Over-Supination and Peroneal Tendinosis

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Abstract

This paper assesses the use of Pilates to decrease over-supination in the forefoot and thus alleviate associated peroneal tendinitis.

For this case study, I examined my own over-supination in my right foot and my associated case of peroneal tendinosis by creating and following six one-hour Block System from the Body Arts and Science International® Pilates sessions. The program applied Pilates’ emphasis on functionality and precision to encourage proper ankle-foot alignment and alleviate inflammation and tenderness in the tendons, while improving the strength and alignment of the body as a whole.

Over the six-week sessions, marked progress was made towards both goals, demonstrating the ability of Pilates to address the functional causes of these conditions. However, the persistence of over-supination suggests that this specific case may involve more structural elements of that demand physical therapy adjustments in addition to continuing the Pilates program.
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Anatomical Description

Ankle-Foot Complex

The ankle-foot complex consists of 28 bones that form 25 joints, but has three key joints. The talocrural or ankle joint is a modified hinge joint that connects the distal ends of the ends of the tibia and fibula with the proximal end of the talus. This uniaxial joint only allows for dorsiflexion and plantar flexion. The midtarsal joint occurs between the talus and navicular and the calcaneus and cuboid, and allows for inversion/eversion. The subtalar joint connects the talus and calcaneus. Pronation/supination occur in the subtalar joint and lies at an angle for the motions of dorsiflexion/plantarflexion, inversion/eversion, and abduction/adduction. Thus, pronation/supination have components of those motions.

The ankle-foot complex relies in large part on ligaments to provide stability, principally the deltoid ligament and the lateral group: anterior talofibular, calcaneofibular, and posterior talofibular ligaments. Many muscles within and outside the foot provide additional stability and mobility. These include the gastrocnemius and soleous (plantar flexors), tibilalis anterior and extensor digitorum longus (dorsiflexors), tibialis anterior and posterior (invertors), and the peroneals and extensor digitorum longus (evertors).

Peroneus Longus and Brevis

The peroneus longus and brevis are primary ankle foot evertors that lie on the lateral portion of the lower leg. The peroneus longus originates at the head and upper two-thirds of the lateral surface of the fibula and the lateral tibia condyle. It extends along the leg and ends in a long tendon that continues under the foot to insert into the lateral side of the base of the first metatarsal bone and the medial cuneiform. The peroneus brevis originates at the lower two-thirds of the lateral body of the fibula and runs vertically downwards, deep to the longus. It ends in a tendon that runs under the foot and inserts at the lateral base of the fifth metatarsal bone.
The ankle-foot complex, pictured with peroneals

Bones of the ankle-foot complex

- Tibia
- Talus
- Navicular
- Second cuneiform
- Third cuneiform
- First cuneiform
- Tarsometatarsal joint
- First metatarsal

Peroneus longus with pain location of peroneal tendinopathy

- Peroneus Longus Muscle
- Tibia
- Pain
- Tendon
Introduction

Over-supination is a gait-deviation that occurs at the subtalar joint and involves the excessive lifting of the arch and tilting towards the outside of the foot. This subtalar position is often coupled with inversion, plantarflexion, adduction and inversion. Thus, over-supination engages and the primary foot invertors (tibialis anterior and posterior) while stretching the primary evertors (peroneals and extensor digitorum longus). Over time, this leads to abnormal stress on the tendons of the peroneus longus and brevis. Thus, over-supinators are more vulnerable to both acute and chronic peroneal tendinopathy – the disease of the peroneal tendons. Acute strain on the peroneal tendon, such as that caused by over-supination, irritates and inflames the tendon (peroneal tendinitis). If unresolved, the issue can result in microtears that weaken the tendon and cause chronic inflammation (peroneal tendinosis).

Case Study

I am an active 25-year-old woman who over-supinates, particularly in my right foot, and presents peroneal tendinosis in my right leg. Since late adolescence, I would notice occasional swelling and dull pain in my right leg above my lateral malleolus, particularly when I would increased my running mileage. When I ran, I wore shoes to decrease my supination, but never followed any treatment to decrease the condition. I was unaware of my tendinosis or the fact that peroneal tendinosis is commonly associated with over-supination. Four months prior to this case study program, I had been running 16-24 miles per week. At that point, I stopped running for about three weeks and then began again, slowly increasing weekly mileage from about 4 miles to 10 maximum. Unsurprisingly, this break and dramatic decrease in mileage lessened discomfort and swelling. Some inflammation and tenderness remained and was still present at the beginning of the case study program.
BASI® Conditioning Program

Over-supination may have both structural and functional components. Structurally, the deviation is common amongst people with high arches and limited foot flexibility, like myself, and people who have had multiple ankle sprains. Functional factors include weak peroneals, tight hip external rotators, and muscle imbalances such as those typical of certain neurological conditions.

In order to further decrease supination and the associated symptoms of peroneal tendinosis, a comprehensive BASI® Pilates program was devised. Per the BASI® holistic approach, the program used the block system to improve strength, stability and alignment throughout the whole body. Furthermore, the program addressed functional factors that contribute to supination and strain on the peroneals, particularly to improve ankle-foot alignment and stability, and address relevant muscular imbalances:

- Increase ankle-foot strength and stability
- Increase foot flexibility (and thus ability to absorb shock)
- Practice correct foot alignment by cueing for eversion
- Increase hip external rotator strength and flexibility
- Increase flexibility in calf muscles and hamstrings
- Practice correct muscle activation in lower limbs

The BASI® Pilates was an ideal method to retrain these principle gait cycle muscles since repertoire emphasizes eccentric contraction – the key muscular function in the gait cycle.

The repertoire for the initial three sessions consisted of exercises on the Reformer. The Reformer allows Pilates practitioners to work on foot-ankle alignment and stability without the usual load of their body weight on top of the feet as a base of support. The three sessions consisted of exercises selected from the following:

<table>
<thead>
<tr>
<th>Block</th>
<th>Exercises</th>
<th>Case-Study Specific Emphasis (if any)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warm-up (Mat work on the Reformer)</td>
<td>Pelvic Curl, Supine Spine Twist, Chest Lift, Chest Lift with Rotation, Double Leg Stretch, Single Leg Stretch, Criss Cross</td>
<td></td>
</tr>
</tbody>
</table>
### Footwork
- Parallel Heels, Parallel Toes, V-Position Toes, Open-V Heels, Open-V Toes, Calf Raises, Prances, Prehensile, Single Leg Heels, Single Leg Toes

### Abdominal Work
- Hundred Prep, Hundred, Coordination; *Short Box Series*: Round Back, Flat Back, Tilt, Twist, Round-A-Bout, Climb-A-Tree

### Hip Work
- Frog, Circles Down, Circles Up, Openings, Extended Frog
- Emphasized pelvic stability, increasing hip range of motion, correct muscle recruitment of hip extensors, flexors, adductors, rotators, and knee extensors.

### Spinal Articulation
- Bottom Lift, Bottom Lift with Extension
- Emphasized foot stability and alignment in plantar flexion.

### Stretches
- Kneeling Lunge
- Hip flexor and hip extensor stretch.

### Full Body Integration (F/I)
- Elephant, Upstretch 1, Upstretch 2, Long Stretch
- Emphasized foot stability in plantar flexion, hamstring and calf stretch.

### Arm Work
- Emphasized correct pelvic alignment and overall trunk stability in seated position, stretch hamstrings and strengthen hip flexors.

### Lateral Flexion/Rotation
- Mermaid

### Back Extension
- Breaststroke Prep, Breaststroke

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After three sessions on the Reformer resulted in increased strength and stability of the ankle and foot, work on the Cadillac and Wunda Chair was incorporated. The Cadillac, particularly in footwork and other exercises that have the feet on the Push-Through Bar, provided an increased strength challenge and clear feedback on ankle-foot alignment. The Wunda Chair provided an increased challenge in that it requires the individual to balance and support his or her own body with minimal support from the equipment. For example, seated footwork on the Wunda Chair demands additional abdominal and back extensor co-contraction to maintain pelvic and spinal alignment as compared to footwork on the Reformer and Cadillac.
The repertoire for the last three sessions consisted of work on the Cadillac and Wunda Chair from the following exercises:

<table>
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<th>Case-Study Specific Emphasis (if any)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warm-up (Mat work on mat or Cadillac)</td>
<td>Pelvic Curl, Supine Spine Twist, Chest Lift, Chest Lift with Rotation, Double Leg Stretch, Single Leg Stretch, Criss Cross</td>
<td>Emphasized ankle-foot stability and alignment in work on toes, calf stretch in Calf Raises and Prances. Cued for eversion, pelvic and trunk stability, correct muscle recruitment of hip extensors, flexors, adductors, rotators, and knee extensors.</td>
</tr>
<tr>
<td>Footwork</td>
<td><strong>Full series on Cadillac or Chair</strong>: Parallel Heels, Parallel Toes, V-Position Toes, Open-V Heels, Open-V Toes, Calf Raises, Single Leg Heels, Single Leg Toes <strong>Just Cadillac</strong>: Prances, Hip Opener</td>
<td>Increased, specific feedback for each leg in single-leg work. Emphasized pelvic stability, increasing hip range of motion, correct muscle recruitment of hip extensors, flexors, adductors, rotators, and knee extensors.</td>
</tr>
<tr>
<td>Abdominal Work</td>
<td><strong>Cadillac</strong>: Mini Roll Up, Mini Roll Up Oblique, Roll Up Top Loaded, Teaser 1  <strong>Chair</strong>: Standing Pike, Cat Stretch Kneeling, Standing Pike Reverse</td>
<td>Emphasized ankle-foot stability and alignment in all Cadillac positions and in Pelvic Curl on the Chair.</td>
</tr>
<tr>
<td>Hip Work</td>
<td><strong>Cadillac</strong>: <strong>Single Leg Supine Series</strong>: Frog, Circles Down, Circles Up, Hip Extension, Bicycle</td>
<td></td>
</tr>
<tr>
<td>Spinal Articulation</td>
<td><strong>Cadillac</strong>: Monkey Original, Tower Prep, Tower  <strong>Chair</strong>: Pelvic Curl</td>
<td></td>
</tr>
<tr>
<td>Stretches</td>
<td><strong>Cadillac</strong>: Shoulder Stretch</td>
<td></td>
</tr>
<tr>
<td>Full Body Integration (F/I)</td>
<td><strong>Cadillac</strong>: Sitting Forward, Side Reach, Kneeling Cat Stretch</td>
<td></td>
</tr>
<tr>
<td>Arm Work</td>
<td><strong>Cadillac</strong>: <strong>Push Through Series</strong>: Shoulder Adduction Single Arm, Double Arm  <strong>Chair</strong>: Shrugs, Triceps Press Sit</td>
<td></td>
</tr>
<tr>
<td>Leg Work</td>
<td><strong>Cadillac</strong>: <strong>Single Led Side Series</strong>: Changes, Scissors, Circles  <strong>Chair</strong>: Hamstring Curl, Hip Opener</td>
<td>Worked on hamstring, hip adductor, hip external rotator control and strength while stabilizing pelvis.</td>
</tr>
<tr>
<td>Lateral Flexion/Rotation</td>
<td><strong>Cadillac</strong>: Side Lift  <strong>Chair</strong>: Side Stretch</td>
<td></td>
</tr>
<tr>
<td>Back Extension</td>
<td><strong>Cadillac</strong>: Prone 1, Prone 2  <strong>Chair</strong>: Swan on Floor</td>
<td></td>
</tr>
</tbody>
</table>
In addition to work from the BASI® repertoire, stretches using an elastic Thera-Band were incorporated specifically to strengthen the peroneals and increase flexibility of the tibialis anterior and posterior. Exercises were done in a seated position on the floor with the legs straight in front, with the Thera-Band looped around the foot and the hands holding either end of the band. Foot inversion, eversion, dorsiflexion, and plantar flexion were practiced in this position, with particular emphasis on eversion.
Conclusion

By addressing the functional factors of over-supination, a thoughtful BASI® Pilates program can help improve ankle-foot alignment, stability, and strength, as well as correct muscle imbalances to decrease supination and related symptoms of peroneal tendinosis. In the case study, there was a marked improvement in ankle-foot alignment, stability, and strength in neutral, dorsiflexion, and plantar flexion. This included an improvement in weight distribution throughout the lateral and medial portion of the feet and increased ability to maintain plantar flexion throughout exercises like Tower of the Cadillac. Inflammation in the peroneal tendon area above the right ankle was visibly decreased. Tenderness also decreased, which was especially evident during in higher-resistance footwork on the Cadillac and Wunda Chair. Over-supination remains visibly noticeable, suggesting that the structural elements of this case of over-supination may be more dramatic than originally thought. The case study subject may require physical therapy adjustments to address structural elements while continuing Pilates to address the functional factors of over-supination and peroneal tendinosis.
Bibliography


