Surgical Management of Exertional Anterior Compartment Syndrome of the Leg

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ABSTRACT

Objective: *To describe the characteristic presentation of exertional leg pain in athletes and to discuss the diagnostic options and surgical management of exertional anterior compartment syndrome of the leg in this group of patients.*

Methods*: Data from a series of athletes presenting with exertional leg pain were analysed and categorized according to aetiology.*

Results*: Sixty-six athletes presenting with exertional leg pain in 102 limbs were analysed. Sixteen patients in a first group of 20 patients with a provisional diagnosis of exertional anterior compartment syndrome of the leg underwent a closed fasciotomy with complete resolution of symptoms. A second group of 42 patients were diagnosed as medial tibial stress syndrome and a third group of four patients had confirmed stress fracture of the tibia.*

Conclusion*: Exertional leg pain is a common presenting complaint of athletes to sports physicians and physiotherapists. Careful analysis can lead to an accurate diagnosis and commencement of effective treatment. Exertional anterior compartment syndrome can be successfully treated utilizing a closed fasciotomy with a rapid return to sport.*

Keywords: Anterior, athlete, chronic, compartment, exertional, fasciotomy, leg, stress, syndrome, tibial

Tratamiento Quirúrgico del Síndrome Compartimental Anterior de la Pierna por Esfuerzo Excesivo

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RESUMEN

Objetivo: *Describir las manifestaciones características del dolor en la pierna que presentan los atletas, y discutir las opciones de diagnósticos y tratamiento quirúrgico del síndrome compartimental de la pierna en este grupo de pacientes.*

Métodos: *Los datos de una serie de atletas con dolor en la pierna debido al esfuerzo excesivo en los ejercicios, fueron analizados y categorizados según la etiología.*

Resultados: *Sesenta y seis atletas con dolor de piernas debido al esfuerzo excesivo en 102 miembros fueron analizados. Dieciséis pacientes en un primer grupo de 20 pacientes con un diagnóstico provisional de síndrome compartimental anterior de la pierna por esfuerzo experimentaron fasciotomía cerrada con resolución completa de los síntomas. Un segundo grupo de 42 pacientes fueron diagnosticados con síndrome de estrés medial de la tibia, y a un tercer grupo de cuatro pacientes se le confirmó fractura por estrés o sobrecarga de la tibia.*

Conclusión: *El dolor de la pierna por esfuerzo en los ejercicios es una queja común con las que los acuden a los médicos y fisioterapeutas de la medicina deportiva. Un análisis cuidadoso puede conducir a un diagnóstico preciso y al comienzo de un tratamiento eficaz. El síndrome compartimental anterior por esfuerzo puede tratarse con éxito utilizando una fasciotomía cerrada que permita un rápido retorno a la actividad deportiva.*

Palabras claves: Anterior, atleta, crónico, compartimental, esfuerzo, fasciotomía, pierna, estrés, síndrome, tibia

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INTRODUCTION

Exertional leg pain is a frequent presenting complaint to sports physicians and physiotherapists; in athletes, a common differential diagnosis includes exertional compartment syndrome, medial tibial stress syndrome and a stress fracture of the tibia (1). Without meticulous analysis, many athletes are misdiagnosed resulting in inappropriate treatment. This results in decreased performance levels and persistent athletic under-achievement.

While this "hit and miss" approach may solve some conditions of tibial stress fractures or medial tibial stress syndrome by forced rest periods and rigorous re-training, the condition of exertional anterior compartment syndrome of the leg remains unrelieved. Careful history and examination coupled with select stress tests, compartment pressure measurements and imaging will allow accurate diagnosis of this condition which has a good prognosis after surgery.

SUBJECTS AND METHODS

Sixty-six athletes presenting with exertional leg pain were reviewed prospectively and categorized according to history, examination and available imaging (plain radiographs, nuclear bone scans and magnetic resonance imaging (MRI) scans). There were 42 male and 24 female athletes with a mean age of 25 (range 18−36) years. All patients were followed for a minimum of one year or until remission of symptoms.

The athletes were placed into three groups based on history, examination and available investigations.

Group A	Exertional compartment syndrome	20 patients
Group B	Medial tibial stress syndrome	42 patients
Group C	Tibial stress fracture	4 patients

A diagnosis of exertional compartment syndrome was made if the athlete had pain in the anterior leg upon exertion which worsened with further activity, was sufficient to cause cessation of the activity and persisted for at least two hours.

Medial tibial stress syndrome was said to exist if the athlete has antero-medial leg pain which commenced with activity, worsened over approximately ten minutes and then was relieved with further exertion. A stress fracture of the tibia was diagnosed in athletes who had pain at rest while weight bearing which worsened with minimal activity. All patients had a positive bone scan.

The majority of those diagnosed with exertional compartment syndrome of the leg underwent surgical release of the compartment. All patients gave written informed consent prior to surgery.

Surgery was performed under general anaesthesia with use of a thigh tourniquet at 300 mmHg. The procedure is a modification of the technique described by Mubarak and Owen (2) and to our knowledge the first to utilize a menisectomy knife (Figure). In the first five cases, two 1 cm incisions were used. The proximal incision was at the level of and three centimeters postero-lateral to the base of the tibial tubercle. The subcutaneous fat was dissected bluntly down to the fascia. This was then opened longitudinally with a traditional blade. The meniscectomy knife was then used to extend the fasciotomy distally. At the full extent of the knife, the tip was then palpated approximately mid-leg and the second incision made over this to identify the tip and fascia. The knife was then withdrawn and repositioned at the distal incision to continue the fasciotomy distally to 6 cm proximal to the transverse ankle joint line in an antero-lateral direction. The entire antero-lateral compartment could then be palpated with the gap in the fascia and muscle bulge through it easily appreciated. The skin incisions were then closed and the leg wrapped in a compressive bandage before tourniquet release.

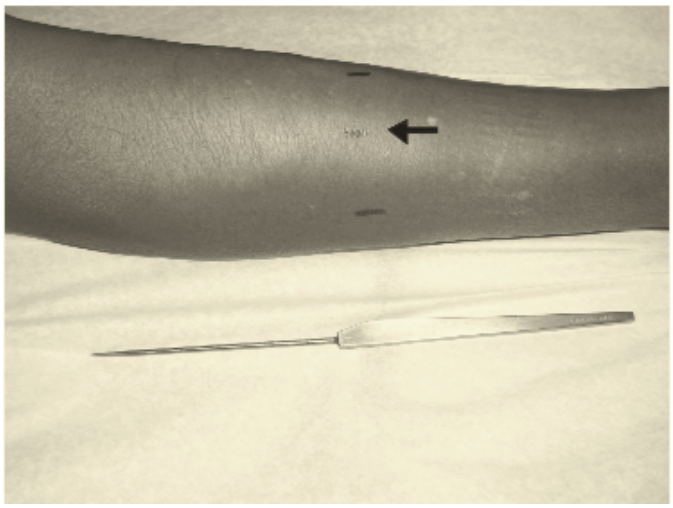

Figure: Menisectomy knife beside a patient. The arrow points to incision site on the antero-lateral aspect of a right leg for anterior compartment release.

For the later cases, a new technique utilizing a single skin incision in the mid-leg, 3 cm postero-lateral to the anterior border of the tibia was used. The meniscectomy knife was then passed upwards to the level of the base of the tibial tubercle and downwards to within 6 cm of the ankle joint. The skin was then closed and dressed as previously described.

Postoperatively, the bandage was maintained for one week and then removed when the patient began physiotherapy. Physiotherapy consisted of dorsi-flexion/plantar-flexion exercises with intervening periods of rest and elevation. Six weeks postoperatively, there was a progressive return to sporting activities.

Athletes with tibial stress fractures (Group C) were initially treated conservatively with rest and structured rehabilitation once healing of the fracture was confirmed clinically and radiologically. Non-healing fractures were treated with intra-medullary nailing followed by structured rehabilitation once healing of the fracture was confirmed clinically and radiologically.

RESULTS

Of the 20 patients in Group A with a provisional diagnosis of exertional compartment syndrome, 16 underwent surgical decompression. Eight of these patients had bilateral procedures, therefore in this group, 24 closed fasciotomies were performed. Surgical decompression was performed as described previously.

All patients who underwent surgical decompression reported complete resolution of their symptoms within six months and there were no complications.

The four patients who did not have surgical intervention opted for treatment by physical therapy, however, they were all still symptomatic at the last follow-up despite switching sports to cycling. All four patients had further investigations (bone scans/MRI scans) which were inconclusive.

The second group of 42 patients (Group B) was referred for physical therapy and re-training. At the final follow-up, 28 patients had responded well and were pain free, a further 10 still had activity-related pain which limited their participation in sports and four had stopped all sports due to persistent leg pain.

The remaining four patients (Group C) were all asymptomatic at one year with one patient having undergone intramedullary tibial nailing for delayed union.

DISCUSSION

Exercise-induced pain in the leg is a commonly seen entity in the Sport Medicine clinic (1) especially at the beginning of pre-season athletic training. Unfortunately, many of these athletes have been put into a convenient diagnosis of "shin splints" or "medial tibial stress syndrome" by coaches, trainers and even attending physicians.

Exertional leg pain may be due to a number of causes but more commonly the following: exertional compartment syndrome (3), medial tibial stress syndrome (4) and stress fracture (5).

In the present study, patients were grouped with these diagnoses as follows:
Group A: exertional compartment syndrome, Group B: medial tibial stress syndrome ("shin splints") and Group C: stress fracture.

All patients in Group A who underwent closed fasciotomy reported clinical resolution of their symptoms; the four patients who refused surgical treatment failed to improve with physical therapy, opting to change sports. These four patients, however, had further investigations (three had bone scans and the other had a bone scan and a MRI scan) which were inconclusive; this may imply that our diagnosis of exertional compartment syndrome was correct based on criteria described earlier.

The patients in Group B showed an excellent response to physical therapy with 28 being pain free, however, the remaining 14 were still symptomatic. Unfortunately, these patients did not have any other investigations or treatment so we are unable to comment on the accuracy of the initial diagnosis since some of these patients may have had other conditions. All patients in Group C had complete resolution of symptoms following relative rest from exercise, however, one patient required intramedullary nailing.

Exertional or "chronic" compartment syndrome is now a well-recognized clinical entity causing leg pain in some athletes especially in high intensity and endurance sports (3). The pathophysiology involves exercise-induced damage to muscle fibres within a fixed volume compartment (3). This damage leads to swelling and increased intra-compartment pressure. This pressure increase may exceed perfusion pressure within this compartment, resulting in tissue anoxia and ischaemia, hence further muscle damage. Nerve damage and loss of pulses are late changes and are associated with acute or chronic exacerbation with delayed treatment or mismanaged cases.

All of our cases (Group A) had multiple episodes of leg pain at the time of presentation, each being of sufficient severity to render the patients incapable of completing their sporting activity. This pain was described as intense and patients 'felt as though their leg would explode". The pain was eventually relieved by rest, ice packs and elevation. Most commonly, the syndrome affects the anterior and deep posterior compartments (6). However, our own series of 20 patients considering 32 limbs, presented with isolated anterior compartment involvement.

Intra-compartment pressure measurement remains the gold standard for confirmation of this diagnosis (7, 8) and the following measures have been shown to be equally effective, assuming correct use: slit catheter (9), microtip pressure method (10), wick catheter (11), microcapillary infusion (12) and needle manometer (13). The criteria of Pedowitz *et al* (8) have been used to evaluate patients. These criteria are appropriate for both the upper and lower extremities: a resting pressure measurement of 15 mmHg, and/or a measurement taken one minute after exercise of 30 mmHg, and/or a measurement taken five minutes after exercise of 20 mmHg. Schepsis *et al* (14) in their study of 46 limbs in 28 patients measured the compartment pressures in all the limbs using the Howmedica Slit Catheter. Unfortunately, due to cost considerations, we were unable to measure intra-compartment pressures nor were most patients able to afford fat-suppressed MRI studies which can also aid the diagnosis (15).

We contend that the diagnosis can be made clinically beginning with a thorough history and examination (pre-, intra- and post-exercise). The relationship of the pain with the activity is important – commencing when the activity increases intensity or becomes prolonged and increases with further activity. Its nature is severe and the athlete may describe the limb "wanting to explode". The pain precipitates premature cessation of activity with athletes unable to resume despite mild to moderate relief with a short rest period. The consequences of not making a timely or

correct diagnosis can be severe for the athlete who may have to be away from sports for a prolonged period or have progressively poor performances, ultimately resulting in withdrawal from sporting activity altogether. Treatment was, therefore, based solely on clinical findings and often cheaper exclusion tests, such as nuclear bone scan (1). Our technique of minimal access fasciotomy is a modification of the technique described by Mubarak and Owen (2). The technique results in minimal tissue injury similar to the endoscopic methods but without the added costs of expensive equipment. Open fasciotomy is associated with increased soft tissue damage including superficial infections and the need for skin grafting.

Precautions taken in a closed technique focussed on protecting the superficial peroneal nerve. These were: careful location of skin incisions, limiting the distal extent of fasciotomy and tilting the tip of the meniscectomy knife to tent the fascia superficially.

In all of our cases, the anterior compartment alone was involved, making this technique particularly appealing. We caution the extrapolation of the technique to the lateral and posterior compartments of the leg.

CONCLUSION

Exertional leg pain is a common presenting complaint of athletes to sports physicians and physiotherapists. Careful history taking and clinical examination will lead to an accurate diagnosis in the majority of cases without the need for compartment pressure measurement. Exertional or "chronic" compartment syndrome can be remedied using a closed surgical approach with rapid return to sports. The findings in this paper suggest that early referral of the athlete with exertional leg pain to a sports physician may allow a more appropriate treatment plan and ultimately the athlete's expedited return to sport.

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