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Foot Science

Case Studies

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Achilles Tendinopathy

Case Study
Achilles Tendinopathy

Practice: Resonance Podiatry & Gait Labs
Patient: 47 year old female netball player

The Achilles tendon is the strongest tendon in the body, it joins the calf muscles (soleus, gastrocnemius and plantaris) to the calcaneus. Achilles tendinopathy is a condition causeing pain, swelling and stiffness in the Achilles tendon and is thought to be caused by repeated micro trauma to the tendon. There are two types of tendinopathy – non-insertional where the mid portion of the tendon is affected, usually 2-6cm from the insertion to the calcaneus and insertional this involves inflammation at the insertion of the Achilles tendon to the calcaneus, pain is generally felt directly over the insertion point.

Current Situation

The patient, a 47-year-old female, presented with left side generalised mid portion Achilles tendon pain that had been ongoing for 12 months. The onset of pain was triggered by a return to social netball and umpiring of netball matches.

Initially sought physiotherapy treatment, this resulted in improvement of symptoms and less pain, however ongoing residual post-game pain, and morning pain and stiffness of the Achilles tendon remained.

Past Medical History

- Previous left side inversion ankle sprain in 2005
- Recalls a left leg tibial fracture at age 12

Goals

- To play netball pain-free
- Umpire pain-free
- Trek Abel Tasman Track pain-free

Assessment

There was palpable thickening to the left Achilles tendon 3cm proximal to the insertion. There was no heat or swelling present to the site of pain. No pain present with double or single leg serial tip toe test. Weak resupination with tip toe on the left leg.

Biomechanical Examination Findings

There was limited first ray, subtalar joint, and ankle dorsiflexion range of motion, left side more than right. Relaxed calcaneal stance in mild varus position left side more than right. The subtalar joint was supinated on stance.

Manual supination: Decreased resupination on the left side, heel inversion occurring however laterally unstable at end range ankle plantarflexion.

Jack's Test: Positive. Hard, full windlass functionality available. Single knee bend: Medial knee deviation occurring owing to proximal insufficiencies.

Thomas Test: Rectus femoris tight bilaterally. Iliopsoas slightly tight. Iliotibial band flexibility good.

Hamstring Length: Slightly restricted hamstring 90:90 test. Able to achieve 70 degrees of hip flexion with knee extended on straight leg raise, bilaterally.

Lunge test: Negative, bilaterally. Left: 7 cm Right: 8 cm.

Biopostural Assessment Overview

Static Pressure: The body's centre of gravity is decentralised, shifted laterally to the left side. Left side mild hyperloading, 57%. Maximum load concentration in the left forefoot, excessive load concentration. Excessive anterior overload, forefoot loading 56% left side. Static peak loading pressure revealed hyperloading in the central forefoot of the left foot.

Dynamic Pressure: Central forefoot yperloading, minimal rearfoot loading; Minimal 1st MTPJ loading bilaterally; Low weightbearing surface area L > R; Minimal lateral midfoot column loading; Dynamic pressure revealed high forefoot loading, minimal rearfoot loading, and minimal first MTPJ loading

Treadmill Video Gait Analysis

There was lateral heel strike on the left side; remains fairly supinated on left side throughout gait. There was a mild medially driven abductory twist, with a lateral toe off.

Video Gait Analysis

Contralateral Trendelenburg occurring during midstance, and consequently quite a lateral low gear toe off. Significant pelvic rotation occurring in the transverse plane. Decreased hip flexion and hip extension bilaterally. Thus, resulting in increased propulsion required from the posterior calf complex/Achilles tendon.

Diagnosis

Overview

The patient's definitive diagnosis is left side midportion (3cm proximal to AT insertion) Achilles tendinopathy, secondary to previous injury and ongoing high impact activity with inadequate proximal and lower limb strength, and insufficient foot mechanics.

Differential Diagnosis Considerations

Achilles tendon partial tear; Retrocalcaneal bursitis; Posterior ankle impingement. Inflammatory arthropathy.

Causes

Subjects Risk Factors

Age, Increased BMI, sudden increase in training intensity, training error, inappropriate footwear (Simpson & Howard, 2009), possible family

Achilles Tendinopathy

history of AT tendinopathy (Kraemer et al., 2012).

Biomechanical reasons the patients Achilles tendon pain has failed to settle due to the patients supinated foot mechanics on the left side, with limited joint range of motion resulting in decreased sagittal plane facilitation, reduced propulsion, lack of shock absorption, and decreased weightbearing surface area throughout both walking and running gait. Increased AT loading forces owing to laterally driven ground reaction forces, and external rotation forces occurring at the tibia.

Additionally, her proximal weakness and inflexibility is contributing to increased Achilles tendon loading owing to minimal glute max activation and lack of propulsion occurring proximally, forcing her posterior calf complex to compensate.

Treatment

Footwear

Replace netball footwear to a neutral, stable netball shoe with minimal forefoot flex resistance for propulsion, 10mm pitch/drop, comfort, fit and feel.

Formthotics

Dual Density Formthotics customised with bilateral lateral forefoot postings extending from styloid process distally through to webbing, to optimally decrease supinatory forces occurring from early midstance, through to propulsion, and optimally engage the windlass mechanism. Thus, increasing weightbearing SA, increasing shock absorption, and reducing lateral bowing of the Achilles tendon. Research has suggested laterally directed forces occurring at early stance phase of gait with medially driven forces at late stance may be risk factors for Achilles tendinopathy (Van Ginckel et al., 2008). Customised orthoses in conjunction with eccentric Achilles tendon loading programmes are effective in reducing pain in symptomatic patients with Achilles tendinopathy.

Strength Training

Eccentric Achilles Tendon Loading programme- Eccentric strength training, which involves actively lengthening the muscle, is an effective therapy that helps promote the formation of new collagen (Simpson & Howard, 2009). 15 repetitions on the symptomatic leg, performed in 3 sets. Performed with both the knee in flexion, and the knee in extension to maximally load soleus and gastrocnemius calf muscles. Perform this twice per day, every day. For 12 weeks. Increasing load in 5kg increments as dictated by alleviation of symptoms.

Calf stretching to improve ankle dorsiflexion range of motion, as 10 degrees of ankle dorsiflexion is required during the stance phase of the walking gait cycle. Hamstring and gastrocnemius-soleus complex-soleus inflexibility is a diagnostic factor for Achilles tendinopathy (Simpson & Howard, 2009).

Proximal gluteal strengthening - Altered knee kinematics and reduced muscle activity are associated with Achilles tendinopathy in runners (Azevedo et al., 2009). Studies have found there is a correlation between the activation of gluteus maximus and gluteus medius and their impact on the kinematics occurring at the leg and ankle, which can result in increased rearfoot inversion and eversion which is a risk factor for Achilles tendinopathy (Franettovich Smith et al., 2014).

The patient is currently working on proximal strength work of her gluteus medius and gluteus maximus. Stretching of iliopsoas and rectus femoris were also important.

Functional activation - it is imperative the gluteus maximus is optimally functioning throughout walking and running gait, as this controls hip extension. It has been found in the literature that with reduced hip extension, there is increased ankle plantarflexion, and early and excessive plantarflexion moments at the ankle have been found to correlate with Achilles tendinopathy (Frannetovich Smith et al., 2014). Thus, glute max activation can be a crucial proximal component to AT tendinopathy.

Management Plan (Patient Follow Up)

Patient education - Ensure exercises are performed daily for maximum benefit and positive outcomes. Gradual breaking in of orthoses. Appropriate footwear, good footwear parameters for all activities. Modification of exercise regime to reduce risk of overload.

Patient review - Patient seen at 2/52, then 6/52 after having orthotics implemented. By this stage, the patient had been working on eccentric loading and proximal work for 8 weeks, and all pain had resolved. The patient continued with the above for a further 4/52, then could discontinue. 12-month review due unless any issues prior.

Goal Related Outcomes

Pain-free during game, post-game, and pain-free the following morning
Completed the Abel Tasman Track pain-free

Further Information for Outcome Measures

Pain and Disability measure

The VISA (Victoria Institute of Sport Assessment-Achilles Questionnaire) provides an index to indicate the clinical severity of Achilles tendinopathy. This is a condition - specific numerical scale, which research suggests will typically provide a higher sensitivity and specificity than general purpose scales (Robinson et al., 2001). This is questionnaire completed by the patient which provides a total numerical value out of 100 (100 is the perfect score) based on domains of pain, function in daily living, and sporting activity. The higher the score, the less severe the Achilles tendinopathy. Patients who score 100 are asymptomatic.

PDI (Pain and Disability Index)

This questionnaire measures the impact pain has on the ability of the person to perform essential activities of daily life (Chibnall, 1994). Complex is too tight (https://www.aofas.org/footcaremd/treatments/Pages/Achilles- Tendinosis-Surgery.aspx).

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Calf Muscle Pain

Case Study
Calf Muscle Pain

Podiatry Practioner: Nick Haley
Practice: Feet n Motion Podiatry
Physiotherapist: Doug Claridge
Practice: Russley Physiotherapy
Patient: Unknown

The calf muscle is made up of the soleus, gastrocnemius and plantaris muscles (tricepts surae). They join together at the Achilles tendon and insert into the calcaneus. Calf muscle strain is a common injury. In this case, on examination and assessment the patient was diagnosed with a different condition where calf muscle pain was a contributing factor.

Current Situation

The patient first presented to Russley Physiotherapy complaining of pain in his calf muscle. The patient is an ex-rugby player who now plays social touch. He has started running again to increase his fitness, however he has had issues with his calf muscles for years.

Every time he increases activity, he ends up with pain similar to a pulled calf muscle. The patient's pain is now starting to linger with diffuse tenderness along the muscle belly and surrounding structures.

This is frustrating for him, and he wants to get the issue sorted once and for all. Some of the patient's problems were stemming from his feet, and as part of his treatment he was referred to a Podiatrist.

Assessment

Balance test
The patient stands on one leg and establishes balance. In this position the foot and leg alignment are similar to that when walking.

It is evident the patient's foot overpronates slightly, which causes his big toe to grip to stabilise his foot. This stresses the flexor halluces longus muscle, which runs along the shin near the calf muscle, causing the patient's calf pain. The patient's knee drops in – a combination of poor foot alignment and weak gluteal muscles.

Jacks Test
This clinical test assesses the ension in the plantar fascia associated with heel lift and propulsion. It indicates whether or not joint changes are occurring in the big toe joint.

The patient had some restrictions which could have influenced his flexor hallucis longus muscle to overload causing pain.

Podiatry assessment
Manual muscle testing of the flexor hallucis longus, produced a similar pain to what the patient experiences when running.

Generalised biomechanical testing of the foot revealed a plantar flexed 1st ray, this can put more strain through the flexor hallucis longus muscle. It was also noted during gait analysis his gluteus medius muscles were weak.

Diagnosis

Together the Podiatrist and the Physiotherapist diagnosed the patient with medial tibial stress syndrome, some flexor hallucis longus muscle belly inflammation, with tibialis posterior involvement. All of these muscles attach along side the calf muscle into the shin bone which is why the patient mainly felt this in his calf muscle area.

Causes

Poor footwear - the patient's shoes were worn and did not provide him with enough support. He liked how they looked but they were not suitable for his foot type.
Sudden increase in training – rather than building up his running slowly the patient dived right in, overloading his muscles and attributing to his injury. Weak and tight calf (gastrocnemius) muscles. Sharp and heavy heel strike when running.

Treatment

For this injury to recover fully the patient needs to back off from running to allow the initial inflammation to settle. He is fine to walk, swim or cycle in the meantime.

Initially, the physio used taping to settle the patient's flexor hallucis longus pain. The patient was fitted with a new pair of running shoes - Adidas Supernova's.

The Podiatrist fitted the patient with Original Dual Hard Formthotics, with some reduction in the rear foot control.

A kinetic wedge was added to allow 1st ray alignment to be the same as other toe joints, reducing stress through the flexor hallucis longus tendon.

Stretches and strengthening for the patient's weak gluteal and calf muscles were also issued.

Running technique coaching was also provided by the Podiatrist to prevent future injury.

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Elderly and Active

Case Study
Elderly and Active

Practioner: Richard Van Plateringen
Practice: Dunedin Podiatry, Dunedin, NZ
Patient: Robert*Not patients real name

Robert* is a fit and active man in his early sixties. A regular at the gym, casual runner and part-time running coach. He presented as a referral after sustaining a mid-shaft 5th metatarsal fracture. An intramedullary screw fixation had been performed. The surgeon had given him the green light to return to activity and considered a podiatry review a good idea.

Foot and lower extremity problems

Robert explained he was forever rolling his ankle and his running suffered from calf and lateral leg strain which he managed by rest, massage and running through the pain! His motion control shoes tended to have a lot of lateral wear and he always 'ripped the back out' of the internal heel counters. Because of his flatter arches he had always been fitted with a motion control shoe by shoe stores.

Diagnosis and Testing

Indeed his feet were of the flatter variety to look at but he did also have some bandy legs sitting over top of them. Asking him to perform a star excursion test was more akin to a man dancing the jive. Bilaterally there was low supination resistance on static stance, the affected side more so, as it was with a simple Windlass (Jack's) test. An x-ray showed some lateral talar tilt and marking a spatial position of the sub-talar longitudinal axis certainly placed it with some lateral deviation. The mid-foot was very stiff but succumbed nicely to some routine mobilisation.

Achieving comfort and performance

We reviewed his functional strength and gait with walking and running then started to put together a treatment plan. The course of action:

1. We worked on the premise that although his foot was rolling toward medial loading, the action around the sub-talar joint had a greater supinatory moment. It seemed we didn't have to push the arch up and out but stop the foot moving laterally to start with.

2. Shoes were first, moving into one with less support in the rear and mid-foot. To these we fitted a low volume pair of Formthotics Medical Low Profile Dual Hard and modified these with a rearfoot lateral post that went just behind 5th metatarsal.

3. After agreeing to a small rehab exercise programme and an incremental return to activity, Robert was sent out to see how it went.

4. On his first review he had made a return to all activity and noted how he felt more stable especially with his running. No discomfort and his calf and lateral leg issues had not raised their heads.

5. Subsequent review was only better news with Robert doing runs – which were once the ones that stopped him in his tracks.

Learnings

The take away message is that form does not always depict function. An understanding of how load parameters on tissues and structures can be changed and altered should be a foremost consideration when using modified devices as part of treatment programme.

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Fibromyalgia

Case Study
Fibromyalgia

Practioner: Richard van Plateringen
Practice: Dunedin Podiatry
Patient: MM
Age: 43
Gender: Female
Social background: Self-employed
Weekly activity level: Medium

Presenting Complaint: Referred from her physio for non-resolving left anterior hip and iliac crest pain with standing and functional muscle pain in the left calf and stiffness of the left anterior ankle.

History of the presenting complaint

The patient gets sustained discomfort and hip stiffness with any periods of extended walking or standing with NDA (Normal Daily Activities). This has been present for 12+ months. She has been receiving physio treatment, consisting of hip and pelvic mobilisation and fascial release of Iliopsoas, Rectus Femoris and Adductors. This has provided some short-term relief, post-treatments, but no lasting resolution. She had also been prescribed calf raises, but these increased her calf pain, especially in the left calf.

Past Medical History

Patient MM has a history of fibromyalgia with a diagnosis 20 years ago. She has been an active walker/tramper. She does continue walking on a regular basis as she needs this for life balance and general fitness.

She has had various fibromyalgic symptoms over the last 20+ years, mainly centred on the lower lumber back/hips and, of late, her left posterior calf and ankle.

Assessment

Base vascular and neural tests were unremarkable. Reflexes present.

On static stance, there was a genu valgum (knock knees), greater on the left. Lateral position of right patella noted. Left side transverse anterior pelvic rotation. Left iliac crest was positioned lower, as was the left gluteal cleft. Slight thoracic curvature to left. RCSP (Resting Calcaneal Stance Position) valgum (eversion) on left. Left foot navicular drop exceeded drift, and Supination Resistance Test (SRT) was high, with the 1st MTPJ being dorsiflexed, leading to a possible Functional Hallux Limitus.

The right side MLA (Medial Longitudinal Arch) profile was higher with an easier SRT (Supination Resistance Test). Jack's test was adequate on the right only. A small amount of metatarsus abduction was seen on the right foot.

She had greater instability on the left leg with single-leg balance, but adding movement over this displayed bilateral medial knee drift, driven proximally from the hip. Single leg heel raises could be performed with a high heel-hold, but she fatigued earlier on the left.

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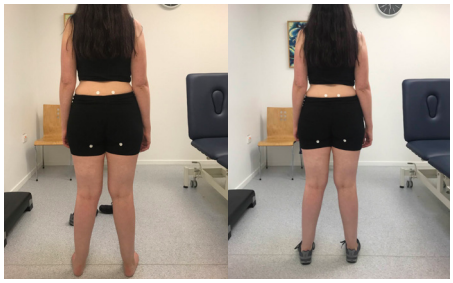

Genu valgum

Knee to wall lunge test showed she had adequate distance when she compensated by dropping and driving the hip on the affected side, forward, but when instructed on correct positioning, she had 3cm on the left side and 5cm on the right.

When we had Patient MM non-weight-bearing on the plinth, at rest, the left leg sat externally rotated. There was no discernible structural leg length disparity with umbilicus to malleoli measurement or skyline knee measurements. The right SIJ (Sacroiliac Joint) rotation test showed a deficit of internal rotation, and there was good ROM (Range of Motion) in both hips.

Straight leg raise was less than 90 degrees, bilaterally, and had greater neural tightness in the left leg.

Manual Resisted Activation and Resistance Tests were a little more interesting. On the left side, Tibialis Anterior and Extensor Digitorum Longus (EDL) had poor resisted strength, while Peroneus Longus activation was unachievable for her.

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Fibromyalgia

On the Right side, the Tibialis Posterior had poor activation and EDL on this side poor resisted strength. Straight leg adduction was adequate while she struggled with resisted abduction. Gluteus Medius bilaterally had poor activation, as did the left hamstring group. Prone hip flexor tightness was noted on the left side.

Bilaterally, she had adequate ROM in the 1st MTPJ, but there was marked hypomobility in the lateral column on the left foot, especially in relation to cuboid plantar glide. Both superior tibiofibular joints had poor anterior glide. Passive, active, and forced ankle joint ROM all had limitations in dorsiflexion on the left side.

With both feet, she had poor elicitation of intrinsic function with short arch pull, digital adduction/abduction, etc.

Observing her walking, the right foot had increased abductory twist at heel lift. There was also a greater arm swing on the right side.

Left foot contact was further lateral of the mid-line. At mid-stance, on the left side, she made contact in an everted position moving through with a medial loading.

Working with this, we felt that she had an underlying functional length discrepancy and had compensatory patterning around this.

Our starting point was block testing for height-differential based on marked positions. The medial column loading on the left foot we felt was exacerbated by increased femoral angle and pelvic drop.

Patient Goals

Patient MM goals were to reduce pain in the lower lumbar back and hip with normal daily activity and to be able to walk for 2+ hours pain-free.

Treatment plan

She wears a low-pitched shoe, as these are the most comfortable for her, and she does not wish to change these.

The decision was made to fit Original Single Medium Formthotics and heat-mould them in the shoes. On the left foot, we Initially added a 4mm heel raise, extended to the midfoot. A small medial rearfoot skive was applied bilaterally to exert a supinatory force, medial to the marked STJ (Subtalar Joint) axial line. The heel was balanced laterally to reduce lateral spill. A small 2mm extended PMP (Proximal Metatarsal Phalangeal Pad) was applied to aid sagittal movement.

We initiated a course of mobilisation and manipulation to alter accessory joint movement and increase ankle joint ROM. This would be reviewed and continued over a 4 to 6-week period.

Added to this was some functional patterning exercises for ankle stability based around engagement of ankle extensor and evertors. Mainly these were tripod holds with excursions.

She would continue hip strengthening as per physiotherapist instructions.

Patient MM was also asked to trial a period without wearing the modified Formthotics to see if there was any perceivable change +/-.

Outcome

Upon first review, ten days after the initial assessment, MM noted that she indeed felt that her pain was improving but still present after an extended time on her feet. Her feeling was that she was now not high enough with the adjustment we had made, and when she did not wear the Formthotics, she noticed the imbalance.

Her functional strength had improved, and she remained diligent at her exercises.

The ankle initially felt as if it had better movement and was not "jamming" but slowly reverted after about a week. On exam, decreased Talocrural posterior glide was noted.

From here, we made a small incremental height adjustment, continued the course of mobilisations/manipulations, added a kneeling ankle stretch.

She had four return visits for manual therapy and orthotic review. Within three months, she returned to tramping in the hills with minimal back/hip and leg discomfort.

She has continued wearing the orthoses and is comfortable at present with the modifications.

Ongoing, the plan is to increase her walking/tramping, and we will review overall foot/ankle strength and movement parameters every three months.

Richard van Plateringen – Dunedin Podiatry

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Bilateral Achilles Bursitis

Case Study
Bilateral Achillies Bursitis

Practioner: Dr Kirill Shlykov
Patient: Elite sprint distance runner in her 20's

Retrocalcaneal bursitis is an inflammation of the bursae, a small fluid filled sac between the tendon and bone of the heel. There are two types **deep** - a true anatomical bursae, located within the soft tissues at the posterior aspect of the heel or **superficial** where a burse forms within the soft tissue superficial to the insertion of the Achilles tendon. They are usually caused by over-use and repetitive trauma, typically at sides of Achilles tendon. Increases in activity without proper training regimes, can lead to the Achilles tendon rubbing against calcaneus causing inflammation and injury.

Current Situation

The patient recently began to experience pain in the heels and achillies tendons of both feet. This made training, competing and every day activity very uncomfortable to the point she had to limp.

Sport: Athletics – Elite sprint distance runner - 800m, 1000m

Current titles: Winner 800m European Athletics Indoor Championships 2011, 2x world record holder in 4x 800m relay (2008, 2010), Russian champion in relay 2008–2010.

Assessment

The patient eventually turned to a Formthotics specialist, Dr. Kirill Shlykov, who diagnosed her complaint as bilateral achillies bursitis.

Dr. Kirill Shlykov fitted the patient with Original Dual Medium Formthotics in her training shoes and Comfort (¾) Single Hard Formthotics in her sprints shoes. Approximately 10 days after the Formthotics were fitted, a wedge was added to both shoes to increase control. She is now also wearing Formthotics in her casual shoes.

On day three of simply being fitted with Formthotics, the patient's left achillies pain and bilateral heel pain had totally subsided, the right achillies pain had also decreased. The patient no longer felt any pain during everyday activities and was able to return to her full training load. With the added wedge adjustments, the patient claimed pain during training was again lessened, furthermore, her feet now felt good during and after training and no longer swell or ache.

Days after being fitted with Formthotics, the patient competed at the Moscow Junior track-and-field Championship, where she gained an out-of-contest officially recorded result of 2.00.27, which was the best time of the season worldwide.

This result was later beaten and she currently holds second place. Following the adjustments to her Formthotics, the patient went on to gain silver in the 1000m at the Russian Winter Race. The patient continued to wear Formthotics throughout the 2011 winter season.

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Diabetes Mellitus (Type 2)

Case Study
Diabetes Mellitus (Type 2)

Practice: Resonance Podiatry and Gait Labs
Patient: 57 year old female

Diabetes Mellitus is part of a group of metabolic diseases. It is a disease of chronic hyperglycaemia due to insulin deficiency, resistance, or both. The result is the body's ability to use glucose for energy is impaired. While the causes and effects of type 1 and type 2 diabetes are different, the long-term effects are the same. Type 1 is believed to be an autoimmune response resulting in a complete lack of insulin, whereas with type 2, the body is still producing insulin BUT is either not producing enough or the insulin it is producing, is not being taken up by cells. Most cases of Diabetes are type 2. It is often seen as a 'lifestyle' illness as it is related to obesity, and sedentary lifestyles. Individuals can have diabetes for years before diagnosis.

Current Situation

The patient, a 57-year-old female, diagnosed with Type 2 Diabetes Mellitus (T2DM) in 1996. There is a longstanding history of plantar first MTPJ pain.

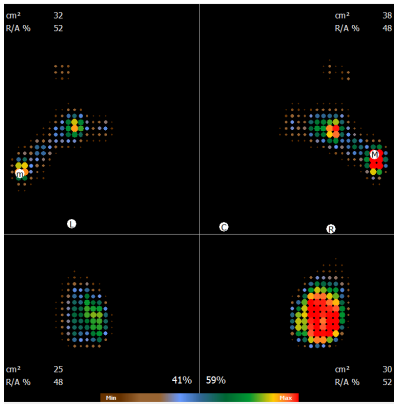
Past Medical Hx
Past history of bilateral Achilles tendinopathy; history of paraesthesia in digits 3-5 on the right foot; history of heel burning in the right foot; history of previous bilateral ulceration to the plantar IPJs of the hallux.

Medications
Thyroxine, Metformin, Cilazapril, Vitamins; HbA1c 42mmol/mol (well managed); High BMI 140kg

Goals
To walk pain-free; to increase walking for exercise and weight loss.

Assessment

Key Examination Findings
Pain when palpating the medial and lateral sesamoids of both feet; Achilles tendon midportion thickening present bilaterally. Lateral forefoot squeeze positive for neuritis +/- neuroma; Capillary refill test 3sec bilaterally within normal limits (WNL); DP/PT pulses slightly diminished, bilaterally; Monofilament testing 10/10, bilaterally (WNL) Reflexes WNL bilaterally; True pes cavus foot structure; STJ varum, forefoot in valgum; Forefoot plantarflexed on rearfoot bilaterally; Very plantarflexed first rays; Retracted digits; Limited STJ eversion; Limited weightbearing ankle dorsiflexion; Lateral instability and weak resupination; Thoracic kyphosis, posterior pelvic tilt; General right side hyperloading, statically; Hyperloading 2nd and 5th MT heads, statically; Low weightbearing surface area, statically and dynamically

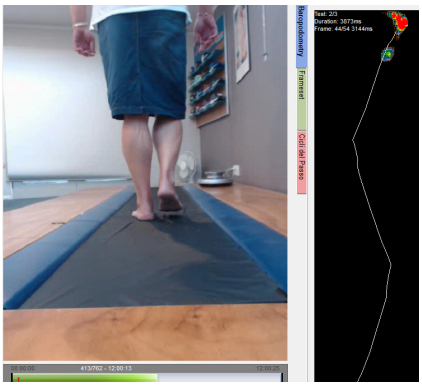


Static pressure footprint

Biopostural Analysis <u>Static</u> Pressure
R>L general hyperload; Peak hyperloading in R>L 5th MT head; Hyperloading R>L 2nd MT head; No lateral column contact at all; Minimal to no contact of the digits; Low weightbearing surface area Bilaterally.

Biopostural Analysis <u>Dynamic</u> Pressure
- Footprint Averages
- No lateral column contact
- High plantar metatarsal head hyperloading
- Low weightbearing surface area
- Minimal contact of digits

Video Gait Analysis: Walking
Narrow base of gait. Extensor Hallucis Longus (EHL) and Extensor Digitorum Longus (EDL) hyperactivity bilaterally throughout swing phase. Lesser digits elevated and not contacting throughout stance. Neutral heel strike, neutral at early stance and midstance, no pronation moments, large abductory twist owing to poor ankle dorsiflexion, no windlass propulsion and low gear toe off. No hip extension, short stride length. Trendelenburg at mid-stance. Postural sway to the right side,


Video gait Analysis

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Diabetes Mellitus (Type 2)

excessive frontal plane sway. No arm swing.

Diagnosis

This patient has the following risk factors predispose them to future ulceration risk:

T2DM managed via Metformin. History of ulceration to the plantar aspect of the hallux, bilaterally. Pes cavus foot structure, retracted digits. Structural joint limitations and foot deformity. Focal areas of high pressure in the forefoot both statically, and throughout walking gait. High BMI. Lack of exercise. Poor diet. Diminished dorsalis pedis and posterior tibial pulses, bilaterally. Mild par aesthesia onset.

Treatment

- Biomedical Management
- Customised Formthotics
- Footwear changes
- Education regarding daily foot checks
- Annual Diabetic Foot checks
- Referral to Dietician
- Education regarding regular exercise
- HbA1c testing

Management Formthotics Modifications
Dual Density Formthotics- modifications including bilateral lateral posting extending from rearfoot to toes.

Dual Density Formthotics

Bilateral poron metatarsal domes. Bilateral plantar covers with winged cut outs at the first MTPJ, and the fifth MTPJ on the right foot. Additionally, a thin PPT (polypropylene thermoplastic) topcover was added.

The lateral posting modification aims to shift the subtalar joint axis medially in the rearfoot, to decrease supinatory forces, it additionally aims to accommodate the forefoot valgum position and increase weightbearing surface area across the lateral column of the foot, and the lateral forefoot.

The metatarsal dome aims to dorsiflex the metatarsal heads to decrease hyperloading, and evenly distribute pressure across the forefoot. The metatarsal domes aim to decrease pressure on the first metatarsal head, in addition to lateral wedging in the forefoot. Additionally, dorsiflexion of the metatarsal heads aims to reduce contracture of the extensor tendons and reduce retraction of flexible digits.

The plantar cover with the cutouts under the first and fifth MTPJs, directly offload the areas of high pressure, revealed on dynamic and static pressure analysis.

The PPT top cover acts as a cushioning slow release shock absorber to also improve comfort and aid in pressure distribution.

Brooks Dyad walking shoe is a structured neutral shoe option, ideal for stabilising the lateral column to decrease supinatory forces. It has a 12mm heel drop, to increase ground contact in the rearfoot and accommodate the pseudoequinus and increase weightbearing ankle dorsiflexion. Additionally, the full contact outsole of the shoe increases weightbearing surface area and thus shock absorption.

"Maximum peak pressure and time of peak pressure on the foot during gait increases with peripheral neuropathy present."

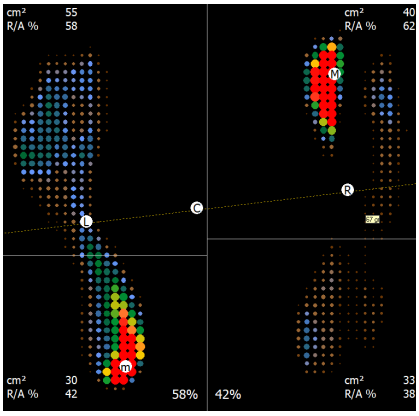
"Patients with a history of previous pressure ulceration have higher maximum peak pressures."

"High plantar pressure variants in conjunction with diabetes duration, smoking, poor glycaemic control, and neuropathy are risk factor for ulceration."

"Pedobarographic high pressures correlate directly to the site of ulceration, thus high plantar pressures are a useful predictor for foot ulceration in the presence of other comorbidities."

Outcome

One Month
Resolved plantar first metatarsal (MT) pain with Formthotics and Footwear. Weightbearing on Formthotics resulted in increased lateral column loading, increased weightbearing surface area. No metatarsal head overload, better weight distribution across the forefoot



Static Pressure standing on Modified Formthotics after one month

One Year
No ulceration to the plantar aspect of the hallux over 1 year; Increased weight loss- down to 90kgs; Walking - daily; Maintained healthy HbA1c for year; No changes in vascular status, no changes in neuropathic status, vascular and neuro testing all same as previous; Static pressure standing on Modified Formthotics.

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Leprosy Ulcers

Case Study
Leprosy Ulcers

Practioner: Keith Aitken
Practice: City Podiatry, Palmerston North
Patient: Unknown

Leprosy (also known as Hansen's disease) is a chronic infectious disease. The disease mainly effects the skin, the peripheral nerves and the mucosal surfaces of the upper respiratory tract and the eyes. It can occur in all ages and is curable with early treatment preventing associated disabilities.

Current Situation

When Keith Aitken, New Zealand Podiatrist, contacted us to ask for our support with his trip to Niger we were curious and intrigued. Keith was going to be working with leprosy patients and as we had never encountered patients with leprosy, we had never thought of this application for Formthotics.

We were impressed by Keith's altruism and willingness to help others so provided him with some product to take to Niger.

Treatment

In Keith's words...

"One of the Leprosy patients had a typical Leprosy Ulcer. He had the ulcer for an estimated 2-3 years, his feet were quite numb clinically. He could not feel any vibration below the knees and was insensitive to 75gm monofilaments.

I debrided the ulcer quite extensively and he couldn't feel a thing. He had good foot pulses so I knew that if we could get the pressure of the ulcer it would probably heal. I had the ulcer dressed and changed every 2-3 days with the patient living in the Hospital grounds in a millet hut.

The patients all use these types of sandals all year round. I heat fitted the Formthotics to his sandal. He was very grateful for all the treatment. Within 1 week the ulcer was granulating nicely from the base and getting smaller. I was there for about another 2 weeks after the fitting of this Formthotics and apart from some further debriding and dressings, no other treatment was used. After I returned to NZ the Doctor looking after this patient emailed me and said that the patient's ulcer had healed. They were very excited.

There were other leprosy patients with other ulcers that had Formthotics fitted and they have all done well. The whole hospital is dedicated to Leprosy. 90% of the patients had foot ulcers. Some had previous amputations. Some had infections that were not able to be resolved with the antibiotics that were available. These needed deep debridement and probing along facial planes to eradicate the infection, all done without x-ray or scanning equipment.

I also heat fitted Formthotics to a child that had cerebral palsy. The Formthotics helped him to improve his gait using a type of walker that they make over there."

Keith is home now, please to be away from water shortages, high security and the constant underlying fear for your life. However, there is a lot more work to be done and he is planning a return trip. If you are interested in getting involved with Keith and his work please contact him directly.

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Medial Tibial Stress Syndrome (Netball)

Case Study

Medial Tibial Stress Syndrome

Practioner: Rebecca Gifford
Practice: PodiatryMed, Christchurch, NZ
Patient: Netball player in her 20's

Medial tibial stress syndrome (MTSS), often referred to as "shin splints" is a frequent overuse lower extremity injury, characterised usually by exercise induced pain along the posteromedial aspect of the distal two thirds of the tibia. "Shin splints" is a general term to describe a number of different potential pathologies. There are several predisposing factors for MTSS; having a poor technique, improper warmup routine, increasing training schedules before being ready to do, or high impact sports contribute as does training on hard surfaces or uneven terrain. A previous leg injury may increase risk of issues. Biomechanical factors can contribute in addition to footwear suitability and design for the activity being undertaken.

Current Situation

The patient presented with pain in her shins, as well as few other issues. The patient is active and in her early 20's. She is a social netball player and in addition to this has just joined a training group.

Over the past 4 weeks she has increased her exercise greatly with interval training and running 3-4 times a week, 5-8km per run. She is experiencing diffuse tenderness along the medial border of the tibia. It is worse with increased activity and subsides with rest.

The patient is frustrated as she had to reduce her running because of the pain and wants to keep training as much as she can.

Assessment

I undertook a range of tests to identify what was causing the patient's pain, including the following:

The Balance Test

This relates to proprioception and postural stability, it also provides a good indication of the level of pronation the patient has.

This test clearly identified the patient significantly over pronates and she grips with her big toe to try and stabilise the foot. It was also evident her foot over pronation was influencing her lower limb alignment negatively.

The Forefoot Stability Test

This test relates to propulsion. During this test, the patient complained of pain up her left shin. Further and more specific manual muscle testing of the posterior tibialis tendon and of the flexor halluces longus again brought on this pain. This test reinforced the compensations resulting from her over pronation are what have led to her injury.

In addition to these tests, I undertook a series of standard alignment, strength and injury specific tests to diagnose the patient.

Diagnosis

My diagnosis is the patient has Medial Tibial Stress Syndrome.

Causes

This has been caused by a number of things:

- Footwear - The patient's running shoe are worn out, and the cross trainers used for Netball may look pretty, but they offer her no support.
- The patient is an "over pronator." Some pronation is good as you need this to adapt to un-even surfaces and terrain, however, when this movement is excessive, it puts a lot more strain through shins, ankles and feet.
- The sharp increase in the patient's training programme has really brought the first two issues to a head.

Treatment

R.I.C.E

The first step is to treat the pain with Rest, Ice, Compression and Elevation. I have recommended the patient ease back on her running until she is pain free and replace this with cycling or walking. In the meantime, she should be able to continue with her other activities.

New Footwear

I have recommended ASICS 2160 running shoes for her running and Asics cross trainers for use at netball and other non-running activities. These will provide her good support and create an excellent foundation for Formthotics.

Formthotics

I have fitted the patient with Original Red Dual Formthotics and have added a self-adhesive arch pad to minimise the excessive pronation and offload the effected muscles. I will continue to see the patient and adjust the Formthotics as her foot strengthens and her pain reduces.

I have recommended calf stretching and strengthening exercise for the patient to ensure she remains injury free long term.

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Medial Tibial Stress Syndrome (Rugby)

Case Study

Medial Tibial Stress Syndrome

Practioner: Rebecca Moriarty
Practice: Olympic Park Podiatry, Melbourne, AUS
Patient: 24 year old male Australian football player

Medial tibial stress syndrome (MTSS), often referred to as "shin splints" is a frequent overuse lower extremity injury, characterised usually by exercise induced pain along the posteromedial aspect of the distal two thirds of the tibia. "Shin splints" is a general term to describe a number of different potential pathologies. There are several predisposing factors for MTSS; having a poor technique, improper warmup routine, increasing training schedules before being ready to do, or high impact sports contribute as does training on hard surfaces or uneven terrain. A previous leg injury may increase risk of issues. Biomechanical factors can contribute in addition to footwear suitability and design for the activity being undertaken.

Current Situation

I recently saw a 24 year old state-level Australian Rules footballer with a 2-year history of bilateral shin pain. He presented with 2-year history of bilateral medial tibial stress syndrome, and occasional calf issues. He had been treated by a podiatrist when the injury initially presented itself, and was prescribed custom made rigid orthoses.

The patient could not tolerate the orthoses and after 6-months of trying, he removed them from his sport shoes. The patient continued to try and play but toward the end of the first season, was forced to miss 6-weeks of games. He had a further 6-week's rest in the off-season before commencing pre-season training again. In the meantime, he had changed his football boots and runners, had regular massage, and occasionally took anti-inflammatory medication for the pain. Mid-way through his second season, the patient visited our clinic after struggling with his shin soreness for 5-weeks.

Assessment

On examination, the patient appeared to have normal ranges of movement through the hip joint, no apparent leg length discrepancy, and slight hamstring tightness. He had normal range of movement in the sub talar and mid tarsal joints – although on the slightly stiffer side. He had adequate ankle joint dorsi flexion, and tight calves. He exhibited a moderate amount of foot pronation, and had not tolerated orthoses in the past. The pronation was a combination of rearfoot and midfoot, and he did exhibit a secondary internal tibial rotation.

Diagnosis

We assessed the mixed aetiology of bilateral medial tibial stress syndrome (MTSS), and deep posterior compartment syndrome.

Treatment

At the time of the consultation, the patient was issued a pair of Single Hard Formthotics with extended rearfoot wedges that were ground slightly at the distal edge of the wedges. He was advised to adjust to these mechanical changes over the first week and in the second week; he was to run in them in his runners. Once this was comfortable, he was advised to wear them in his football boots.

The patient was to continue the management plan that he was already doing – regular massage, stretching and post activity icing.

6-weeks after the initial consultation, the patient's symptoms were reviewed, and he presented a very happy young footballer. Whilst he still had an element of calf tightness, he was not experiencing any sharp medial shin soreness, and had been able to play the past 2 games in full without medication.

The patient was monitored for the following 6-months and continued to be pain free. After 9-months, the Formthotics were updated for his running shoes, and the older pair was worn in the football boots. The Formthotics were better tolerated by the patient when compared to the rigid devices.

MTSS is an impact-related pain, and I feel Formthotics are ideal to control some of the mechanical influences of the pains, without creating a "hard" platform within the sports shoe.

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Plantar Fasciopathy

Case Study
Plantar Fasciopathy

Practice: Resonance Podiatry and Gait Labs
Patient: 43 year old female netball umpire

The plantar fascia is a tight band of thick connective tissue supporting the medial arch of the foot running from the calcaneus (heel) to the metatarsal heads. Plantar fasciopathy is one of the most common causes of heel pain and usually occurs at the medial tuberosity of the calcaneus. There are a number of predisposing factors contributing to plantar fasciopathy including obesity, occupations requiring people to stand on hard surfaces for long periods of time, excessive pronation or reduced mobility in the ankle, footwear or taking up activities such as running or suddenly increasing the run distance.

Current Situation

A 43-year-old female professional netball umpire presented with a 6-month history of right plantar medial heel pain. The onset of pain was triggered by increased umpire training to compete for spot in ANZ Championship.

The training regime consisted of:

- Running on flat interval running of 3 x 2km sprints; or 4-minute runs, 3-minute rests, up to 45 minutes.
- Agility training including ladder work, shuttle runs, working on pivoting technique, particularly off the right foot.
- Weight training
- Pilates x1 per week
- Swimming

Past Medical History

The patient has a history of left Achilles tendinopathy.

Previous Treatment Interventions include:

- Physiotherapy, foot mobilisation, foot strapping modalities, deep tissue massage (foot and calf), Hamstring and Calf stretching, lower Back Mobilisation.
- The patients training/umpiring shoes were Asics GT2000

Goals

The patient's goals were to achieve Level 17 on the Yo-Yo Intermittent Test and to obtain a spot as an ANZ Netball Championship Umpire.

Assessment

- Pain on palpation of the medial calcaneal tubercle.
- Pain on palpation of the Abductor Hallucis muscle belly.
- There was limited first ray, first MTPJ, midtarsal and subtalar joint, range of motion.
- A plantarflexed first ray, limited plantflexion, more dorsiflexion.
- The subtalar was pronated on stance.
- There was a tibial valgum position of the legs, Jack's Test was hard and delayed
- The first ray dorsiflexes functionally with Squat Test.
- Static pressure revealed right heel hypoloading, and lateral forefoot hyperloading.
- Dynamic pressure revealed hypoloading through first MTPJ and hallux.
- Dynamic pressure revealed low weightbearing surface area right foot, relative to left.

Biopostural Analysis

Static Pressure

- Right heel hypoload
- Right lateral forefoot hyperload
- Left central to lateral forefoot hyperload
- Left general limb hyperload (59%)

Biopostural Analysis Dynamic Pressure

- Dynamic Pressure bilaterally first MTPJ and hallux hypoload
- Peak loading central forefoot
- Low surface area right foot, relative to left

Video Gait Analysis: Walking

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Plantar Fasciopathy

- Left lateral heel strike
- Right central heel strike
- The right foot is in a slightly abducted position.
- There is excessive pronation of the rear and midfoot throughout stance phase; thus, applying a dorsiflexion force on the first ray.
- As confirmed with dynamic pressure analysis, there is first MTPJ hypoloading, causing ineffective windlass firing and a lateral, low gear toe off.
- There is an increase in frontal plane motion through the pelvis.
- There is increased hip extension at toe off on the right side, more than left.
- Windlass propulsion is decreased on the right side.
- Increased knee flexion at heel strike, bilaterally.

Video Gait Analysis: Running

- Lateral heel strike, bilaterally
- As with walking the right foot is in a slightly abducted position.
- Pronation is well managed through midstance.
- Toe off is lateral on the right which causes a slight circumduction of the right limb through swing phase
- During late stance phase of the right limb, the left hip anteriorly rotates in order to help the right hip achieve adequate extension for propulsion.
- More hip extension occurring on the right side than left
- Backswing is higher on the right side compared to left
- Increased trunk torsion in the transverse plane

Diagnosis

The differential diagnosis is Chronic plantar heel pain, including abductor hallucis tendinopathy/overload, and plantar fasciopathy. Additionally, there could be a component of flexor hallucis brevis/longus weakness.

I felt the Asics 2000 was adding to the first ray dorsiflexion and ineffective windlass function, combined with the nature of her training/umpiring whereby she needs to pivot and turn; abductor hallucis was overworking and pulling on the medial calcaneal tubercle.

Treatment

- New footwear- torsionally structured, neutral, running shoe - Brooks Defyance, and Asics Cumulus for games.
- Dual Density Red Formthotics
- Exercise regime

Exercise Regime

- Continued physiotherapy
- Mobilisation
- Strength/Loading
- Strapping

Formthotics

Dual Density Formthotics customised with a right side medial rearfoot post, lateral forefoot post and a cluffy extension. These modifications encourage maximal first ray plantarflexion and optimise windlass activation and sagittal plane propulsion, to unload the plantar fascia and abductor hallucis, reduce excessive pronatory sheering forces, and decrease low gear toe off.

Increased sheering forces and greater peak dorsiflexion force on the first MTPJ have been recognised in the literature as contributing factors to plantar heel pain.

Footwear

Moving into a neutral running shoe; the patient went on to purchase the Brooks Defyance, and has been given the Asics Cumulus for her games. A running shoe is preferable for umpiring as most of the direction is forward running down the sideline, with pivoting only at the end of the court. Additionally, we had found from her previous left Achilles tendinopathy a netball shoe/cross training aggravated her Achilles.

Outcome

One Month Post Treatment

- Level 17 Yoyo Intermittent Test achieved pain-free, with only mild residual lateral forefoot discomfort, which resolved with foot massageAgility work and running is pain-free.

12 Months Post Treatment

- Selected to Umpire in the ANZ Championship
- Umpired the season pain-free.

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Sever's Disease - Case 1

Case Study
Sever's Disease

Practioner: Rebecca Gifford
Practice: PodiatryMed, Christchurch, NZ
Patient: 10 Year old male

Sever's disease (also known as a calcaneal apophysitis) is one of the most common causes of heel pain in growing children, usually occurring between the ages of 8-15 years. It is an inflammation of the growth plate in the calcaneus (heel) caused by repetitive stress to the heel usually during a growth spurt. It is more likely to be seen in children who are active in sports such as football (soccer).

Current Situation

Severs disease or calcaneal apophysitis is the most common cause of heel pain in the growing athlete. It is due to overuse and repetitive micro trauma of growth plates of the calcaneus in the heel. It occurs in children aged 7 to 15, mostly presenting between the ages of 10 to 14.

The patient presented with painful heels on both feet, which are much worse after prolonged activity. He has also experienced knee pain in the past. The patient is a very active 10-year-old boy, he plays representative football and training has recently increased to about 8 hours a week.

Patient walking

He claims walking on the side of his foot helps relieve the pain and Ibuprofen gel makes a small difference when massaged into the area.

The patient is very frustrated with the situation as he is passionate about loves football and playing at his very best. I undertook a range of tests to identify what was causing the patient's pain.

Assessment

Balance Test

This relates to proprioception and postural stability, it also provides a good indication of the level of pronation a patient has.

This test clearly identified the patient significantly over pronates which influences his lower limb alignment negatively. This also puts a lot of stress through his achillies tendon which connects into the back of his heel.

Supination Resistance Test

This test involves the Subtalar Joint Axis, the test is graded 1-5 in regards to how hard it is to supinate the foot. The patient scored a 4 indicating a heavily pronated foot type.

Over pronating increases the loading on muscles and associated structures in the heel area and creates a higher chance of overuse symptoms.

Squeeze Test

This test involves squeezing the heel along the area of the growth plate. A positive test will be uncomfortable for the patient, eliciting the same symptoms associated with the injury, which was the case for the patient.

Carrying out the Squeeze Test

Diagnosis

The tests I conducted confirmed my initial opinion of Severs Disease.

Severs is a traction apophysitis in which inflammation of the calcaneal apophysis (growth plate) occurs as a result of overuse or micro trauma.

Severs Disease

The apophysis is where growth of the calcaneus/heel bone begins from. Prior to the age of 14 before this plate fuses into bone, it is prone to overuse and micro trauma.

Causes

The patient is an over pronator, mainly through the rear foot. This over pronation is causing increased tension at the achillies insertion into the heel bone which is pulling on the growth plate leading to inflammation and pain. Increase in frequency, intensity and duration of activity. The sudden increase in football training didn't allow the patient's growing body time to adapt. This put a lot more strain on his legs and feet.

Footwear also played a big role in the patient's injury. Football boots do not have much arch or heel support. On natural turf the sprigs sink into the ground unevenly putting additional strain on the growth plate area.

The patient's running/training shoes were also worn and lacking in inappropriate support.

Treatment

Footwear

First, we had to get the patient into some more appropriate shoes for his for everyday use. Front Runner Bush Inn fitted the patient with Asics Torrana. These have inbuilt medial support which will reduce some of his over pronation, they are also a great base for Formthotics to work from.

The Asics Torrana is an "off road" shoe which is more durable than your standard running shoe – ideal for the rough and tumble lifestyle of a 10-year-old boy.

ASICS Torrana shoe

Formthotics

The patient was fitted with Original Hard Dual Formthotics in both his running shoes and football boots. I added rear and mid-foot postings to gain better control and support of his feet. I also fitted Formthotics Heel raisers in his football boots to directly offload his achillies tendon relieving tension on the growth plate.

Fitting Formthotics to new soccer boots

Running Technique

Due to the rapid acceleration needed in football, the patient had developed a forefoot running style. This puts the calf muscles and achillies tendon under too much strain, landing on the mid foot would remedy this. Mid foot striking would also allow the orthotic to work better as the base in this area is much more stable.

I undertook running technique analysis and retraining with the patient to help achieve this.

Streching and Strengthening

- Stretching of the calf muscles and achillies tendon
- Strengthening of the calf muscles

In addition I have recommended:

- Icing the area after practice and game to relieve inflammation
- A reduction in training load over the next month to let the injury settle down

Carrying out recommended stretches

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Sever's Disease - Case 2

Case Study
Sever's Disease

Practice: Resonance Podiatry and Gait Labs
Patient: 12 year old male rugby player

Sever's disease (also known as a calcaneal apophysitis) is one of the most common causes of heel pain in growing children, usually occurring between the ages of 8-15 years. It is an inflammation of the growth plate in the calcaneus (heel) caused by repetitive stress to the heel usually during a growth spurt. It is more likely to be seen in children who are active in sports such as football (soccer).

Current Situation

12 year old male, Rugby player.
Extremely hard playing surfaces due to drought. Pain in the posterio-plantar aspect of calcaneus. The patient also presented with:

- Tibial valgum
- Negative Lunge test
- Low supination resistance
- Trendelenberg with single knee bend
- Thomas test negative
- Anterior pelvic tilt
- Core weakness
- Tight hip flexors

Anterior assessment view

Proximal weakness is driving functional pronation moments.

Reduced calf/ Achilles length is traction at calcaneal apophysis.

Posterior assessment view

Assessment

- Clinical symptoms & gait pattern
- X-ray films to rule out other conditions
- Calcaneal apophysitis - 'Severs'

Patient x-ray films

Treatment

Formthotics

Formthotics dual density were selected to increase shock absorption, maintain fatty pad of heel under calcaneus. Increase weight bearing surface of foot, control excessive pronation and to increase cushioning.

A lateral forefoot post from styloid was also added to the Formthotics.

Other treatment modalities

- Ice
- Tuli Heel Cups
- Stretching & Strengthening Exercises - calf complex

Results

- 80% improved
- Some soreness with rugby only, which settles quickly

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Thank you for reading.

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