Active Bones
Orthopaedic Surgery and Sports Medicine Teaching and Research Foundation Newsletter
otrfund.org
Spring 2017

Dear Reader:

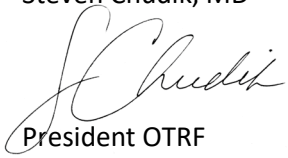
The sandhill cranes are migrating north, the robins have arrived and baseball is back. It must be spring. Even though we didn't have a typical winter, I'm ready to get outside and enjoy the warmer weather as I am sure you are.

In preparation for outdoor activities and sports, we wanted to remind parents and coaches of baseball pitchers about the dangers of developing rotator cuff injuries from overuse and poor mechanics. In the article we look at how and why injuries and overuse happen and how they can be prevented. We also included an article on throwing guidelines and the need for proper warm up and stretching to prevent injuries in throwers age eight to 18. I think you'll want to save this issue and refer to the various recommendations for pitch counts, days of rest and the age pitchers should be when adding new pitches to their repertoire.

We didn't forget about those who will move their exercising outdoors now that spring is here. We found some interesting research on the benefits of sprint training versus endurance training and put together a progressive program you can use to change up your routine and reap the benefits.

Although baseball is America's pastime, lacrosse is rapidly growing in participation at all age levels. Because of this, we want to remind parents, coaches and players about the need for proper training and conditioning. My foundation, the Orthopaedic Surgery and Sports Medicine Teaching and Research Foundation's (OTRF) health performance team and I developed an in-season strength and conditioning program for lacrosse. It includes dynamic warm-ups, form drills for jumping, cutting, and running, and acceleration drills prior to full speed activities. Coaches will find it quick, efficient and well timed, but it does require some planning to avoid training too close to competitions. We've also included a link to the OTRF website where you can download the lacrosse program, as well as many other sport-specific ones I know you'll find beneficial.

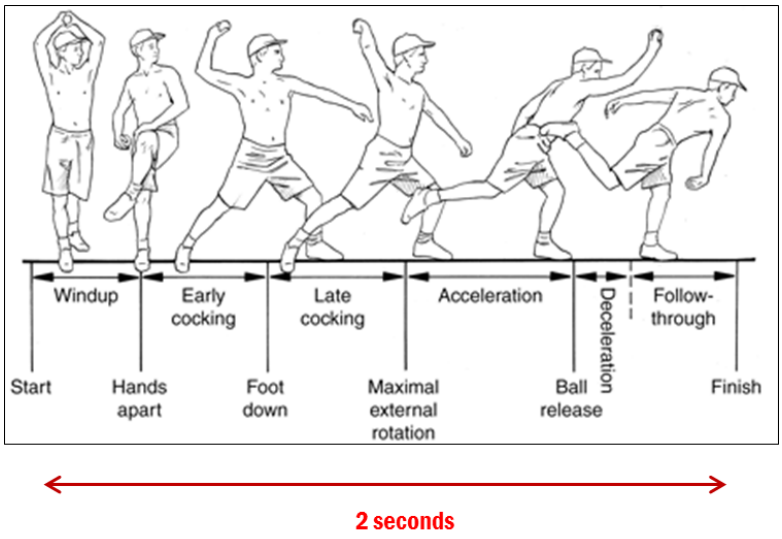
Steven Chudik, MD



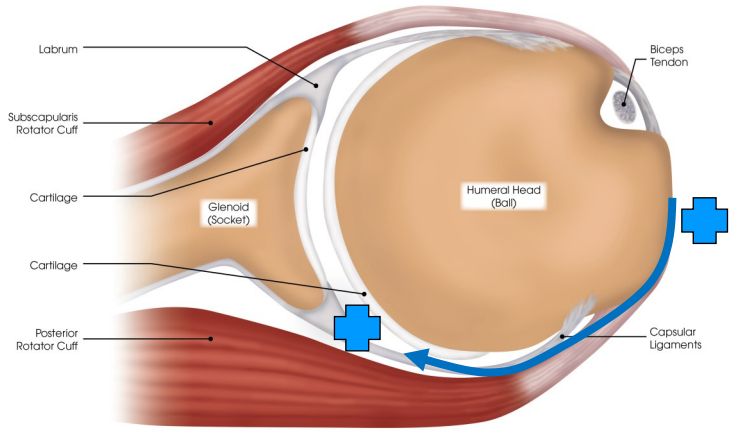
President OTRF
Orthopaedic Surgeon and Sports Medicine Physician

Poor rotation mechanics, overuse result in rotator cuff injuries

Anyone who has observed the throwing motion of a pitcher knows how unnatural it is from the early cocking phase when the hand and arm are behind the pitcher's head, through the late cocking phase when the arm is actively moving forward and in maximum external rotation through acceleration, deceleration and follow-through. In less than two seconds, this kinetic chain requires a sequence of body segment motions involving the legs, trunk, shoulder and arm. When this motion is performed repetitively, the wear and tear from the extreme throwing forces challenge the physiologic limits of the shoulder and surrounding tissue.



One injury that results from overuse and poor throwing mechanics is internal impingement that affects the rotator cuff muscles. This occurs when the arm is cocked backward to throw and the humerus (upper arm bone) rotates until there is contact between the labrum (thick tissue) on the glenoid (socket) and the undersurface of the rotator cuff muscles on the humeral head (ball). This repetitive contact results in a tearing of the labral and rotator cuff tissues. In addition, repetitive throwing can cause the anterior (front) ligamentous stabilizers of the shoulder to also stretch out and allow the humerus to shift forward, thus increasing the severity of internal impingement. The condition most often is characterized by pain around the shoulder, especially in the late cocking phase of pitching or overhead hitting in volleyball or tennis and a decrease in velocity and accuracy.



The blue crosses indicate the contact points for internal impingement. As the shoulder rotates (depicted by the blue line) the contact points come together and cause pain for the thrower.

Internal impingement and resulting shoulder injuries are preventable with an appropriate warm up and stretching before practice or competition. Also, resting between appropriate conditioning and proper throwing practice, as well as competition.

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technique and mechanics to avoid overextension of the shoulder especially during the late cocking phase.

Painful internal impingement without tears of the labrum or rotator cuff may improve with conservative treatment consisting of:

- Avoidance of aggravating activities
- Medication and ice to relieve pain
- Rehabilitation stretching and strengthening exercises
- Correction of throwing mechanics
- Gradual return to overhead activities

Treatment is geared toward the rotator cuff and shoulder blade muscles to help stabilize the shoulder, as well as normalizing the shoulder range of motion to alleviate the contact in the back of the shoulder. An injection of cortisone to the area around the tendon (within the bursa) is rarely recommended. It is important to correct throwing mechanics and participate in an interval throwing program in order to safely return to activity.

If conservative treatment fails to improve symptoms, or if internal impingement resulted in a labral and/or rotator cuff tear, arthroscopic surgery often is recommended to repair or debride the torn labrum and rotator cuff tissues and sometimes to tighten a stretched anteroinferior capsule (soft tissue surrounding the joint). Return to activity is usually possible after six weeks in a protective sling, four to six months of physical therapy and two to three months of an interval throwing program. In other words, an athlete easily can miss out on a year of playing time or even longer making injury prevention paramount.

Because proper conditioning is so important to help prevent rotator cuff injuries for throwers, Dr. Chudik and his health performance team developed a research-based, in-season stretching and conditioning program to maintain pre-season conditioning levels during the time of highest injury risk and around competition. To download a free copy of this program, or any of the other sport-specific performance programs from OTRF, enter this URL in your browser ***http://tinyurl.com/OTRF-baseball/***, or visit ***otrfund.org*** and click on the sports performance tab at the top of the home page.

Proper stretching, warm-up exercises critical to preventing throwing injuries

In 2007, Little League Baseball changed its pitching rules opting to use pitch counts to determine when a pitcher should rest instead of innings pitched. The change occurred because of pressure from orthopaedic surgeons treating a growing number of pitchers for overuse injuries. Little League Baseball was the first youth organization to make the change and many other organizations and clubs have since followed suit.

How many innings should a child throw?

This is one of the most common questions asked of sports medicine professionals by parents of youth baseball players. However, the number of overall throws during a given period, rather than innings pitched, is more important. The USA Baseball Medical and Safety Advisory Committee commissioned a survey from baseball experts about pitching limits and other injury factors. Although the response rate was only 33 percent, the survey is the most reliable data available at this time and provided valuable insight and recommendations including:

- The number of pitches is more important than number of innings when determining rest requirements. See tables 1 and 2 on next page.
- The maximum number of pitches during a single outing should gradually increase with age.
- A pitcher should be limited to two appearances per week.
- Compared to younger pitchers, older pitchers can throw a few more pitches for a given number days of rest.
- Participation in multiple leagues, playing other positions, and practice pitching should be considered when defining and regulating rest.
- In general, a child can begin to throw a fastball at the age of eight, a change-up at age ten and a curveball at age 14. See table 3 on the next page.
- Improper technique is a major factor in injury potential. Learning proper pitching mechanics is critical.
- Conditioning of the throwing arm and entire body can reduce a young pitcher's risk of injury.
- While the number of pitches should be limited, the young pitcher should be encouraged to throw. This includes playing catch, playing other positions besides pitcher, and practicing pitching. Throwing is necessary for a young pitcher to strengthen and condition his/her arm and body.
- Symptoms of discomfort or fatigue should be respected and longer periods of rest are recommended.

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Table 1: Recommended maximum number of pitches (mean +/- standard deviation)

Age	Maximum Pitches/Game	Maximum Games/Week
8-10	52 +/- 15	2 +/- 0.6
11-12	68 +/- 18	2 +/- 0.5
13-14	76 +/- 16	2 +/- 0.4
15-16	91 +/- 16	2 +/- 0.4
17-18	106 +/- 16	2 +/- 0.6

Table 2: Recommended minimum rest periods for a given number of pitches (mean +/- standard deviation)

Age	One Day Rest	Two Days Rest	Three Days Rest	Four Days Rest
8-10	21 +/- 18	34 +/- 16	43 +/- 16	51 +/- 19
11-12	27 +/- 20	35 +/- 20	55+/- 23	58 +/- 18
13-14	30 +/- 22	36 +/- 21	56 +/- 20	70 +/- 21
15-16	25 +/- 20	38 +/- 23	62 +/- 23	77 +/- 20
17-18	27 +/- 22	45 +/- 25	62 +/- 21	89 +/- 22

Table 3: Recommended age for throwing various pitches*

Pitch	Age (Years)		Pitch	Age (Years)
Fastball	8 +/- 2		Slider	16 +/- 2
Change-Up	10 +/- 3		Forkball	16 +/- 2
Curveball	14 +/- 2		Screwball	17 +/- 2
Knuckleball	15 +/- 3			

*Although studies reveal higher injury rates for those who start throwing breaking pitches at younger ages, biomechanic studies fail to show greater detrimental forces with breaking balls versus fastballs.

Lacrosse participation grows, but injuries should not with proper training and conditioning

Because of increased interest and participation, lacrosse became an official Illinois high school sport in 2016. Nationally, lacrosse participation jumped from 250,000 players in 2001 to more than 800,000 in 2015. Currently, there are 2,677 schools sponsoring boy's teams and 2,446 schools sponsoring girl's teams—similar to the number of schools sponsoring indoor track teams. However, like other physically demanding sports, participating in lacrosse also has its risk for injury.

Boy's lacrosse is considered a full-contact sport with full shoulder pads and chest protector. Girl's lacrosse is a "relatively" non-contact sport and the only protective equipment is goggles. The difference between the two can lead to a slightly different sets of injuries, but both are at risk to various contact injuries. Overall, there are greater rates of injury during games, as compared to practice—especially for concussions. Girls experience 0.76 concussions per 1,000 athletic exposures compared to 0.16 for practices. The boys had 1.23 concussions per 1,000 exposures during games and 0.17 concussions during practices.

The risk for concussion during games can be reduced by wearing proper equipment and following rules regarding legal stick-to-player and player-to-player contact. Additionally when any signs or symptoms are observed or suspected, the player must be immediately removed from play until a medical professional evaluates the athlete. Bruises and fractures are other common contact injuries in lacrosse. The most common fracture locations are the hands or forearms from stick-to-body contact.

Ligament and muscle strains are the most common non-contact injury with the majority occurring in the lower body, of which the greatest number (33.3 percent) is to the foot, ankle and or lower leg. These injuries result in players missing on average nine days or less and generally occur during general play, conditioning, chasing a loose ball, or defending. A well-maintained field, proper cleats, good body mechanics with running, jumping and cutting, excellent overall conditioning, and a thorough warm-up can help reduce the risk of injury for most lower extremity, non-contact injuries. Fortunately less than 7.4 percent of all lacrosse injuries are season ending and only 6.9 percent require surgery.

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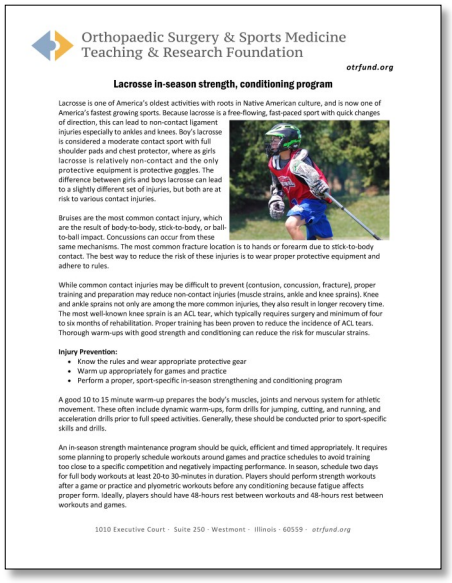
To minimize lacrosse injuries this coming season, make sure to wear well-fitting protective equipment, follow the rules regarding contact and complete a proper warm-up before every practice and game. You also should consider incorporating an in-season lacrosse strength and conditioning program like the one developed by Dr. Steven Chudik and his team of health performance team through the Orthopaedic Surgery & Sports Medicine Teaching & Research Foundation (OTRF). Based on research and Dr. Chudik's years of treating sports injuries, this program is designed to be quick, and a timed workout around games to avoid training negatively impacting performance. Ideally, players using this in-season program should have 48 hours of rest between workouts and 48 hours rest between workouts and games. In addition to helping prevent injuries, the program will improve player strength and endurance to keep them in the game all season.



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Lacrosse in-season strength, conditioning program

Lacrosse is one of America's oldest activities with roots in Native American culture, and is now one of America's fastest growing sports. Because lacrosse is a free-flowing, fast-paced sport with quick changes of direction, this can lead to non-contact ligament injuries especially to ankles and knees. Boy's lacrosse is considered a moderate contact sport with full shoulder pads and chest protector, where as girls lacrosse is relatively non-contact and the only protective equipment is protective goggles. The difference between girls and boys lacrosse can lead to a slightly different set of injuries, but both are at risk to various contact injuries.

Bruises are the most common contact injury, which are the result of body-to-body, stick-to-body, or ball-to-ball impact. Concussions can occur from these same mechanisms. The most common fracture location is to hands or forearm due to stick-to-body contact. The best way to reduce the risk of these injuries is to wear proper protective equipment and adhere to rules.

While common contact injuries may be difficult to prevent (contusion, concussion, fracture), proper training and preparation may reduce non-contact injuries (muscle strains, ankle and knee sprains). Knee and ankle sprains not only are among the more common injuries, they also result in longer recovery time. The most well-known knee sprain is an ACL tear, which typically requires surgery and minimum of four to six months of rehabilitation. Proper training has been proven to reduce the incidence of ACL tears. Thorough warm-ups with good strength and conditioning can reduce the risk for muscular strains.

Injury Prevention:

- Know the rules and wear appropriate protective gear
- Warm up appropriately for games and practice
- Perform a proper, sport-specific in-season strengthening and conditioning program

A good 10 to 15 minute warm-up prepares the body's muscles, joints and nervous system for athletic movement. These often include dynamic warm-ups, form drills for jumping, cutting, and running, and acceleration drills prior to full speed activities. Generally, these should be conducted prior to sport-specific skills and drills.

An in-season strength maintenance program should be quick, efficient and timed appropriately. It requires some planning to properly schedule workouts around games and practice schedules to avoid training too close to a specific competition and negatively impacting performance. In season, schedule two days for full body workouts at least 20-to 30-minutes in duration. Players should perform strength workouts after a game or practice and plyometric workouts before any conditioning because fatigue affects proper form. Ideally, players should have 48-hours rest between workouts and 48-hours rest between workouts and games.

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For a free copy of OTRF's in-season lacrosse strength and conditioning program, or to see all the sport-specific programs available, visit the ***OTRF website at otrfund.org/sports-performance-programs/***.

Play, participate at peak performance with sport-specific OTRF programs

Through the Orthopaedic Surgery & Sports Medicine Teaching & Research Foundation (OTRF), Dr. Steven Chudik and his health performance team provide reliable and proven training information to help athletes of all ages and abilities compete and perform at their best—no matter if it is a state athletic championship, or a weekly golf outing with friends. One of the most popular resources is OTRF's sports performance programs. Research-based, these programs incorporate appropriate exercises, weights and stretching into weekly training schedules to maintain strength and help minimize injuries.

Sports performance programs developed by OTRF are available as PDF downloads on the OTRF website, ***otrfund.org.*** To download, click on the sports performance tab. Or for a printed copy, you can email ***contactus@chudikmd.com***. Make sure to include your mailing address.

Incorporating an in-season football strength maintenance program

Football

Golf Warm-Up and Stretching Program

Golf

In-season stretching, conditioning program helps prevent baseball injuries

Baseball

Incorporating an in-season basketball strength maintenance program

Basketball

Incorporating an in-season leg strengthening and conditioning program to help performance and prevent sports injuries

Soccer

Volleyball warm-up, strengthening program helps prevent injuries

Volleyball

Sprint program vs. continuous training

According to a recent study conducted by McMaster University in Ontario, Canada, the physiological effects of sprint interval training (SIT) are congruent with the effects of moderate-intensity continuous or endurance training (MICT). Sprint interval training consists of several short periods of intense exercise, each followed by a period of low-intensity exercise, whereas moderate-intensity continuous exercise is characterized by a constant level of moderate exercise for a long period of time.

Over a period of 12 weeks, researchers recorded the changes in body fat, heart and lung fitness, blood sugar control, and skeletal muscle content in participants who were deemed inactive by an International Physical Activity Questionnaire. The total body fat percentage in all participants decreased by two percent, and the maximum oxygen intake increased by about 19 percent for both the SIT and MICT groups. Additionally, the body's ability to absorb blood sugar similarly increased in both groups, and the concentration of an energy-metabolizing protein in muscle cells increased by 48 percent and 27 percent in the SIT and MICT groups, respectively.

Twelve weeks of sprint interval training decreased body fat and increased cardiorespiratory fitness, blood sugar control, and skeletal muscle fitness to the same degree as moderate-intensity training; the only difference between these two exercise methodologies is the length of time each one took. A session of SIT took ten minutes, whereas a session of MICT took 45 minutes—almost an 80 percent difference in time commitment. While SIT may appear to be a better option than MICT with regard to time commitment, not all people have the level of physical activity, fitness, and motivation that SIT requires.

Dr. Steven Chudik and the Orthopaedic Surgery & Sports Medicine Teaching & Research Foundation (OTRF) along with Fitness Consultant and Personal Trainer, Keith Tesch, CSCS, CNT, developed a sprint interval training program.

Before starting any program, you should consult your physician. Also, always warm up for several minutes before beginning any workout and never exercise beyond the level at which you feel comfortable. The following are some specific warm-up exercises to be performed before each sprint interval training session.

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OTRF Sprint Training Program

Fitness Level	Jog/Sprint Time (Seconds)	Number of Sets by Weeks 1-7					
		Week 1	**Week 2**	**Week 3**	**Week 4**	**Week 5**	**Week 6**
Bad Shape	60/15	5	6	7	6	7	8
Average Shape	60/15	6	7	8	7	8	9
Good Shape	60/30	5	6	7	6	7	8
Great Shape	60/45	6	7	8	7	8	9
Elite Athlete	60/45	7	8	9	8	9	10

Fitness Level	Jog/Sprint Time (Seconds)	Number of Sets by Weeks 7-12					
		Week 7	**Week 8**	**Week 9**	**Week 10**	**Week 11**	**Week 12**
Bad Shape	60/15	9	6	7	8	9	10
Average Shape	60/15	10	7	8	9	10	11
Good Shape	60/30	9	6	7	8	9	10
Great Shape	60/45	10	7	8	9	10	11
Elite Athlete	60/45	11	8	9	10	11	12

This is a 12-week sprint interval training (SIT) program. One begins by estimating their starting fitness level either “bad shape,” “average shape,” “good shape,” “great shape,” or “elite athlete.” After a proper warm up (see next page), one performs a comfortable jog for 60 seconds followed by 15 to 45 seconds of a continuous and sustained sprint (based on fitness level chosen) to complete a set. Sets of jogging and sprinting are repeated a number (five to 12) of times without rest based on your fitness level and the week number (see above chart). Start at a conservative speed for week one. Each week as you increase your sets, you also can increase your sprint speed. Keep the jogging speed the same each week. As your conditioning level progresses, you can advance your fitness level as tolerated.

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Warm Up Exercises	Reps
Jumping Jacks	30
Foot to Hand	10 each side
Inchworm	5
Leg Swings Forward and Back	10
Leg Swings Side to Side	10
Butt Kicks	20

Good body and running mechanics also are very important to minimize injury and ensure you benefit from the program. Here are a tips to remember as you perform the sprinting exercises in the program.

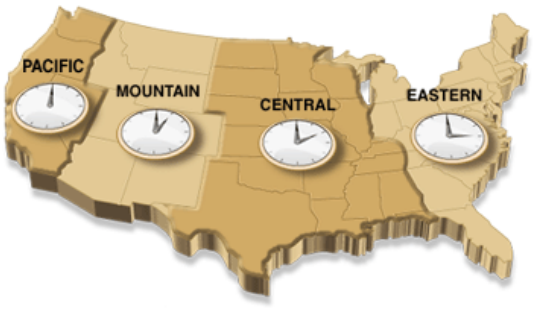
Some tips on proper running mechanics

- Stay relaxed in your face, neck, and shoulders
- Keep your upper body tall and upright
- Keep your elbows tight to your body
- Avoid crossing your body with your arms.
- Swing your arms at your shoulders, not your elbows
- Lift your leg at the hip
- Drive your foot into the ground

Research Roundup

Travel direction tied to baseball teams' performance

Researchers at Northwestern University found jet lag from cross-country eastward travel may affect the performance of Major League Baseball teams based on a study of winning percentages and other statistics spanning 20 seasons.



According to the study, teams were 3.5 percent less likely to win when they traveled east across at least two time zones, while no significant differences were found in winning percentage when the teams traveled west.

The research looked at whether jet lag differentially affects the home and away teams and whether it affects all or only specific features of performance, and if so, which ones? Their findings showed that most major jet lag effects were evident after eastward but not westward travel which supports the hypothesis that observed effects are due to a failure of the circadian clock to synchronize to the environmental light-dark cycles and not due to general travel effects. Furthermore, the findings regarding eastward travel reflected that of previous studies including a 10-year retrospective study of circadian advantage in baseball published in 2009 and an analysis of other professional sport teams traveling eastbound.

New research takes closer look at links with sport specialization, overuse injuries

A study published in *The American Journal of Sports Medicine* looked at the association between high levels of sport specialization with injuries, specifically overuse injuries, independent of age, sex, or the amount of weekly sport training time. Researchers from the University of Wisconsin studied questionnaire responses from 989 girls and 1022 boys ages 12 to18 about their sport specialization status, yearly and weekly sport participation volume, and injury history. The sample included athletes in more than 14 different sports.

According to the lead researcher, they found that significant associations exist between sports specialization and injury. Specifically, athletes reporting a previous injury was 45 to 91 percent higher among highly specialized players compared with those who did not specialize, and 26 to 85 percent higher in young athletes who exceeded sport volume recommendations of months per year and hours per week compared to those who met the recommendations. Researchers also noted specialization prevalence peaked at about age 15, and girls are more likely to be classified as highly specialized.

"There are approximately 60 million youths ages six to 18 participating in sports and in our sample, 37.5 percent (754) were highly specialized which agrees with previous research," the researchers said. "If these rates are applied to a national population, potentially more than 20 million young athletes are highly specialized in a sport and at an increased risk for a sport injury. Using the injury prevalence rates from our study for the different specialization categories, more than two million potential injuries could be prevented by adhering to sport volume recommendations and prescribing appropriate rest periods," they added.

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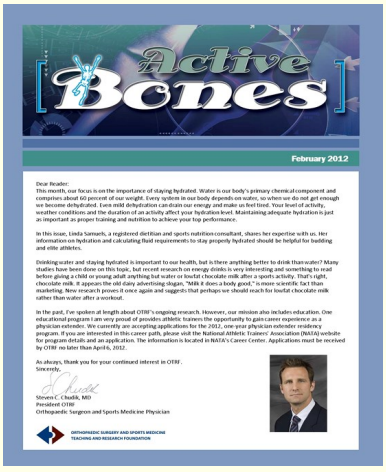
Sports Medicine Injury Clinic

Monday Evenings

Call 630-324-0402 for an appointment

Sign Up Today!

Don't miss another issue of ***Active Bones***, an email newsletter from OTRF. Each issue contains information to help you stay healthy and live an active life with tips on injury prevention, sports conditioning, research and newsmakers.



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