationship between injury-days and finish league table position. The authors ran a statistical model that predicted how 271 injury-days per annum statistically led to a team losing one position in the league table and that 136 injury-days led to a team losing one point in the league table.

These observations certainly give injury preventive strategies, like strength training, a lot of merit. However, the investment in time and finances for injury preventive strategies is often insignificant relative to the astronomical costs associated with an injured athlete. Even if the level of sport is significantly lower, where there is less money involved, strength training is often more of a recommendation for its injury prevention and performance enhancement effects relative to the individual athlete and team.

EFFECT OF STRENGTH TRAINING ON REDUCED RISK OF INJURY

Strength training has been shown to be a very effective modality when it comes to injury prevention. In a systematic review with ~ 27,000 subjects and ~ 3,500 injuries, Lauersen et al., (2014) investigated the effectiveness of different training modalities. In this review, strength training was seen as a superior modality for injury prevention when compared to other forms of training like proprioceptive training (balance or stability training) and stretching. According to the authors, implementation of regular and sufficient strength training could prevent 2 out of 3 sports-related injuries from happening. More specifically, almost 40% of all acute injuries and 50% of all overuse injuries could potentially be prevented.

Zouita et al., (2016) implemented regular strength training as an intervention across a 7-month long soccer season. The experimental group (soccer + strength group) did 2-3 strength sessions per week plus their normal soccer practice, while the control group (soccer group) only participated in their soccer practice. The results showed that the experimental group only had a total of 4 injuries

across the season, in comparison to a total of 13 injuries in the control group. If looking at the injury rate (number of injuries/1000 playing hours), the experimental group had an estimated injury rate as low as 0.82, whilst the control group had an injury rate of 2.74, which is more than a 3-fold increase in injury incidence (Zouita et al., 2016).

In another systematic review, high volume and high-intensity strength training were presented as superior to low volume and low-intensity strength training for injury prevention. According to the data, an increase of 10% in training volume over a period of time was predicted to reduce the injury risk by ~ 4% (Lauersen et al., 2018).

If overuse injuries are the main preventive target, Laursen et al., (2018) recommend successive conditioning of the tissues, development of appropriate technique, and high variation of training. Simply stated, this refers to applying a consistent and progressive programming strategy sensitive to the readiness and fatigues states of athletes (training load), which utilizes a variety of movement patterns in various planes of motion, delivered with a structured coaching process.

Proper monitoring of athletes' training load is critical for knowing when they need to progress and when they need to recover (Bowen et al., 2019; Gabbett, 2018). Utilizing various movement patterns allows force to be distributed differently over various tissues, decreasing the prolonged and cumulative stress to the same tissue (Paterno, 2013). These factors can effectively be overcome with proper and professional coaching.

If, however, the preventive target is acute injuries, the focus should instead be shifted towards "strengthening failure thresholds of relevant tissues" among other variables. Put in another way, this means that you are using strength training to increase the tolerance of specific tissues (e.g., nerve, muscle, and associated connective tissue) to endure more stress or load without getting injured. This is achieved in much the same manner as targeting chronic injuries – ensuring proper technique, coaching, and programming – with an added emphasis that volume and internsity is adequately increased to the level of demand the tissue will encounter in sport.

Provided proper monitoring of readiness and fatigue exists, short bouts of increased intensity with adequate recovery/tapering may assist in overcoming actue injuries prior to play (Bowen et al., 2019; Gabbett, 2018). It's important to remmeber that too little volume / intensity can often be as detrimental as too much (Bowen et al., 2019; Gabbett, 2018).

INJURY PREVENTION TARGET	STRATEGY	METHOD
ACUTE	Increase the tolerance of specific tissues to endure more stress	Increase bouts of volume / intensity with adequate recovery prior to play
CHRONIC	Progressive programming sensitive to readiness & fatigue; Variety of movement patterns; Structured coaching	Monitor training load & incorporate various movement patterns to decrease cumulative stress to tissues

RECOMMENDATIONS FOR STRENGTH TRAINING TO REDUCE RISK OF INJURY

Assessment

Assessments are often used by teams to help identify factors that may be associated with increased risk of injuries in athletes. These range from postural and movement based assements to more specific range of motion assessments as well as individual muscle testing. Each can be helpful and provide valuable information concerning an athletes physical movement status.

However, from a strength training standpoint, recent research has shown that the relative strength in a 1 RM squat is significantly associated with lower exertremity injuries in collegiate athletes (Case et al., 2020). For males, a relative squat strength below 1.9-times bodyweight was associated with an increased risk of LE injury and above 2.0-times bodyweight was associated with decreased risk of injury. For females, a relative squat strength below 1.4-times bodyweight was associated with an increased risk of LE injury and above 1.6-times bodyweight was associated with decreased risk of injury. The authors suggest that strength coaches may consider the 1RM back squat, normalized to bodyweight, to screen athletes for the risk of LE injury (Case et al., 2020).

Programming

When starting to implement a strength training program, it is recommended to use an initial familiarisation phase. Though often overlooked, this intial, or Base, phase is advantageous for establishing the athletes' strength and capacity levels as well as engraining appropriate training techniques before increasing intensity and/or volume. This is considered of importance to reduce the risk for injuries during strength training (Laursen et al., 2018).

It is further recommend to use RPE-methods and/or percentage of 1RM to control for training intensity and sufficient recovery between sessions

(Helms et al., 2018; Laursen et al., 2018). Helms et al., (2108) has further demostrated that RPE-methods may provide a small advantage for increasing 1RM strength gains.

For athletes new to strength training, it is recommend that they should wait ~72 hours between maximally neuromuscular taxing strength training sessions, whereas more well-trained athletes could potentially train more often (Laursen et al., 2018).

What is also worth considering is the value of progressively increasing the strength training volume over time, taking into account recovery periods (or, tapering) to avoid overtraining (Bowen et al., 2019; Gabbett, 2018; Resistance Training for Health and Fitness, 2013).

SUMMARY

Based on the above information, there is no doubt strength training is an appropriate training modality if the aim is to reduce injuries and increase our chances of keeping our best players on the pitch. Strength training is considered a safe training modality, especially when being supervised by a professional strength coach. The systematic use of strength training is especially important for team sports to help enhance the mental and physical performance of athletes as well as build team comradey. As we have learned, team sports are greatly affected by injuries due to the possible negative effects on the athlete, team performances, and finances. Implementation of regular strength training should be recommended for team sport athletes based on its injury prevention and performance enhancing effects.

RECOMMENDATION	PURPOSE
1 RM Squat Assessment	Identify potential risk of lower body injuries; Males >2.0 x bodyweight = decreased risk Females >1.6 bodyweight = decreased risk
Familiarsation (Base) Phase	Establishing athletes' strength & capacity levels; Engraining appropriate training techniques
Use RPE and/or % of 1RM	Control for training intensity & sufficient recovery between sessions
Between Session Recovery	~72 hour for beginning athletes & less for experienced
Progressive Increase in Volume	Increase stress to system for necessary adaptation (must account for recovery to avoid overtraining)

Overall, strength training is considered a safe training modality, with an injury incidence as low as 0.0035 injuries / 100 hours, reported by Hamill et al., (1994). Even with this low incidence of injury, some risk factors could aggravate the risk of sustaining an injury during strength training in youth. Factors noted by Faigenbaum & Naclerio, (2016) such as:

- poor lifting technique
- inaccurate use of equipment
- lack of supervision from a professional coach
- excessive training load for prolonged periods without a recovery period
- inappropriate progression of strength training (too much or too little)

However, these are all factors easily eliminated when a professional strength coach is supervising the program.

Every team or club should look towards strength training as an effective method for decreasing the numbers of injuries to:

- **save money** (injured players costs a lot of money)
- **improve team performance** (injured players decrease the likelihood of performing at a high level during competition)

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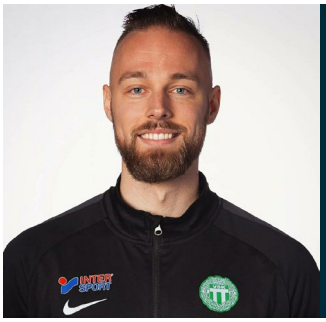

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