Treatment of Pronated Foot - A Review

Ngilyang Mica[1], Omeshree Nagrale[2]

[1]MPT Student, [2]Assistant Professor, Department of Community Physiotherapy, R.V. College of Physiotherapy, 4th Block Jayanagar, Bangalore, India

Abstract

Foot Pronation, also called as "eversion" is a normal and necessary component of the gait cycle. However, abnormal pronation occurs when foot pronates, when actually it shouldn't. It occurs during the half of the stance phase. The foot rolls inward when one lands their foot on surface while walking and running. The complementing structures of the ankle or foot complex permits both stability and mobility depending on conditions acting on it. This article presents on overview on current knowledge on pronated foot and focuses on biomechanics, etiology diagnosis and treatment strategies, conservative treatment.

Keywords- *pronated foot, physical therapy, supination, pronation, eversion.*

Biomechanics of the Pronated Foot

The major joint taking part in pronation of the foot is subtalar joint and calcaneonavicular joint. So, if these structures are weak the pronation takes place. If the pronation force of the foot continued distally throughout, the lateral border of the foot would tend to lift from the ground, diminishing the stability of the base of the support, resulting in unequal weight bearing, and imposing stress at multiple joints. This undesirable effect of weight bearing subtalar joint pronation may be avoided if the fore foot remains flat on the ground. This can occur if the transverse tarsal joint is mobile and can effectively absorb the hindfoot pronation. When the talus and calcaneus moves on an essentially fixed naviculocuboid unit, there is a relative supination of the bony segments distal to the transverse tarsal joint, with the result that the forefoot remains relatively flat on the ground. The transverse tarsal joint maintains normal weight bearing forces on the forefoot while allowing the hindfoot to absorb the rotation of the lower limb. In a bilateral standing position on level ground, both the subtalar joint and transverse tarsal joints pronates slightly, to allow the foot to absorb the body's weight. As a result of the pronation there will be a slight medial rotary force on the leg. (1)

Types of Pronation

Neutral Pronation:

- 'Eversion', is natural in the body's regular movement
- In neutral pronation the weight distributes fairly among all of the toes with a slight emphasis on the big toe and second toes which are better adapted to handle more of the load.
- Any deviations from normal pronation may cause injuries. One injury that is commonly rooted in foot pronation problems is shin splints.
- weight of the foot is distributed in the middle of the shoe
- If soles of your shoes become worn from the outer heel towards the big toe, you are likely to have a neutral stride.
- Lessens the probability of injuries due to running.
- How your Foot Contacts the Ground: foot lands on outside of the heel, then rolls inward (pronates) to absorb shock and support body weight.
- Push Off: even distribution from the front of the foot.

• Injuries: less likely due to effective shock absorption, but neutral runners are not immune to injury.

• Foot Type: normal-size arches

Over Pronation

• Pushes off almost completely from the big toe and second toe.

• This results into shock from the foot's impact doesn't spread evenly throughout the foot and the ankle has trouble stabilizing the rest of the body.

• In addition to this, an unnatural angle formed between the foot and the ankle causes the foot splays out abnormally.

• Overpronation occurs when the weight of the foot is distributed in the inside (medial side) of the foot.

• Overpronators usually have a low arch and they are likely to suffer from achilles tendon problems. Overpronators should consider using shoes with maximum support.

• How Your Foot Contacts the Ground: foot lands on outside of heel, then rolls inward (pronates) excessively, transferring weight to inner edge instead of ball of the foot

• Push Off: big toe and second toe does majority of the work

• Injuries: shin splints, plantar fasciitis, bunions, heel spurs

• Foot Type: low arches or flat feet[2,3]

Supination

• Supination (underpronation) targets the weight to the outside of the foot.

• Supinators have high arches and they are likely to suffer from stress fractures as the impact to the body is increased.

• Supinators should use a neutral shoe with plenty of cushioning.

• **How Your Foot Contacts the Ground:** outer side of the heel hits the ground at an increased angle with little or no normal pronation, causing a large transmission of shock through the lower leg.

• **Push Off:** pressure on smaller toes on outside of foot.

• **Injuries:** plantar fasciitis, shin splints, ankle strain.

• **Foot type:** high arches.

Etiology of Overpronation

• Leg length discrepancy:- As leg length discrepancy increases, the total loading increases. Forefoot loading increased, hindfoot loading remained the same. The contact phase of gait decreased in the shortened length, the midstance phase remained the same, the propulsion phase increased from 44% to 50%. There is compensatory knee bend and foot pronation of the longer leg. Leg length discrepancy has significant effects on the foot.

• Ligament laxity:-when the ligament on the medial side of the foot is laxed, and ligaments on the lateral side is stronger; and when the body's weight falls on the ankle, the subtalar joint moves towards medial side and forms calcaniovalgus angle more than 180* leading to pronation of the foot.

• Muscular weakness or tightness in gastrocnemius and soleus:- If the muscle is weak the stability of the joint is compromised, thus pronation of the foot. But when the muscle is tight there is no proper contraction and relaxation of the muscle which will hamper the stability of the joint and will lead to pronation of the foot. Gastrocnemius and soleus are the major muscle which goes and gets attach to the calcaneal bone, therefore responsible for the stability of the ankle joints as a whole along with the other small muscles, tendon and ligament.

• Tibia vara>10 degree:-

Genu vara *(a medial angulation of the distal tibial in relation to the thigh)*. The gait cycle movescenter of weight and its effect on the foot. At heel strike, the foot encounters the ground in very slight supination. This triggers an immediate shift toward pronation, absorbing

shock and adjusting for uneven terrain. As weight transfers from hindfoot to midfoot, the foot moves into pronation. At mid-stance, the foot is in slight pronation and continues in that direction. In rolling through to toe-off, the ankle transfers weight to the forefoot, with the foot leaving the ground again in supination.

- Flatfoot:-

The arches of the foot are responsible for the equal weight distribution throughout foot. When there is loss of medial longitudinal arch is called flat foot and affects the balance and weight distribution causing the foot to pronate and roll inward. Decrease in the arch height causes instability of the subtalar joint and thus affects ankle and knee joint and so on.

- Improper shoe:-

Shoes like high heels, shoes without medial arch or too much arched, pointed shoes, loafers where when the leg is lifted most of the work is done by the forefoot straining the muscles. When the shoes is tight the foot doesn't get enough space to move and thus affects the overall function of the foot. Likewise, when the shoe is loose, there is excess work of the muscles of the foot since they have to over work to lift up the loose shoe hanging on the foot. Shoes without frictionless soles will tend to slip on the surface and when the person wears such shoes and walk they have to work excessively to compromise the slippery surface in order to prevent themselves from falling. Therefore, it is important to wear a shoe of proper material and size with all the support needed from the shoes itself.

According to the study the people who have spent most of their lives barefoot had significantly wider feet, and more evenly distributed pressure on their when they walked, than those who habitually wore shoes. The barefoot walking enables the foot to achieve its biologically normal shape and function. Many shoes are designed with bullet shaped toebox, or tapering of the width of the shoe towards the toes and prevent the toes from spreading apart.

- Arch height:-The higher the arch height, lower is the chance of foot pronation. The arch is totally responsible for the proper weight distribution of the foot. When the arch is proper it distributes the weight to the lateral and medial side of the foot equally and prevents the foot from pronation.[4,5]

Diagnostic Criteria Test for pronation type and arch height

a. Examine your old running shoes for signs of wear and to see which type of footprint you leave behind.

b. To determine type of arch, step out of the shower and examine your foot print.

- A medium arch (neutral) leaves a distinctive curve alongside the foot.
- A flat arch (over pronation) leaves a flat foot print with very little curve.
- A high arch (supination) leaves a sharp curve with a very thin line gong towards the toes.
- Shoes worn from the middle indicate that your pronation is neutral.
- Shoes worn from the inside indicate that you over pronate.
- Shoes worn from the outside indicate that you are a supinator.

c. Foot pronation index developed by Tony Redmond.

Method: patient should stand in their relaxed stance position with double limb support. The patient should be instructed to stand still, with their arms by the side and looking straight ahead. It may be helpful to ask the patient to take several steps, marching on the spot, and prior to settling into a comfortable stance position. During the assessment, it is important to ensure that the patient does not swivel to try to see what is happening for themselves, as this will significantly affect the foot posture. The patient will need to stand still for approximately two minutes in total in order for the assessment to be conducted. The assessor needs to be able to move around the patient during the assessment and to have uninterrupted access to the posterior aspect of the leg and foot. If an observation cannot be made (e.g. because of soft tissue swelling) simply miss it out and indicate on the datasheet that the item was not scored. If there is genuine doubt

about how high or low to score an item always use the more conservative score. Features commensurate with an approximately neutral foot posture are graded as zero, while pronated postures are given a positive value, and supinated features as negative value. When the scores are combined, the aggregate value gives an estimate of the overall foot posture. high positive aggregate values indicate a pronated posture, significantly negative aggregate values indicate a supinated overall foot posture, while for a neutral foot the final FPI aggregate score should lie somewhere around zero.[6,7,8]

Prevention and Treatment

Self Care and Exrecises:

1. Self-massage to the soles of your feet, roll a golf or other small ball under them.

2. For a relaxing foot soak, add Epsom salts to a basin of warm water and soak your feet and ankles for at least ten minutes. You can also add a few drops of essential oils.

3. Ice Technique: Use ice to reduce inflammation, pain and spasms to the involved area apply to the involved area for at least 15-30 minutes/session. If you are sensitive to putting the pack directly to your skin, cover the pack with a thin towel to protect the skin. If the area is bony, you may want to cool it down slowly to improve the tolerance. Apply the ice in 15-second increments, on/off until the skin surface cools enough to leave the ice on. You can apply the ice on/off throughout the day in 15-30 minute increments. Ice packs are excellent for use on swollen, tight, muscle spasm, trigger points or areas that are burning or very sore and achy.

4. Task interruption/rotation at work regularly.

5. Ergonomic changes

6. Barefoot walking and running.[8]

Conservatives Method

1. ORTHOTICS, BRACES and SPLINTS: - Orthotics in a shoe for over pronation helps carry out daily activities and avoid other treatment options that could be potentially costly and time consuming. Orthotics (also known as orthotic insoles, shoe inserts, or orthoses) are devices placed inside the shoes with the purpose of restoring our natural foot function. This is necessary when the natural biomechanical balance of our lower body has been disrupted by overpronation. Many common complaints such as heel pain, knee pain and lower back pain are caused by poor foot biomechanics. Orthotic insoles correct over-pronation and realign the foot and ankle bones to their neutral position, restoring natural foot function. In turn, this will help alleviate problems not only in the feet, but also in other parts of the body, such as the knees, hips, and lower back.

2. SHOE TYPE

- Motion control shoe
- Anti slip shoe
- Stability shoes

3. EXTRA CUSHIONING THE SHOE For flat foot or under pronation.

4. TAPING "LOWDYE taping technique" procedure studied in University of Queensland. Effective for both movement and standing.

5. SHOE-LACING patterns

6. Pronation decreases with higher number of eyelets in the shoe used for lacing and Shoe are tied as tight as possible.

7. BAREFOOT RUNNING

> Decreases pronation on the foot's impact with the ground.

> Acc. to the researchers in the Swissfederal institute of technology "the least

amount of pronation takes place when running barefoot".[10,11]

Medical Intervention:

- Your doctor may have prescribed pain medication and anti-inflammatory for your condition. If you have other medical problems, discuss these

medications with your doctor before taking them.

Surgical Correction:

• Surgery can sometimes help cure and prevent over pronation if you suffer from inherited or acquired *pes planus* deformity. Surgery typically involves stabilizing the bones to improve the foot's support and function.

Physiotherapy Management:

a. Curl Your Foot to Grasp and Pull the Towel exercises 5 to 10 times atleast. Now push the towel forward by curling and uncurling your toes. Again, keep your heels on the floor so it isn't your ankle or heel dong any of the work.

b. Calf stretching

c. Plantar fascia stretching.

d. Strengthening exercises for the foot with resistance band in all direction i.e.; plantar flexion, dorsi flexion, eversion and inversion.

e. Toe standing

f. One leg standing balance exercises

g. Toe exercises.

h. Equilibrium board balance exercises to increase the stability of the ankle.

i. **Lift the Arches:** Keep your toes relaxed, don't scrunch them up, and initiate a bit of a sliding motion pulling the ball of your foot and heel toward each other.

o Trigger point release: A constant amount of pressure on the trigger point is believed to relieve the pain.

o Dry needling technique

o Faradic foot bath

o Interferential therapy

o Ultrasound therapy

o Paraffin Wax bath[12,13]

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