

does not sag and gives even support. This can be a difficult problem when the athlete is travelling a great deal. A side-lying sleeping position in which all sections of the spine are in slight flexion is preferable to any position that puts all or part of the spine in

extension. A pillow under the top leg will sometimes help relieve pain in the lower back.

In 1955 Jones<sup>1</sup> described the relation of the foot to problems with the back. His description is still valid and reinforces my belief that the athlete

needs a shoe that has a good counter, is not too worn in the heels, fits in width as well as length and has proper arch support.

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## 7. Physiotherapeutic treatment of athletic injuries to the muscle-tendon complex of the leg

DAVID D. WISE,\* B SC, PT, M ED

An overview is presented of the most common soft-tissue injuries of the leg in athletes. A simple classification is made on the basis of cause, location of the injury and severity. These injuries can be classified into direct and indirect types. Direct injuries, which are usually the result of one episode of trauma, can be classified further into three grades of severity. Treatment is based on the severity of the injury and its location in the muscle-tendon complex. Indirect muscle-tendon injuries are the result of repetitive subacute microtrauma to the muscle-tendon complex or injury to the structures associated with muscle function (bursa, tendon sheath or fascia). Appropriate treatment regimens are suggested.

On présente une revue des blessures des tissus mous des jambes les plus souvent rencontrées chez les athlètes. Une classification simple s'appuyant sur la cause, la localisation de la blessure et sa gravité est faite. Ces blessures peuvent être classifiées selon qu'elles sont de type direct ou indirect. Les blessures directes, qui résultent habituellement d'un traumatisme, peuvent être sousclassifiées selon trois ordres de gravité. Le traitement dépend de la gravité de la blessure et de sa localisation dans l'axe muscle-tendon. Les blessures indirectes des muscles et des tendons sont le résultat de microtraumatismes subaigus répétés ou de blessures affectant des structures associées à la fonction musculaire (bourse, gaine tendineuse ou fascia). Des modes de traitement appropriés sont suggérés.

Clinical records of the athletic injury centre at the University of Western Ontario, London, for 1972 to 1975 show that by far the most common injuries of the leg are those of the muscle-tendon complex, which includes the muscle belly, the muscle-tendon

junction, the tendon and the tendoperiosteal junction. Injuries to this area can be direct (e.g., muscle contusion or muscle strain) or indirect (e.g., inflammation of the synovial tendon sheath, bursa or fascial attachments). Direct injuries are associated with the more violent, or acceleration, sports (i.e., football, soccer, rugby, hockey, sprinting and tennis), while indirect injuries are associated with repetitive sports (i.e., distance running, swimming, basketball and volleyball).

In this paper I will describe these injuries as seen in athletic injury treatment centres, and discuss their prevention and treatment.

#### Direct injuries

##### *Muscle contusion*

Muscle contusion in the leg is a constant problem in the more violent sports. Usually the muscle and associated tissue are crushed between a hard external object and the bone. For most sports in which muscle contusion is a problem, specialized padding is available to prevent these injuries. Anyone associated with such a sport should try to ensure that the athlete uses the best equipment and that it is well fitted and in good repair. Such measures can eliminate a large part of this problem.

##### *Muscle strain*

Muscle strain in the leg is a problem in both violent collision sports and acceleration sports. The usual mechanism of injury is that the muscle is contracted violently while under full stretch.<sup>1</sup> The result is an overload of the muscle-tendon complex, which gives way at its weakest point. Serious muscle strains often are sequential to previous subclinical muscle strains, contusions or inflammations. Some maintain it is virtually impossible to strain seriously a healthy muscle-tendon complex.<sup>1</sup>

The basis of prevention of muscle strain lies in the mechanism of injury. A strong and supple muscle is rarely strained. Developing flexibility is a

current fitness fad — and no wonder, since it leads to a much lower likelihood of injury. Several very good flexibility programs have been developed recently that make use of well known clinical methods.<sup>2</sup> Development of balanced antagonistic strength is also a preventive procedure since muscle strain is often due in part to muscular imbalance.<sup>3</sup> Avoidance of repeated insult to slightly injured muscles or tendons is important, as is not returning too soon to competition. Finally, there are screening tests that can be used to identify persons most susceptible to serious muscle injury.

#### Management

The sequential inflammatory responses to muscle contusion and muscle strain are similar; therefore their management can be considered together.

Whether the athlete is seen immediately after the injury or later, the first task is to ascertain the exact location of the contusion or strain in the muscle-tendon complex, and the second is to classify the severity of the injury. Both tasks are very important for prognosis and for determining the treatment to be given.

Location of the injury is ascertained by palpation and contraction tests. Muscle belly injuries are quickest to heal, tendon injuries take a little longer, and injuries of the muscle-tendon junction are slowest. Basically all these injuries are treated the same way, but a much longer and more difficult treatment should be expected for the last category of injuries.<sup>4</sup>

Severity of the injury is classified into three grades (Table I) on the basis of the following features:

1. Severity of pain and its location as determined by palpation.
2. Difference in circumference (measurement of amount and rapidity of swelling).
3. Degree of stretch tolerated.
4. Severity of pain on contraction.
5. Loss of power on contraction.
6. Loss of function.

After first aid is performed grade 1

Reprint requests to: Mr. David D. Wise, Fitness and therapy centre, Ottawa Athletic Club, 2525 Lancaster Rd., Ottawa, Ont. K1B 4L5

injuries are usually treated solely by physiotherapeutic means. Grades 2 and 3 injuries should be (but often are not) immediately referred to and treated by a knowledgeable physician before physiotherapeutic treatment is applied.

**Immediate treatment:** The general immediate treatment of grades 1 or 2 muscle contusion or strain has the following steps:

1. Compression. This should be applied immediately and maintained.

2. Ice. The leg should be placed in ice from attachment to attachment or immersed in cold water (10°C) for 10 minutes while held under slight stretch, then left at room temperature for 10 minutes. This procedure should be repeated as often as possible.

3. Exercise. Immediately after the application of ice the muscle should be very mildly stretched 10 times, then very mildly contracted 10 times.

4. Rest. The muscle should be rested from any undue activity except for the mild stretch and contraction routine. With grade 1 injuries there should be no heavy practice; with grade 2, partial weight-bearing; and with grade 3, no weight-bearing.

5. Elevation. Whenever the athlete is sitting or lying the leg should be elevated and he or she should avoid standing for long periods because gravitational swelling is often a problem.

With grade 1 injuries this routine should be repeated as often as possible for 2 to 5 days; with grade 2 injuries, for 5 to 7 days; and with grade 3 injuries, for 14 days.

**Rehabilitative treatment:** After the period of immediate treatment rehabilitative treatment is instituted with the following measures:

1. Prolonged application of ice (20 to 30 minutes), heat packs, whirlpool baths or ultrasound therapy for superficial muscles to increase circulation within the injured muscle-tendon complex.

2. Ultrasound, diathermy and microwave therapy to increase circulation in deep muscles.

3. Electric stimulation (by faradic, galvanic, interferential or diadynamic current generator) to relieve spasm,

maintain strength and eliminate waste products.

4. Strengthening exercises, gradually increased within limits of pain.

5. Stretching exercises, gradually increased within limits of pain.

The athlete or coach often asks when the player can safely return to competition. The answer is simple: the athlete may return when his symptoms return to grade 1 level and he has regained near-normal function. Taping and wrapping procedures are often most beneficial at this stage.

#### Indirect injuries (inflammation)

Indirect injuries to the muscle-tendon complex of the leg include tendinitis, tenosynovitis, bursitis and fasciitis. Any one of these may be combined with or be a complication of muscle contusion or strain.

#### Deep posterior flexor compartment syndrome

A common indirect soft-tissue injury of the leg in athletes is the deep posterior flexor compartment syndrome, often called "shin splints". This syndrome is usually caused by sudden unaccustomed overuse of the flexor compartment as an accessory arch support mechanism in running and jumping sports. The irritation takes place at the periosteal and fascial origins of this muscle group. The injury can be classified as a combination of muscle strain and fasciitis.

Healing of strains at the tendoperiosteal junction or at fascial origins is slow and is hindered further by the relatively reduced blood supply occurring naturally in the leg. Furthermore, this injury is often associated with various diagnosed or unrecognized foot abnormalities. Hence the clinical picture is confused and the syndrome takes time and patience to treat.

**Treatment:** We have had the most success in treating this injury as a muscle strain for an extended period. The treatment consists of the following steps:

1. Prolonged icing — 20 to 30 minutes over the entire medial edge of the tibia.

2. Longitudinal or metatarsal arch support, or both.

3. Stretching exercises for the posterior tibial compartment.

4. Resistance exercises, gradually increased, for the deep posterior flexor muscles.

5. Rest from running, then gradually increased running on soft surfaces.

6. Acetylsalicylic acid for relief from pain and anti-inflammatory effects.

#### Bursitis

Bursitis is caused by either overuse or contusion. There are over 15 bursae in the lower limb. The most common sites of inflammation are, in order of frequency: prepatellar, suprapatellar, infrapatellar, calcaneal and greater trochanteric.

**Treatment:** Ice application, because of its anti-inflammatory properties, is very important in the treatment of any irritation of synovial structures. When irritation of the synovium is the major problem ice is always to be preferred to heat.<sup>5</sup> Ultrasound therapy is also very important because it mechanically breaks down the large protein molecules that are a major factor in the change of osmotic pressure within the bursa.<sup>6</sup>

General treatment includes the following measures:

1. Rest from activities that irritate the bursa, as much as possible.

2. Anti-inflammatory drugs as prescribed by a physician.

3. Massage at the edges of the bursa in later stages.

#### Tendinitis specific to athletes

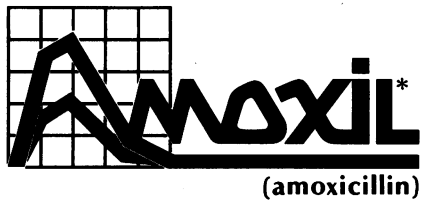
The three most common types of insidious tendon strain caused by repetitive activities are patellar, Achilles and popliteal tendinitis.

Patellar tendinitis is a strain of the muscle-tendon complex caused by repeated violent use of the quadriceps muscles. This condition is commonly called jumper's knee but often occurs in kicking sports as well.

Achilles tendinitis (distinct from Achilles tenosynovitis), also a muscle strain, occurs with violent use of the sural muscles, as in jumping sports or sports that require quick changes from

Table I—Classification of severity of direct injury to muscle-tendon complex of leg

Grade of severity	Pain	Difference in circumference (mm)	Range of motion (%)	On contraction		
				Pain	Loss of power	Function
1	Minimal to palpation; well localized	< 6	100, with no pain	Minimal	None	Mildly disturbed
2	Substantial to palpation; poorly localized	6-12, developing slowly within 12-24 hours	50	Considerable	Considerable	Gait greatly disturbed
3	Intractable, diffuse	>12, developing rapidly within 1 hour	< 50	Severe	Almost total, with flicker contractions	Cannot bear weight



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### INDICATIONS AND DOSAGE

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#### USUAL DOSE:

**ADULTS** 250 mg every 8 hours

**CHILDREN** 25 mg/kg/day in divided doses every 8 hours

In severe infections or infection associated with organisms where sensitivity determinations indicate higher blood levels may be advisable: 500 mg every 8 hours for adults, and 50 mg/kg/day in divided doses every 8 hours for children may be needed. This dosage should not exceed the recommended adult dosage.

Infections of the lower respiratory tract due to streptococci, pneumococci, penicillin-sensitive staphylococci and *H. influenzae*:

#### USUAL DOSE:

**ADULTS** 500 mg every 8 hours

**CHILDREN** 50 mg/kg/day in divided doses every 8 hours

This dosage should not exceed the recommended adult dosage.

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backward to forward motion, such as tennis. It is also common in running sports, especially in older individuals.

Popliteal tendinitis is common in long-distance runners, beginning joggers and race walkers. The continuous locking and unlocking of the knee causes the popliteal tendon to rub on the fibular collateral ligament. This results in inflammation of the tendon, the ligament or the bursa between them.

**Treatment:** Similar measures apply to all three injuries:

1. Prolonged application of ice or heat.
2. Local massage — that is, transverse friction over the tendon.
3. Administration of ultrasound in heating doses.
4. Rest and protection from overuse or violent use.

### Tenosynovitis

Inflammation of the synovial covering of the tendon is caused usually by unaccustomed overuse of the tendon. However, the problem can be a complication of ankle sprain. Although the tendon is indirectly involved it can become directly involved by adhesions if the condition is allowed to become chronic. It is very important, then, to treat well the first episode of inflammation.

The two most common sites of tenosynovitis are the Achilles and peroneal tendons. Achilles tenosynovitis is common in jumping and running sports when there are biomechanical foot defects, unaccustomed overuse or faulty footwear.<sup>7</sup> Peroneal tenosynovitis usually follows ankle sprain.

**Treatment:** The two types of tenosynovitis are treated similarly by the following steps:

1. Application of ice or immersion in cold water.
2. Local massage.
3. Administration of ultrasound in mechanically effective doses.
4. Rest from running and jumping.
5. Use of devices to limit tendon excursion in the sheath, such as Achilles tendon-heel lift or wrap, or eversion wrap to support the peroneal tendon.

### Specific fasciitis

The most common type of specific fasciitis is plantar fasciitis. This occurs commonly in any running or jumping sport. It starts from a sudden or repeated strain at the calcaneal attachment of the plantar fascia and is usually dismissed as a "bruised heel". Inflammation becomes more severe with use, and function is soon disturbed. Often at first the pain is severe in the morning, decreases during the day, then worsens at night. The athlete therefore is tempted to continue activity because the condition eases with

activity, only to return afterwards "with a vengeance". Often the plantar fascia will rupture partially or completely during the inflammatory stage. This can result in relief of symptoms when the inflammation subsides.

**Treatment:** Conservative treatment consists of the following measures:

1. Application of ice.
2. Administration of ultrasound in mechanically effective doses at first, then in heating doses later.
3. Cold whirlpool baths for 2 or 3 days, followed by warm whirlpool baths. The massage effect of the whirlpool is much better tolerated than direct local massage.
4. Taping for arch support is beneficial at first. Solid arch support is needed later.

### Comments

For each of the conditions discussed above I have outlined the conservative physiotherapeutic treatment. These methods are usually successful when applied to the conditions in their early stages, but since most of these injuries are insidious the athlete, coach or trainer tends to deny them until they reach a severe state. Therefore it is important for physicians, coaches, athletes and trainers to be thoroughly familiar with the early signs of these problems, particularly in the "mileage-mania" sports.

Once the condition is advanced the methods I have outlined are effective only when combined with medical treatment such as anti-inflammatory drugs (administered orally or intravenously); surgery (fasciectomy or tenodesis), aspiration, immobilization or podiatric investigation.<sup>7</sup>

When symptoms are severe there is often some mild residual complication that may affect the athlete's later participation.

### Conclusion

I hope that this review of the most common soft-tissue injuries of the leg as seen in most athletic injury treatment centres will serve as direction for enlightened treatment of these injuries, and that it has demonstrated the proper role of the physiotherapist in this treatment.

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