Plantar fasciitis in a Professional Boxer:
Clinical Case Report for ‘The Trevor Silver Memorial Essay Prize’

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Abstract

Plantar fasciitis is a common condition that presents with heel pain. A detailed understanding of the anatomy and biomechanics of the plantar fascia underpins assessment of patients’ affected. It acts as cushioning for the sole of the foot, and is integral in the function of the medial longitudinal arch of the foot. It therefore plays a vital role in dissipating the forces that are applied across the foot on weight bearing. Plantar fasciitis causes 10% of all injuries due to running, but 80% of cases will resolve within twelve months. In this case report, the management of a 26 year old professional boxer is described. Professional boxers typically run and skip daily as part of their training regime. Persistent heel pain profoundly restricted his training and he was unable to fight professionally for eighteen months. The management of recalcitrant cases is uncertain. The lack of evidence to support treatments, especially in athletes, is highlighted.

Introduction

Plantar fasciitis is a condition which commonly affects sedentary individuals, recreational exercisers and elite athletes alike. 15% of all foot complaints presenting to health professionals are diagnosed as Plantar fasciitis[1]. It is estimated to cause of 10% of all injuries due to running[2]. Men and women are equally affected[3]. Classically, those between the ages of 40 and 60 years old have the highest incidence of the condition[4]. However runners are symptomatic younger[5].

Typically, patients complain of inferior-medial heel pain on weight bearing. This pain is usually worst after rest, especially after a nights sleep[4]. It may be so severe that initially the patient is unable to weight bear on the affected foot, however as the patient attempts to walk it eases[6]. A dull ache often persists throughout the day. For the elite athlete these symptoms will impact on training and performance.

The anatomy and biomechanics of the plantar fascia, also known as plantar aponeurosis, is vital in understanding Plantar fasciitis. Hicks[7], in 1954, wrote a paper on the anatomy and biomechanical importance of the plantar fascia during the gait cycle. Much of our current knowledge stems directly from Hick’s seminal work. The plantar fascia consists of three segments; medial, central and lateral segments[6]. It originates from the inferior-medial process of the calcaneal tuberosity and runs distally, to insert via the five plantar pads of the metatarso-phalangeal joints in to the individual proximal phalanges[7]. The fascia is innervated at its origin by the Medial Calcaneal nerve, a branch of the Posterior Tibial nerve[6]. The remainder is supplied by the first branch of the Lateral Plantar nerve[6]. At its origin, in health, it measures between 12-29mm in thickness[8]. The skin of the plantar surface of the heel is the thickest in the body[8]. Between the skin and calcaneus inferiorly sits a fat pad, which is an area of fat globules grouped together in a matrix[6]. The fat pad acts as a “shock absorber.” The plantar fascia, skin of the heel and fat pad together provide cushioning and support to the foot on heel strike during the gait cycle[7].

The Plantar fascia has a key role in the integrity of the medial longitudinal arch of the foot, thereby playing a vital role in supporting the foot during weight bearing activities[9]. Hicks[7] described the “Windless mechanism” which occurs during the gait and running cycles, on each cycle.
performed. “...When the toes are extended they pull the plantar pads and hence the aponeurosis forward around the heads of the metatarsals, like a cable being wound on to a windlass. The arch is caused to rise because the distance between the metatarsal heads and the calcaneum is thereby shortened[7].” The medial longitudinal arch rises on dorsiflexion of the toes of that foot. A pronounced arch allows the body weight to be supported more efficiently[7]. The anatomical attachments mean that this mechanism can occur without the influence of any muscles supporting the arch[7]. A dysfunctional “Windlass mechanism” would mean more weight would be borne through the Plantar fascia rather than the medial arch of the foot[9]. This could mechanically overload the fascia.

Plantar fasciitis is an ‘overuse’ injury. 7.9% of ‘overuse’ injuries identified were due to Plantar Fasciitis[5]. This was the third most common cause. Running expedites the ‘overuse’ of the plantar fascia. A typical elite runner will perform 10,000 steps in a single hour of continuous running[9]. An average adult may take up to 10,000 steps in a day[9]. 2.8 times a runner’s body weight passes through the plantar fascia during the stance phase of each step[10]. The plantar fascia therefore needs to withstand considerable force in the runner. Plantar fascitis is the pathology that arises when it cannot. It is stretching of the ‘overloaded’ fascia, at its attachment to the calcaneus, that has been implicated as the cause of pain[2]. Overnight, we sleep with a relatively plantar-flexed foot. This shortens the Plantar fascia, meaning the first weight bearing steps on waking cause a marked stretch and hence severe pain[2].

Plantar fasciitis implies an inflammatory pathology. However, tissues removed after surgery, in those with recalcitrant symptoms have shown no acute inflammatory cells[8]. It is hypothesised that chronic overload of the plantar fascia causes micro tears, which triggers an acute inflammatory response. Continual overload prevents repair of these tears. The acute inflammatory response persists and becomes chronic[8]. The histopathology has revealed “...disorganisation of the collagen fibres, an increase in the amount of mucoid ground substance, and an increase in number of fibroblasts, with minimal inflammation of fascia[6].” This appearance is similar to achilles and patellar tendinopathy, and represents degeneration rather than inflammation[11]. The histopathology reaffirms that Plantar fasciitis is an ‘overuse’ injury.

There are few studies which have determined risk factors for Plantar fasciitis. The biomechanics suggest any factor that overloads the fascia may exacerbate the condition. Obesity, prolonged standing, reduced ankle dorsiflexion, pes planus/cavus are all implicated[12]. The association with runners has meant a change in training regime, foot wear condition and running surface have been suggested as factors too[1, 8].

Plantar Fasciitis is a self limiting condition. Fortunately 80% of cases will resolve in a year[1]. But 5% of cases will need surgery[8]. For the elite athlete a year of pain affecting training and performance is clearly unacceptable. Management of those with chronic symptoms, especially in athletes, is uncertain. A major problem is the lack of sound controlled trials to guide management. In this essay, I will present a case of Plantar fasciitis in a boxer, and will evaluate some of the treatment options used, in the discussion.

**Case Report**

RC, a 26 year old professional middleweight boxer, presented to my General Practice surgery complaining of right inferior heel pain for eight months. The symptoms were initially localised and sharp in nature with no radiation. The pain was restricting his training and he had not been able to fight for ten months. There was no history of direct trauma. His symptoms were severe at the start of his daily morning five kilometre run, but he was able to “run the pain off” up until two months ago. From then on, his symptoms have deteriorated; he has been unable to jog more than 100 metres, perform interval skipping or train on punch bags. He was still attempting to train daily despite his pain. Immediately prior to assessment, RC had continuous pain “all over” his heel, which would affect his sleep. There were no symptoms of paraesthesia in his foot. RC rated the pain as 8/10 on a visual analogue scale. Regular ibuprofen had not provided any relief. A year ago,
RC had started road running. Previously, his running had exclusively been on grass. Training schedules aside from this were unchanged. His past medical history was otherwise unremarkable.

On examination, RC was noted to have an antalgic gait. He was a muscular man with a Body Mass Index, BMI, of 22.3. Hip, knee and second ray of the foot alignment showed bilateral femoral anteverision, tibial torsion and pronation of the feet at the subtalar joint. The medial longitudinal arch of the foot was flattened in keeping with pes planus bilaterally. There was no skin changes noted. Palpation revealed generalised tenderness of the inferior calcaneus, with maximal tenderness over the anterior-medial aspect. No bony tenderness was elicited elsewhere and none found at the insertion of the Achilles tendon or over the calcaneal fat pad. Active and passive dorsiflexion of both ankles only reached 5 degrees bilaterally. Riddle et al[12] identified ankle dorsiflexion of less than 10 degrees is a significant risk factor for plantar fasciitis. Reduced dorsiflexion tends to increase foot pronation increasing the force across the plantar fascia[4].

Ankle range of movement and muscle power was within normal limits. Windlass test, both weight and non-weight bearing, was positive in reproducing RC's pain. This test has an excellent specificity of 99%, but a poor sensitivity of 32% for plantar fasciitis[13]. Tinel's test over medial calcaneal and lateral plantar nerves was negative. Examination of the lumbar spine was normal with unremarkable lower limb neurology bilaterally. Poor hip abductor strength and control was noted on single-leg squat, bilaterally.

It is generally considered that history and examination alone is sufficient to diagnose plantar fasciitis[1]. From this assessment other differential diagnoses were unlikely, such as achilles pathology, nerve compression, fat pad pathology and enthesopathies. RC complained of nocturnal pain and has a history of repetitive distance running so bony pathology, such as calcaneal stress fracture, was necessary to exclude. Plain radiograph of the right foot and ankle was normal. RC's symptoms were limiting his occupation and quality of life, so the decision was made to refer him to a local foot surgery specialist. MRI was arranged which showed no evidence of stress fracture but did show oedema, intra-fascial tears and increased signal uptake around the aponeurotic insertion, at the calcaneus on the T2-weighted scan. These features are typical of plantar fasciitis[1] and confirm the diagnosis.

Treatment and rehabilitation began immediately prior to the results of the imaging. Acutely, RC was advised absolute rest and prescribed Naproxen, a more potent anti-inflammatory medication. RC was taught a series of stretching exercises, targeting both the plantar fascia and Achilles tendon/triceps surae complex, by the physiotherapist. A programme of strengthening to improve the load bearing capacity of the foot was shown. This consisted of strengthening Tibialis Posterior, the plantar-flexors of the ankle, the intrinsic muscles of the foot and the proximal hip musculature, including the hip abductors. Arch tapping was used to the right foot. It was immediately effective, reducing RC’s pain score to 6/10 on the visual analogue scale. A referral for full podiatric assessment was made via the Orthopaedic Foot clinic.

Three weeks later, custom made orthotics were measured for and ordered. A corticosteroid/Local anaesthetic injection was administered by the Orthopaedic surgeon. The injection was transiently effective for 2 weeks but by three weeks post intervention, RC’s pain score was 8/10. This was despite compliance with his rehabilitation programme and use of orthotics. Two interventions were discussed by the Surgeon; surgery, consisting of endoscopic fasciectomy with denervation, or a single treatment of Extracorporeal Shock-Wave Therapy (ESWT). RC opted for the less invasive ESWT and was privately referred to a centre in London experienced in the technique.

Eight weeks after initial medical assessment, RC received a single treatment of high energy ESWT under Local anaesthesia. He was discharged with analgesia and instructions to continue the rehabilitation programme and use of his orthotics. RC had dramatically improved at his follow up 6 weeks later. His pain score was now 2/10 and for the last fortnight, RC had walked two miles daily. He now recorded improved dorsi-flexion of 10 degrees bilaterally. A negotiated graduated return to training programme was formally constructed, after a multi-disciplinary meeting where RC and his trainer attended. Road running was agreed to stop and initially RC would be allowed to jog 400
metres, or to the point of pain, on grass. Aerobic fitness would be maintained by swimming and cross training. Boxing specific training was also adapted to reduce weight bearing. Weekly reviews would guide progression of training.

The supervised regime meant within three months RC was fit enough for a Professional fight. At that point, RC would run one kilometre on grass and swim 2500 metres per day. All boxing specific training was back to his pre injury intensity. In November 2011, RC's severe right heel symptoms reoccurred and his return fight was cancelled. He is due for elective right endoscopic fasciotomy in January 2012.

Discussion

RC’s case illustrates the uncertain prognosis of those with recalcitrant Plantar fasciitis. The key issue is the lack of consensus in how best to manage these cases, especially in elite athletes. The literature describes approximately twenty individual interventions, ranging from rest to the use of autologous blood injections[14]. The evidence for the majority of these interventions is limited with few controlled trials supporting their efficacy. All aspects of RC’s treatment are included in published guidelines[15] for the treatment of the general public, as well as reviews looking at the management of elite athletes[4]. I will review some of the aspects of RC’s management referring to the literature, to show what evidence there is for this.

Rest is often advocated. Wolfin[16] found that 25% of sufferers found rest gave them their greatest relief of symptoms. This study was based on subjective opinion, however there are no controlled trials analysing the affect of rest, absolute or relative, in isolation. For the elite athlete, relative rest is often more appropriate to maintain fitness. The comparison of absolute versus relative rest may be a pertinent subject for future research.

Non Steroidal Anti-inflammatory Drugs (NSAIDS) are effective in reducing inflammation. The histopathology of Plantar fasciitis is degenerative not inflammatory. Initially there may have been an acute inflammatory phase[11] however the effectiveness of NSAIDS in recalcitrant cases is doubtful. NSAIDS are analgesics too and their use in management is likely to be centred on this. But their relative benefit as compared to other simple analgesia, such as paracetamol, is uncertain in Plantar fasciitis. Again there are no trials that have examined the effect of NSAIDS in isolation.

29% state that stretching the plantar fascia improves symptoms[16]. Stretching is commonly recommended, but the majority of studies have combined stretching programmes with other interventions, like taping, night splints and orthotics. DiGiovanni[17] compared stretching of the plantar fascia against stretching the Achilles tendon. After eight weeks, both programmes improved pain, but the plantar stretch was significantly beneficial as compared to Achilles stretch. This study has formed the basis of recommendations, where both the plantar fascia and Achilles are stretched. However this study was limited by a high “drop out” rate of 28% in the Achilles stretching group and lack of blinding.

Kibler’s[18] analysis of Plantar fasciitis’ patients concluded that plantar flexor strength deficits were noted in the majority of subjects. Kibler’s work is cited as indirect evidence of the potential effectiveness of planter flexor strengthening. The use of intrinsic muscle strengthening of the foot is also commonly used. Logically they may improve the function of the medial longitudinal arch. The evidence for strengthening is indirect at best.

Injection of corticosteroid, with or without local anaesthetic, is a convenient intervention for clinicians. Crawford[19] compared a local anaesthetic injection against corticosteroid and local anaesthetic. After a month the corticosteroid group had significantly improved pain, but after three months and a year, no difference was noted between the groups. Two recent control trials have reinforced that corticosteroids have short term benefits and appear to be superior to autologous blood injections[14, 20]. Indeed the use of iontophoresis, an electrical current to administer the steroid which is in solution, can improve symptoms six-fold in 2 weeks[21]. There is evidence to support the use of steroid injections short term which may be useful to athletes, however concerns
exist that steroids are associated with plantar fascia rupture[22]. There is no evidence that they facilitate long term recovery. RC had minimal benefit after his steroid injection.

Extracorporeal Shock-Wave Therapy (ESWT) provided RC with his greatest benefit in symptoms. ESWT uses high energy sound waves and has been hypothesised to stimulate an acute inflammatory response, which triggers the healing process[1, 4]. Double blinded control trials have been performed in this area[3, 23-26]. Results have been variable but a meta-analysis has shown ESWT is marginally more affective versus placebo[25]. A study exclusively of runners showed significant improvement of symptoms with ESWT versus placebo[26], more so than other trials. The authors suggested that runners may be more sensitive to the effects of ESWT, through an unknown cause[26]. Promisingly, Alvarez[27] found that 65% of the 20 cases he studied were pain free after 2 years. For RC, ESWT did not produce the long term relief. Currently ESWT is not available routinely on the NHS.

All these initial interventions were poorly effective for RC. This is not surprising when looking at the evidence for each of them. Night splints[28-29], “botox” injections[30] and autologous blood injections[14, 20] have been trialled and all provide short term benefits. Surgical evidence, whether open or endoscopic, is based on case series rather than control trials. Success rate appear high (75%) with the Open fasciotomy with denervation procedure[31]. However 25% may suffer from persistent pain, secondary to the change in biomechanical function of the foot[31]. Endoscopic procedures have quicker recovery rates[32]. Post surgery, rates of return to elite sport are unknown. This data would be important in establishing the benefits of the surgical option for elite athletes.

Ultimately, we are trying to facilitate a return to work, in this case professional sport, in those with Plantar Fasciitis. Dyck[4] concludes that “…aggressive management using combination treatment is most efficacious and affords athletes the best opportunity for a quick and full recovery.” This is a reasonable conclusion; however I would contest that we do have the knowledge about the effect of basic interventions to advise appropriate evidence based “combination treatment.” If we did RC’s boxing career may not be under threat as it is. Further research with appropriately controlled trials must be the future aim particularly with regard relative rest and surgical interventions.

References


