Spring 5-5-2016

A Coach's Guide for Injury Prevention in Youth Football

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A COACH’S GUIDE FOR INJURY PREVENTION IN YOUTH FOOTBALL

By

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Submitted in Partial Fulfillment
of the Requirements for
Graduation with Honors from the
South Carolina Honors College

May 20, 2016

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THESIS SUMMARY

This thesis is a combination of both a written report on preventative injury strategies and an educational resource that serves as a Coach’s quick-guide to injury prevention. The thesis starts off introducing the prevalence effects of injury in youth football. It mentions that the incidence of skeletal muscle injuries in sport injuries is 55% of all sport injuries, while noting that participation in youth football has dropped drastically over the past 10 or so years, and continues to decline. The decline can be attributed to the increasing rates of injury as well as increasing media coverage of football-induced injuries. Building off of these claims, it becomes apparent that there is a need for preventative injury protocols in sports, especially in high-contact sports such as football.

The thesis then moves to describe skeletal muscle injury and the effects of preventative-injury strategies. Key terms in muscle injury prevention, such as warm-up and stretching, are introduced and are later defined in their respective sections. Skeletal muscle is defined, and its structure and function are discussed. The anatomy of skeletal muscle is broken down all the way from the outer layer, epimysium, into cellular terms of myofibers and fascicles. The function of skeletal muscle is also discussed, and mainly focuses on types of isotonic contractions, eccentric and concentric. Narrowing in, the thesis further discusses the myotendinous junction (MTJ) and the muscle-tendon unit (MT unit), which are two main sights for musculoskeletal injury. The MTJ is dissected further, and the theory of compliance and its effects on muscle injury are discussed. Researchers have studied compliance and have found positive associations with preventing skeletal muscle injury; in fact a more compliant MT unit allows for the
effective storage and release of series elastic energy, helping decrease force on the MT unit, decreasing chances of injury. The thesis then moves to define skeletal muscle injury and to discuss types of skeletal muscle injury, mainly focusing on shearing injury, which occurs when a muscle is stretched to far, and muscle fibers tear. MTJ compliance is then further reviewed with its role in force transmission, a key factor in preventing skeletal muscle injury. The more compliant the MTJ, the less likely injury will occur.

The thesis then transitions to discuss both warmup and stretching, and their relationships with skeletal muscle injury. There is both supporting and antagonizing evidence for the claim that these protocols decrease rate of injury. The next section discusses two more key ideas in injury prevention protocols: hydration and technique. These two subjects are discussed briefly in their role in injury prevention, although there is some controversy on their effectiveness. Recommendations, adapted from major organizations such as the ACSM and USA Football, were then given on warmup, stretching, hydration, and technique protocols. Using these recommendations and the information discussed throughout the thesis, WeStayHealthyTogether was created.

WeStayHealthyTogether is a pneumonic based upon the four main injury prevention ideas: warmup, stretch, hydration, and technique. A website was created that provides an interactive guide to injury prevention protocols. As of right now, there is approximately one protocol for each topic, but the aim of this website is to eventually serve as a universal guide containing many sport-specific preventative injury protocols, which will easily accessible by coaches and parents everywhere.
ABSTRACT

Youth football is a declining sport this day in age, and this decline can be associated with the negative connotations on football portrayed by the media. Parents need a sense of security when it comes to the health of their children, and this can be achieved by creating a safer environment; one in which young athletes correctly learn safe techniques improving the quality of the game, leading to a decrease in injuries. By creating a website that details instructions and provides protocols to educate coaches on proper preventative injury practices, football can take a step forward in injury prevention, resulting in a decrease youth football injuries. The thesis contains several sections starting from detailed descriptions of prevalent injuries, containing the physiological reasons for injury to skeletal muscle. It then continues to define the physiological components to these injuries that can be prevented using certain preventative injury protocols. Building upon the functional stepping-stones, a coach’s guide was created in order to offer coaches across America the knowledge and strategy essential to provide a fun and safe environment for today’s youth. WeStayHealthyTogether is a pneumonic created for the four main ideas that will be discussed: warmup, stretch, hydrate, and technique. An interactive website was created based on these principle to be used as an educational resource for coaches and parents across America. The mission of WeStayHealthyTogether.com is to provide coaches and players an educational resource for preventative injury practices in youth football. Using these four key protocols, WeStayHealthyTogether.com hopes to reduce rate of injury in youth football, and increase participation while doing so. In the future, WeStayHealthyTogether.com aims to expand its preventative injury protocols to other sports as well.
INTRODUCTION FOR INJURY PREVENTION IN YOUTH FOOTBALL

Skeletal muscle injuries play a role in a great number of traumas in sports medicine. In fact, they are the cause up to 55% of injuries that occur in sports (Garrett, 1995). Without proper treatment, these injuries can limit and restrict athletes from participation in his or her sport, and without precautionary protocols, these injuries can delay one’s return to the playing field. In order to prevent this from happening, it is important to take the necessary steps to provide a safe and healthy environment for our youth.

There are many factors that come into play when thinking of the perfect preventative injury strategy. It is a known fact that football produces the highest amount of injuries in the United States. According to the U.S. Consumer Product Safety Commission, in 2012, approximately 466,492 people were treated for football-related injuries in hospital emergency rooms (AAOS, 2013). This fact is known by the population, as is seen by a participation drop in Pop Warner football by 9.5 percent from 2010 to 2012, the largest decline in organization history (Fainaru, & Fainaru-Wada, 2013). The decline continues to grow, and it seems that there is more and more evidence that supports the eventual demise of American football, particularly the demise of youth football.

To combat this decline and to decrease injuries in the sport, coaches and those involved in youth sports need to be educated on the steps/protocols that can provide an ideal environment for the growth and well-being of our youth. Four known protocols that are known to help prevent injury in sports are warm-up, stretching, ample hydration, and proper technique (AAOS, 2013).
INTRODUCTION TO WARM-UP AND STRETCHING

Warm-up is defined as an exercise that does two things: improve the dynamics of a muscle so that injury is less likely to occur, and prepare the athlete for the demand of exercise (Woods, Bishop, & Jones, 2007). A good way to identify increasing intramuscular temperature is to produce a mild sweat during warm-up (Woods et al., 2007). There are two main types of warm-up, passive and active. Passive warm-up is the use of external means to increase body temperature, whereas active warm-up involves the use of physical activity or exercise to increase body temperature (Bishop, 2003). Active warm-up can be general or specific; the latter is usually tailored to each respective sport. Warm-up has been shown to decrease the incidence of musculoskeletal injury (Woods et al., 2007). Another widely accepted theory is that pre-exercise stretching leads to improved performance while decreasing injuries (Witvrouw et al., 2004).

The results of stretching and its effects on preventing skeletal muscle injury have been studied thoroughly and have yielded somewhat controversial results. It has been thought that stretching is a beneficial procedure in injury prevention when conducted in the correct manner, yet many researchers question this theory, and numerous studies have observed the physiological effects that stretching has on skeletal muscle. These studies have yielded both positive and negative results regarding stretching’s role on injury prevention and performance. These results have provided understanding on what is the correct way to decrease skeletal muscle injuries, but to prevent and treat these injuries; it is necessary to first obtain physiological knowledge on why and how these injuries occur.
SKELETAL MUSCLE AND MTJ STRUCTURE AND FUNCTION

In order to understand the physiology of skeletal muscle injuries, it is important to have a basic knowledge of the anatomy of the muscle. As shown in figure 1, skeletal muscle is more or less made up of three layers of connective tissue: the epimysium, perimysium, and endomysium.

The epimysium is the first layer that encompasses the entire muscle. Inside of the epimysium you find groups of 10-100 muscle cells that are known as muscle fascicles. These fascicles are surrounded by the perimysium. Inside of these muscle fascicles are individual muscle cell, known as muscle fibers (MacLauren & Morton, 2012). Within a muscle fiber lies a complex yet functional combination of structural components that allow for successful contraction of skeletal muscle. Muscle fiber cells are relevant to injury prevention because when muscles are injured, these fibers are usually damaged.

An important structural unit of the muscle is located where the muscle meets the tendon. Within the muscle-tendon unit is the myotendinous junction, also called the MTJ. The MTJ is a specialized anatomical region that connects skeletal muscle, the active contractile component, to tendon, the passive component, and represents the primary site of force transmission. (Charvet, Ruggiero, & Le Guellec, 2012). Combined...
with the muscles, a mechanical unit is formed, which is important in the transmission of nervous system stimuli leading to the contraction of skeletal muscle.

There are two main types of contraction, isometric and isotonic. Isometric is defined as muscle force production when the muscle neither shortens nor lengthens. While in isotonic contractions, the muscle either shortens or lengthens during force production. Isotonic contraction can be broken down further into concentric and eccentric contractions. During concentric contraction, the muscle shortens as it contracts, whereas in eccentric contraction, the muscle lengthens as it contracts (MacLauren & Morton, 2012).

The muscle-tendon unit generates force in two different ways: as an elastic-like spring in stretch-shortening motions (SSC), and as a mechanical work producer creating a concentric contraction (Witvrouw et al., 2004), usually followed by an eccentric contraction. It has been established that if a muscle is stretched before shortening, its performance can be enhanced during the concentric phase, and enhanced even higher in the stretch-shortening contraction (SSC) discussed above (Witvrouw et al., 2004). This evidence was supported by a study from Wilson, Murphy, and Pryor (1994). In this study, it was concluded that MTJ stiffness was significantly related to isometric and concentric performance but not to eccentric performance. It was found that with the stiffer subjects there was a significant increase in performance than the more compliant subjects on both the isometric tests and on most of the concentric tests. These results are support the idea of compliance since the stiff muscles transfer higher amounts of force directly to the muscle-bone junction with little absorption of energy by the tendon. The study also found that compliant muscles generated less power due to the delayed transfer
of energy through the muscle-tendon (MT) unit. This phenomenon is the result of strain energy stored in the tendon structures, which is interrelated with the compliance of a motor unit. A more compliant MT unit allows for the effective storage and release of series elastic energy, which is more applicable in SSC movements and exercises (Witvrouw et. al., 2004). This is supported by a study from Wilson, Elliott, and Wood (1992) that observed that by increasing the compliance of the MJ unit via stretching, there was an increase in the impact of elastic strain energy to movement, increasing performance in an SSC movement. From these studies, it can be concluded that MTJ compliance is more beneficial to SSC movements rather than isometric and concentric and contraction. This notion will continue to be discussed later on in its key role in skeletal muscle injury.
SKELETAL MUSCLE INJURY

The majority of skeletal muscle injuries are caused by either contusion or excessive strain of the muscle fibers (Garrett, 1995). Figure 2 shows some common sports induced injuries musculoskeletal injuries. A strain to the muscle is a contraction-induced injury in which muscle fibers tear due to extensive mechanical stress. Muscle strains occur as a result of powerful eccentric contractions or overstretching of the muscle, particularly in sports that involve sprinting and/or jumping (Garrett, 1995). This type of injury usually falls under what is considered a shearing injury in which not only the myofibers tear, but so do the mysial sheaths (Kujala, Orava, & Järvinen, 1997). The degree to which these fibers tear can determine the severity of the injury.

There are three degrees in which a muscle strain can be classified: first, second, and third degree stains. First-degree strains are considered mild strains in which only a few muscle fibers are torn with minimal loss of muscle strength and movement. Second-degree strains are considered moderate strains in which more muscle fibers are torn, and loss of muscle strength is significant. Third-degree muscle strains are considered severe strains in which muscle fibers are completely torn across the whole muscle resulting in total loss of muscle function (Järvinen, Kääriäinen, Järvinen, & Kalimo, 2000). This
muscle damage is accompanied by symptoms such as muscle weakness and delayed onset muscle soreness, also known as DOMS (Chen et al., 2011). It is important to note that these muscle strain injuries are usually located near the myotendinous junction (Järvinen, Kääriäinen, Järvinen, & Kalimo, 2000).
MTJ COMPLIANCE AND FORCE TRANSMISSION

The MTJ is known to have a significant part in skeletal muscle injury prevention. An important factor in understanding stretching’s preventative effectiveness in reducing skeletal muscle injury is the compliance of the MTJ. Understanding differences in both the active contractile and passive components will better define the idea of compliance (Witvrouw et al., 2004). The ability of a muscle to absorb energy is dependent on both components. In a compliant system, the contractile elements are active to a high level, allowing for more energy absorption by the tendon tissue, reducing trauma to muscle fibers (Sanfran, Seaber, & Garrett, 1989). On the other hand, in the situation of a low compliance system, forces will be transferred from the tendon to the muscle with little energy absorption, increasing trauma to the muscle fibers (Sanfran, Seaber, & Garrett). This relationship helps explain the association between reduced flexibility and occurrence of muscle injury during SSC motion.

Muscle fibers have a certain force that they can withstand before shearing injury occurs. Since less compliant systems send greater amounts of force to the muscle, these muscles have a higher tendency to become injured. Therefore, increased compliance has an inverse relationship with rate of skeletal muscle injury during SSC exercise. In order to increase the compliance of the MTJ unit, research has shown that warm-up combined with stretching is considered to be most effective.
WARM-UP

Warming up is a highly recommended and practiced routine by nearly every athlete in the world. The ultimate goal of warming up is to prepare the athlete both mentally and physically of exercise and competition by increasing heart rate, blood flow, and internal temperatures of the muscle (NCSA). By increasing the intramuscular temperature, the length of muscle fiber can be increased (Safran et al., 1989). Studies have reported that a warm-up provides a protective mechanism to muscle by requiring a greater length of stretch and force to produce a tear in the warmed muscle (Safran et al., 1989), allowing stretching to further increase the compliance of the MTJ. This increase in compliance has shown to cause a decrease in rate of injury.

A study by Safran et al. in 1989 studied the effect of strictly “warm-up” on incidence of skeletal muscle injury by comparing muscle fiber tears in the hindlimbs of rabbits of isometrically preconditioned (stimulated before stretching) muscle to control groups (nonstimulated). Researchers found that physiological warming (isometrically preconditioned) muscles required a greater force and longer length to tear than the opposing control group. In all muscles, the MTJ was the side of failure regardless of preconditioning. Therefore it was concluded that warm-up could reduce the incidence of injury.
STRETCHING

Stretching is defined as movement applied by an external and/or internal force in order to increase muscle flexibility and/or joint range of motion (Weerapong, Hume, & Kolt, 2004). The purpose of pre-exercise stretching is to increase MT unit length and flexibility (Taylor, Dalton, & Garrett, 1990), which may help to enhance athletic performance and decrease the risk of injury from exercise (Gleim & McHugh, 1997). Stretching can be done in a number of ways, and nearly all athletes use some form of stretching in his or her warm-up protocol. As a whole, all stretching techniques result in the lengthening of muscle fibers and soft tissues (Weerapong et al., 2004).

The many different types of stretching are all athlete, sport, and preference dependent, but there are three main methods that are normally practiced for sport activities. These methods include dynamic stretching (DS), static stretching (SS), and proprioceptive neuromuscular facilitation (PNF). DS techniques comprises of bouncing or jerking movements to stretch a muscle group, SS protocols involve slow movements to essentially lengthen a muscle group, and PNF requires the combination of steps in the following order: a static stretch, an isometric contraction and relaxation, and then another static stretch (Woods & Jones, 2007). All techniques have benefits and drawbacks, and can/should be used in certain training protocols. The mechanisms for which stretching helps lengthen muscle fiber are used to explain theories regarding skeletal muscle injury prevention.
MECHANISMS FOR MUSCLE FIBER ELONGATION

There are a few mechanisms in which stretching works to result in muscle fiber elongation. The first mechanism in which both the range of motion and viscoelastic properties of the MT unit are influenced is the biomechanical mechanism. During stretching, and external force causes the lengthening of muscle fibers and connective tissue, leading to an increase in MT unit length. This increased MT unit length is thought to play a part in increased range of motion, but many studies remain inconclusive. It is possible that this increase in range of motion can be due to increasing stretch tolerance and pain threshold since the individual will be able the stretch the MT unit further without feeling the pain associated with stretching (Weerapong et al., 2004).

In addition to increase in range of motion, many changes have been observed in studies regarding the viscoelastic properties of the muscle-tendon unit. Researchers have not been able to form relationships from certain viscoelastic phenomena (like the stress-relaxtion theory in which force decreases when muscle fibers are held at a constant length) to the rate of muscle injury or performance (Weerapong et al., 2004) so it is difficult to relate increased MT unit length to changes in viscoelastic properties. Even though few relationships have been made regarding both increases of range of motion and changes in viscoelastic properties, these two phenomena are thought to help muscle fiber elongation.

The second mechanism that is shown to increase muscle flexibility is the neurological mechanism. The main neurological system that stretching affects is the Hoffman-reflex response (H-reflex). The H-reflex is a valuable tool in assessing the
monosynaptic reflex activity in the spinal cord, or in other terms, the neurological response. The H-reflex is an electrically stimulated reflex that mirrors the involuntarily spinal stretch reflex. The main disparity between the H-reflex response and the spinal stretch reflex is that the H-reflex does not include the muscle spindle so that muscle spindle activity, which varies across subjects, can be excluded (Palmieri, Ingersoll, & Hoffman, 2004). H-reflex is used to study changes in the reflex excitability of a group of muscle fibers, and has been shown to decrease following stretching protocols, allowing for decreased reflex response, allowing for a more flexible muscle (Weerapong et al., 2004). This decrease has been attributed a changes in presynaptic and postsynaptic changes (Guissard, Duchateau, & Hainaut, 2001). The mechanisms in which MT units can be lengthened are important because they provide a foundation on which further studies regarding stretching can be conducted. By further researching these mechanisms, it is possible that definitive relationships between stretching and skeletal muscle injury can be made.
EVIDENCE SUPPORTING STRETCHING AND WARM-UP

As a part of many warm-up protocols, stretching is a widely accepted pre-exercise routine that many researchers think decreases the rate of muscle injury. Stretching is used regularly around the world, and it has been prescribed as part of many injury prevention protocols. These protocols were created using evidence that linked less compliant muscles to muscle damage, especially in SSC exercises. For example, a study by McHugh, Connolly, and Eston (1999) found that decreased MTJ compliance leads to increased muscle damage after eccentric exercise. Male and female participants, of both predetermined compliant and non-compliant MTJ, were subject to eccentric actions of the hamstring. They found greater symptoms of muscle damage in subjects with less compliant hamstring muscles, which supports the idea that more compliant muscles have a decreased rate of muscle injury. From this, it is important to remember that stretching has been shown to increase muscle compliance; concluding that stretching could be an important protocol for decreasing rate of muscle injury.

A study by Bixler and Jones (1992) studied the effect of muscle warm-up and stretching on high school football injuries and found advantageous results. By adding a pre-third quarter warm up and stretch protocol, researchers were able to compare sport-related injury in stretching in and control results. There results showed a decreased number of injuries in the third quarter for the warm-up and stretching group. Their findings support the association between warm-up and stretching and decreased rate of skeletal muscle injury. These studies are just a few of many, which show strong evidence that stretching plays a role in decreasing skeletal muscle injury.
EVIDENCE AGAINST STRETCHING AND WARMUP

Although pre-exercise stretching is a common prescription to help reduce skeletal muscle injury (in certain exercises), many researchers think that stretching, and in some cases over-stretching can be harmful to performance, and in some circumstances increase muscle injury. This notion is supported by a study by Church, Wiggins, Moode, & Crist in 2001, in which a group of forty female participants were asked to perform a vertical jump after three different stretching protocols on three nonconsecutive days. The three protocols included a general warm-up only, a warm-up and static stretching, and a warm-up and PNF stretching. From the results, Church et al. concluded that warm-up and PNF stretching before a vertical jump test were detrimental to performance. In 2000, a RCT by Pope, Herbert, Kirwan, and Graham studied the effect of muscle stretching during warm-up on the risk of exercise-related injury by looking at lower-limb injuries in a military population. Using two groups, the recruits performed a dynamic workout with (stretch group) or without (control group) stretching. The results showed no significant effect of stretching on all-injuries risk, concluding that stretching did not decrease incidence of injury risk.

The contradicting point of views by both researchers who support stretching as a preventative injury technique and those who do not can provide a somewhat unclear message for if stretching truly is beneficial for decreasing skeletal muscle injuries. With that being said, it is important to identify certain characteristics of each respective study. For example, some studies have defined injury differently. The study by Pope et al. defines an injury as a lower-limb injury that kept the recruit from resuming full duties within 3 days, whereas the study by Safran et al. considered injury just the tearing of
muscle fibers. Also, some studies make conclusions of stretching preventative effectiveness based on different types of exercise. In the majority of these studies, more explosive exercises involving high SSC movements were studied, but some studies involved exercises involving more concentric reactions, in which stretching would be detrimental.

From the overview of stretching’s role in injury prevention, we are able to come to multiple conclusions. Mainly, even though there is controversial evidence, it is correct to say that stretching can have an effect on skeletal muscle injury. Injuries occur at certain lengths, as a result of an eccentric force stretching the muscle beyond its ‘free range of motion’ to the point of failure (Woods and Jones, 2012). By increasing the compliance of a muscle in order to absorb energy, the force will be reduced on muscle fibers, leading to a reduced risk of muscle injury and muscle damage. With the combination of a pre-exercise protocol involving both stretching and warm-up, the rate of skeletal muscle injury may be further decreased. Therefore, it is important to include stretching as a preventative injury measure before exercising, especially in explosive sports that contain many SSC movements (like football), which require a more compliant muscle-tendon unit. In the future, it may be important to further study the effects of different stretching techniques combined with different lengths of “warm-up” to see if there is an optimal length of warm-up and optimal stretching technique that could act as a universal pre-exercise preventative injury protocol since there is so much controversy regarding stretching’s effectiveness across different activities.
HYDRATION

Stretching and warm-up, alone, play crucial roles in preventing skeletal muscle injury, but are not sufficient in preventing all types of injury and illness that occur during competition. Hydration can also play a large part in reducing rate of injury, heat injury/illness in particular. Water is recognized as the most essential nutrient, meaning that its uptake is imperative for survival (Manz, Wentz, & Sichert-Hellert, 2002). The Adequate Intake (AI) for water is about 3.7 for adult males and 2.7 for adult females, but how much water is really needed involves many factors and is specific to each individual (Williams, Anderson, & Rawson, 2013). The more active an individual, the more water he/she will need.

Water has many functions in the body, and is the basis of many physiological systems. Without water, other nutrients would not function properly, because water is more or less, the “solvent of life” (Williams et al., 2013). Water levels in the body play a role in the physiological processes, and if water levels are too high or low, it can act as a negative effector. Normal body-water is called euhydration, and if the body retains too much water, then the body is in a state of hyperhydration (Williams et al, 2013). If adequate uptake of water is not reached, then the body reaches the state of dehydration, which is defined as the loss of body water (Williams et al., 2013). Water’s function can be significantly affected in thermoregulation when dehydration levels are reached. Water makes up the majority of sweat, and through evaporation from the skin, excess heat can be dissipated. During prolonged exercise, dehydration has a high incidence rate, especially in activities with high environmental heat. If dehydration occurs, many bodily functions can be impaired, causing cardiovascular strain and mental performance. Even a
small amount of dehydration can restrict the body from properly transferring heat from skeletal muscle to the skin, resulting in increased chances of heat injury and decreased performance (Convertino et al., 1996). Dehydration is a serious matter, and water loss can be very dramatic in some circumstances. In football, research has shown that some athletes can lose up to 22 pounds of water weight in multiple session workout days (Williams et al., 2013). To decrease the chances of dehydration, it is important to implement a hydration routine that involves water intake before, during, and after exercise.

Hydration before exercise is considered the most important protocol when it comes to proper hydration levels. To reach appropriate euhydration levels, athletes need to start drinking water weeks and even months in advance. Thinking of water as somewhat of a supplement can assist in this process. To reach proper levels, it is necessary to have somewhat of a loading phase, and then it is imperative to maintain these levels. Coaches frequently forget to stress this, and athletes go into competition with hydration levels that are significantly less than optimal. Recommendations for proper pre-hydration protocols will be given below.

To help with body water retention, sodium has proved to be very beneficial (Maughan, Leiper, & Shirreffs, 1996). This has a large part to do with osmosis. When there is sodium in the body, water will be absorbed into the cells to move from a low to high concentration. And when there are decrease levels of sodium, the opposite can occur leading to dehydration. Sodium intake before exercise is important, because it can help to retain fluid and has been shown to stimulate thirst (Maughan et al., 1996). During exercise, sodium is important helps replace sweat electrolyte losses (Sawka et al., 2007).
After exercise, if sodium levels are too low, the body will be prevented from returning to a euhydrated state, and excess urination can occur. Dehydration and sodium deficits are associated with skeletal muscle cramp (Sawka et al., 2007).
TECHNIQUE

It is well known that proper form and technique in high-contact sports can be key contributors in preventing injury. Injuries can occur many times throughout the competition, but the majority of collision sport injuries have been shown to occur within the tackle (Carlisle et al., 2008). By obtaining a greater understanding on the factors that affect tackling performance and success, injury prevention protocols can be implemented.

It is imperative to learn proper tackling techniques when playing football. Since it is a contact sport, there are many ways to get injured. As stated above, many of these injuries occur during the tackle, so using proper technique is thought to help decrease the likeliness of injury. There is some evidence that does not support this theory, and has found that proper technique has little to no association with decrease in injury rate (Gabbett, & Ryan, 2009). Although these results occurred, researchers blame external circumstances on injury rate. Accidents happen, but researchers believe that technique is essential for injury prevention.

Head injuries are becoming a more and more controversial topic in collision sports, and have brought a lot of negative attention to the game. In this thesis, I have not and am not going to discuss head trauma, but proper technique is relevant to head trauma issues because it is thought to be a key prevention strategy. Proper technique is not an inherit skill in youth football players, so the skills and techniques that pertain to proper form must be taught over and over again. The first line of defense against collision injuries lies in the hands of those that teach tackling techniques; this includes both parents and coaches (USA Football, 2016). These people play a huge role in the safety of our
young athletes, and it is necessary to implement an educational protocol that provides safe and healthy techniques to conquer football skills.

In the technique recommendations section, a five step tackling technique (USA Football, 2016) will be provided that helps combat collision sport injuries.
WE STAY HEALTHY TOGETHER: A COACH’S GUIDE TO INJURY PREVENTION

The pneumonic We Stay Healthy Together was created on the four main keys to injury prevention: Warm-up, Stretch, Hydration, and Technique. Using the principles of the key ideas discussed above and recommendations from the American College of Sports Medicine (ACSM) and other well-known organizations, a website containing a coach’s quick guide to injury prevention was created. The website shows much promise for future development, and can be tailored to fit specific needs of athletes and coaches. The website is based upon the following principles, and recommendations:

WARM-UP AND STRETCH RECOMMENDATIONS: ACSM AND NSCA

As discussed, it is necessary to start every workout with some form of warm-up. The warm-up should induce a mild sweat, indicating increased heart rate and blood flow to working skeletal muscles. The warm-up should start slow and easy, using some form of exercise that will increase cardiovascular activity. This part of warm-up should last from five to ten minutes.

The next phase of warm-up should focus on muscles and movement specific to the activity/sport that is going to be performed. This period of the warm-up phase should last from 8-12 minutes, and should work the muscles through their entire ranges of motion. These exercises can vary by sport, and are important to increase muscle compliance before beginning the practice of each respective sport. Once the muscles are warm, stretching can then implemented. Both static and dynamic stretches can increase flexibility in the muscles, and allows for A successful warm-up protocol should look something like this.
HYDRATION RECOMMENDATIONS: ACSM

Before exercise:

An athlete should start to hydrate at least several hours before the exercise task, so that fluid absorption can occur and urine excretion levels can return to normal. As stated above, beverages and/or snacks with small amounts of sodium can help stimulate thirst and retain needed fluids.

These recommendations only include day of protocols, but to ensure proper hydration levels it is important to begin drinking water at around three weeks before intense exercise occurs, and to drink ample amounts of water daily.

During exercise:

An individualized fluid replacement plan should be developed so that excessive dehydration resulting in body weight losses greater than 2% can be prevented. By measuring body weight pre and post exercise, and individual can gain an idea of how much water they are losing in order to create a customized fluid replacement programs. It’s also important to consume drinks with electrolytes and carbohydrates so that fluid-electrolyte balance can be sustained. As a baseline, it is important to take water breaks every thirty or so minutes during a group practice. For longer practices, this may want to be more frequent, and for very hot days, there should be no restriction on water breaks. They should be frequent and ample in duration.
After exercise:

Normal meals and beverages will restore euhydration, if time is not a factor. In the case of excessive dehydration, individuals can drink ~1.5 L of fluid for each kilogram of body weight lost. As stated above, the consumption of fluids and foods with sodium will help expedite rapid and complete recovery. In the case of extreme dehydration, intravenous fluid replacement can be administered. (Sawka et al., 2007).

**TECHNIQUE RECOMMENDATIONS: USA FOOTBALL**

USA football has developed a system called the “Heads-up tacking system” in order to decrease the rate of injury. They recommend that the “heads up” technique always be used when executing a tackling. As the title suggests, the head should never lower be lowered and should never be the main point of contact. If these first two steps are not followed, serious injury can occur, including but not limited to concussion and/or paralysis. Instead, use the front of the shoulder as the main point of contact. The USA Football “heads up” tacking system provides a series of 5 main techniques/steps that will combine to form a successful and safe tackle.

i. The first is the breakdown position”, which is the foundation starting point for all tackle movements.

ii. The second step is called “buzzing the feet”. This step is important for balance, posture, and stability when preparing for contact. This step is very important for
preventing skeletal muscle injuries, because the feet are constantly moving, providing less time for an injury to occur when in contact with the ground.

iii. The third step is the “hit position”. This step is considered to be one of the most important in preventing injury. This step allows for correct body posture and movement at the moment of impact helping create an overall safer tackle.

iv. The fourth technique that must be taught is “the shoot”. This technique teaches the athlete to use power from his/her hips rather than diving and creating an unsafe situation in which the head could lower.

v. Last is “the rip” and this technique was created to ensure successful tackling, but also allows the athlete to drive through his opponent rather than reaching, which could compromise form and lead to injury.

These steps are all better explained on the WeStayHealthTogether.org website and examples are given in an attached video. (USA Football, 2016)
HOME PAGE:

A COACH'S GUIDE TO INJURY PREVENTION IN OUR YOUTH

OUR MISSION

The mission of WeStayHealthyTogether.org is to provide coaches and players an educational resource for preventative injury practices in youth football.

This website focuses on preventing primarily musculoskeletal injuries, but also includes protocols for combating heat illness and. With the use of four main ideas: warmup, stretch, hydration, and technique, WeStayHealthyTogether hopes to reduce the rate of injury in youth football while increasing participation. In the future, WeStayHealthyTogether aims to expand it's preventative injury protocols to other sports as well.
WARMUP OF THE DAY (WOD)

This page is created for the WARMUP of the Day (WOD). I will try to keep this page updated as much as possible and will provide links to certain exercises so that these warmups can be executed with correct technique. WOD will include the following:

- Low intensity warmup
- Dynamic warmup exercises
- Static stretching exercises
- (all should be sport specific)

Thanks for visiting the site, and feel free to comment on the forum page if you have any questions or suggestions.

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In regards to injury prevention, every workout or exercise should start with a warmup. A warmup should be somewhat progressive, starting slow and building in intensity as time goes on. For example, as time increases, intensity should increase until a light sweat occurs. A light jog is one of the best ways to increase intramuscular temperatures to prevent injury. A light jog should be limited so that it does not cause exhaustion and should last for around 2 minutes. It is then appropriate to transition into sport specific movements and exercises. This transition has proved to be an impactful preventative injury practice. For football, there is a variety of movements that can be emphasized during warmup. Since the sport is dynamic, using motions that involve full body coordination are very effective. The videos and flow chart to the right provides an example of what a typical warm-up for football practice should include and resemble.

(Visios are neither owned nor produced by WeStayHealthyTogether. All rights belong to their respective owners.)
As observed during the warmup phase, stretching plays a key role in warming up. Stretching can be executed in many ways, but WeStayHealthyTogether likes to emphasize dynamic stretching and static stretching. Dynamic stretching involves active contractions of muscles by using motions that move the muscle-tendon unit to its full range of motion. Although much research has shown that dynamic stretching alone can be an adequate form of muscle lengthening, supplementation with static stretching has proven to be effective. Static stretching involves slow movements that stretch the muscle-tendon unit to its full range of motion, without causing pain. The figure to the right gives a diagram of many different static stretches that increase the flexibility of different muscles. Since football is a dynamic sport, it is important to work muscles of every part of the body. As stated above, static stretching should be done after some form of dynamic warmup. By holding these stretches from around 10-20 seconds and repeating 3 times each, the range of motion for each muscle-tendon unit can be increased. Another thing to keep in mind is that it can be beneficial to add position-specific stretches for individual athletes. For example, a quarterback will want to do more arm stretches, focusing on shoulder and elbow stretches, whereas a running back or wide receiver might want to focus on stretching isolated muscles in the legs. These stretches can also be performed at the end of the workout as part of a cool down, further increasing range of motion and mobility.
**Pre-Exercise**

Before exercise: an athlete should start to hydrate at least several hours before the exercise task, so that fluid absorption can occur and urine excretion levels can return to normal. Beverages and/or snacks with small amounts of sodium can help stimulate thirst and retain needed fluids. It is important to relay these recommendations to your young athletes, and athletes’ parents. By creating a hydration plan, heat illness can be avoided.

**During Exercise**

During exercise: An individualized fluid replacement plan should be developed so that excessive dehydration resulting in body weight losses greater than 2% can be prevented. By measuring body weight pre and post exercise, an individual can gain an idea of how much water they are losing in order to create a customized fluid replacement programs. It’s also important to consume drinks with electrolytes and carbohydrates so that fluid-electrolyte balance can be sustained. It order to making sure that the athletes are staying hydrated during practice, implement scheduled water breaks into your practice schedule. Also, do not restrict water usage, especially on hot days.

**Post-Exercise**

After exercise: Normal meals and beverages will restore euhydration, if time is not a factor. In the case of excessive dehydration, individuals can drink ~ 1.5 L of fluid for each kilogram of body weight lost. As stated above, the consumption of fluids and foods with sodium will help expedite rapid and complete recovery. In the case of extreme dehydration, intravenous fluid replacement can be administered. Similar to pre-exercise protocols, talk to the athlete and his/her parents individually. Create a plan that will ensure proper hydration for practice and competition.
It is well known that proper form and technique in high-contact sports can be key contributors in preventing injury. Injuries can occur many times throughout the competition, but the majority of collision sport injuries have been shown to occur within the tackle (Carlisle et al., 2008). By obtaining a greater understanding of the factors that affect tackling performance and success, injury prevention protocols can be implemented. USA football has developed a system called the "Heads-up tackling system" in order to decrease the rate of injury. They recommend that the "heads up" technique always be used when executing a tackling. As the title suggests, the head should never lower be lowered and should never be the main point of contact. If these first two steps are not followed, serious injury can occur, including but not limited to concussion and/or paralysis. Instead, use the front of the shoulder as the main point of contact.

The USA Football "heads-up" tackling system provides a series of 5 main techniques/steps that will combine to form a successful and safe tackle.

1. The Breakdown Position
   Last is “the rip” and this technique was created to ensure successful tackling, but also allows the athlete to drive through his opponent rather than reaching, which could compromise form and lead to injury.

2. Buzzing the Feet
   The second step is called "Buzzing the feet". This step is important for balance, posture, and stability when preparing for contact. This step is very important for preventing skeletal muscle injuries, because the feet are constantly moving, providing less time for an injury to occur when in contact with the ground.

3. The Hit Position
   The third step is the “hit position”. This step is considered to be one of the most important in preventing injury. This step allows for correct body posture and movement at the moment of impact helping create an overall safer tackle.

4. The Shoot
FORUM FOR COACHES AND PLAYERS:
REFERENCES


