Continuing Medical Education

The Top Five Running Injuries Seen in the Office—Part 1

Here's the current evolution in thought, literature, and treatment of these conditions.

BY STEPHEN PRIBUT, DPM

Objectives

1) Describe the features of the top running injuries.

2) Present recent concepts on muscle imbalance and the relationship of core muscles to clinical entities including PFPS and iliotibial band syndrome.

3) Review the significance of tendinopathy and fasciopathy in clinical practice.

4) Review the concept of enthesis and tendinopathy as they pertain to Achilles tendon injuries.

5) Review current theories of the cause of medial tibial stress syndrome.

6) Present current concepts of stress reactions and stress fractures of bone as repetitive stress injuries of bone.

7) Describe an outline of treatment recommendations for Achilles tendonitis, plantar fasciitis, iliotibial band syndrome, patellofemoral pain syndrome, medial tibial stress and stress reactions of bone.

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*Following this article, an answer sheet and full set of instructions are provided (pg. 198).—**Editor***

Introduction: Where Do We Come From and Where Are We Going?

We've previously looked to the future in articles such as "All The Small Things"[1a] and examined difficult problems in "Challenging Running Injuries".[1b] As we are products of evolution, our scientific understanding also evolves. The future of the science of sports medicine will include items we've so far heard little of. Besides genomics, we will hear more of systems biology, stochastic phenomena, Markov decision processes in biological phenomena and mechanobiology. Today we will take a straightforward look at the current state of the most frequently encountered running injuries.

Keep in mind what George Box

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said: "All models are wrong, but some are useful.'' You may couple that with the following words of wisdom, a paraphrase of Nobel Laureate James Black: "Our models are not merely pathetic descriptions of nature; they are accurate descriptions of our pathetic thinking about nature."

Long distance running is a uniquely human undertaking. No other primate runs long distances. Considering mammals in general, some cover shorter distances at a faster speed, but only a select few are able to maintain a rapid pace over a long distance. The development of bipedal locomotion and an upright posture has resulted in structural and functional differences in our musculoskeletal system and in the biomechanical function of our locomotor systems. It is thought that running may have been a significant evolutionary adaptation permitting easier survival by virtue of primitive hominids' enhanced ability to escape from predators and to catch prey.

Running is a vitally important part of the lives of many people. It is not only a sport, an integral segment of the runners' lives that is often carried out with near religious fervor. Running yields health benefits ranging from those which impact our psychological well being to our physical health. Running has been found to have a positive impact on depression, cardiovascular health, muscular fitness, osteoporosis, diabetes, blood pressure, obesity, prevention of colon cancer, and a variety of other measures of health.[1,2]

What Makes Runners Different

Runners have made their athletic activity an integral part of their lives. Runners have begun running and continue their sport for a variety of reasons. Runners often participate in charity runs and dedicate their run to causes or people that are close to them. They do not do well when their sport is interrupted by bad weather, work, or even worse, an injury. Many times runners have integrated their exercise into a diet and weight loss program. When the runner is forced to stop exercise their body image suffers.

Emotional Aspects

Most runners are highly motivated. They suffer physically and emotionally when their exercise is interrupted. Exercise withdrawal can have a large impact on mental health and may result in insomnia or depression. Runners have high expectations that treatment of their injuries will be speedy and have excellent results. Most runners do not want to be told not to run! In fact, the advice most often given by other runners is that "if a doctor tells you not to run, the first thing to do is to run out of their office". The concepts of relative rest, cross-training, and alternative forms of exercise must be carefully explained to the runner. Clearly spell out the modifications to training that must be made to assist in recovery from injury.

Runners often look for a physician who is a participant and shares their passion for running. While football coaches are not usually chosen for their ability to catch or throw passes, running docs are frequently sought out if they are knowledgeable and also runners themselves.

Physical Aspects

Most runners are physically fit, with the exception of those who are recent converts to the sport. The ranks of marathoners continue to swell. Chorley, et al. studied runners joining a 25-week marathon training program and found that 52% had never run a marathon before and 16% had been sedentary in the three months prior to starting training.[3] Previous injuries were reported by 38% of runners and 35% of those injuries were still symptomatic at the inception of the training program. Desire may oftentimes be greater than readiness. No longer do the new runners slowly work up to a marathon by running for six months to a year before starting marathon training.

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In looking at the biomechanics of running, it is important to remember that running is a one-legged sport. Unlike the walking gait, the runner is only on one foot and leg at a time, and never on two. Significantly higher forces are encountered while running. The foot gear used for distance running is designed for straight ahead motion and is not suited for significant side-to-side motion or sudden changes in direction.

Risk Factors, Studies on Injury Prevention

After many years of study we still can not accurately predict what factors are responsible for running injuries.[4] While many have conjectured that shoe selection plays a role in pre-

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Abbreviations

MPFL	medial patellofemoral ligament
VMO	vastus medialis obliquus
PFPS	patellofemoral pain syndrome
ITB	iliotibial band
ITBS	iliotibial band syndrome
MRI	magnetic resonance imaging
RSI	repetitive stress injury
MTSS	medial tibial stress syndrome
VL	vastus lateralis
BMU	bone multicellular unit

dicting injury, the use of motion control shoes based on foot type was associated with an increased incidence of injury. The minimalist shoe movement has not backed up their claims of lowering injury rates with any hard data. Clinical observations seem to indicate that there is a change in injury pattern among minimalist shoe wearers. Clinically those changing to minimalist shoes and forefoot strike often present with forefoot stress fractures or calf and Achilles tendon pain. Runners who would like to use minimalist shoes should follow the consensus of advice which is to carefully and slowly transition or integrate minimalist shoe use into their training program..

Over the years different injury patterns have been seen. As shoes became more cushioned, we saw an increase in Achilles and calf injuries created by the eccentric forces occurring during heel and midfoot strike. We did see a decrease in peripatellar pain while also seeing an increase in iliotibial band syndrome. As the manufacturers make shoes lighter and incorporate a lower heel to forefoot drop, we should expect to see other changes in injury trends.

A general agreement exists that most running injuries are injuries of overuse.[3-6] A detailed history must be taken and all aspects of a patient's exercise program must be evaluated. Look for changes in shoe use such as a new shoe model, a different shoe brand or old shoes that have become excessively worn. These changes may be factors in aggravating or creating an injury. Besides these changes in running shoes, a change in the training program may have triggered the problem. The "terrible too's" are often linked to these over-training injuries. These include "too much, too soon, too fast, too often, with too little rest."

A risk factor that is omitted from most evaluations of running injuries is injury from concomitant training. Plyometric exercises often lead to injury. Strength training, which is often supplemental and helpful, can occasionally create an injury. These should be explored while taking the patient's history.

The stress loads of exercise must be gradually increased. These loads should not outpace the body's physical ability to adapt to the new loads. While some studies have not been sufficiently designed to discern running-related injuries per hours run (RRI/1000 hours), other authors have posited the significance of the gradual build-up although not successfully demonstrated it in an epidemiological study.[7]

In the rush for fitness, many are injured. As we examine these injuries, we'll also note that there has been an evolution in the conceptualization of many of these injuries. This evolution has occurred slowly and in the face of imperfect knowledge. The concept of tendinopathy, as the appropriate term for tendon pathology, is an evolution of thought as is the conceptual and terminology changes suggested for problems such as plantar fasciitis. Is the iliotibial band syndrome a problem of friction or something else? Is the Vastus medialis the muscle that we need to have the patient strengthen to improve quadriceps function and treat patellofemoral pain syndrome? We'll consider these problems below.

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Top Five Running Injuries

Knee Pain (PFPS, ITBS)
Achilles Tendon
Stress Fractures
Medial Tibial Stress Syndrome
Plantar Fasciitis

Knee Pain: Patellofemoral Pain Syndrome (PFPS) and ITB Syndrome

Called by a number of different terms over the years, patellofemoral pain is one of the top five running injuries impacting up to 2.5 million runners in the United States. Chondromalacia patella, runner's knee, and anterior knee pain have all been applied to this condition. Since the site of origin of pain in this area includes several structures, the appellation "chondromalacia" is too limiting. Therefore, the nonspecific term patellofemoral pain syndrome (PFPS) is preferred by most authors. Pain here is thought to arise from any or all of the following structures: the subchondral bone, medial and lateral retinaculae, infrapatellar fat pad and the anterior synovium. Patellofemoral pain syndrome has been reported to affect up to 30% of all runners. While many features of this very common malady remain to be detailed, a number of risk factors have been cited over the years. The complex relationship of anatomical alignment of the limb, patellar shape, presence of patella alta, and even the functional aspects of the peripatellar retinaculum[8] have an impact on both the forces occurring within this sys-

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tem and the development and resolution of symptoms of this condition. A number of risk factors have been thought to contribute to PFPS. They are detailed in Table 1.

TABLE 1
Risk Factors

- Increased Q Angle
- Weak or ineffective Vastus Medialis (VMO)
- Patellar Dysplasia (e.g., small medial pole of patella)
- Trochlear Dysplasia (congenital flattening of the lateral femoral condyle)
- Patella Alta (Ward et. al. JBJS 2007 Patella Alta: Association with Patellofemoral Alignment….)
- Hypermobility of Patella
- Ligamentous Laxity
- Genu Varum/Valgum
- Female gender (possibly multifactoral, wider hips, higher Q angle, etc.)
- Malalignment of Extensor Mechanism
- Abnormal knee joint moments
- Abnormal pronation of the foot
- Other Lower Extremity Malalignment
- Weak Hip Abductors
- Increased Hip Adduction
- Canted Surface
- Overtraining

Changing Concepts in PFPS

We need to keep in mind the myriad factors that come into play with this disorder. The stability of the patellofemoral joint occurs via the interplay of soft tissue structures, bone and joint surfaces, and overall lower extremity biomechanics.[9] Clearly more than excessive pronation of the subtalar joint and a weak vastus medialis muscle contribute to this problem.

Senavongse and Amis view the stabilizers of the patellofemoral complex as 1) active stabilizers—the quadriceps muscles, 2) passive stabilizers—the retinaculum and ligamentous structures, and 3) static stabilizers—the joint surfaces.[9] Structures providing medial stability to the patella include the Vastus Medialis Oblique (VMO), medial patellofemoral ligament and, to a small degree, the medial retinaculum.[8] The patella itself is found to have the lowest amount of medial stability at 20 degrees of flexion.[9] This is only part of the story but gives a larger picture than we usually consider.

Quadriceps weakness is most often addressed in rehabilitative exercises. While the VMO is often mentioned as the weak link within the quadriceps, the VMO cannot be directly and independently strengthened using most exercise programs. The only method that has emphasized the VMO over the Vastus Lateralis (VL) has been with the use of biofeedback. While the VMO[10,11] is known to be the primary muscular stabilizer of the knee, it functions throughout the range of flexion and extension of the knee.

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Hip abductor weakness is associated with PFPS and should be addressed in crafting a rehabilitation program.[12,13] Cichanowski noted significant differences in hip abductor and external rotator strength between limbs suffering from PFPS and the normal limbs. Noehren et. al. in a prospective study of 400 female runners, found an increase in the hip adduction angle in those who developed PFPS.[13a] The study also noted this may occur in conjunction with compensatory trunk mechanics such as an ipsilateral lean.

Abnormal pronation of the subtalar joint was first mentioned as a contributing factor to this condition in early lectures and books of George Sheehan, M.D.[14] More recent research has confirmed Sheehan's early feelings on this and reaffirmed his suggestion that foot orthoses were likely to be effective.[15]

The pain of PFPS appears to be caused, in part, by overload of the richly-innervated subchondral bone, the extensor retinaculum, and the infrapatellar fat pad. Chondromalacia is a surgical observation, and no longer a term applied diagnostically to this clinical condition.

Treatment of PFPS (Table 2)

Treatment for this condition includes a decrease in running via relative or absolute rest. NSAIDs can be

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used to reduce pain. It is important to strengthen the quadriceps by a carefully instituted program. Straight leg lifts result in the least amount of force occurring at the patello-femoral joint while strengthening the quadriceps. Core body exercises are recommended including hip abductor exercises and gluteal strengthening exercises which may consist of bridges and single leg bridges. Gentle hamstring and calf stretches are also often recommended.

Lower extremity biomechanics and foot structure should be assessed. Recommendations for proper shoes, and orthotics, if deemed necessary, should be made. Orthotics have been found to be helpful in the treatment of PFPS.[16] Resumption of running should be gradual with incremental increases in at first distance, and later speed work.

Other Considerations

Patellar tendinopathy is often found alone or in conjunction with PFPS. Patellar tendinopathy many years ago was called "jumper's knee". In runners it may be related to hill running, plyometric exercises or speed work. We have already noted that running is a one-legged exercise. Another important factor to be aware of is that with foot strike, the major muscle activity in the limb is to effect a braking action. The quadriceps is working after contact to prevent the knee from bending too rapidly. This creates eccentric forces within the tendon. At the same time, the calf muscle is firing to slow the forward motion of the tibia, especially in heel and midfoot contact gait, while the gluteal muscles are firing to slow the forward motion of the femur. The larger gluteal muscles have been hypothesized to come into play more with faster running and speed work. Gluteal muscle activity is clearly evident in kicking a soccer ball as the forward movement of the leg is braked. Strengthening the gluteal muscles is often used for basketball players with this injury and is equally helpful for runners. Combining the therapy described above with an emphasis on gluteal strengthening is often successful in rapidly decreasing the symptoms of patellar tendinopathy.

Another important factor to be aware of is that with foot strike, the major muscle activity in the limb is to effect a braking action.

TABLE 2

Outline of Therapy for PFPS

Relative or Absolute Rest
Pain reduction with medication (NSAIDs)

For 8-12 Weeks the following exercises:
- Therapeutic Exercise Program Strengthening the Quadriceps
  - Straight leg lifts—Start with 3 sets of 10 reps each side, work up to 10 sets of 10 reps.

Hip and Core Muscle Strengthening (Gluteus Medius, Maximus)
- Bridges 10-15, Planks, After 3 weeks add Single Leg Bridges 8-12

Strengthen Calf Muscles—standing with knee straight

Posterior Stretching—Hamstrings and calf muscles

Additional Therapy:
- Patellar Tendon and Peripatellar Massage and Manipulation
- Taping or Bracing

Upon return to running:
- Easy graded return.
- Avoid speed work
- Avoid down hills
- Proper shoes for biomechanical needs of lower extremity
- Orthotics, if indicated

Gradual return to speedwork
Continue to be wary of downhill running

Iliotibial Band Syndrome (ITBS)

Iliotibial band syndrome (ITBS) is found among the top injuries in recent studies.[3a] The change in training methods and the characteristics of many of today's long distance runners, including the "sudden marathoner syndrome", is the most likely cause of the dramatic increase in this malady. For more than ten years, it has been clear that ITBS is associated with weak hip abductor muscles. The gluteus medius works hard to keep the pelvis level. Weak hip abductor muscles result in the recruitment of the muscles which insert into the iliotibial band itself to assist with hip abduction. This causes an

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increase in tension developing within the ITB and possibly increased forces in both the tissue of the ITB and the adjacent fatty tissue. Most of the historical literature refers to this syndrome as a "friction band syndrome" and inflammation was often mentioned as contributing to the pain.[17] In spite of this terminology, no studies documenting inflammation within the tendon turned up on a Medline search. The view that it is primarily a "friction"-based syndrome is fading.

More recently further anatomical studies have suggested that pain in the iliotibial band area is not caused by friction.[18,19] Fairclough raises the question "Is the iliotibial band syndrome really a friction syndrome?"[18,19] He contends that the ITB is firmly attached to the femur and is not anatomically capable of moving forward and backwards over the lateral epicondyle of the femur. Recent cadaver studies and MRI studies have failed to document the expected evidence for friction or for a primary anatomical bursa. Instead an area of compression has been noted which seems to affect the richly vascularized and thoroughly innervated fat below the tendon. On MRI a zone of signal intensity abnormality was found in this area and felt to be associated with intermittent fat compression.[19,20]

Tension within the iliotibial band was cited by Noehren et. al. as a contributing factor, with compression occurring rather than friction:

The ITBS seems to be primarily caused by overuse in the presence of muscular imbalance.

"The development of iliotibial band syndrome appears to be related to increased peak hip adduction and knee internal rotation. These combined motions may increase iliotibial band strain, causing it to compress against the lateral femoral condyle. These data suggest that treatment interventions should focus on controlling these secondary plane movements through strengthening, stretching and neuromuscular re-education."[21]

Muscular and neuromuscular fatigue and the resulting kinematic changes that occur during long distance running may also contribute to this and other overuse injuries. Impact shock, while more often studied, is not a factor. Instead, increased hip adduction, an increase in knee flexion at heel strike, and maximum knee internal rotation velocity were found to be higher at the end of a run in individuals with ITBS.[22] Miller's computer modeling system also indicated that tension would be greater in the ITB for patients throughout the stance phase of the running gait cycle.

TABLE 3
Treatment Outline for ITBS

Relative or absolute rest

Strengthening:
Hip Abductor Muscle Strengthening—Standing hip tilts on one leg to isolate hip abductors.

Stretching:
Side bends to stretch tight lateral structures, hip capsule and fibers inserting into the iliotibial band. The latissimus dorsi is also stretched with this exercise. The latissimus dorsi can alter trunk and hip movements.

Ancillary stretches—adductors and rotators of hip.

Advanced stretches:
Stair dip
Stair Strides

Optional:
Ice
Foam roller

Anatomical Considerations

The iliotibial band (ITB) is a continuation of the tensor fascia lata as a thickening of the lateral fascia of the upper leg. A significant portion of the gluteus maximus inserts into the ITB. Along the course of its descent down the leg there are connections to the linea aspera of the femur. The ITB fans out distally to insert on the lateral aspect of the patella, the lateral retinaculum and Gerdy's tibial tubercle. Functionally the tensor fascia lata, gluteus medius and gluteus minimus function as hip abductors.

Diagnosis of ITBS

Iliotibial band syndrome (ITBS) is a clinical diagnosis which is made in the presence of lateral knee pain in the general region of the lateral femoral epicondyle, with tenderness and pain upon compression of this

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area while the knee is flexed and extended. Tenderness in adjacent structures, including the lateral collateral ligament of the knee and at the lateral joint line, should not be present. In early stages, the pain might only manifest itself while running or following a run.

Evolution in Conceptualization of ITBS (Summary)

The ITBS seems to be primarily caused by overuse in the presence of muscular imbalance. Weak hip abductor muscles are the culprit. ITBS, in most cases, is not a friction syndrome with a "popping" of the tendon over the femoral epicondyle. Instead, there is a compression in this region that most often affects the fat tissue overlying the femoral epicondyle. Clinically, pain while walking and tenderness is not always found in the early stages. Tension does develop within the band and early stage tendinopathic changes may be present, but no research has demonstrated this yet.

The same factors that create ITBS can lead to hip pain which is frequently found in conjunction with this condition. Hip pain associated with weak hip muscles and ITBS can be caused by trochanteric bursitis or gluteus medius insertional tendinopathy. A more serious condition, a tear of the hip labrum, occurs less often.

Treatment of ITBS

Relative or absolute rest is an important component of the treatment plan for any of these running-related overuse syndromes. Directly addressing the cause of the ITB syndrome, in most cases, seems to give significant clinical success. Weak hip abductor muscles have been directly implicated in this condition. An additional factor may be tendon and capsular tightness. A treatment program should include hip abductor strengthening in conjunction with lateral hip capsule and soft tissue stretching.

NSAIDs or ice may be used to reduce discomfort. Foam rollers and tissue-mobilizing massage have been recommended. Abnormal biomechanical functioning of the foot and leg should be addressed, including limb length discrepancy, but there is no evidence that either motion-control shoes or excessively cushioned shoes contribute to this condition or help to alleviate it. Table 3 outlines a treatment program for ITBS.

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Achilles Tendinopathy

Anatomy

The Achilles tendon is the continuation of the gastrosoleus complex of muscles and is at the terminal aspect of this multijoint system. The gastrocnemius begins above the knee joint, the soleus below. The joints on which they have a direct impact include the knee joint, the ankle joint, and the subtalar joint. The most distal aspect of the insertion becomes contiguous with the plantar fascia. The complex anatomy of the insertion is described below as an enthesis organ.

Pathology

For years, almost all tendon pain was lumped into the category of tendonitis. It was mistakenly believed that inflammation was the underlying process causing the pain and pathology in what was called Achilles Tendinitis. Tendinopathy is now the lump-all category for tendon pathology. This term includes early stage tendinitis, paratendinitis, and later stage chronic tendinosis. Histological studies have demonstrated that those with chronic tendon pain do not have inflammatory changes in the affected tendon, but rather degenerative changes.[23]

The term tendinosis is used specifically to apply to tendons with known chronic degenerative changes. The term tendinopathy itself does not have this connotation and is well used to apply to overuse tendon pain and swelling in the absence of a histopathological diagnosis (Maffulli, Khan, Paddu). In long-standing tendinopathy, at surgery, the tissue demonstrates the appearance of mucoid degeneration. The tissue appears brown or yellow and shows disorganization, and an apparent lack of well-defined tightly bundled collagen fibers. Microscopic examination reveals degenerative changes and concomitant fibrosis.[24] Ultrasound examination has previously demonstrated neovascularization in the injured tissue.

Tendinopathy may occur at the insertion of the Achilles tendon or within the main body of the tendon itself.

Achilles tendon disorders are often divided into three zones: 1) Noninsertional—the tendon proper (and paratenon), 2) conditions affecting the tendon insertion, and 3) proximal—at the muscle tendon interface and more structures proximal.[25,26] An outline based on Puddu, et al., and Werd is seen in Table 4.

Evolution of Thought in Insertional Enthesopathy

Tendinopathy may occur at the insertion of the Achilles tendon or within the main body of the tendon itself. It is possible that these two differing areas may result from diverse predisposing factors. It has been suggested that repeated stresses that are well within a clinical and functional

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range may create the pathology in a manner similar to the manner in which bone stress reactions may occur.[27] The major contributing causes cited include overuse, abnormal biomechanical factors, fluoroquinolone antibiotics and corticosteroid use.

At the insertion of the Achilles tendon, a variety of conditions may occur. In addition to insertional tendinopathy of the Achilles tendon, one may find retrocalcaneal bursitis, Haglund's deformity, and pre-tendinous bursitis. When the Haglund's deformity is symptomatic, it is usually found as a triad of insertional tendinopathy of the Achilles tendon, a prominent posterosuperior calcaneal process, and retrocalcaneal bursitis. Insertional tendinopathy can occur in the absence or presence of calcaneal bursitis. Numerous studies indicate that insertional tendinopathy occurs in up to 5%—20% of Achilles tendon overuse injuries.[28] Older individuals appear to be at higher risk for this injury.[28]

The insertion of the Achilles tendon is complex. At the osteotendinous junction of the Achilles tendon, histological examination reveals tendon, fibrocartilage and bone. There are three types of cartilage found here: sesamoid, periosteal, and enthesial fibrocartilage. The term "articular enthesis organ" has been applied to the insertion of the Achilles in view of the complexity of its insertion (with the presence of a complex of fibrocartilages, a fat pad, and bursae).[29] The sesamoidal fibrocartilage is located at the deeper portion of the tendon and is termed such since it is within the tendon. The periosteal fibrocartilage is located on the opposing superior tuberosity of the calcaneus and is termed such since it is a modification of the periosteum. While rheumatologists began viewing this insertion as fundamentally different, the concept of enthesis organ is only slowly breaking ground in the discipline of sports medicine. What has been termed an insertional tendinopathy might more correctly be called an insertional enthesopathy.

An enthesis is by definition the insertion point of a tendon, ligament, fascia or articular capsule into a bone.

An enthesis is by definition the insertion point of a tendon, ligament, fascia or articular capsule into a bone. This area is susceptible to drug-induced enthesopathies by fluoroquinolone antibiotics (which may also affect the tendon prior to its insertion). In the case of the Achilles complex, the combination of tendon, fibrocartilage, fat pads, and bursa may be affected at any of those areas, or in multiple tissue types, which alters function and forces.[30]

Fibrocartilage functions to resist shear and strains at the enthesis. This new conceptualization has great and significant future implications for understanding of forces, function, and treatment of Achilles tendon insertional disorders.

Bone spurs which form at this location have been noted to not be within the substance of the tendon itself. The relationship of the "spurs" here to the fibrocartilage remains to be detailed. There are several additional conditions to consider near the insertion of the Achilles tendon in addition to insertional Achilles tendinopathy and enthesopathy. These conditions include retrocalcaneal bursitis alone and Haglund's disease which consists of a painful retrocalcaneal bursa in conjunction with a prominent postero-superior calcaneal process. Haglund's deformity itself is often asymptomatic. In the

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TABLE 4

Classification of Injuries to the Achilles Tendon and Surrounding Structures

Zone 1: Non-insertional Achilles Injuries
- Achilles paratendinopathy
- Achilles tendinopathy
- Achilles tendinosis
- Achilles tendon rupture

Zone 2: Insertional Achilles Injuries
- Achilles insertional tendinopathy
- Haglund's Triad
- Achilles insertional calific tendinopathy
- Retrocalcaneal bursitis
- Pre-Achilles tendon bursitis
- Avulsion fracture of calcaneus

Zone 3:
- Partial tears/tears of muscle-tendinous junction
- Strain of medial head of gastrocnemius muscle
- Plantaris strain/rupture

differential diagnosis, be certain to consider Achilles tendinopathy caused by inflammatory arthropathy.

In Achilles enthesopathy or insertional Achilles tendinopathy, pain is present at the back of the heel. The pain is aggravated by running uphill, and by prolonged walking, standing, or running. Table 5 offers possible differential diagnoses of insertional enthesopathy of the Achilles tendon.

TABLE 5
Differential Diagnosis of Insertional Enthesopathy

Seronegative spondyloarthropathy
Gout
Avulsion injury
Haglund's disease
Sever's disease (found in adolescents)
Retrocalcaneal bursitis
Systemic steroid induced injury
Fluoroquinolone tendinopathy
Familial hyperlipidemia
Sarcoidosis
Diffuse idiopathic skeletal hyperostosis

Non-Insertional Achilles Tendinopathy

The Achilles tendon is most often affected in non-insertional tendinopathy at a location 2 to 6 cm. proximal to its insertion into the calcaneus. The paratenon substitutes for a true gliding synovial sheath. It is comprised of fatty areolar tissue surrounding the Achilles tendon and is organized into a mesotenon. Werd has pointed out a clinical manner of distinguishing tendinopathy from paratendinopathy.[25] Upon palpation of the painful area, if the foot is dorsiflexed and plantarflexed and it is noted that the area of maximal tenderness does not move, the presumption is that the site of tenderness is within the paratenon itself, which is firmly attached to the surrounding tissues and does not move. If the tenderness shifts with dorsiflexion and plantarflexion, the tenderness is deemed to be within the tendinous tissue.

Fluoroquinolone use is associated with non-insertional Achilles tendon injuries. The risk is increased with a concomitant use of oral corticosteroids, increasing age, magnesium deficiency, and HLA B27 associated disease. The mechanism of injury has not been definitively described. Contributing factors may include the chelation of Mg2 + by the Fluoroquinolone which may affect the transmembrane integrin proteins. A reduction in collagen type I, elastin, fibronectin, and Beta1 Integrin which mimics Magnesium deficiency has been found in dogs given fluoroquinolones. Athletes should avoid "all use of fluoroquinolone antibiotics unless no alternative is available". Training should be reduced in volume, intensity, and duration during the use of fluoroquinolones with careful monitoring and an easy return to full activity during the month following treatment completion.[25a]

Additional Calf and Posterior Calcaneal Injuries

Injuries to runners are also noted at the myotendinous junction, within the calf muscle itself, and to the plantaris.

Approach to Treatment

Conservative treatment is directed to decreasing strain on the tendon and allowing the tissue to repair itself. Relative rest, absolute rest or the use of a pneumatic walking boot may be required. NSAIDs are often used, and offer a decrease in symptoms and a more normal gait and motion pattern through pain reduction, although their anti-inflammatory effects are no longer thought to be of assistance.

Cross friction massage and ice application are often used. The modalities of ultrasound and high voltage galvanic stimulation may also be helpful. Heel lifts and possible custom functional foot orthotics may also assist in reducing mechanical strain.

After the pain is reduced, a gentle and gradual return to activity and then speed is helpful. Avoiding hills or inclined treadmills is advised. Excessively cushioned shoes, which will increase the eccentric forces within the tendon, should be avoided.

Alfredson has proposed the use of eccentric stretching and strengthening with heavy loads, which when performed as described, is meant to cause pain.[31,32] Similar approaches have been suggested for several other tendinopathies, including patellar tendinopathy. Two review articles examining eccentric strengthening as treatment for a number of tendons were recently published.[33] The authors thought, in general, that the evidence was weak and underpowered. It is important to note that Alfredson has recommended that eccentric stretching should not be used to treat insertional Achilles tendinopathy.[32a]

For severe, chronic, and unremitting tendinosis, surgery remains an option.

The current literature was described as having a "dearth of high quality research in support of the clinical effectiveness of EE (eccentric exercise) over other treatments in the management of tendinopathies."[33] Kingma, et al. agreed, that while the technique appeared promising "large methodologically sound studies ….are warranted."[34]

For severe, chronic, and unremitting tendinosis, surgery remains an option. The described surgical proce-

Continued on page 196

dures include stripping of the paratenon, linear tenotomies, and excision of non-viable tissue.[28,35]

Treatment for Achilles tendinopathy is outlined in Table 5. **PM**

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Dr. Pribut is a Clinical Assistant Professor of Surgery at George Washington University Medical School. He serves on the Runner's World Board of Advisors. He is a past president of the American Academy of Podiatric Sports Medicine. Dr. Pribut is in private practice in Washington, DC.

CME EXAMINATION

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SEE ANSWER SHEET ON PAGE 199.

1) Running gait demonstrates which of the following features:
- A) Two feet are in contact with the ground 25% of the stance phase
- B) Two feet are in contact with the ground 75% of the stance phase
- C) The forces of running are less than the forces of walking.
- D) Two feet are never in contact with the ground at the same time.

2) A viable approach to ITB Syndrome would not include:
- A) Strengthening hip abductors
- B) Decreasing running and "relative rest"
- C) Soft shock absorbing shoes
- D) Side bends to stretch tight lateral structures

3) In reference to the impact on the patellofemoral complex, the vastus medialis oblique is:
- A) a static stabilizer
- B) a dynamic stabilizer
- C) a passive stabilizer
- D) a destabilizer

4) The patella has the least amount of medial stability at:
- A) zero degrees of flexion
- B) 20 degrees of flexion
- C) 45 degrees of flexion
- D) 90 degrees of flexion.

5) Factors considered important to the development of patellofemoral pain syndrome include:
- A) abnormal pronation of the foot
- B) patella alta
- C) weak hip abductor muscles
- D) all of the above.

6) Pain that develops after running in the anterior region of a patient's knee is most likely to be what is appropriately termed:
- A) Runner's Knee
- B) Patellofemoral pain syndrome
- C) chondromalacia patellae
- D) terrible triad

7) Evidence in studies has indicated that a large contributing factor to iliotibial band syndrome is:
- A) weak hip abductor muscles
- B) over pronation of the foot
- C) high arches
- D) low blood levels of Vitamin D

8) The pain of iliotibial band syndrome is most often experienced in the region of the:
- A) anterior knee
- B) posterior aspect of the knee
- C) medial aspect of the knee
- D) lateral aspect of the knee.

9) The most frequently occurring Achilles tendon injuries in runners are best termed
- A) Achilles tendonitis
- B) Achilles heel
- C) Achilles bursitis
- D) Achilles tendinopathy

10) All of the following types of footgear could aggravate pain in the Achilles tendon area except:
- A) zero drop, minimalist shoes and a switch to forefoot contact running style
- B) firm heel shoe, flexible at ball, with 1/4" heel lift
- C) well-cushioned shoes
- D) shoes with a stiff and hard-to-bend sole.

11) The insertion of the Achilles tendon and the plantar fascia are similar in that they both:
- A) insert into the talus
- B) are both improved with stiff running shoes
- C) are improved by jumping jacks and running in sand
- D) are entheses

12) The histological findings of tendinosis include:
- A) myxoid degeneration
- B) parakeratosis
- C) inflammatory exudates
- D) copius lymphocytes

13) Fluoroquinolone use has been associated with:
- A) Achilles tendinopathy and enthesopathy
- B) Peri-patellar pain sydnrome
- C) Stress fractures
- D) Osteopenia

14) Minimalist shoe gear has been clinically associated with:
- A) Change to a "paleo" diet
- B) ITB sydnrome
- C) Achilles tendinopathy and forefoot stress fractures
- D) Osteoarthritis of the hip and knee

15) Hakim Alfredson, the author of several studies on eccentric stretching in the treatment of Achilles tendinopathy, does not recommend it for:
- A) Non-insertional Achilles tendinopathy of 4-6 weeks duration
- B) Non-insertional Achilles tendinopathy of 6-8 weeks duration
- C) Non-insertional Achilles tendinopathy of 10-14 weeks duration
- D) Insertional Achilles tendinopathy

16) The following statement about patellofemoral pain disorder is false:
- A) the preferred name of this condition is anterior knee pain
- B) pronation of the foot has been found in studies to

Continued on page 198

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CME EXAMINATION

be a risk factor
C) studies indicate weak hip abductors to be associated with PFPS
D) the subchondral bone, extensor retinaculum and infrapatellar fat pad are possible sources of pain in PFPS.

17) All of the following statements about the Achilles tendon insertion are true except:
A) Fibrocartilage is found at the insertion of the Achilles tendon
B) Sesamoidal cartilage is found at the insertion of the Achilles tendon
C) periosteal cartilage is found at the insertion of the Achilles tendon
D) articular cartilage is found at the insertion of the Achilles tendon

18) Surgical treatment of Achilles tendinosis most commonly would likely include any of the following except:
A) stripping of the paratenon
B) excision of non-viable tissue
C) Gastrocnemius recession (e.g., Strayer Procedure)
D) linear tenotomy

19) The most specific statement we can make about the Gastrosoleus complex and the Achilles tendon is that this complex is:
A) Multi-joint functioning
B) Primary function is supination of the subtalar joint
C) Primary function is plantar flexion of the great toe in ballet dancers
D) associated with ITB syndrome

20) Although evidence based proof is weak, overuse running injuries are thought to be contributed to by all of the following except:
A) carbohydrate loading
B) overtraining
C) shoes losing shock absorption and wearing down substantially
D) starting marathon training never having run more than 20 minutes at a time

See answer sheet on page 199.

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EXAM #4/13
The Top Five Running Injuries Seen in the Office—Part I (Pribut)

Circle:

1.	A	B	C	D	11.	A	B	C	D
2.	A	B	C	D	12.	A	B	C	D
3.	A	B	C	D	13.	A	B	C	D
4.	A	B	C	D	14.	A	B	C	D
5.	A	B	C	D	15.	A	B	C	D
6.	A	B	C	D	16.	A	B	C	D
7.	A	B	C	D	17.	A	B	C	D
8.	A	B	C	D	18.	A	B	C	D
9.	A	B	C	D	19.	A	B	C	D
10.	A	B	C	D	20.	A	B	C	D

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Strongly agree [5]	Agree [4]	Neutral [3]	Disagree [2]	Strongly disagree [1]

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2) The educational objectives were accomplished ____

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