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Now you can fall in love all over again with this sweet line of felt footwear.
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President’s Message

BRAD GIBBS, C. Ped (C)

REFLECTIONS

True story. My first week on the job, back in early 1988, an elderly gentleman walking with a cane came into the clinic and sat down with his wife. I introduced myself and asked how I could help him. He promptly removed his left lower leg and handed it to me, saying with a curt and abrasive tone, “I need shoes to fit this.”

Working in the back room, out of sight of the client, I broke into a mild sweat as I struggled to remove the existing shoe from the prosthesis and fought to fit the leg into the new shoe. Cursing and laughing at the same time, I wrestled for what seemed an eternity as the leg flipped, banged and slid around, falling to the floor several times from the work bench. Finally, brushing blue dust from the sock on his portable appendage, I casually presented him with what I considered my own symbolic trophy.

AHH, THE HUMBLE BEGINNINGS OF A FUTURE PEDORTHIST.

Pedorthics is a sometimes bizarre, often challenging and constantly rewarding profession.

On the one hand we steel ourselves to react professionally, when in reality we want to run from the gnarly and psyche-destroying vision of the Crypt Keeper’s feet, that she calmly releases from each tomblike, ill-fitting, mangled and horrifyingly rank smelling sarcophagus for a shoe, ironically named something that conjures up the opposite image, Munro.

We approach the older gentleman who we instantly like, with open, sincere, compassion and concern, while secretly doing mental cartwheels at the prospect of treating such a challenging, complicated and profitable misfortune of having been run over by a tow motor some 25 years ago.

We feign surprise and concern, and stifle a yawn when the factory worker describes how his heels feel like someone is driving red hot pokers into the bottoms of them when he first gets out of bed. With well rehearsed authority in our voices, we address him with “It’s known as plantar fasciitis and I (dramatic pause) can help you.”

How can we forget the moment when we fit the young man, who lost all the toes of both his feet to frostbite, with rigid rockered footwear and orthotics that make him exclaim with raw emotional ecstasy as he walks the hallway of your office, that you have given him back his toes.

This, my final soliloquy as president of pAC, marks the end of the latest chapter in a long line of unforgettable and irreplaceable moments of learning and character building in my career as a pedorthist, and frankly, as a person.

It is a role I embraced from day one. And it has been an honour to represent what I feel is a truly enjoyable profession and an association of like-minded professionals, unified in making Canadian Pedorthics the best foot care profession in Canada and subpar to none, across the globe.

IT IS A ROLE I INVITE ALL OF YOU TO CONSIDER.

Consider being a director of the Pedorthic Association of Canada. Help strengthen the branding of Canadian Pedorthics. Contribute to PAC’s role as the hub for networking among your peers, the exchange of knowledge, professional development and personal and business growth. Your efforts and time will help the continued growth of the profession across our country, enhance its credibility and ultimately make Canadian Pedorthists the most recognized foot care professionals in Canada.

The experience is sometimes bizarre, often challenging but constantly rewarding.
Participants were fitted with multiple pairs of prefabricated orthoses constructed of EVA with fabric covering (Vasyli International, Labrador). Three orthoses exhibited the same contouring but were of different durometers: hard (Shore A 75°), medium (Shore A 60°) and soft (Shore A 52°). A fourth orthosis featured identical Shore A value to the soft orthosis, but was uniform thickness (3mm) along it’s length (i.e. flat). All participants were classified into one of two foot posture cohorts: those with a midfoot width change from weightbearing to non-weightbearing of >10.96mm, and those with <10.96mm (for further explanation of protocol see McPoil et al., 2009).

Surface EMG was measured using silver-silver chloride electrodes placed over the tibialis anterior (TA), soleus (SOL), medial gastrocnemius (MG), rectus femoris (RF), vastus lateral and medialis obliques (VL, VMO), biceps femoris (BF) and gluteus medius (GM). Three-dimensional motion analysis of the ankle, knee, hip and pelvis was conducted using a 14 camera VICON system (Oxford Metrics, Oxford, UK).

Subjects were asked to jog on a treadmill in three-minute intervals alternating between their usual jogging shoe and their shoe coupled with an orthotic insert, until all orthoses had been trialed (eight intervals). They were blinded to which orthoses they were wearing, and the order of presentation was randomized between subjects. Shoes were inspected to rule out excessive wear prior to testing. Participants were requested to run at a self-selected pace that would not provoke their pain and could remain constant throughout the protocol. Subsequent to testing, participants were asked to rank the orthoses (i.e. trial number) in order of most comfortable to least comfortable (1 = most comfortable, 4 = least comfortable).

The results of the study indicated that the orthoses were equally distributed over the four possible rankings. However, when they discounted contouring (i.e. combined both soft orthotic conditions), the authors found that subjects rated orthoses constructed of the softer material to be the most comfortable. There were no significant differences in EMG activity or kinematic between the shod and orthoses conditions. Multivariate analysis of kinematic data found a significant interaction of orthosis comfort and midfoot morphology for frontal plane motion of the hip with respect to relative adduction. When participants rated the orthosis as least comfortable there was a corresponding increase in frontal plane motion for a mobile midfoot and the opposite for a non-mobile foot. Significant differences were found relating to midfoot mobility and MG activity, with those with less midfoot mobility experiencing a later MG offset. Additionally, there was a tendency for the least comfortable orthosis to produce the greatest peak VL activity.

Given that the authors found that orthoses, regardless of perceived comfort, had no immediate effect on lower limb EMG or kinematics compared to baseline shoe conditions, perhaps we may expect that the effect of orthoses might be time dependent, as previous studies have included familiarization periods from 12 days (Murley et. al, 2010) to four weeks (Murley and Bird, 2006; Nawoczenski et al., 1999), and thus does not produce an immediate effect as in this study.

Previous research on asymptomatic individuals demonstrated that soft, flat orthotics were deemed most comfortable by subjects (Mills et al., 2011). Interestingly, the follow up study of symptomatic AKP individuals found an even distribution of comfort ratings across subjects. The authors acknowledge that using an ordinal ranking system prevents analysis of how much comfort varied between
orthosis models (i.e. unable to determine whether the level of comfort between soft vs. medium, medium vs. hard or soft vs. hard was measurably different). It could be argued that the title of the article is somewhat deceptive in this respect, as authors combined cohorts to offer a case for soft orthoses intervention. Regardless, as pedorthists, we should not be bewildered by this finding as we can acantorally appreciate that immediate comfort is not necessarily equated with device efficacy. There is often a break-in period for both off-the-shelf and custom made devices. Simply finding an insert ‘comfortable’ should not lead one to assume it is a more appropriate or effective intervention. And the obvious argument: given that this study was investigating non-custom orthoses, it stands to reason that the softer, more forgiving materials would be preferred by participants, given the device profile was not anatomically synchronized. Future research may benefit from evaluation of the difference in comfort perceptions between symptomatic and asymptomatic individuals, and between custom vs. non-custom CFOs over time.

The second aim of the study was to determine whether perceived comfort of orthoses and foot mobility influenced the magnitude of the acute EMG and kinematic adaptation. Participants with a mobile midfoot exhibited an increased in relative hip adduction wearing their least comfortable orthosis. The authors postulate that this may be a compensation strategy to preserve VMO: VL ratio in response to the significant peak VL activity that was also observed in the least comfortable insert. Excessive VL activity can lead to lateral patellar tracking, thereby increasing the inherent risk of AKP (Besier et al., 2009). It may also be an example of the global hip weakness that individuals with patellofemoral pain exhibit, specifically with respect to reduced function of the hip abductors (Robinson & Nee, 2007; Cichanowski et al., 2007). The consequential increase in hip adduction can augment the dynamic Q angle at the knee and increase lateral patellar contact pressure, thus contributing to AKP (Cichanowski et al., 2007). The authors acknowledge that measuring rearfoot frontal plane motion may have revealed some causal relationship between rearfoot evasion angle and changes in hip adduction.

In summary, this article offers thought-provoking work regarding various levels of firmness of non-custom orthoses intervention and perceptions of comfort in individuals with symptomatic AKP. It is important to interpret the data critically, as neuromotor adaptations may take several weeks to become apparent, and future work may seek to trial a more homogeneous subject population. Nawoczenski et al. (1995) state that there may be a cumulative effect of minor kinematic changes in response to orthoses that is clinically meaningful to the treatment of overuse syndromes. Additionally, in purposely not provoking knee pain in the study protocol, the authors could not ascertain any interaction between pain and kinematics or EMG. Given the increase in relative hip adduction in individuals with mobile feet and the increase in peak VL activity regardless of foot type, clinicians should acknowledge the potential contribution of comfort as a consideration for orthoses design.

REFERENCES


Short Report:

An Analysis of Hip Abduction Isometric Strength in Patients with Achilles Tendinopathy

MICHAEL RYAN, C. Ped (C), PhD

Traditionally, clinicians have viewed Achilles tendinopathy to be a result of lower limb deficiencies (i.e. overpronation) causing excess strain on the Achilles tendon. Clement et al found that the most prevalent factors contributing to this injury in runners were overpronation and gastrocnemius/soleus deficiency combined with a restriction in dorsiflexion.1 These clinical findings have been supported by biomechanical evidence of association between rearfoot eversion and the occurrence of Achilles Tendinopathy in runners.2 From a movement science perspective, increasing awareness is being paid to the coordination of proximal hip musculature, its control of the pelvis during ballistic movement (such as running and jumping), and the associated effects down the kinetic chain of the leg to the ankle and foot. Insufficient activation or weakness of stabilizers of the pelvis will result in an increase in hip adduction and internal rotation that will in turn drive an increase in dynamic knee valgus and internal tibial rotation. At the foot and ankle level, the end result of weak pelvic stabilization is an increase in pronation. Unfortunately, there is no previous research that has examined whether there is any association between hip abductor muscle weakness and the occurrence of Achilles tendinopathy. Therefore, the goal of the present study was to investigate whether there is any association between isometric hip abduction strength and Achilles tendinopathy. If a clinical association between hip abductor weakness and Achilles tendinopathy is found to exist, it would broaden our understanding of the relationship between injuries of the Achilles tendon and structural deficiencies in proximal muscle groups.

Peak isometric hip abductor measurements were recorded on the injured side of 15 female subjects with previously diagnosed Achilles Tendinopathy with the use of a hand-held dynamometer. Strength
testing was performed with each subject lying on their side with hips and knees extended and with hips at approximately 30 degrees of abduction. The dynamometer was applied to the leg just proximal to the lateral malleolus with increasing downwards force while the subject was instructed to resist as long as possible. The mean of 3 trials was recorded for each side. Strength measurements were taken in this manner from the injured and non-injured side from 15 individuals with Achilles Tendinopathy, as well as the corresponding limb of 15 age and activity-level matched control subjects. Control subjects were recruited from the community for the purpose of comparison, and were matched for age and approximate activity level. Age, weight and height were self-reported by the subjects and leg length was measured. Hip abductor strength was normalized for body weight and height. When comparing the injured limb with the non-injured limb, a paired t-test was performed, and independent samples t-test was performed to compare study patients with controls. There were no significant differences between either Achilles patient’s injured and non-injured limbs or the Achilles patient’s injured limb with that of the corresponding limb of the control (Figure 1).

These preliminary findings suggest that the occurrence of Achilles tendinopathy is unrelated to the isometric strength of the hip abductor muscles; however, there may be additional factors to consider. Most importantly, using an open chain resistance of hip adduction loads (to test hip abduction) as done in this study is not functionally comparable to the closed chain function of this muscle group during gait. Strength alone is also likely not representative of the functional demands from the hip abductors when stabilizing the pelvis – it would have been more appropriate to have integrated electromyography to estimate the timing of muscle activation during selected tasks and compare those findings to the strength measures taken in this study. There still remains the question of whether it is more a factor of the timing of the firing of the hip abductor muscles, rather than their absolute strength, that is more appropriate for this clinical population.

REFERENCES:
Biomechanical and Clinical Factors Related to Stage I Posterior Tibial Tendon Dysfunction


Posterior tibial tendon dysfunction (PTTD) is a progressive and debilitating condition that is estimated to affect nearly 5 million people in the United States. In the early stages (stage I) of the condition, PTTD is a common running-related injury. While the aetiology of PTTD has not been established, it is considered multifactorial in nature and has generally been related to progressive alterations in arch structure, muscular strength, and gait biomechanics.

Few studies have been conducted to understand how arch structure may play a role in the progressive nature of PTTD. Williams et al conducted a retrospective analysis of running injuries in runners with high and low plantar arch and reported that the low-arch group had a 3-fold higher incidence of stage I PTTD compared to the high-arch group. Dyal et al also reported that a lower arch height was associated with the symptomatic PTTD foot compared to the uninvolved foot. In contrast, Shibuya et al reported that radiographic and MRI scans of patients with PTTD at various stages showed damage to the spring ligament, with a lower arch height only present in patients with stages III and IV PTTD. Thus reduced arch height may be a predisposing factor related to stages III and IV PTTD, while a more typical arch height would be expected in stage I PTTD. Moreover, stage I PTTD is characterized by tendon inflammation, with no change in foot shape, while stage II PTTD is characterized by the tendon’s elongation and dysfunction, as the foot develops adult acquired flatfoot disorder. Thus it can be hypothesized that no differences in arch shape would be expected for patients with stage I PTTD, and, consequently, other factors, such as reduced ankle muscle strength, should be considered.

There is a paucity of research regarding differences in ankle invertor muscle strength for individuals with PTTD. Alvarez et al reported significant concentric and eccentric ankle invertor strength reductions for the involved compared to the uninvolved ankle. Following a 10-week
The purpose of this study was to investigate differences in arch height, ankle muscle strength, and kinematic factors in individuals presenting with stage I PTTD in comparison to healthy individuals. Compared to the control group, we hypothesized that the PTTD group would demonstrate (1) no differences in static arch height, (2) decreased ankle invertor muscle strength, and (3) greater and prolonged peak rearfoot evasion and lower peak MLA during the stance phase of walking.

METHODS

Subjects

Subjects were recruited through the Running Injury Clinic at the University of Calgary and various sports medicine clinics, including local practitioners such as podotherapists, podiatrists, and medical doctors. All subjects were actively involved in running and running-related sports and provided informed, written consent. The study protocol was approved by the Conjoint Health Research Ethics Board of the University of Calgary.

A Canadian certified athletic therapist, who is also a Canadian certified podotherapist, screened potential subjects through a clinical assessment that included a detailed history, differential diagnosis for other tendinopathies and musculoskeletal injuries, muscle strength testing, and manual palpations. Several steps were taken to differentiate between individuals with stages I and II PTTD. Typically, individuals with stage I PTTD exhibit signs of tendinopathy without postural changes in the foot, whereas those with stage II PTTD exhibit tendon elongation, acquired flatfoot deformity, and fixed rearfoot deformities. Moreover, with stage I PTTD, individuals generally exhibit pain superior and posterior to the medial malleolus, whereas those with stage II PTTD exhibit pain near the distal insertions of the tendon. Thus a clinical examination of passive rearfoot evasion and midfoot mobility was conducted and location of pain was evaluated to initially screen potential subjects. Once selected, potential subjects were screened according to specific inclusion and exclusion criteria.

Each subject was required to meet the following inclusion criteria to qualify for the PTTD group: (1) mild swelling and/or tenderness posterior to the medial malleolus, (2) pain posterior and/or superior to the medial malleolus, aggravated by recreational activity, (3) pain that had been present for at least 3 weeks, and (4) participation in recreational running or walking a minimum of 3 times per week and 30 minutes per session. Subjects were excluded from the PTTD group if they met any of the following exclusion criteria: (1) previous surgery on the affected foot, leg, or knee; (2) osteoarthritis in the knee of the affected side; (3) fixed rearfoot deformities; (4) recurrent ankle sprains on the affected side; (5) ligament tears or boney abnormalities of the affected foot; (6) a physical or medical condition that contraindicated the testing protocol; (7) pregnancy; or (8) flexor hallucis longus or flexor digitorum longus tendinopathy.

In total, 15 individuals with PTTD presented for consideration, 3 of which

**TABLE 1**

| TABLE 1               | Demographic Data
|-----------------------|------------------
| **PTTD (n = 12)**     | **Control (n = 12)** | **P Value** |
| Age, y                | 30.3 ± 7.9       | 28.5 ± 8.6   | .30 |
| Weight, kg            | 65.7 ± 11.5      | 68.9 ± 12.8  | .26 |
| Height, cm            | 168.2 ± 10.8     | 170.1 ± 7.8  | .32 |
| BMI, kg/m²            | 23.2 ± 3.4       | 23.7 ± 2.8   | .37 |

Abbreviations: BMI, body mass index; PTTD, posterior tibial tendon dysfunction.

*Values are mean ± SD unless otherwise specified.
were excluded from the study, 1 due to incorrect location of pain (presentation of lateral ankle pain), another who met all the inclusion criteria but whose data were deemed unusable after processing, and a third due to multiple confounding injuries, including plantar fasciitis and metatarsalgia. Based on a 0-to-10 visual analog scale, with 0 representing no pain and 10 extreme pain, the PTTD group reported an average pain score of 5 during running activity and 3.5 during activities of daily living. The visual analog scale has been established as a reliable and valid measure of self-reported pain.29 No individuals with stage II PTTD were screened, most likely because the sample was recruited primarily from sports medicine clinics, which typically see patients involved in recreational sports that demand a level of activity limited by stage II PTTD.11,13,14

Control subjects (9 females and 3 males) were matched to individuals with PTTD (9 females and 3 males), based on age, gender, and body mass index (BMI), and screened by the same exclusion criteria as those used to screen the PTTD group. There were no statistical differences between groups for the variables listed in Table 1 and other demographic variables.

**Structure**

Arch height index (AHI) was measured using a custom-built arch height index measurement system (Figure 1). Two boards were placed under the foot, 1 under the calcaneus and 1 under the forefoot, to allow the midfoot to achieve maximum deformation. AHI was defined as the ratio of dorsum height at 50% of total foot length, divided by the foot length from the back of the heel to the head of the first metatarsal (truncated foot length).25 Seated AHI was obtained with the subject seated, hips and knees flexed to 90°, and approximately 10% of total body weight on the foot. Standing AHI was obtained with the subject standing, with equal weight on both feet. Arch rigidity index (ARI) is defined as the ratio of standing AHI divided by seated AHI.25 AHI and ARI were deemed appropriate measurements of static foot structure, as their reliability has been previously demonstrated.2,25

Additionally, and to better understand the anatomical structure of the foot, kinematic measurement of passive rearfoot range of motion was obtained. With the subjects in a prone position, the calcaneus was passively and maximally everted by the therapist (Figure 2). The mean ± SD passive and maximal rearfoot eversion for the subjects with PTTD was 6.5° ± 3.1° and 4.8° ± 2.0°, respectively. Pilot testing was conducted on 7 control subjects, and the test-retest reliability for the measurement of passive rearfoot eversion was \( r = 0.94 \).

**Strength**

To assess the strength of the ankle invertor muscles, the subjects were seated on the ground, with their knee fully extended and their foot in a plantar-flexed and inverted position (Figure 3). They were instructed to use only their ankle invertor muscles to produce a force against the stationary force dynamometer (Lafayette Instruments, Lafayette, IN). During the contraction, the investigator palpated the tibialis anterior tendon to ensure that this muscle was not being recruited. The movements of subtalar inversion and forefoot adduction were based on strength testing, as described by Kendall et al,22 to best isolate the ankle invertor muscles. Four trials of ankle invertor maximum voluntary isometric contraction were collected and the average of these 4 trials was recorded. Force measurements from the dynamometer were normalized to body mass.29 Pilot testing, using the aforementioned 7 control subjects, indicated a test-retest reliability for ankle invertor strength of \( r = 0.86 \).

**Biomechanics**

Three-dimensional walking data were collected using an 8-camera motion analysis system (Vicon Motion Systems Ltd, Oxford, UK). All subjects were barefoot and fitted with 9-mm retroreflective markers, adhered to the skin at the anatomical landmarks of the tibia, fibula, and foot (Figure 4). A standing calibration of 1 second was obtained with the feet 0.30 m apart and pointing directly forward. Following the standing calibra-
tion, the subjects were provided a 1-minute warm-up walk on the treadmill at 1.2 m/s. Following the familiarization period, marker trajectory data were captured at a rate of 120 Hz.

Ten continuous footfalls of the walking trial were selected for analysis. Raw marker trajectory data were filtered using a fourth-order low-pass Butterworth filter at 12 Hz. Anatomical coordinate systems were created for the shank and rearfoot using Visual 3D software (CMotion Inc, Germantown, MD). Only the stance phase of gait was analyzed, and all kinematic data were normalized to 100 data points. Stance phase was defined as initial heel contact to toe-off and these events were identified using the velocities of the superior calcaneal and hallux markers.38

Cardan angles were used to calculate 3-dimensional angles for the rearfoot and shank. Rearfoot eversion was expressed as frontal plane motion relative to the shank segment. The MLA was calculated in a manner similar to the method used by Tome et al.32 The MLA was defined as angle subtended by 2 lines, one from the marker on the medial aspect of the calcaneus (MCAL) to the navicular tuberosity and the other from the head of the first metatarsal (D1MT) to the navicular tuberosity (FIGURE 5).

Custom LabVIEW software (National Instruments Corp, Austin, TX) was used to calculate discrete kinematic variables of interest, which included peak rearfoot eversion, peak MLA, and the time of peak rearfoot eversion.

Statistical Analysis
An a priori power analysis was conducted using kinematic rearfoot data previously published.23,32 Individuals with stage II PTTD, compared to healthy controls, had a significant difference in rearfoot eversion angle (PTTD, 10.4° ± 4.5°; control, 5.4° ± 3.6°). Using these values, the following calculation was used to estimate the required number of subjects to adequately power this study: 
\[ n = \frac{\left[ 2 \times SD^2 \left( Z_a + Z_b \right) \right]^2}{\Delta^2} \]
where SD is the pooled standard deviation, \( Z_a \) is the z score of alpha (.05), \( Z_b \) is the z score of beta (.80), and \( \Delta \) is the difference between the 2 means.33 Applying this calculation gives an estimation of 10 subjects per group, with a statistical significance of 0.05. Thus 12 subjects per group was considered appropriate for the study.

The following biomechanical variables obtained during walking were compared between the PTTD and control groups: (1) peak rearfoot eversion, (2) eversion excursion, (3) time to peak rearfoot eversion, and (4) peak MLA. The following anatomical and strength variables were compared between groups: (1) seated AHI, (2) standing AHI, (3) ARI, (4) passive rearfoot eversion range of motion, and (5) ankle invertor strength. Because the biomechanical and strength variables were associated with directional hypotheses, independent 1-tailed \( t \) tests were employed. Because no differences in static arch height were hypothesized, independent 2-tailed \( t \) tests were employed. All comparisons were conducted using an alpha of .05, in SPSS, Version 17 (IBM Corporation, Armonk, NY) software.

RESULTS
Structure

The PTTD group demonstrated significantly lower seated AHI (PTTD, 0.36 ± 0.01; control, 0.38
Static and Strength Measurements*  

<table>
<thead>
<tr>
<th>Measurement</th>
<th>PTTD (n = 12)</th>
<th>Control (n = 12)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>AHI seated</td>
<td>0.36 ± 0.01</td>
<td>0.38 ± 0.02</td>
<td>0.02</td>
</tr>
<tr>
<td>AHI standing</td>
<td>0.34 ± 0.01</td>
<td>0.35 ± 0.02</td>
<td>0.28</td>
</tr>
<tr>
<td>ARI</td>
<td>0.92 ± 0.02</td>
<td>0.90 ± 0.04</td>
<td>0.06</td>
</tr>
<tr>
<td>AIS, N/kg</td>
<td>1.00 ± 0.41</td>
<td>0.99 ± 0.35</td>
<td>0.49</td>
</tr>
</tbody>
</table>

Abbreviations: AIS, ankle inverter strength; AHI, arch height index; ARI, arch rigidity index; PTTD, posterior tibial tendon dysfunction.  
*Values are mean ± SD unless otherwise specified.

Biomechanical Variables*  

<table>
<thead>
<tr>
<th>Measurement</th>
<th>PTTD (n = 12)</th>
<th>Control (n = 12)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peak eversion, deg</td>
<td>6.0 ± 4.6</td>
<td>2.9 ± 2.6</td>
<td>0.03</td>
</tr>
<tr>
<td>Eversion excursion, deg</td>
<td>6.6 ± 2.9</td>
<td>5.9 ± 1.5</td>
<td>0.24</td>
</tr>
<tr>
<td>Time to peak eversion, %</td>
<td>45.8 ± 8.1</td>
<td>38.1 ± 12.9</td>
<td>0.05</td>
</tr>
<tr>
<td>Peak MLA, deg</td>
<td>12.5 ± 8.0</td>
<td>13.0 ± 9.4</td>
<td>0.49</td>
</tr>
</tbody>
</table>

Abbreviations: MLA, medial longitudinal arch; PTTD, posterior tibial tendon dysfunction.  
*Values are mean ± SD unless otherwise specified.

The PTTD group demonstrated a lower arch height in a seated position but no differences in standing AHI measurements or ARI, compared to controls. Because the differences in seated AHI were minimal and no other structural differences were measured between PTTD and controls, these findings support our hypothesis and indicate that there were no differences in static foot measures between groups. Moreover, the AHI values for both the PTTD and control groups fall within the normative ± SD value of 0.34 ± 0.03 for a group of 100 recreational runners reported by Butler et al., suggesting overall typical static arch height measures.

Shibuya et al.30 also reported no differences in talar declination angle, or Meary’s angle, between individuals with stage I PTTD and healthy controls, as measured using radiographs. However, these authors did not measure AHI, so comparisons are difficult. Both Neville et al.24 and Houck et al.39 measured AHI in individuals with stage II PTTD and found significantly lower values than in healthy controls. Therefore, the results of the current study suggest that arch structure, while perhaps not a contributing factor in stage I PTTD, may be more apparent in later stages of the condition.

In contrast to our hypothesis, there were no differences in ankle inverter strength between the 2 groups. These results are in contrast to the findings of Alvarez et al.8 and Houck et al.14,15 who reported that individuals with PTTD exhibited significantly reduced ankle inverter strength compared to healthy controls. However, these authors investigated persons with a mean age of 50 and 61 years, respectively. Our subjects were classified as having stage I PTTD, were 30 years old on average, and were regularly act-
tive in either running, exercise walking, or running-based sports for a minimum of 30 minutes per day, 3 times per week. Thus the similarities in ankle invertor muscle strength between the PTTD and controls in the current study seem reasonable, considering that both groups were involved in regular physical activity and those with PTTD exhibited only minor swelling and pain to the posterior tibialis region.

In support of our hypothesis, the PTTD group exhibited greater peak eversion while walking, compared to the control subjects, which is similar to the findings of previous studies involving stages II to IV PTTD. Moreover, those with PTTD demonstrated approximately 4° less inversion at heel strike compared to controls, and a significant positive association was found between rearfoot angle at heel strike and peak rearfoot eversion angle. These data suggest that the PTTD group exhibit altered rearfoot kinematics throughout the entire stance phase of gait. It is possible that greater rearfoot eversion is associated with early identification of the PTTD; however, prospective studies are necessary to answer this question.

Interestingly, when calculated with respect to the amount of passive maximal rearfoot eversion, the PTTD group utilized 92% of their available rearfoot range of motion, reaching a peak eversion value of 6° out of 6.5° of available range of motion. In contrast, the control group used only 60% of their available eversion range of motion, reaching 2.9° out of a possible 4.8°. These results are similar to those reported by Youberg et al, in which healthy subjects used 68.1% of their available passive rearfoot eversion range of motion while walking. Thus the results of the current study suggest that individuals with stage I PTTD exhibit atypical and excessive pronation mechanics. While speculative, these data also suggest that they may be at risk for ligamentous damage, which is consistent with the progressive nature of PTTD.

Although both groups reached the peak eversion in the first half of stance, the PTTD group reached peak eversion at 45.8% of the stance phase as compared to 38.1% of stance for the control group. These findings are in contrast to the data by Tome et al, who reported that individuals with PTTD reached peak eversion earlier in the stance phase compared to controls. Thus, we postulate that the increased rearfoot eversion measured in the present study places greater strain on the posterior tibialis muscle, which may partially explain the progressive nature of this condition. While no strength deficits were found in the PTTD group, other elements of muscle control, such as improper activation timing, lack of eccentric control, and atypical fiber recruitment, may contribute to the altered rearfoot eversion. Future research is necessary to better understand the interrelationship of muscle function and biomechanical movement patterns.

Because the posterior tibialis muscle is a major invertor and stabilizer of the MLA, we also expected a greater MLA value (lower arch) in those with PTTD while walking. However, no differences in MLA angle between the groups were measured, which is consistent with the finding of no difference in standing AHI between groups and no differences in strength. These results are in contrast to those of Tome et al, who measured the difference between standing MLA, normalized to subtalar neutral position, as compared to the peak MLA value in gait. Because we did not obtain MLA values in a subtalar neutral position, we are not able to directly compare our results to those of Tome et al. In addition, the present study was limited, in that the vertical height of the medial calcaneal marker from the plantar surface was not standardized, which might have masked between-group differences.

The biomechanical results of the current study provide support for PTTD being a progressive condition. For example, the stage I PTTD group exhibited a 3.1° increase in rearfoot eversion compared to controls, whereas Tome et al reported that patients with stage II PTTD demonstrated a 6.2° increase compared to controls.
controls. Moreover, while discrete values were not reported, Ness et al\(^\text{23}\) provided data showing that an approximately 10° increase in rearfoot eversion throughout the stance phase of gait could be observed in individuals with stage II PTTD compared to controls. Thus, increases in frontal plane rearfoot kinematics appear to be associated with PTTD severity. Interestingly, a strong positive association was found between rearfoot angle at heel strike and peak rearfoot angle in the current study. Ness et al\(^\text{23}\) reported a similar eversion offset throughout stance. These results suggest that individuals with PTTD exhibit altered rearfoot kinematics throughout the stance phase of gait, regardless of stage I or II of the condition. Moreover, the lack of differences in MLA between groups for the present study and a reported 8° change in MLA for stage II PTTD\(^\text{32}\) suggest that stage I PTTD may not involve midfoot or forefoot changes in walking kinematics, whereas these factors may be apparent in stage II and beyond.\(^\text{5,7,24}\) Thus, PTTD progression may be best understood by rearfoot kinematic measures during stage I, whereas altered midfoot and forefoot kinematics may play a role in stage II and beyond.\(^\text{19,20}\) Finally, the results of the current study also suggest that patients with stage I PTTD exhibit similar arch structure and ankle invertor strength as compared to healthy controls and that these variables may not be associated with early identification of the condition.\(^\text{5,34}\) In contrast, individuals in the more severe stages of the PTTD progression generally exhibit marked differences in arch height, strength, and gait kinematics.\(^\text{20,24}\)

Several limitations are acknowledged. First, this study did not include the classically defined PTTD demographic of sedentary women over the age of 40, who are diabetic or obese.\(^\text{5,13}\) However, the use of a younger, more active population is supported by previous research demonstrating PTTD that is a common injury among runners.\(^\text{31,36}\) It is also possible that stage I PTTD is distinct and only associated with tendon overload due to the altered rearfoot mechanics reported in the current study. In contrast, tendon overload in stages II to IV PTTD may be associated with other factors, such as obesity, altered MLA and rearfoot mechanics, as well as neuromotor and muscular strength deficits. Second, due to the placement of markers directly on the skin, participants had to undergo biomechanical analysis barefoot, and foot kinematics have been shown to be different between barefoot and shod gait.\(^\text{2}\) Third, the examiner responsible for determining inclusion/exclusion criteria, data collection, and analysis of the data was not blinded to group allocation. However, a different clinician initially screened all patients over the phone, and all subjects were assigned a research number to blind the examiner during statistical analysis and to help minimize potential bias. As well, the present investigation was designed as a case control study; yet we sought to theorize about the interrelationships between variables. In addition, we powered the study based only on potential differences in rearfoot eversion. Thus future research, involving multiple covariates, with a sample size calculated considering a variance inflator factor, is necessary to better understand the multifactorial nature of biomechanical, strength, and structural factors for patients with PTTD.

**CONCLUSION**

The results of the current study suggest that runners with stage I PTTD are likely to present with normal inversion ankle muscle strength, significant differences in rearfoot pronation during walking gait, and no differences in foot posture as compared to healthy controls. The increased foot pronation is hypothesized to place greater strain on the posterior tibialis muscle, which may partially explain the progressive nature of this condition. Future investigations should be directed towards assessing the effects of rehabilitation programs for individuals in the early stages, to shed light on the interrelationships between variables.
on the clinical and biomechanical factors that can be altered to prevent PTTD progression.

**KEY POINTS**

**FINDINGS:** Runners with stage I PTTD exhibited significant differences in rearfoot pronation during walking gait, along with normal inversion ankle muscle strength and foot posture, as compared to healthy controls.

**IMPLICATION:** The increased foot pronation is hypothesized to place greater strain on the posterior tibialis muscle, which may partially explain the progressive nature of this condition.

**CAUTION:** This study involved a group of healthy runners that does not represent the classic PTTD demographic of middle-aged, sedentary women with diabetes and obesity, which are often identified as primary risk factors.

**ACKNOWLEDGEMENTS:** This work was supported in part by research grants from the Alberta Innovates: Health Solutions and the Olympic Oval High Performance Fund at the University of Calgary, and through a charitable donation from SOLE Inc.

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Look for the Pedorthic Research Foundation of Canada representatives and visit our booth at the upcoming symposium in Whistler, BC. We’d love to discuss our future plans for the Foundation with you and how we can help improve your access to pedorthic-related research, as well as how you can contribute to creating an evidence-based profession.

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Subtalar Control Orthoses

By: Freeman Churchill, C. Ped (C)

The subtalar joint is the calcaneo-talar joint found below the ankle joint and proximal to the midtarsal joints of the foot. Motion at the subtalar joint occurs in all three planes.

Excessive subtalar joint pronation (medially deviated subtalar joint axes) or excessive supination (laterally deviated subtalar joint axes) are both contributors to foot, lower extremity and knee pathologies. Foot orthoses control subtalar joint pronation (and supination) by altering the effects of ground reaction forces (GRF) on the planter foot.

Controlling subtalar motion in either pronation or supination begins with a detailed history of the patient including symptoms, and a physical assessment to determine subtalar joint motion. This should be performed in non-weight bearing and weight bearing.

The design and fabrication of foot orthoses to reduce the excessive subtalar pronation or supination is very much dependant on one’s ability to:

1. Capture a 3D impression or cast of the foot accurately with the subtalar joint neither supinated nor pronated (neutral) and with the midtarsal joint in a loaded position.

2. Balance, dress and apply appropriate cast modifications.

3. Construct a functional foot orthosis with appropriate rearfoot post.

In casting, the subtalar joint must be captured in neutral. The forefoot should be pronated or everted to its range compared to the subtalar joint. The midtarsal joint is then locked. The subtalar joint should be pronated or everted to its end range compared to the subtalar joint in a relaxed position. On weightbearing, an angle finder can measure how much the heel everts beneath the talus and tibia. Keep in mind the vertical angle alone is not the only indicator of subtalar pronation. The tibial angle needs to be added to the resting calcaneal stance position. For example, a resting calcaneal angle of zero and 12 degrees of tibial varum might represent a fully pronated subtalar joint virtually at its end range. The vertical heel posture can deceive one into thinking there is no pronation.

The orthotic constructed is a reflection of the cast and its modifications. If the desired outcome is to minimize or control excessive or undesirable amounts of subtalar joint pronation, the cast must be prepared in such a way that the dorsal surface of the orthotic shell hugs the medial heel, through the sustentaculum tali to the medial long arch. Do not wash out that aspect of the cast in cast dressing.

Similarly, if the desired outcome is to reduce excessive supination of the subtalar joint, there should be no plaster added laterally from the lateral heel to the base of the fifth metatarsal. That is to say the contour of the cast should not be washed out in cast dressing at the calcaneo-cuboid joint and lateral column. A reverse Blake or lateral skive may provide the desired outcome of preventing inversion on heel strike.

When a subtalar joint axis is found to be medially deviated, modifications to the cast may include the Blake Inverted modification developed by Dr. Richard Blake or the Kirby skive technique developed by Dr. Kevin Kirby. The Blake Inverted Orthotic consists of inverting the forefoot with a significant plaster modification, where the Kirby skive attempts to provide a similar outcome by shaving off plaster from the medial aspect of the heel. The medial skive technique provides a supinating moment at the medial anterior aspect of the heel, redirecting the axis of the subtalar joint from a medially deviated angle to one more in line with the first metatarsal ray. It can also displace excessive soft tissue at the medial aspect of the calcaneus.

When performing medial skives, plaster must be added to the lateral side of the heel to equal the resting heel width measurement. It is best to do a weightbearing heel width measurement with calipers to identify exact heel width in standing. Otherwise the heel will not sit within the heel cup of the orthotic. If the heel is not expanded, the lateral edge of the orthotic will sit uncomfortably 3-5 mm in from the outside edge of the patient’s heel. The edge may be very uncomfortable and the effect of the medial skive on the foot will be lost because the lateral aspect of the heel cup will act as a buttress resisting the inversion application you have attempted to apply. The same applies to doing a lateral skive.

The rearfoot post is designed to allow a limited degree of calcaneal eversion during the contact phase of gait, thereby allowing a quantified amount of subtalar pronation to occur during this phase of the gait cycle.

The rearfoot post applies a force beneath the sustentaculum tali, as the foot moves into midstance phase of gait, to stop excessive calcaneal eversion. This helps control abnormal compensatory subtalar joint pronation and stabilizes the midtarsal joint during midstance.

Posting for a subtalar joint pronation should take into account the magnitude of the eversion, the patient’s weight, and the length of time the foot pronates. The more the pronation, the further forward the post should be anteriorly. Heavier patients will require a higher durometer of post material. The post must be vertical on the medial side and must not be bevelled in such a way that the post angles toward the center of the heel. Otherwise, the weight of the body and the pronation moment will cause the orthotic to slide out from beneath the foot. The broader the base of the post on the medial side, the greater the resistance is to the pronatory force.

For a supinated subtalar joint, the lateral post edge should be vertical so that the supinating forces do not push the orthotic out from beneath the foot. Additionally, a lateral phalange will assist the tendency of the foot to slide laterally off the edge of the orthotic. The lateral edge of the orthotic from the heel to the head of the 5th metatarsal must be straight, and not adducted.
Shell materials must be selected to suit the condition or disease, the patient’s sensitivity, weight, and the relative range of motion of the patient. For a very mobile, flaccid foot, a more rigid material would be more suitable than for a person whose ligaments are tighter. It should be noted that the break-in period for functional foot orthoses dispensed to the patient requiring subtalar joint control should be gradual. The patient who has walked or run previously untreated may experience both initial discomfort and remarkable awareness of the orthosis in their footwear. Changes in posture and muscular function may be experienced from the foot and lower extremities to the back.

Finally, for a functional foot orthosis controlling excessive subtalar motion to be maximally effective it is imperative that suitable footwear, activity-appropriate and properly sized, be utilized in such a way that the foot, orthoses and footgear work harmoniously. For excessive pronators, the heel cup/counter must be stable. The orthoses must sit on a firm stable platform. For excessive supinators the shoe must, in particular, not be constructed with anti-pronation devices built into its midsole. Midsole density, outsole shape and configuration shape must compliment the orthoses in its design, rather than work against it. Footgear needs to be replaced regularly and orthoses, as well should be checked regularly for wear accuracy in control.

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A Review of the Efficacy of Foot Orthoses in Treating Patellofemoral Pain Syndrome

By: LAUREN SIMONDS, C. Ped (C)

INTRODUCTION

Patellofemoral Pain Syndrome (PFPS) is the most common diagnosis among runners and in sports medicine centers, and accounts for 11% of complaints in office settings (Dixit, Difiori, Burton, & Mines, 2007). It is present in all age groups but is most commonly seen in adolescents and young adults (Johnston & Gross, 2004). The characteristic anterior knee pain tends to be provoked by activities such as squatting, stair walking, prolonged sitting, and running, and therefore impacts activities of daily living and work related activities (Saxena & Haddad, 2003).

Three major contributing factors have been identified that predispose individuals to developing PFPS. These include mal-alignment of the lower extremity and/or patella, muscular imbalance of the lower extremity and over activity (Thomee, Augustsson, & Karlsson, 1997).

More recently, there has been an increase in the use of foot orthotics to alter lower-extremity mechanics and alleviate symptoms of PFPS. Over the last 20 years studies have emerged examining the efficacy of foot orthoses in the treatment of PFPS.

PATELLOFEMORAL JOINT ANATOMY

The patellofemoral joint is the articulation of the patella on the anterior surface of the distal femur. The patella is a sesamoid bone that protects the knee joint and increases the moment arm of the quadriceps tendon (Dixit, Difiori, Burton, & Mines, 2007).

Its irregular shape allows the patella to sit within the groove of the femur called the femoral trochlea. This “fit” between the patella and the femur, along with the peripatellar retinaculum allows for passive stability of the joint. Dynamic stability is created by surrounding muscles that pull the patella at specific angles in order to hold the patella in proper alignment within the femoral trochlea (Thomee, Augustsson, & Karlsson, 1997).

These muscles, along with the passive stability within the joint, place the patella in optimal position for patellar tracking which is the movement of the patella within the trochlea of the femur. Imbalances in any of these structures can alter patellar tracking and can present as anterior knee pain.

PATELLOFEMORAL PAIN SYNDROME

PFPS is also referred synonymously as anterior knee pain, patellar pain, chondromalacia patella, or patellofemoral arthralgia (Thomee, Augustsson, & Karlsson, 1997). It is often difficult for clinicians to diagnose PFPS because patients tend to experience a variety of symptoms with varying levels of pain and physical impairment.

Commonly reported symptoms include clicking, crepitus, catching, and the sensation of “giving way” at the knee joint (Johnston & Gross, 2004). The majority of stiffness and pain tends to be experienced during prolonged sitting, running, squatting, ascending and descending stairs (Dixit, Difiori, Burton, & Mines, 2007). The patient will frequently report a dull ache beneath their patella but the exact location of pain can often be difficult to localize.

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## STEP ONE: Identify the material to be bonded

<table>
<thead>
<tr>
<th>Material</th>
<th>How to recognize</th>
<th>How to prepare</th>
<th>Vulkofest</th>
<th>Super-Fix</th>
<th>Ortec</th>
<th>Colle de Cologne</th>
<th>Syntic-TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leather</td>
<td>fibre structure</td>
<td>sand</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Chrome tanned Leather</td>
<td>fibre structure, green colour</td>
<td>sand</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>H</td>
</tr>
<tr>
<td>Rubber</td>
<td>typical smell</td>
<td>sand</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Natural Rubber</td>
<td>melts when sanded</td>
<td>sand</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>-</td>
</tr>
<tr>
<td>EVA</td>
<td>soft porous</td>
<td>sand</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Cork</td>
<td>Cork structure</td>
<td>-</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Vinyl (PVC)</td>
<td>Melts when sanded, typical chlorine smell</td>
<td>Sand and clean with Acetone</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>TR</td>
<td>Similar to natural rubber</td>
<td>Sand and prepare with Rehagol</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>R</td>
<td>R</td>
</tr>
<tr>
<td>PUR</td>
<td>porous, light weight, integral foam</td>
<td>Sand, prepare with Primer for PUR</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>P</td>
<td>✓</td>
</tr>
<tr>
<td>Polyethylene Polypropylene</td>
<td><strong>Hardplastic</strong> for orthopedics and orthotics</td>
<td>Touch the surface with an open flame (gas) for a few seconds</td>
<td>-</td>
<td>-</td>
<td>✓</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>PS-Polystyrene</td>
<td>Hardplastic for high heels</td>
<td>Sand or clean with Acetone or MEK</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

H: + Hardener C  R: + Rehagol  P: + Primer

## STEP TWO: Bond with Renia COLLE DE COLOGNE® or Renia MULTI-COLLE®

Renia COLLE DE COLOGNE® and Renia MULTI-COLLE® have identical adhesive properties. The open time for COLLE DE COLOGNE® is 5 - 30 minutes. The open time for MULTI-COLLE® is 3 - 15 minutes. Use whichever product best fits your own operation.

## SIMPLE USAGE INSTRUCTIONS:

1. As in all bonding: sand and clean dust from the surfaces.
   - Greasy surfaces (like PVC or TR) should be chemically cleaned with acetone or thinner.
2. The softer the material, the less pressure. But with less pressure, press longer.
3. Dry before bonding.
4. COLLE DE COLOGNE® and MULTI-COLLE® can be used cold - or reactivated with infra-red, a heater or a hair dryer.
5. Bonded parts can be sanded, trimmed and finished immediately after pressing.
   Most products can be bonded without special preparation.
   Some man-made materials may show good initial bonding, but later separate under wear conditions.

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With TR - Use Renia Rehagol (yellow)
Pre-coat TR with Rehagol the yellow primer and wait 15 minutes before applying Renia Adhesives

Greasy Material - Use Renia Hardener
Mix 5 to 10% of Renia Hardener with the amount of Renia Adhesives you might need for the job and then work normally with this mixture. Any leftovers can be used for the next gluing job.
A comprehensive and in depth assessment is often required by the clinician. Development of PFPS is multifactorial and can be attributed to any single factor or a combination of factors including overuse, imbalances in the surrounding muscles, and mal-alignment of the lower extremity and/or patella.

Treatment of PFPS tends to be patient specific and will address the underlying factors that led to the development of the pain (Dixit, Difiori, Burton, & Mines, 2007). This may include correction of muscular imbalances, patellar taping to correct mal-alignment of the patella, alteration of frequency, duration, and intensity of activity and training to prevent reoccurrence and/or foot orthoses to address underlying pathomechanics of the foot and lower limb.

ORTHOTIC TREATMENT

In previous research PFPS has been found to strongly correlate with excessive pronation of the subtalar joint (Eng & Pierynowski, 1993). Excessive pronation through midstance of the gait cycle can result in compensatory internal tibial rotation relative to the femur which causes transverse plane torque at the knee joint and can alter patellar tracking leading to patellofemoral pain (Johnston & Gross, 2004). It has been suggested that correcting abnormal foot pronation through the use of foot orthoses can improve alignment and patellofemoral tracking (Tiberio, 1987).

The use of medial posting at the forefoot and/or rearfoot has been shown to decrease both maximal calf-to-calcaneus and calcaneus-to-vertical angles. By correcting a forefoot varus through a medial forefoot post or correcting a calcaneal valgus through a medial foot and/or rearfoot post, pronation at the subtalar joint can be significantly decreased. This control of excessive pronation decreases internal tibial rotation which allows for proper patellofemoral tracking and a reduction in PFPS symptoms.

The desired posting can be achieved through various methods that tend to be categorized into either intrinsic or extrinsic posting. Intrinsic posting involves directly modifying the positive cast, which in turn affects the shell. Another method of posting is called extrinsic posting; this involves the addition of a semi-rigid material (e.g. EVA or cork) to the exterior surface of the shell to achieve the desired degrees of correction.

In recent years, several studies have emerged that have examined the efficacy of foot orthoses in alleviating symptoms of PFPS. In 1993, a preliminary study was conducted by Eng and Pierynowski that investigated the efficacy of foot orthoses in combination with an exercise program in treating symptoms of patellofemoral pain syndrome. The research included 20 adolescent females between the ages of 13-17 years old and each participant had been diagnosed with PFPS and demonstrated excessive calcaneal valgus and/or forefoot varus. All participants were assigned an exercise program consisting of quadriceps and hamstring strengthening/stretching and half of the participants were also required to wear off-the-shelf soft foot orthoses that were posted medially at the rearfoot and forefoot to position the subtalar joint toward a neutral position.

The authors discovered that both the treatment (exercise + orthoses) and control (exercise only) groups demonstrated a significant decrease in reported pain but the treatment group was significantly higher than the control group. They concluded that in addition to an exercise program, the use of a medially posted foot orthoses is an effective means of treatment for a patient with PFPS.

In a similar research study conducted by Johnston and Gross (2004), 16 subjects between the ages of 14-50 years old were tracked over a three month time period. In order to be included in the study the subjects had to have experienced anterior knee pain for at least two months prior to participation. All participants were examined and were determined to have a minimum of nine degrees of calcaneal valgum and demonstrated excessive pronation in the subtalar joint through the midstance portion of the gait cycle. Following the initial assessment, custom made foot orthoses were distributed to each individual with a medial rearfoot post to correct the calcaneal valgum and decrease excessive pronation.

Significant improvement was seen on pain measures at both the two week and three month follow-ups, which lead the authors to suggest that custom-fitted foot orthoses with a medial rearfoot post may improve patellofemoral pain symptoms for patients who demonstrate excessive foot pronation.

CONCLUSIONS

Based on a review of recent studies it appears that the use of foot orthoses with medial foot and/or rearfoot posting can be an effective means of relieving anterior knee pain associated with PFPS in those patients that exhibit excessive pronation with calcaneal valgum and/or forefoot varus. If excessive pronation is present due to calcaneal or forefoot mal-alignment, current research suggests that foot orthoses that are posted accordingly, whether through intrinsic or extrinsic posting methods, should be recommended as part of their treatment.

It is recommended however, that further research be conducted in the future to replicate and strengthen these positive findings as well as examine more long-term effects of treating PFPS with foot orthoses.

REFERENCES


The Importance of Being a Mentor/Practicum Supervisor

NANCY KELLY, C. Ped Tech (C), C. Ped (C)

As we all recognize, it is important that pedorthic students and apprentices have good supervisors in the practical aspects of the learning experience. With increasing numbers of students in the Diploma Program in Pedorthics, having C. Ped (C)s to share their knowledge and skills with the future leaders of our profession is paramount. There are also benefits to the C. Ped (C)s that take on this responsibility.

Graham Archer, a C. Ped (C) in British Columbia, notes that students bring a great deal of energy and are eager to learn more and develop as pedorthists. Jordanna Jones, an Ontario based C. Ped (C), echos this sentiment. She remarks that students can bring a lot of ideas and bring a fresh perspective to the daily tasks as pedorthists. Students’ questions provide motivation for continued learning. As Ms. Jones mentions “...it’s a great way to keep myself current with all of the new information coming our way.”

Although the goal of a supervisor or mentor is to pass along knowledge and skills to the students, both Mr. Archer and Ms. Jones mention that being a practicum supervisor has lead to them becoming better pedorthists themselves. As every student may learn in a different way, we may need to take different roads to get to the same end point. Graham states that mentorship allows your team to grow through the sharing of experiences, positive and negative. Nova Scotian Canadian Certified Pedorthist, Freeman Churchill, described his experience as a supervisor: “You realize you have an opportunity to help someone grow, and it makes you aware that you can be a positive role model and an ambassador for PAC, UWO and your company.”

The decision to become a practicum supervisor is not an easy one. There is a sense of responsibility which goes along with taking on this role, but it is also a role which can be very rewarding for both the student and mentor.

For more information on becoming a practicum supervisor, please contact Aimee Froude (afroude@uwo.ca) or Heather Wakley (hwakley@uwo.ca).
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**CASTING AND MEASURING FOR CUSTOM MADE ORTHOPEDIC FOOTWEAR: CLINICAL APPLICATIONS AND TECHNICAL METHODS**
Instructor: Jay Paul, C. Ped Tech (C), C. Ped (C)

**FOOTWEAR MODIFICATION: CLINICAL APPLICATIONS AND TECHNICAL METHODS**
Instructor: Kevin Fraser, C. Ped Tech (C), C. Ped (C)

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Alternatives to Standard Adhesives

**JIM PATTISON, C. Ped (C)**

Standard organic adhesives have a variety of Volatile Organic Compounds (VOCs). VOCs have negative health effects, both to the worker using them and the wearer if they have allergies to the finished glued product. Another concern is toxic breakdown, as toxins leach out of these products when they are in a landfill. There are means to reduce the risks to some of the glues, but there are tradeoffs with the effectiveness of the glue. Some people point out that if you get rid of the “stinky stuff”, the glue sticks less.

Toluene is one of the more effective organic solvents that has both contributed to strong glue and the need for ventilation and safety precautions. There are alternatives that are organic toluene free glues. Both Renia and Barge have toluene-free glues on the market. However, these are not without health risks as they still emit VOCs and require ventilation. I have still had several coworkers report headaches as a result of me using this glue in a well-ventilated room.

Other alternatives have been developed because of pressures of environmental rules in Europe. The rules place very low allowable limits for minerals like Chromium, Lead, Cadmium as well as volatile organic compounds, pesticides and fumigants. There is considerable pressure put upon manufacturers and importers to comply, because the sale of their goods in Europe is not allowed if the product exceeds the limits. This pressure has widened the number of alternatives for adhesives available.
TYPES OF GLUES

There are a number of different kinds of adhesives available. Organic glues are much more commonly available because of their cost and speed of drying. These are popular despite the health effects, flammability, and other issues.

Hot Glues: These EVA based glues were developed in the 1940’s. The glue is heated until it melts and is extruded from a glue gun. It bonds immediately because it cools quickly. This glue has no VOC’s, but can cause burns if it comes into contact with the skin.

Polymer Dispersive Adhesives: These are milky white dispersions often based on polyvinyl acetate. These glues are sprayed on the surfaces. They may contain VOCs.

Reactive Adhesives: Two components are added and react to form the adhesive. Epoxy glues are an example of this kind of glue. Resin and hardener are mixed together and react to hold the surfaces together.

Solvent-Based Adhesives: A solvent carries the active ingredients to the surfaces being glued. The solvent dries and the adhesive hardens holding the pieces together. Neoprenes and related compounds are commonly used in contact cements. These are the most commonly used adhesives in our industry and may contain VOCs.

Synthetic Glues: Cyanoacrylic glues (e.g. Krazy Glue) are among this group. These glues are quite expensive and there are some fumes that can irritate the eyes and mucosa when first applied.

WATER-BASED CONTACT CEMENT

A VOCs-free solvent is preferable. Solvent based adhesives can include water as a solvent to carry the adhesives. Since it is water carrying the adhesive’s ingredients, there are no VOCs involved. For proper adhesion, water needs to be evaporated off the surface. This can be achieved by heating the surface or increasing the air flow over the surface.

WHY WOULD WE WANT TO GO TO THIS TROUBLE?

The water based glues do not contain VOCs. This means that they are better for the environment and there are reduced health effects with their use. The right water based glues are cheaper to apply and have a stronger bond than conventional organic glues. Although these cost more per ounce in the bottle, there are some offsetting factors. First, you put the glue on just one surface. Second, the glue spreads out to cover a larger surface area than organic adhesives.

As well, ventilation systems do not need to be as elaborate with this type of adhesive. I have seen a plant in Mexico that used VOC based glue and the ventilation system had to be more robust than when they switched to water based adhesives. When the conversion was made, there was no smell of glue in the air. There are a number of reasons why they switched:

- cost savings were the prime reason (cheaper glue, less ventilation),
- health effects,
- and compliance with European laws

WHAT HURDLES DO WE FACE?

The biggest hurdle we face in Canada to using a water-based contact cement is the supply. There are some water-based contact cements that are available in Canada. The most commonly available ones you see in hardware stores are suitable for wood, but not all materials, such as leather.

I have seen first-hand the results from at least two different glue manufacturers while at CIATEC in Mexico. The first water based organic cement was developed in Mexico. It is distributed in Canada, but only in 25 and 55 gallon drums. This is simply too large a volume for many practitioners to use in a timely fashion. The second water based organic cement that I am familiar with comes from Germany. This manufacturer tells me that it is not distributed in Canada because of a lack of demand.

Perhaps we could show significant interest to encourage a greener alternative.
Lab Malarkey

A. BRIAN STOODLEY, C. Ped Tech (C), C. Ped (C)

According to a recent survey by the Pedorthic Association of Canada the average cost of custom foot orthotics across the nation is just under $500 a pair. Given this, it is no wonder why there are so many medical professionals who have adopted dispensing foot orthoses into their clinical practices. As professionals who have footcare credentials, we often find this reality irritating; however as business owners one can hardly argue why this happens…it’s just too profitable to resist!

Clinicians from north to south will continue to debate which profession is the smartest and best qualified to dispense foot orthoses. This debate serves only to better our professions, reduce our complacency and improve our skills to be the best footcare practitioners. In the end, true medical professions subscribe to regulation, in turn protecting their patient. One has to ask why central manufacturing labs for foot orthoses are not held to the same standard.

The reason is this: in most professions the clinicians are held responsible by their college for all products they dispense to their patients. However, it does not seem that these same medical professionals hold their foot orthoses fabrication labs to this same high standard of accountability. Central fabrication laboratories can be guilty of taking advantage of this relationship by keeping clinicians in the dark about manufacturing protocol, creating processes that "wash out"* casting errors, developing terminology to confuse insurance companies, creating products that are not truly custom and feeding clinicians continuing education that is simply proprietary to lab sales. Enthusiasm to grow our companies with short term sales techniques can never overshadow the strength of long term commitments to our profession.

Reputable foot orthoses clinicians who use lab services should educate themselves about the prospective lab they plan to utilize. Never hesitate to ask for:
- a lab tour
- a transparent manufacturing process/technique
- quality control systems
- administrative organization
- credentials of technical support
- credentials of actual fabricators
- affiliations with applicable professional associations
- commitment to continuing education of the profession
- commitment to continuing education of their staff
- environmental responsibility

An ethical foot orthoses manufacturer will take pride in discussing all of the above information; however any self-proclaimed “lab” that cannot address all of these fundamental requirements should be avoided.

Clinicians need to be aware that an orthotic is not just an orthotic and a lab is not just a lab. There is a reason a clinician may find disparity in charges from one lab to another. The reason is usually linked with accountability, education of lab staff, commitment to the profession and legitimate manufacturing processes. A reputable foot orthoses manufacturing company should have a commitment to a higher standard of accountability to the clinician and their patients.

A clinician can not assume a manufacturing lab is okay just because they “talk the talk”, have good marketing material or you like the color of their top covers. Always keep in mind that the central manufacturing lab you use should be considered a credential to your practice. If you cannot brag to your peers about the lab you use, get another lab.

*The term “wash out” refers to laboratory fabrication processes such as posting every device to 0 degrees (post to lab evaluation), adding full arch fill to every positive cast, mirroring devices, cutting the distal shell overly short, and keeping the shell design overly shallow. Agreeably, these conservative approaches do encourage greater patient compliance and deserves appropriate consideration. However when these practices are utilized by the clinician and lab as automatic defaults, one has to question if the individual needs of the patient are being properly addressed. Providing a custom device for your patient extends far beyond just taking a 3D cast; it also gives the clinician paramount diversity as per design and material choice thus utilizing a one style fits all approach often ignores the needs of your patient.
PAC AT CAREER FAIRS

PAC regularly exhibits at career fairs at universities to attract students to the pedorthic profession. PAC was recently represented by volunteer members at two events.

UNIVERSITY OF CALGARY

PAC had a booth at the University of Calgary’s Health and Social Sciences Fair on January 23. PAC members Kim Nicoll, C. Ped Tech (C), C. Ped (C) and Patrick Bergevin, C. Ped Tech (C), C. Ped (C) manned the booth and fielded questions from a steady flow of students visiting the booth throughout the day. 42 exhibitors attended the event which is a 20% increase from last year’s number, with only one other exhibitor at the event offering a continuing education certification. With such a great student response and a growing event, PAC intends to attend the event again next year.

QUEENS UNIVERSITY

PAC member Amy Guest, C. Ped (C) and Diploma in Pedorthics Student Leah Publicover man the booth at the Queens University Health Sciences Career Fair in Kingston, Ontario. Many inquiring minds asked questions that a PAC member and pedorthics student could answer. Great energy and positive feedback resulted.

PAC relies on members to volunteer at these events. If you are passionate about growing the profession, or are a recent Diploma in Pedorthics graduate who could speak to current students about the program, please contact the PAC office for information on getting involved.

THE COLLEGE OF PEDORTHICS OF CANADA

Fall 2011 Examination Passes

The College of Pedorthics of Canada would like to congratulate the following individuals who recently passed their certification examination.

CERTIFIED PEDORTHIC TECHNICIAN (CANADA)
Rovshan Aliev, Toronto, ON
Mahmoud Elsobky, Hamilton, ON
Amy Garthwaite, Kamloops, BC
Apostolos Kavadas, Markham, ON
Yo Han Kim, Vancouver, BC
Jong Kwon Moon, Toronto, ON
O’Llenecia Walker, Scarborough, ON

CERTIFIED PEDORTHIST (CANADA)
Jacob Cahoon, Surrey, BC
Kirk Cook, Winnipeg, MB
Tasha Fensom, New Westminster, BC
Alexandra Garner, Aurora, ON
Graham Gilbert, Toronto, ON
Stephen Handel, Dieppe, NB
Laura Jenne, Stoney Creek, ON
Sara John, Brampton, ON
Kathleen Klement, London, ON
Tavish Lahay-Decker, Waterloo, ON
Brooks McClennan, St. Catharines, ON
Steven Moffatt, Grimsby, ON
Lauren Simonds, Pickering, ON
Alexander Whyte, Halifax, NS

Thank you to those who gave their time as proctors at this sitting. Your efforts are aiding us in continuing growth within the profession. The CPC always needs more volunteers in this area, so please get involved.
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This second semester sees the students of the program taking three 8-week courses concurrent with a 360 hour placement for footwear and footwear modifications. Initially the students take two courses: PEDS 6013 Footwear and Footwear Modifications, and PEDS 6011 Introduction to Orthotic Systems. Following the end of these courses, they immediately start with the PEDS 6012 Advanced Orthotic Systems.

Following now is Leah’s continued saga as a Diploma in Pedorthics program student...

First term ended without too many hiccups. I realized on my last day of placement at the first clinic that I was about to embark on an all new adventure which was going to put me in the same nervous position that I was in to start my first placement once again. I asked my boyfriend to pick me up a binder while he was out one day for my new course notes to which he kindly obliged. When he arrived home I asked him about the binder and he said he forgot. Later, on my desk, was a brand new pink binder with the word pedo-files written across the front of it in black permanent marker, which he thought was hilarious. What I found much more amusing was when I took his binder and switched it for my pink pedo-file one the morning he went off for his first day of trade school.

My first day going to my new placement was a bit stressful. Trying to figure out what to wear and what to say feels just like the first day of high school all over again, but thankfully without the acne. You anticipate the worst and once you get there things are not bad at all. People end up being very nice and you breathe a huge sigh of relief. This term is all about footwear modifications, which has its challenges with this type of seasonal footwear not being the easiest shoes to modify. When it comes to winter footwear people are funny. Nobody waits all summer just so they can pull out their Sorel’s or Mukluks and tromp around in the muck that comes with Southeastern Ontario winters. Unless you like skiing, most people are just looking for something to get them through the season as fashion savvy as you can be in a Canadian winter.

Over the last few months, I have become very aware of the idiosyncrasies of my entire family’s lower limbs. I have been practicing my evaluations, footwear modifications (when necessary) and casting on my entire family. I have even started making a few pairs of orthoses for some of them.

The first pair that I made was for my boyfriend. I think I may have overcorrected him as he tried them for two hours and then complained about them for another two days. Oops! Since being shown how to properly modify a cast rather than my own artistic interpretation of how soft tissue will displace, I have had much more success with subsequent pairs.

I still have all my extremities and haven’t had too many safety mishaps in the lab. End of January and February are slow times of the year but March sale season is quickly approaching which means that we will likely have tons of shoe fittings and modifications to keep me busy til my placement is over.

My dad asked me today why we have three terms of school when people have at most only 2 feet. Sigh. The bad jokes never stop and my family of comedians continues to create new material for any kind of laugh.

Look out for the last installment of my log in the next PQ and thanks for staying tuned!
Hot off the Presses

PAC’s Clinical Practice Guidelines Published

In the fall of 2010, PAC embarked on a journey to raise the bar of pedorthic practice in Canada by developing a comprehensive set of Clinical Practice Guidelines.

The decision was made to engage volunteer pedorthists from across Canada to serve as writers, and to invite experts from inside and outside of the pedorthic profession to offer a high-quality review. The entire process was overseen by a six-pedorthist Task Force and coordinated by an external publication consultant.

“It would be no exaggeration to say that it took several thousand volunteer hours over the last year and a half to put these guidelines together,” said Mike Forgrave, C. Ped (C), Chair of the Task Force. “This was a labour of love and I think the end product truly reflects our intention of developing content that would help improve patient care in Canada.”

The CPGs, scheduled to be released at the Whistler Symposium, are designed to be a handy reference for pedorthists. With more than 50 pathologies covered by the guidelines, the Task Force envisions that pedorthists will refer to the publication to confirm their diagnoses and treatment plan, or to seek the latest information on an uncommon foot condition that might not walk through the door every day.

“We also think the publication will be helpful to physicians, physiotherapists, occupational therapists and others who see patients dealing with feet and leg issues,” added Forgrave. “Aside from improving patient care, we think the Guidelines will help us improve communication with these professionals and others.”

Mike Forgrave was joined on the Task Force by Ryan Chang, C. Ped Tech (C), C. Ped (C), PhD; Linda Deschamps, C. Ped (C); Jeff Fink, C. Ped (C); Jennifer Gould, C. Ped Tech (C), C. Ped (C); and Brian Scharfstein, C. Ped (C). The Task Force worked with Stu Slayen, a communications and publication consultant.

“The Task Force and our writers and reviewers can’t be thanked enough,” said Forgrave. “For me, seeing so many people demonstrating such passion for the profession and for the patients made me feel very proud and excited about the future of pedorthics.”

To learn more about the CPGs or to obtain copies, call 1.888.268.4404.

Bioped Beach (Toronto): JOB OPPORTUNITY

Bioped Beach (Toronto) is seeking an ambitious professional to manage and operate one of our GTA clinics. For suitable candidates, a shared ownership opportunity will also be made available.

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For those interested, please contact Desiree Johnson at 416-316-7622. Resumes can be sent to djohnson@bioped.com.
Member Profiles:

ANNE PUTNAM, BSc., MSc., C Ped (C)

Originally from Barrie, Ontario, Anne Putnam has travelled around the world in her journey to become a pedorthist. After graduating from Wilfrid Laurier University with her degree in Kinesiology, Anne worked in a physiotherapy clinic, which is where she first noted her interest in lower extremity injuries. Not yet knowing where this interest could lead her, she left Canada to travel, ending up in Australia.

Living in the small town of Curl Curl, north of Sydney, Anne had the beach at the end of her street. She bought a surfboard on her second day in the city and spent most evenings teaching herself to surf. When not riding the waves, Anne worked selling technical footwear at a store called The Athlete’s Foot, similar to Canada’s Running Room. “That was really interesting for me because I got to really get to know a number of the different footwear brands prior to coming back and doing my Masters”, notes Anne.

On returning to Canada after a year away, Anne went back to university in 2006 to pursue a Masters degree in Kinesiology, where she specialized in biomechanics. Her interest in lower extremity injuries led her to write a thesis focused on flat-footed individuals and the effects of arch support on different kinematic variables during running. As her research was clinically based, she started working with pedorthist Kim Rau in Kitchener, to make sure the research was clinically appropriate. This was Anne’s first introduction to pedorthics and she was thrilled to discover what she’d been looking for. “I loved research, but I enjoy human interaction and sometimes research can get a little bit lonely!” Anne explained, “When I was introduced to the pedorthics field, I thought this is perfect. You get a lot of lower extremity focus, a lot of footwear education and modification, and a lot of hands on stuff too”.

After enrolling in the Diploma in Pedorthics course at UW0, Anne did two practicums with Kim and one with Ryan Robinson, both of whom she has plenty of praise for: “They both really shaped me early on – I owe a lot to them”. After leaving Kitchener and returning to her home town of Barrie ten years after she originally left, Anne worked with Ryan for a year at his clinic before starting out on her own. She now operates her own clinic in Barrie and is part of Pedorthic Services, the collaborative professional group founded by Howard Feigel. Although she admits that she didn’t know where her interests would lead her in her career, Anne is very happy to have found pedorthics and is enthusiastic about the profession; “I love the variety of your day, I love the interaction with the clients, I love the problem solving and I love the ability to work with your hands”.

As with other PAC events, Anne is looking forward to Whistler, which she will be attending along with her husband, Wayde, and their new baby, Adam. “The other thing I love about the profession is the wider pedorthic community. I love going to the conferences and symposiums and getting to know more of the pedorthists. Everyone is wonderful and really open to sharing and really wanting to further the profession as a whole, even more so than wanting to grow their own practice. It’s so unique in that sense, it’s really wonderful.”

FREEMAN CHURCHILL, C. Ped (C)

As the first private C. Ped (C) in Nova Scotia, Freeman Churchill has been in the pedorthic profession for a long time. When attending the AGM 4 years ago with Murray Wood, who he has known from the beginning, he remembers with a laugh that “Murray looked around and said ‘Hey, where are the old guys?’ and I said ‘Murray, we’re the old guys!’”

Born in Brandon, MB, raised in Yarmouth, NS, and now living in Halifax, NS, Freeman completed his first degree in Recreation at Acadia University before moving to Dalhousie University to do his Kinesiology degree. A strong believer that people should be as active as possible, he was a keen hiker and runner. Having already run one marathon in PEI, he was encouraged by other runners in Nova Scotia to train for another, but found that he couldn’t do over 30 miles a week without injury. Keen to stay active and to find a solution to his injury woes, in 1979 Freeman met Dr. Bob Stalker, a key medical adviser in the early days of PAC. With his first pair of orthotics made by Bob, Freeman quickly increased his training from 30 miles a week to 60 miles. Qualifying for the 1981 Boston Marathon, Freeman ran an impressive time of 2 hours 34 minutes and has now completed a total of 14 marathons in his running career.

Having experienced first hand the successful impact of orthotics on his life, Freeman was encouraged by Dr. Stalker to help him at the Nova Scotia Sport Medicine Clinic with athletes and orthotics. In 1983, he moved from working at the running shoe store, Aerobics First, to working at the Clinic full time. Orthotics East, a collaboration with Lisa Irish, was formed in February 1986, with what Freeman notes were “the most rudimentary of tools”. Using just a flat grinder and employing duct tape to hold insole modification together, Freeman concedes that “it was really the simplest beginnings you could ever imagine”.

From so simple a beginning, Freeman’s career and those of many people he has affected, has blossomed. Embracing the concept of ‘paying it forward’, Freeman has welcomed many future C. Ped (C)s and C. Ped Techs into the practice, just as Dr. Bob Stalker welcomed him. He and his team would teach students about pedorthics and orthotics and help to get them qualified. Because he enjoys every day of his work, Freeman considers himself “one of the lucky people” and passes that enthusiasm on to all those who work with him. On a national level, Freeman has had an impact on a lot of PAC members, serving as Director and President of PAC and sitting on the committee of the College.

Pedorthics has not only given Freeman success in his career and outdoor pursuits; it’s also an important part of his home life. Freeman met his wife Elaine, who is an occupational therapist, while she was on an orthopaedic rotation in 1984. Living in Halifax since marrying in 1985, they now have four children; three of which, Freeman proudly notes, are also entering health professions.
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