The Benefits of Orthotics for a Patient with Metatarsalgia

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Orthotics have been compared to eyeglasses—they are not designed to cure the problem, but to assist/solve the functional problem, and to help the patient's foot work better. They can be valuable tools in the treatment of foot pathology and are often prescribed appropriately. However, they are also often misused, and not well thought out in their application. The American Academy of Orthopaedic Surgeons defines an orthotic as a device that is used to help a part of the body to function better.

A foot orthosis is a device placed inside a shoe and worn underneath the foot that is used to help the foot and lower kinetic chain (LKC) function. Foot orthotics can be classified based on their inherent goals for treatment. Orthotics can be designed to synchronize the mechanics of the LKC by holding the foot as near to its optimal functional position as possible. They can also be used to reduce shock or impact forces by absorbing or attenuating them, or to relieve a specific area of pressure and accommodate a tender area. Most often, a patient's orthotics can include a blend of all of these design features.

CASE STUDY

Let us consider the case of a 45-year-old female factory worker who presents with a history of forefoot pain that has bothered her for the past two years, and whose discomfort has become worse over time. By the end of an eight-hour shift on concrete floors, she needs to take an analgesic. The patient experiences foot pain while jogging, which has limited her fitness regimen. Furthermore, she cannot wear dress shoes because she experiences severe pain almost immediately after putting them on. Her pain also worsens when she is barefoot at home. The patient had surgery for a Morton's Neuroma between her second and third MTP's five years ago, and at that point received custom orthotics, which she now leaves in her work boots. Examination reveals a marked reduction in height of the longitudinal arch and forefoot pronation. She also has early hallux valgus.

Case Discussion

This presentation—a loss of medial longitudinal arch height, excessive pronatory mechanics, hallux valgus, reduced transverse metatarsal (MT) arch, forefoot discomfort that worsens with prolonged weight-bearing and neuralgic-type pain as seen with Morton's Neuroma—appears frequently in clinical settings. It is commonly labeled as metatarsalgia. However, it should be understood that this is a descriptive term rather than a diagnostic one.[1] These symptoms and signs must be examined carefully untreated, they lead to impaired function and decreased quality of life.

Metatarsalgia is the most frequent cause of foot pain, so it is crucial that any clinician dealing with foot disorders thoroughly understands its multivariate etiology and pathogenesis, even before treatment begins. Thus, it is imperative that the first step in treatment is ascertaining the etiology. The initial medical assessment must rule out systemic/extraregional diseases including vascular, metabolic, rheumatic, neurologic or psychogenic diseases.[1] These presentations have also been categorized as secondary metatarsalgia. A complete medical examination and diagnostic work-up is crucial.

Biomechanical Assessment

As the secondary component of assessment, the clinician should examine the role biomechanics play in the

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patient's presentation. Biomechanical dysfunction often leads to alterations in weight distribution and overload to the forefoot. These are seen as a result of functional anomalies including excessive or insufficient pronation of the talocrural (TC) and subtalar (ST) joints, ligamentous laxity, and insufficient or excessive loading of the first ray, intermediate rays or fifth ray.[1] These presentations have been categorized as primary metatarsalgia.[2] These functional anomalies lead to altered functional biomechanics in gait leading to pain.

It is crucial that physiotherapists who encounter many patients with this clinical pattern perform a comprehensive biomechanical examination. This should include the assessment of active and passive range of motion (ROM), joint stability, static and dynamic joint positions and mobility, muscle strength, neural tissue, palpation, weight-bearing function, and foot and ankle stability.

The practitioner must assess the LKC to evaluate its contribution to the biomechanical function of the foot. Poor core stability, and knee, hip and lumbar spine biomechanical dysfunction can play an integral role in foot and ankle biomechanical alterations. A lumbar spine scan and gait assessment would be beneficial in ruling out other factors which could be causing the patient's symptoms. In this case, the patient exhibited an excessive pronatory gait pattern.

The clinician must also examine the patient's footwear—in this case work boots and other shoes she wears at home during activities of daily living (ADL) and for recreation and fitness activities—to help determine biomechanics and the role footwear may play in the pathology. Overall, this patient's work and sports footwear were old and showed excessive wear patterns consistent with excessive pronation and forefoot loading. Her other footwear consisted of "fashion-type" footwear and sandals that offered no support or cushion.

In this patient's case, she showed slight posterior muscle tightness (hamstring, glutes, and puriformis) and slight increased sciatic nerve neural tension. The patient also exhibited tightness of the calf muscles, limited ankle dorsiflexion and ankle joint laxity with talar tilt (from a previous ankle sprain). There was also slight ST joint hypermobility and marked first ray instability with hypermobility into dorsiflexion. Her first MTP joint was slightly limited for dorsi-plantar flexion mobility. Her hallux was in varus, but mobile and correctable. She exhibited a rearfoot and forefoot varus deformity. Her lesser rays and metatarsal head were slightly dropped (second < third > fourth > fifth) with a loss of the transverse MT arch. Resisted muscle testing exhibited supinatory calf muscle, hip external rotator and core muscle weakness. There was marked point tenderness on palpation of the MT heads with slight distal migration of the MT fat pads. She described slight dysthesia between her second and third MT heads and toes consistent with her previous neuroma resection. In weight bearing, she exhibited poor single-leg balance with excessive pronatory mechanics, excess ankle valgus, excess internal leg rotation and poor trunk, pelvic and hip stability and control.

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The patient's orthotics must be examined to see if they are designed and fabricated appropriately to match her biomechanics and to see how they function within her footwear. Her orthotics were custom-made and appeared adequately designed to control her excessive pronatory mechanics, but time and wear had degraded their support and function. There were no accommodations made to address her forefoot pathomechanics and excessive loading.

Treatment

Once these medical and biomechanical assessments are complete, the clinician can formulate a treatment plan designed to reduce or eliminate pain and inflammation, improve biomechanical function of the foot, the ankle and the rest of the LKC, and ultimately enable the patient to resume a desired level of activity (work, home and recreation/fitness).

Many therapeutic modalities are designed to decrease pain and inflammation, such as thermotherapy (ice or heat); electro-physical modalities (*i.e.*, ultrasound, laser therapy, and electro-magnetic stimulation); acupuncture; massage; and manual therapy. Though these modalities do not prove conclusive or show a strong evidence-based effectiveness,[3] patients do describe improvement in pain and function with their use.

In my own practice, I utilize some forms of these modalities when patients come for in-clinic treatment.

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As part of their home-treatment program, I generally instruct them to warm their feet up prior to activity to improve blood flow and tissue extensibility. This can be accomplished through a warm soak during a morning shower or with the application of a heat pack. I also advise patients to apply cold (ice) after activity and at the end of the day to reduce any inflammatory response created through excessive loading.

Exercise to improve tight muscle groups and stiff joints can be very beneficial in improving biomechanics. The patient described here exhibited the commonly seen pattern of tightness in her gastrocs/soleus complex and posterior-medial leg muscle tightness. Calf muscle tightness alters TC/ST joint mobility and mechanics, increases compensatory pronatory mechanics and increases forefoot loading. Therefore, she should be instructed in a calf and general leg stretching regimen to be performed at home on a daily basis, first thing in the morning and at night. I would instruct her in a muscle-strengthening regimen to address supinatory calf muscles, hip external rotator and core muscle weakness. This would incorporate non-weight-bearing open kinetic chain and weight-bearing closed kinetic chain exercises.

Due to the patient's poor weight-bearing stability in this case, I would also introduce her to an extensive at-home balance and stability routine to improve her static and dynamic whole LKC mechanics. Improving core stability, pelvic, hip and knee control and foot and ankle stability will assist controlling excessive pronatory mechanics. Tailoring a progressive program to match her daily work, ADLs and sport activity demands will help her to attain the goal of returning to her desired level of activity. The home-treatment regimen is integral in empowering patients to take an active role in their treatment.

Proper Footwear

Proper footwear is also integral to improve the biomechanics contributing to forefoot pain. Generally, footwear should exhibit the appropriate amount of motion control or motion facilitation needed, provide

the appropriate shock attenuation properties and match the activities the wearer will perform. In patients with the pathomechanics, signs and symptoms exhibited by the patient in question, proper footwear should assist in limiting excessive pronation and excessive forefoot dorsi-flexion, and should also provide good shock attenuation in the forefoot and rearfoot.

To control excessive pronation, footwear should have a rigid heel cup, resist excessive torsion and not flex excessively in the forefoot and midfoot. This patient's work footwear must meet the "safety requirements" of being steel-toed, which often poses a fit problem. Some varieties of work footwear come with oversized toe caps that may fit better. More recently designed work boots have rubber midsoles and outsoles to provide good traction and provide better cushioning. In addition to proper fit, work boots should be made of durable materials that won't break down prematurely.

Athletic footwear should exhibit the same characteristics of motion control and shock absorption, and match the activity she is going to do (*e.g.*, jogging). I recommend footwear be of adequate depth and have removable insoles to accommodate orthotics.

Contoured-bed walking sandals are better than traditional flip-flops. As for dress shoes, many newer designs exhibit the aforementioned characteristics while remaining fashionable.

With my own patients, I suggest time spent in fancy shoes should be limited to those times when they really must be dressed up. I also direct all patients with forefoot pain to completely avoid walking barefoot, in socks or in slippers. Footwear must fit properly as to not allow excessive side-to-side movement or pistoning back and forth within the shoe. Patients with wide forefoot and hallux valgus deformities often make the mistake of purchasing too-large shoes to compensate. Most footwear can be modified (stretched, punched or cut out) to specifically match the patient's foot if needed. This can be done by a shoemaker or certified pedorthist.

As experienced practitioners, we have a good understanding of our patients' specific footwear needs. I will often write a specific prescription with desired design components. I also direct patients to footwear stores that have a better understanding of footwear design and biomechanics who can fit them appropriately, have a wide variety of makes, models and sizes of properly designed footwear, and will communicate with me if they have any questions or concerns. I remind my patients to take along their orthotics and wear the socks that they would normally wear with shoes when they try on footwear.

Figure 1

Example of the Components of an Orthotic

Image courtesy of Paris Orthotics Ltd., Vancouver, B.C.

Orthotics

Although evidence-based literature is limited and inconclusive regarding the efficacy of custom orthotics, some research shows they also benefit patients suffering from metatarsalgia.[4-8] The patient in question would benefit from new, custom-made orthotics to help control excessive pronatory pathomechanics. The orthotic shell should be made of a material that doesn't flex excessively, be of adequate width that matches her foot shape and size, be contoured to her anatomy, have good rearfoot and midfoot intrinsic ± extrinsic posting and have a deep heel cup. Finally, the shell should be covered with a full-length shock-absorbing top cover. Please see Figure 1 for an example of the components of an orthotic.

The orthotics should incorporate accommodations such as an anatomically positioned MT pad or specific relief/cut-out for a painful MT head.[4-8] See Figure 2 for examples of various forefoot modifications for metatarsalgia.

The practitioner must take care to ensure the orthotics take into account their fit into footwear. For this patient, I would recommend two pairs of

Figure 2

Various Forefoot Modifications for Metatarsalgia

Image courtesy of Paris Orthotics Ltd., Vancouver, B.C.

orthotics—one to leave in her work footwear and a second pair to utilize in all her other shoes. In patients who require wearing dress shoes for their work or ADLs, a smaller, dress-type of orthotic may be indicated to fit properly into those shoes.

Education

A complete treatment regimen must include educating the patient on their pathology, the causative factors and the goals and benefits of their treatment. A well-informed patient is an empowered patient who will take an active role in treatment, and is dedicated to making themselves better.

In summary, patients with forefoot pain present with multiple etiological factors and their own unique pathomechanics. A thorough assessment must be done to direct the appropriate treatment. Treatment must be multifaceted to address all the causative factors. This should include passive components such as proper footwear, orthotics and education and the dynamic components of an extensive home exercise and treatment regimen. After all, we don't make patients better—we help them make themselves better.

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