Foot and Ankle Athletic Injuries

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Bob Baravarian, DPM, FACFAS

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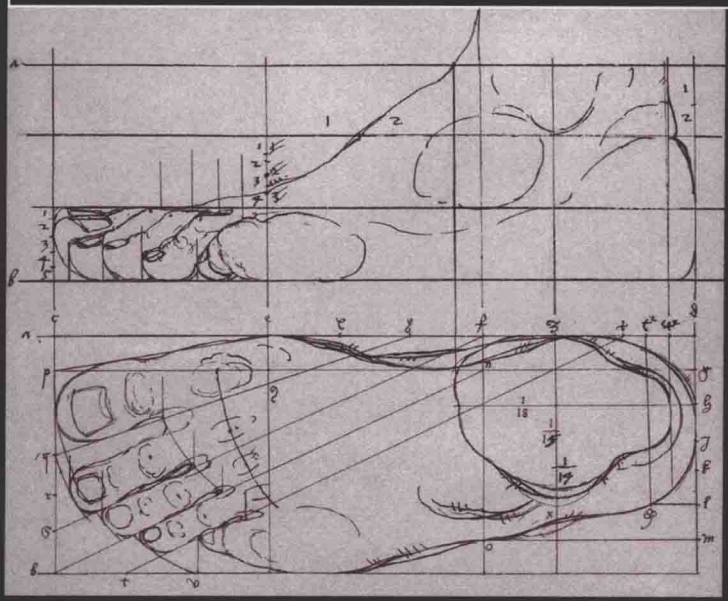

CONSULTING EDITOR
Thomas Zgonis, DPM, FACFAS

January 2011 • Volume 28 • Number 1

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Guest Editor

BOB BARAVARIAN, DPM, FACFAS

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Recent Advances in Hallux Rigidus Surgery
Molly S. Judge, DPM, FACFAS, *Guest Editor*

July 2011
Foot and Ankle Arthroscopy
Laurence Rubin, DPM, *Guest Editor*

October 2011
Advances in Fixation Technology for the Foot and Ankle
Patrick Burns, DPM, *Guest Editor*

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October 2010
Forefoot Pain
D. Martin Chaney, DPM, MS and Walter W. Strash, DPM, *Guest Editors*

July 2010
Heel Pathology
George Wallace, DPM, *Guest Editor*

April 2010
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Lawrence A. DiDomenico, DPM, *Guest Editor*

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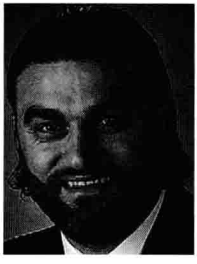
Foreword

Athletic Foot and Ankle Injuries



Thomas Zgonis, DPM, FACFAS
Consulting Editor

This issue of *Clinics in Podiatric Medicine and Surgery* is devoted to the overall management of sports-related foot and ankle injuries. Choosing the most effective treatment modalities for restoring normal function following major ligamentous and tendon injuries, fractures, and osteochondral defects requires not only an understanding of the injury but also the sport involved. Dr Baravarian, who has extensive experience in this area, has put together an all-star team, providing us with the most current and rational approaches to treat these challenging athletic injuries.

The articles in this issue focus on ankle and subtalar joint instability, peroneal and achilles tendon pathology, heel pain, osteochondral injuries, midfoot trauma, stress fractures, forefoot pathology, and dance injuries. The invited authors have submitted their work with concise evidence-based recommendations while sharing their personal experience and insight into new technology and advances in this field.

A comprehensive approach to the conservative and surgical treatment of sports-related foot and ankle injuries is essential for the athlete to improve function and return to their respective sport while preventing further injury. I thank you for your continuous efforts and your outstanding submissions.

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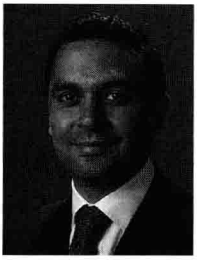
Preface

Athletic Injuries of the Foot and Ankle



Bob Baravarian, DPM
Guest Editor

Ten years and so much has changed.

I am privileged and proud to be asked to be a guest editor for this *Clinics in Podiatric Medicine and Surgery* on athletic injuries of the foot and ankle. What is amazing is that I was a guest editor for a *Clinics in Podiatric Medicine and Surgery* 10 years ago and how much has changed in that short period of time.

I am proud to be the director of University Foot and Ankle Institute with 11 locations in Southern California. We have a team of 7 podiatric foot and ankle surgeons, 1 fellow, 3 physical therapists, and extensive foot and ankle services as part of our establishment. I am also proud to still be involved with UCLA as the chief of podiatric foot and ankle surgery at Santa Monica/UCLA Medical Center and Orthopedic hospital as well as an assistant clinical professor.

We have published over 100 articles in the past 10 years and multiple book chapters and taught dozens of seminars. We have helped educate hundreds of doctors and residents from all over the world and tried to improve our profession to the best of our abilities.

Ten years seems like a long time, but it has passed faster than I could ever imagine. What has been a constant and a rock in my life has been the love of my family. I want to thank Yas, my wife, Haley, my daughter, and Michael, my son, for their love, laughter, and constant praise in the past 10 years. I also want to thank my partner and co-director of University Foot and Ankle Institute, Gary B. Briskin, for taking a chance and opening the new practice with me. Who would have thought 2 guys could grow so much in just 7 years. Finally, I want to thank the doctors at the University of Pittsburgh residency program who helped train me. You are truly in my thoughts daily and I often thank you in my head for all the lessons and guidance. You have made me the surgeon I am and I thank you from the bottom of my heart.

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Finally, let me add that what I have done in the past year is what all of us need to do. We all need to train young residents, whether with 1 surgery, 1 patient, or 1 article. We all need to improve ourselves through courses and education. It is not enough to be a good doctor; you need to think about being a good doctor and a good member of your profession. Give back and it will come back to you multiple folds over. I hope the topics presented today help guide you in your patient care and also help you delve deeper into critical thinking on the topics presented.

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Bob Baravarian

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Patrick R. Burns and Nicholas Lowery

The majority of injuries during sport are to the lower extremity (more than 50%), most of which occur in children and young adults younger than 25 years and involve fractures, ligament injuries, or tendon injuries. This article discusses the etiology of some of the most common foot and ankle sports-related injuries. The authors focus on clinical findings, associated injuries, pathophysiology, and current trends. Many of these factors are discussed in detail elsewhere in this issue.

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David J. Soomekh

The advancement of new technologies in the treatment of foot and ankle injuries seems exponential over the last several years. As surgeons expand their knowledge of the pathology and improve their treatment techniques, they come upon new and different ways to treat the same pathologic conditions. Foot and ankle injuries are commonplace in competitive sports. This article provides an overview of the diagnosis and treatment, including surgical techniques, of common foot and ankle injuries.

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Daniel K. Lee, Gerit D. Mulder, and Alexandra K. Schwartz

Hallux, sesamoid, and first metatarsal injuries are common foot injuries and have implications in the biomechanical functionality of the first ray and foot. They are essential for propulsion in normal gait. As part of the first ray, it is an important contributor to normal locomotion. Any structure disruption or injury can create angular changes or arthritis, which can have biomechanical implications, including pain, disability, compensation, swelling, and reduced range of motion.

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Bob Baravarian, Jonathan Thompson, and Doron Nazarian

Forefoot pain is one of the most common presenting problems in a foot and ankle practice. One of the most common presenting problems, yet

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most commonly missed problems, is a plantar plate tear. Often the problem is considered to be potential neuroma, fat pad atrophy, or a generalized diagnosis of metatarsalgia or metatarsal head overload. Unfortunately, not enough attention is placed on the plantar and medial/lateral ligamentous structures of the metatarsal-phalangeal joints. This lack of attention results in poor diagnosis, lack of care, treatment for the wrong condition, and ultimate frustration for the patients and doctor.

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Bora Rhim and Joshua C. Hunt

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Chronic Ankle and Subtalar Joint Instability in the Athlete **87**

Matthew J. Hentges and Michael S. Lee

Chronic ankle and subtalar joint (STJ) instability is a common clinical entity and the physician must be able to determine the exact pathologic condition for proper treatment. There are many diagnostic techniques that can be used to evaluate the ankle joint and STJ. These diagnostic techniques do not take the place of a proper patient history taking. Appropriate and aggressive rehabilitation should be attempted in all cases of chronic ankle and subtalar instability before electing surgical reconstruction.

Lateral Ankle Triad: The Triple Injury of Ankle Synovitis, Lateral Ankle Instability, and Peroneal Tendon Tear **105**

Justin Franson and Bob Baravarian

Many articles have been published that discuss various lateral ankle injuries and specific lateral ankle pathology. The purpose of this article is to explore and present a specific combination of findings that the author's multiphysician practice has noticed on a frequently recurring basis. The triple injury of ankle synovitis, ankle instability, and peroneal tendon tear can be termed the Lateral Ankle Triad. While it is common to find each of these specific injuries individually, they are often found in combination.

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Jonathan Thompson and Bob Baravarian

The Achilles tendon is the most injured tendon of athletes in the lower extremities and is the most common tendon to rupture spontaneously. Operative repair provides earlier return to sporting activities and lesser rate of rerupture. The general goal is to attempt anastomosis of the acute ruptured ends; however, delayed ruptures may require more extensive procedures.

New surgical approaches, including percutaneous and mini-open techniques, are being introduced to potentially diminish perioperative complications. Advent of early protective range of motion and rehabilitation has shown a potential for earlier return to sporting activities for Achilles ruptures.

Dance Medicine of the Foot and Ankle: A Review 137

Bruce Werber

All forms of dance are highly demanding activities, with a lifetime injury incidence of up to 90%. Most dance types are stressful, particularly on the dancer's forefoot, but certainly there is no area of the foot or ankle that is exempt from potential injury. Dancers often have unusual difficulties related to the dynamic biomechanical forces required by their individual dance form. A thorough understanding of these movements guides the physician to the cause of the injury, particularly in understanding specific overuse injuries. This article discusses biomechanics of the foot and the imaging and treatment of dance-related injuries.

Current Concepts for the Use of Platelet-Rich Plasma in the Foot and Ankle 155

David J. Soomekh

Platelet-rich plasma (PRP) injections have been used and studied since the 1970s. Its use has become more popularized over the last several years in the treatment of foot and ankle injuries. Platelets are a normal product found in the clotting cascade and inflammatory process of healing. They produce granules that release growth factors that promote healing. PRP works by increasing the concentration of platelets, thereby increasing the concentration of growth factors and increasing healing potential. PRP has an advantage over many tissue engineering products in that it is autologous. It has been studied and used for the treatment of tendon injuries, chronic wounds, ligamentous injuries, cartilage injuries, muscle injuries, and bone augmentation. The results from in vitro and in vivo studies in foot and ankle injuries are promising. The applications for treatment in the foot and ankle may be broader than once thought.

Pathology-Designed Custom Molded Foot Orthoses 171

Kevin B. Rosenbloom

Treating patients with custom foot orthoses for common pathologies is a rewarding experience when the proper steps are taken during foot casting and custom-orthosis prescription writing. This article describes successful methods for orthoses casting and prescription writing for custom-molded orthoses for Achilles tendonitis, pes planus, hallux limitus, plantar fasciitis/heel spurs, lateral ankle instability, metatarsalgia, and pes cavus. In addition, a summary of orthotic laboratory instructions for each pathology-designed custom orthosis is provided, which should be considered by orthotic laboratories.

Physical Therapy and Rehabilitation of the Foot and Ankle in the Athlete 189

Suzanne T. Hawson

Foot and ankle injuries in athletes are common. Physical therapy plays a fundamental role in the management of sports injuries. The purpose of

this article is to (1) raise awareness for using physical therapy for treatment of foot and ankle injuries in athletes, (2) discuss considerations specific to athletes during the rehabilitation process, and (3) increase the reader's knowledge about the in-depth role of physical therapy in the management of foot and ankle injuries in athletes.

Current Concepts and Techniques in Foot and Ankle Surgery

Primary Subtalar Joint Arthrodesis with Internal and External Fixation for the Repair of a Diabetic Comminuted Calcaneal Fracture **203**

Zacharia Facaros, Crystal L. Ramanujam, and Thomas Zgonis

Comminuted, intra-articular calcaneal fractures can cause severe lower extremity impairment and have devastating effects on a patient's well being. Diabetes is a multisystem process that may cause neuropathy and loss of protective sensation further complicating the prognosis. Not all calcaneal fractures are created equal and when considering the patient's overall presentation and extent of injury, the combined approach of internal and external fixation for fracture reduction may be beneficial for restoration of anatomic alignment and function.

External Fixation for Surgical Off-Loading of Diabetic Soft Tissue Reconstruction **211**

Crystal L. Ramanujam, Zacharia Facaros, and Thomas Zgonis

Early and aggressive treatment of diabetic foot wounds is imperative for the reduction of amputation risk. Whereas sound local wound care is important for successful management; chronic wounds often reach a stagnant point in healing because of diabetic vasculopathy, immunopathy, or neuropathy. The type, size, shape, and location of wound may not always allow primary closure or grafting. In patients with adequate perfusion and in the absence of infection, local advancement flaps are suitable for durable closure. A review and case report demonstrating the use of these flaps with external fixation as an adjunctive therapy for surgical off-loading is presented.

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Etiology, Pathophysiology, and Most Common Injuries of the Lower Extremity in the Athlete

Patrick R. Burns, DPM[a,b,*], Nicholas Lowery, DPM[b]

KEYWORDS

• Sports injury • Foot injury • Ankle injury • Lower extremities

The number of participants in sport activities continues to increase. Approximately 6 million adolescents now participate in school-sponsored activities alone, with many more participating in after-school and community leagues. In the past 10 years, participation in these activities is on the rise; there is as much as a 10% increase for boys and 40% for girls.[1] At the other end of the spectrum, older individuals are also increasing their participation in sport. Many, on the advice of their primary care physicians, are doing so for health benefits such as reducing medications and limiting arthritic complaints.

It is well known that participation in these activities instills positive habits and has many benefits. Learning to be active begins a habit of health maintenance and fosters the concept of teamwork. Participation in sports allows one to acquire these traits early in life along with other physical and mental benefits. Physical activity aids growth and development, helps control weight, and can decrease chances for certain illnesses. What is less clear is the effect on risk-taking behavior as well as the impact of both short- and long-term injuries. Some studies show increased alcohol abuse as well as increased emphasis on self-image and possible eating disorders associated with sport participation.[2] Most of these studies have focused on athletics at the collegiate level. What is known is that the majority of injuries during sport are to the lower extremity (more than 50%), most of which occur in children and young adults younger

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than 25 years.[3] These injuries make up as much as 20% of the emergency room visits in that age range.

Sports injuries are broadly divided into overuse or traumatic as well as either acute or chronic. Traumatic injuries are more typical in collision or contact sports such as football and soccer, due to their nature. Overuse injuries are seen mostly in training situations and sports that require endurance or repetitive activities such as gymnastics and track. The most common injuries to the lower extremity associated with sport involve fractures, ligament injuries, or tendon injuries.

The current trend of increasing participation in sporting activities among adolescents can lead to fatigue, which plays a large role in overuse injuries. If the body cannot recover, the risk for injury increases. As muscle fatigues, increased stress shifts to the ligaments and bony architecture. This shift plays a large role in overuse injuries. Fatigue may come in 2 ways, the first of which is pure overuse. Participation in various sporting activities on a daily basis with training, practice, scrimmage, and games does not leave adequate time to recover. This situation is especially apparent in adolescents as they and their parents try to maintain a rigorous schedule. The second form of fatigue is seen in the participant with a single sporting interest. In years past activity and participation changed with the seasons, allowing for the use of different muscle groups and different stresses to the body as seasons change. Someone participating in baseball one season and basketball the next would use different skills, with different movements and muscles to fit the requirements of the sport. In some ways this is thought to have helped minimize overuse to any one area. The increase in the number of stress fractures reported recently is in some cases thought to be a reflection of a single activity repeated all year. Specialization in one sport is more common, as there are opportunities for the same sport all year with indoor leagues, outdoor leagues, travel leagues, camps, and tournaments. The same activity using the same muscles, same ligaments, and same motions may be one reason for overuse and subsequent fatigue injury.

It is estimated that high school athletes account for more than 2 million sport-related injuries each year requiring over 500,000 office visits, while children of ages 14 and under produce more than 3 million injuries.[3] Most adolescents want to play and be on the field. Their cartilage is softer and muscles not fully developed, and their ligaments may be stronger than the bone to which they are attached. When these factors are combined with adolescents being unaware of the clues their body is giving them during overuse, delays are made in diagnosis and treatment. Parents, coaches, and trainers need to look for signs of injury early, such as favoring one side, slowing down, difficulty sleeping, and aches and pains including headaches.

Certain injuries are more common with particular sports and seem to be more common in competition than in practice.[4–6] This situation is obviously a result of the training involved as well as the type of impact. Football and soccer tend to have the highest rate of lower extremity injuries, with sprain being the most common at 50%.[3] The ankle is the most often involved, at 42% of all injuries, followed by the knee at 25%. When it comes to fracture, again the ankle is the most likely to be involved, at 42% of all sport-related fractures.[3] Girls tend to have more significant injuries requiring surgical intervention. Approximately 13% of injuries to the lower extremity in girls lead to a "season-ending" decision, which is 1.5 times that of boys at 8%.[3]

In recent years, many simple sports-related injuries were treated with the "RICE" protocol. More recently, this has been modified to include protection ("P") and referral ("R"), now deemed the "PRICER" protocol. For organized sports, many schools and organizations have athletics trainers available to guide practice and physical activity, who are also useful in early diagnosis and treatments. However, if the athlete is not

responding to typical conservative therapies then referral should be made to a specialist.

Prevention of injury has been an important development regarding warm-up and bracing in particular. Because ankle injuries are so common, much investigation has been done on the effects of ankle bracing. It appears that ankle taping and bracing provides a benefit in prevention for athletes with chronic sprains, but it is not cost effective to brace or tape every participant. Other conservative treatments such as proprioceptive training may be more cost effective and still may provide significant risk reduction in preventing sprains. Some concerns exist, however, about bracing interfering with activity. In a meta-analysis on the effects of ankle support on function, lace-up bracing showed a negative effect of only approximately 1% impairment of a sprinter's speed (meta 6). Warm-up exercise is also debatable, but it is still thought that most warm-up activities should include 3 parts: increasing heart rate, static stretches, and dynamic stretches. Proper equipment is also paramount. New technologies in helmet design and protective padding are currently being tested with hopes of protecting athletes as they start at younger ages, play and practice faster and more aggressively, and continue sports year-round.

This article discusses the etiology of some of the most common foot and ankle sports-related injuries. The authors focus on clinical findings, associated injuries, pathophysiology, and current trends. Many of these factors are discussed in detail elsewhere in this issue.

LIGAMENT INJURIES

Ligaments are a dense connective tissue composed of collagen fibers connecting bone to bone. Due to their collagen fibers, they are elastic under tension but the cross-linking enables ligaments to remain strong enough to maintain structure and prevent dislocation. Within this tissue, feedback from stretch receptors and other proprioceptors allow for the body to monitor itself to maintain position. This second and possibly more important function of ligaments is commonly overlooked.

The most common sports-related injuries are ligament sprains. As much as 45% of all injuries reported in a 12-year high school analysis involved ligament injuries.[1] Of those the majority were ankle sprains, comprising 15% of all sports injuries.[3,4] The most common sport for ligament sprain was basketball. Although most injuries were minor, the average return to sport was 8 days. Common ligament injuries to the foot and ankle include lateral ankle sprains, Lisfranc complex sprains, and first metatarsal phalangeal (MTP) joint or "turf toe" (**Fig. 1**).

Lateral ankle instability and sprain is one of the most common emergency room and office complaints. Approximately 25,000 of these injuries occur each day in the United States. Many are caused by shoe gear or falling from a curb or into a pothole, but sport activity is another frequent cause. Fortunately the majority are more of a nuisance, requiring therapy and time. Only 15% of ankle sprains include a significant fracture, chondral lesion, or more significant issue requiring further imaging and surgical intervention (**Fig. 2**). The lateral ankle ligament complex comprises the anterior talofibular ligament, calcaneofibular ligament, and posterior talofibular ligament. The syndesmotic ligament between the tibia and fibula completes the complex and when injured is termed a "high" ankle sprain; this may be involved in as many as 10%.[7]

Instability of the lateral ankle is a common problem and can lead to a history of sprain. Instability itself has many causes. It is crucial to look for this instability when examining patients, and in particular when treating athletes and those participating in sports. Ankle sprains are common and continued sprain will eventually lead to

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