



Body Mechanics

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Overpronation

Pronation and supination are normal healthy motions of the foot that occur between the tarsal bones.

These motions occur primarily at the subtalar joint between the talus and calcaneus; however, they also occur at the transverse tarsal joint (the transverse tarsal joint is actually composed of two joints: the talonavicular joint medially between the talus and navicular; and the calcaneocuboid joint laterally between the calcaneus and cuboid) (Figure 1).

Pronation and supination each occur in one oblique plane around one oblique axis, therefore they are uni-axial motions; however, because these oblique plane motions occur across all three cardinal planes, pronation and supination are often described as triplanar motions.

The principle cardinal plane component motion of pronation is frontal plane eversion. For this reason, it is common to hear pronation described as eversion. However, eversion is only one component of pronation, albeit the largest. Pronation also involves subtalar abduction (effectively lateral rotation) of the foot in the transverse plane, and subtalar dorsiflexion of the foot in the sagittal plane. Similarly, the largest component motion of supination is inversion. However, supination also involves subtalar adduction (effectively medial rotation) of the foot in the transverse plane, and subtalar

plantarflexion of the foot in the sagittal plane.

Foot pronation causes the arch structure of the foot to drop. The arch structure consists of three arches: the medial longitudinal arch on the big toe side, which is the largest and best known of the arches; the lateral longitudinal arch on the little toe side; and the transverse arch across the metatarsal heads (Figure 2). Whenever any one of these arches collapses, as a rule, the entire arch structure collapses.

OVERPRONATION/FLAT FOOT

Dropping the arch structure of the foot is a natural and healthy posture. It occurs during the gait cycle during midstance when our body weight is directly above the foot. Before much of our world was paved and flat, the ground was often uneven. From a position of full supination, varying the degree of pronation would therefore allow the arch to drop and flatten the necessary amount to mold to the contour of the ground upon which we are standing (Figure 3). Pronating to drop the arch also allows for shock absorption when striking the ground during walking, running, and jumping. The problem is

when our arch structure excessively pronates, in other words, overpronates.

Because overpronation causes the arch structure to drop, it is known in lay terms as *flat foot*. In scientific terms, it is known as *pes planus*, which is Latin for “foot flat” (*pes cavus* is the term for an overly supinated foot, in other words, an excessively high arch). There are two types of overpronation/flat foot: rigid flat foot and supple flat foot. With supple flat foot, which is the more common of the two types, the client’s arch is perfectly healthy when not weight-bearing, but upon weight-bearing, the foot pronates excessively and the arch structure collapses. By contrast, a rigid flat foot is always flat/overly pronated, regardless of whether the

client is weight-bearing or not (Figure 4).

CAUSES

There are many causes of supple flat foot. Given that the arch structure of the foot is determined by soft tissue pulls of musculature and ligaments, a supple flat foot is caused by either lax ligaments and/or weak musculature that cannot support the arch when the weight of the body passes through the subtalar (and transverse tarsal) joint. Muscles that act to support the arch can be divided into the following groups (Table 1):

Supinators (invertors) of the foot – These muscles have their bellies located in the leg. They are the tibialis anterior and the extensor hallucis longus in the anterior

Foot pronation causes the arch structure of the foot to drop.

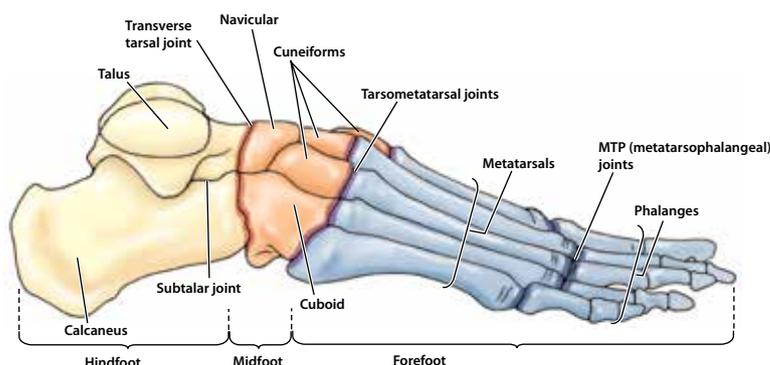


Figure 1 The subtalar joint of the foot. The transverse tarsal joint is also seen. *Muscolino, JE. Kinesiology: The Skeletal System and Muscle Function. 2ed. Elsevier.*

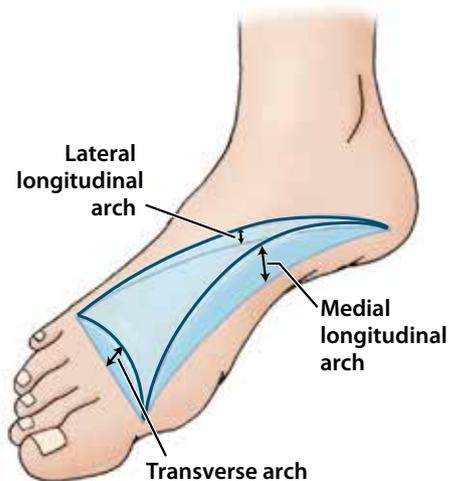


Figure 2 The Arch structure of the foot is composed of the medial longitudinal arch, the lateral longitudinal arch, and the transverse arch. *Muscolino, JE. Kinesiology: The Skeletal System and Muscle Function. 2ed. Elsevier.*



Figure 3 Varying the degree of supination/pronation allows the foot to mold to the contour of the ground. *(Modeled from a figure in Neumann, DA: Kinesiology of the musculoskeletal system: foundations for physical rehabilitation, ed 2, St. Louis, 2010, Elsevier.)*



Figure 4 Overpronation of the foot, also known as flat foot. A, Supple flat foot when not weight-bearing. B, The same supple flat foot when weight-bearing. C, Rigid flat foot. Note: The contour of the medial longitudinal arch is highlighted in each figure. *Courtesy Joseph E. Muscolino DC*

Table 1 Musculature that supports the arch

LEG/SUBTALAR JOINT	FOOT/PLANTAR FASCIA	THIGH/HIP JOINT
Tibialis anterior		Gluteus maximus
Extensor hallucis longus		Gluteus medius and minimus
Tibialis posterior	Flexor digitorum brevis	Piriformis
Flexor digitorum longus	Abductor hallucis	Quadratus femoris
Flexor hallucis longus	Abductor digiti minimi pedis	Superior and inferior gemellus
Fibularis longus		Obturator internus and externus
		Sartorius
		Tensor fasciae latae (TFL)

compartment; and the *Tom, Dick and Harry group*: tibialis posterior, flexor digitorum longus, and flexor hallucis longus muscles of the posterior deep compartment (Figures 5A and 5B).

“Stirrup Muscles”—The stirrup muscles, whose bellies are also located in the leg, are named because they support the arch/underside of the foot like a stirrup. They are the tibialis anterior of the anterior compartment (already mentioned above) and the fibularis longus of the lateral compartment (see Figure 5A).

Intrinsic plantar musculature—Muscles of Plantar Layer I group of the intrinsic plantar musculature have attachments into the plantar fascia. By supporting the plantar fascia, they help to support the arch (see Figure 5C). They are the flexor digitorum brevis, abductor hallucis, and abductor digiti minimi pedis.

Lateral rotators of the thigh at the hip joint—This group indirectly supports the arch because it acts to prevent the thigh from medially rotating. When the weight-bearing foot pronates, because the foot is planted on the ground, the calcaneus of the subtalar joint is not fully free to move, therefore the talus moves as well. This is a closed-chain reverse action of the proximal talus upon the distal calcaneus, and results in medial rotation of the talus. Because the ankle (talocrural) joint does not allow rotation, the tibia medially rotates with

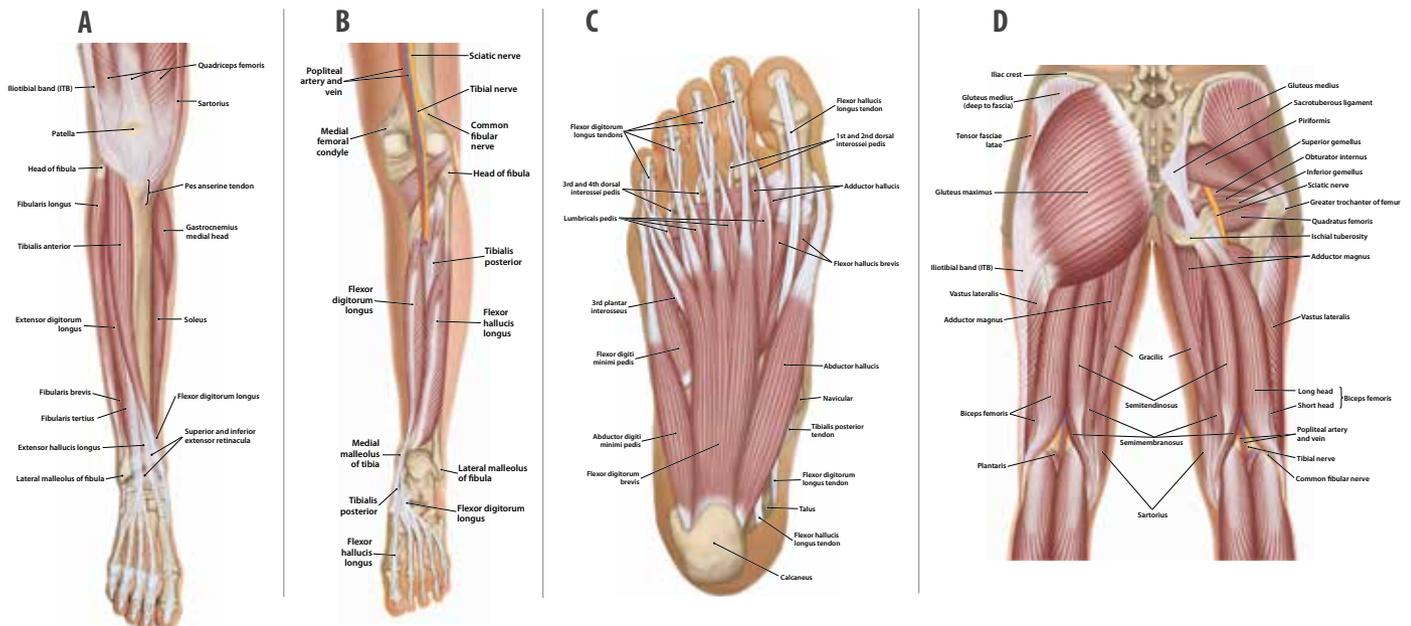
the talus; and because the extended knee joint also does not allow rotation, the femur medially rotates with the tibia. Therefore, hip joint lateral rotation musculature can support the arch by acting to brake/prevent medial rotation of the femur/tibia/talus. Hip joint lateral rotation musculature includes the posterior gluteal musculature, the deep lateral rotator group (piriformis, quadratus femoris, superior and inferior gemellus, and obturator internus and externus), and the sartorius. (Figure 5D)

It should be mentioned that hip joint abductor musculature can also be important for maintaining the arch of the foot. If this musculature is weak, the thigh can fall into adduction, this causes a genu valgus force (abduction of the leg at the knee joint), which tends to result in medial rotation of the thigh, and therefore the leg and talus, promoting arch collapse. Abductors of the hip joint are the gluteal muscles, tensor fasciae latae (TFL), and the sartorius.

Another contributor to overpronation is tight pronator (evertor) musculature (fibularis musculature and extensor digitorum longus), which can pull the foot into pronation on that side, making it more difficult for the supinator musculature to support the arch structure.

Most all fascial ligamentous tissue that is located on the plantar side of the foot helps to support the arch. Most notable are the long and short plantar ligaments, the spring ligament, the intertransverse metatarsal

Figure 5 Muscles that support the arch. A, Superficial view of the anterior leg. B, Deep view of the posterior leg. C, Superficial view of the plantar foot. D, Deep view of the posterior pelvis. *Muscolino, JE. Kinesiology: The Muscular System Manual: The Skeletal Muscles of the Human Body, 3ed. Elsevier.*



ligaments, and the plantar fascia (Figure 6). If this fascial ligamentous tissue is excessively lax, perhaps due to genetic factors or to forces placed upon it during life, it will not be able to hold the bones in their proper posture, especially during weight-bearing postures, and the arch will collapse.

As stated, the collapsed arch of overpronation essentially occurs because of the inability of the musculature and ligament complex to support the arch structure, especially when bearing weight. Therefore, any factor that increases downward force through the arches will tend to exacerbate this condition. First among these factors is being overweight, which increases the weight that is borne through the arches. Carrying heavy loads/objects acts in a similar manner because the weight of whatever is being carried must ultimately pass through the arches of the feet.

Another factor is a turned out posture of the foot. This usually occurs because of excessively tight baseline tone of deep lateral rotation musculature of the thigh at the hip joint (e.g., piriformis). When walking with a turned out posture, the person's weight passes more directly over the medial longitudinal arch, increasing the likelihood that it will collapse (Figure 7). Ironically, the baseline tone of the lateral rotation musculature of the hip joint might be tight enough to cause the unhealthy turned out posture of the foot, but not strong enough to prevent the weight-bearing foot from overly pronating as a result of this altered posture. It is important for the lateral rotation musculature to have a healthy and loose baseline tone, but to be strong enough to contract to prevent overpronation when needed during the gait cycle.

Proper footwear can be another factor. If a person does overly pronate, then wearing shoes that have little or no arch support can allow the excessive pronation to occur. Wearing high-heeled shoes can also exacerbate this problem because they shift body weight to be borne more anteriorly in the foot, increasing force through the transverse arch, causing it to collapse. This will result in weakness of the entire arch structure of the foot, including the medial and lateral longitudinal arches, thereby resulting in overpronation.

Finally, the longer that a client has had an overly pronated foot, the more likely it is that fascial adhesions accumulate that exacerbate the condition by holding the foot in a posture of excessive pronation. This is especially true for rigid flat foot, but might also become a factor that causes a supple flat foot to gradually transition toward becoming a rigid flat foot.

SIGNS AND SYMPTOMS

The first and most obvious sign of overpronation is a flat

There are two types of overpronation/flat foot: rigid flat foot and supple flat foot.



Figure 6 Fascial ligamentous tissues on the plantar surface of the foot that help to support the arch. Medial view. Note: The intertransverse metatarsal ligaments are not seen.

Figure 7 Walking with the foot turned out increases weight-bearing force directly over the medial longitudinal arch of the foot, increasing the likelihood that the foot will overly pronate. *Courtesy Joseph E. Muscolino DC*





Figure 8 Effects higher in the body of overpronation of the right foot. A, Medial rotation of the entire lower extremity; note the orientation of the right patella compared to the left. B, Overpronation often results in a dropped pelvis (iliac crest) on that side as well as a compensatory scoliosis. *Courtesy Joseph E. Muscolino DC*

foot/dropped arch (See Figure 4). The supple flat foot will have an arch when not weight-bearing but will be seen to lose the arch upon weight-bearing. A rigid flat foot will be flat whether the person is bearing weight through the foot or not. Because overpronation results in medial rotation of the talus, leg, and thigh, the client's lower extremity will usually excessively medially rotate when standing (Figure 8A).

Pain does not necessarily accompany this condition, but it often does. A supple flat foot results in the arch excessively dropping each time the foot strikes the ground. This causes the soft tissues on the underside of the foot to be forcefully stretched each time the foot contacts the ground, tugging at their attachments and likely causing either spasms in the plantar intrinsic musculature (due to the muscle spindle reflex) and/or inflammation of the plantar fascia (known as plantar fasciitis). Either of these conditions can cause pain, especially upon weight-bearing. Because these tissues attach to the underside of the calcaneus, the stretching forces placed upon them will be transmitted to the calcaneus, possibly leading to a heel spur (due to Wolff's Law: the deposition of calcium in response to physical stress). Therefore, overpronation is often accompanied by plantar intrinsic musculature spasm, plantar fasciitis, and/or heel spur.

Overpronation can also cause ramifications farther up the client's body. Dropping the arch tends to increase genu valgus (knock-kneed) posture, which places increased tension stress on the medial knee and increased compression stress on the lateral knee. Further, if the overpronation is present on only one side, or if it is present to a greater degree on one side than the other, then the pelvis on that side will drop. This places an asymmetrical force on the client's sacroiliac joints and also often results in a compensatory scoliosis to bring the head back to level (Figure 8B).

ASSESSMENT

Assessment of overpronation follows from the signs and symptoms of the condition. The most important assessment tools are static and dynamic postural assessment, which will reveal the characteristic dropped arch.

For static postural assessment, have the client stand facing you, a few feet away, and note the height of the arches, including the relative symmetry of the arches of the left and right feet (Figure 9A). Note also the orientation of the patella on each side. Patellar orientation will follow the rotation of the femur/thigh; with overpronation, the patella on that side will be oriented more medially (See Figure 8A). If a dropped arch is found, postural examination should also look to correlate the presence of genu valgus.

Static postural assessment can also be done from the posterior perspective. In this case, instead of viewing the arches directly, look at the Achilles' (calcaneal) tendons; each tendon should be vertical. With a collapsed arch, the Achilles' tendon will bow inward instead (Figure 9B). The medial malleolus will also usually be seen to jut inward. If the dropped arch is unilateral or greater on one side than the other, postural examination should include evaluation of a dropped iliac crest and possible compensatory scoliosis as well (See Figure 8B).

Dynamic postural assessment can be even more effective than static postural assessment. With the client facing you, ask the client to march in place. It is important that the client moves slowly and lifts each foot high enough (close to the height of the other knee) so that you have time to observe how much the weight-bearing arch drops each time the foot strikes the ground. If you have enough space, for example a long hallway, the client can be asked to walk while you observe their lower extremities. As the client walks toward you, assess how much the medial longitudinal arch drops and the patella medially rotates when the foot hits the ground. As the client walks away from you, assess the degree of bowing in the Achilles' tendons and the excursion of the medial malleolus as the foot hits the ground.

When evaluating pronation motion, keep in mind that when standing, marching, or walking (in other words, upon weight-bearing), the foot should pronate to some degree, and therefore the arch structure should drop somewhat. Because there is not universal consensus on exactly what subtalar joint neutral posture is, and exactly how much pronation is healthy versus unhealthy, it is best to eyeball this motion, using your judgment. It is also helpful to compare left and right sides; symmetry should be present.

Passive range of motion assessment of the foot at the subtalar and ankle joints can also be done, with particular attention to the client's inversion and eversion ranges. Inversion is often limited in clients who overly pronate; eversion is often excessive.

Hands-on palpatory examination should then be done. Check for the presence of tightness and/or myofascial trigger points (TrPs) in the associated musculature. It is important to check all muscles that help to support the arch of the foot (i.e., foot supinators and hip joint lateral rotators, and their synergists [see Table 1]) because they might develop TrPs as they attempt to control the excessive pronation. Similarly, palpate the antagonists to these muscles (i.e., foot pronators and hip joint medial rotators, and their synergists) to see if their baseline tone is contributing directly to the overpronation; if they are tight/overly facilitated, they might be creating forces that pull the foot into excessive



Figure 9 Static postural examination of overpronation. A, Anterior view. B, Posterior view. *Courtesy Joseph E. Muscolino DC*

ARCH IMPRINT ASSESSMENT

A fun and instructive assessment for the arch structure of the foot can be done with a little oil and construction paper. Place a film of oil on the plantar surface of the client's foot and then ask the client to step on colored construction paper. When the client lifts the foot, an imprint of their arch will be visible on the paper. This can then be repeated for the other foot. These imprints can be shown to the client to demonstrate the posture of their arches (see accompanying figure). When performing this assessment, be sure to instruct the client to place their weight evenly on both feet as they place the oiled-foot down.



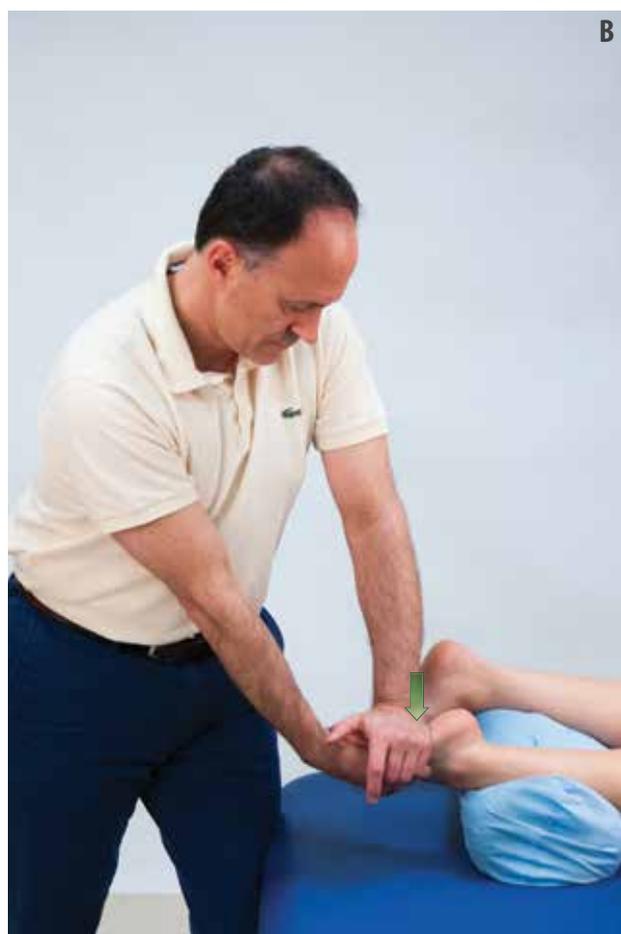


Figure 10 Joint motion palpation (joint mobilization) of the foot with force being directed from plantar to dorsal in direction. A, Reinforced thumb pad contact. B, Pisiform contact. *Courtesy Joseph E. Muscolino DC*

pronation. Palpatory examination should also be performed to assess for fascial adhesions within the plantar surface of the foot. Generally speaking, the more fascial adhesions, the more “rigid” the foot is.

Finally, it is important to assess for joint play/mobilization of the joints of the foot. Because overpronation usually results in “dropping” of the tarsal bones (as the arch structure drops, the tarsal bones drop), it is especially important to assess the motion of the bones to move from plantar to dorsal in direction (Figure 10). Mobilization of the tarsals from plantar to dorsal will usually be restricted in an overpronating foot, especially a rigid flat foot or a chronic supple flat foot.

In addition to physical examination, it is also important to conduct a verbal history to determine whether the client has any habitual postures that might contribute to overpronation. For example, sitting cross-legged with the ankle of one leg placed on the thigh of the other, or driving with the heel of the right foot placed in front of the brake and the thigh turned out so that the toes of the foot are on the gas pedal; these postures tend to promote a turned-out posture of the foot. A habitual pattern of standing on one leg with body weight shifted to that side will tend to increase weight-bearing and therefore physical stress to the foot on that side. Checking the client’s shoes for excessive wear on the lateral side of the heel can also be helpful.

MEDICAL DIAGNOSIS

Overpronation is a dysfunctional postural condition of the musculoskeletal system, so no further medical diagnosis/assessment is usually needed. However, if X-Rays are done, they can support the assessment by showing the dropped posture of the bones of the foot. Both weight-bearing and nonweight-bearing films should be done. A rigid flat foot will demonstrate the dropped arch on both weight-bearing and nonweight-bearing films, whereas a supple flat foot will demonstrate the dropped arch only on the weight-bearing film.

DIFFERENTIAL ASSESSMENT

When a client presents with overpronation, it is important to differentially assess whether it is due to a rigid or supple flat foot. It is also important, as mentioned, to assess the possible presence of the postural affects of overpronation higher up in the body. Look especially for genu valgus, medially rotated femur/thigh, and dropped iliac crest on the side of overpronation, as well as a possible compensatory scoliosis.

MANUAL TREATMENT

Because overpronation, whether it is a supple or rigid flat foot, usually does not directly cause pain, and even

its effects farther up the body will probably not cause pain for many years or decades, it is likely that the client's condition will be chronic by the time that it is addressed. For this reason, there is a good chance that it will be stubborn and resistant to treatment. Chronicity, not severity, is usually the biggest determinant to how easily a client's condition responds to treatment. With chronicity comes increased fascial adhesions as well as entrenchment of the neural patterning of muscle memory tone. For this reason, treatment of an overly pronating foot must be consistent.

A good guideline for all rehabilitative manual therapy care is to treat the client two times per week until the desired outcomes have been met. Treatment frequency of twice-a-week is not common in the world of massage, but is the norm in all other musculoskeletal rehabilitative fields, and should be adopted if clinical orthopedic massage is being done to remedy a musculoskeletal pathologic condition. Treating a client once per week might feel good temporarily, but is often ineffective at creating true and lasting improvement.

For a supple flat foot, manual therapy's role is indirect. By employing both soft tissue manipulation and stretching, the goal is to loosen tight musculature and eliminate TrPs. This can both relax the baseline tone of muscles that are pulling toward pronation as well as strengthen muscles that support the arch by increasing the efficiency of their contraction. Manual therapy should also be directed to any sequelae of overpronation, such as tight lateral rotation hip joint musculature or tight paraspinal musculature as a result of scoliosis, if present.

For the rigid flat foot, as well as the supple flat foot that is becoming more rigid, manual therapy's role is more direct. It is performed to loosen fascial adhesions that are locking the bones in a position of pronation. In these cases, deeper soft tissue manipulation into the plantar side of the foot, stretching of the tight muscles, and arthrofascial stretching (Grade IV soft tissue joint mobilization) are called for. And because stretching is always more effective if the soft tissues are warmed up first, moist heat is also valuable as a modality. Depth of pressure should always begin as light to moderate, but will usually have to transition to being deeper to access long-standing fascial adhesions and deeper tight musculature that are likely with a rigid flat foot or even a chronic supple flat foot.

As important as manual therapy can be for overpronation, it can never fully and permanently resolve the condition. The primary objective of manual therapy is to loosen the tight musculature and other taut soft tissues. However, this only addresses one part of the problem, and usually the lesser part. The other aspect of

this condition is the weakness of the musculature that must support the arch structure against the forces that cause overpronation. These muscles must be strengthened. Therefore, referral to a fitness trainer, physical therapist, yoga or Pilates instructor, or the recommendation of specific exercises to strengthen the muscles that support the arch (see Table 1) is imperative (for more on the strengthening of these muscles, see the *Self-care for the client* section below).

PRECAUTIONS/CONTRAINDICATIONS

There are a few precautions when working on a client with overpronation. Care must be exercised if working near the fibular head because of the presence of the common fibular nerve; and care must be taken if working the medial ankle region because of the presence of the tibial nerve and artery. If work is being done in the gluteal region for the deep lateral rotators of the hip, be aware of the location of the sciatic nerve near the piriformis and lying superficial to the quadratus femoris.

One precaution and possible contraindication is to be careful when attempting to make any structural change to a middle-aged or elderly person's foot. Their tissues are less elastic than a younger person's; and if they have been overpronating for decades, it is likely that all the tissues throughout their body have adapted to this structure. A good guideline is to exercise caution if the

SUMMARY OF MANUAL TREATMENT PROTOCOL FOR OVERPRONATION

- 1 Heat, soft tissue manipulation, and stretching of the muscles of the leg/foot (especially the pronators)
- 2 Heat, soft tissue manipulation, and stretching of the plantar musculature
- 3 Arthrofascial stretching (joint mobilization) of the foot from plantar to dorsal in direction, especially for a rigid flat foot
- 4 Soft tissue manipulation and stretching of the hip joint musculature (especially lateral rotators, medial rotators, adductors, and abductors)
- 5 Assess and treat the spine if appropriate (especially for compensatory scoliosis)
- 6 Strengthen (or refer out to strengthen) the weakened/inhibited musculature

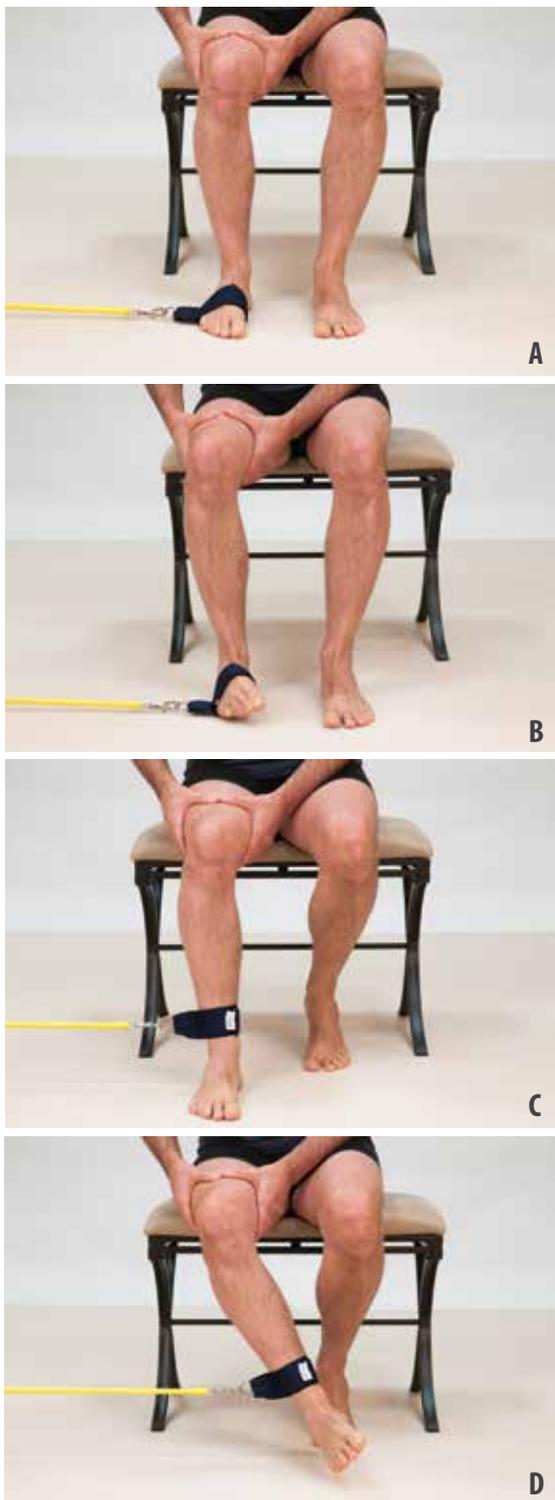


Figure 11 Resistance exercise for overpronation using elastic tubing. A and B, Performing inversion of the foot at the subtalar joint against resistance. A, Starting position. B, Inversion of the foot. C and D, Performing lateral rotation of the thigh at the hip joint against resistance. C, Starting position. D, Lateral rotation of the thigh. *Courtesy Joseph E. Muscolino DC*

client is over 50 years of age. The older the client, the more slowly and carefully the treatment regimen should be introduced. Changing something as fundamental as the foot's foundational posture for the body might cause unwelcome compensatory adaptations above. Beyond these precautions, be sure to gradually transition from light to deep pressure for all clients when working the plantar side of the foot because many people are tender in this region.

SELF-CARE FOR THE CLIENT

When working with a client for the treatment of overpronation of the foot, client self-care is extremely important. Supple flat foot is essentially a condition of weakness of the ligament complex and musculature that support the arch structure of the foot. Therefore, strengthening the weak musculature is imperative if the condition is to be resolved. The specific musculature that should be assessed and strengthened if weak is given in Table 1. The challenge is that this musculature must be strengthened to the point that it can not only do its originally intended job, but also be strong enough to compensate for the weakened fascial ligament complex. If this is possible, it will require dedication on the part of the client. The major muscle groups to strengthen are the supinators (invertors) of the foot, and the lateral rotators and abductors of the thigh at the hip joint.

One very easy, inexpensive, and low-tech way to accomplish home-care strengthening is to use elastic tubing or bands to provide resistance when performing the exercise (Figure 11). One end of the elastic tube can be stabilized by being placed in a closed door (or by being tied to a stable structure). The resistance of the exercise is determined by the length of the tube, which is easily altered by changing the distance that the client sits from the door.

As a general rule, these exercises should be performed in four phases. Phase one involves performing the exercises slowly through a short range of motion; phase two is done by moving through the same short range of motion, but quickly. Phase three is performed slowly through a large range of motion; and phase four is performed by moving quickly through a large range of motion. Begin by performing each exercise for approximately 15-30 seconds, gradually working toward 60 seconds. Once each phase can be comfortably and proficiently performed, direct the client to transition to the next phase. As a general guideline, each phase should be performed approximately 2-4 weeks before the client is ready to graduate to the next phase. Once all four phases have been mastered, your client can begin again, this time with greater resistance.

One excellent self-care exercise for the intrinsic plan-

tar musculature of the foot can be performed with a towel. Instruct the client to be seated, bare-footed, with a towel placed in front of them on a hardwood, tile, or linoleum floor. Ask the client to flex their toes, scrunching up and drawing the towel toward them; then relax the toes and release the towel. Have the client repeat this until the entire towel has been drawn toward them (Figure 12). This exercise can be repeated as desired.

Another excellent exercise for the intrinsic plantar musculature can be performed using marbles or small balls. Instruct the client to be seated, bare-footed, with marbles/balls on the floor in front of them. Ask the client to pick up a marble, one at a time, and then place it back down (Figure 13). This can be repeated as long as desired.

Finally, it is important to discuss with the client postures to be avoided, proper shoes or orthotics to wear (for more on orthotics, see the next section, Medical Treatment), and if the client is obese, the possibility of losing weight. If you are schooled in orthopedic taping, this modality can also be valuable. The importance of taping is not to temporarily support the arch, but rather to help the client's nervous system receive proper proprioceptive feedback so that it can begin to re-learn the proper static posture and dynamic acture between pronation and supination.

MEDICAL TREATMENT

Overpronation is a postural dysfunction pattern, therefore there really is no “medical” approach. If a podiatrist is consulted, it is likely that orthotics to support the client's arches and control excessive pronation will be recommended. Generally, orthotics can be divided into two categories: soft and rigid. Rigid orthotics better control the client's foot motion, but do not provide shock absorption for the joints of the lower extremity and spine; whereas soft orthotics provide excellent shock absorption but do not control the client's pronation as well. The best orthotic to use will vary from client to client. There is also the choice of custom made/fitted orthotics that can be quite expensive, versus pre-made store-bought orthotics that cost far less. Custom fitted orthotics are superior, but their cost may be prohibitive for the client. Often, store-bought orthotics will work perfectly fine. Again, the decision must be made on a client-by-client basis.

It should be stated that the decision to wear orthotics is a controversial one. Orthotics are a passive brace that do little or nothing to retrain the client's body to stop overpronating. In fact, it could be argued that they do harm in that they remove the need for the client's arch support musculature to contract, thereby causing it to further weaken. The same argument could be made

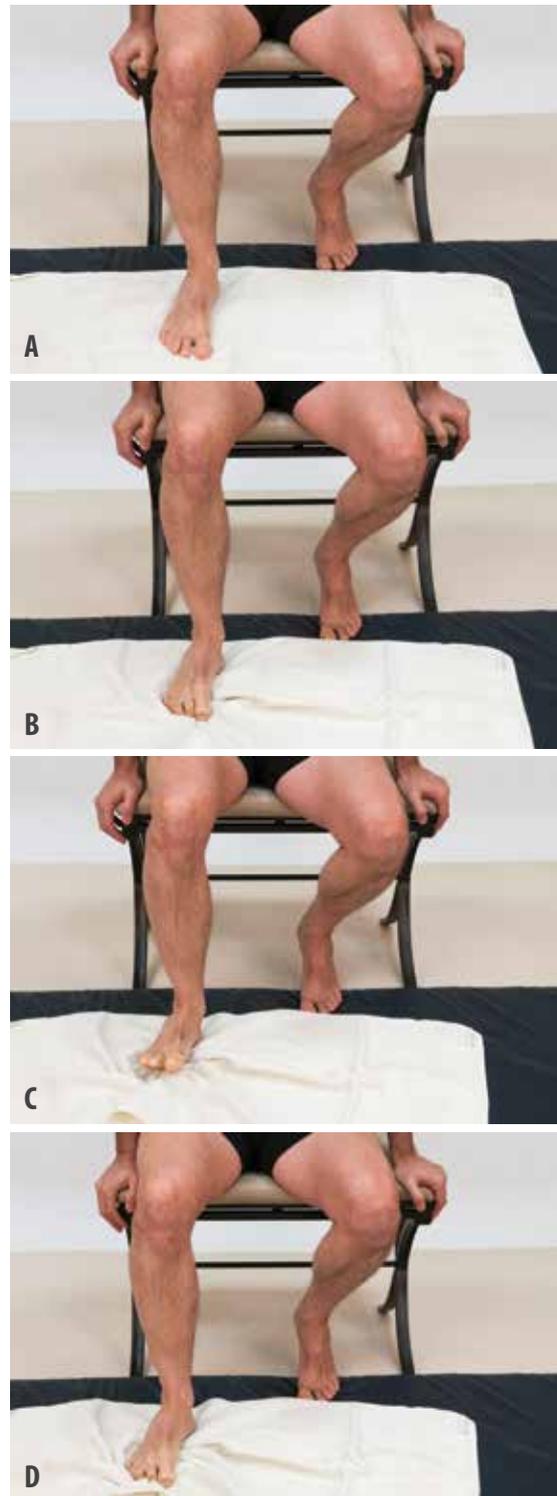


Figure 12 Towel scrunching exercise for the plantar intrinsic musculature. A, Starting position. B, Flex toes and draw towel toward you. C, Relax toes. D, Flex toes and draw towel toward you again. *Courtesy Joseph E. Muscolino DC*



Figure 13 Marble pick-up exercise. A, Gripping the marble. B, Picking up the marble. *Courtesy Joseph E. Muscolino DC*

for shoes with sturdy arch support. There is merit to this argument. However, if the client's musculature cannot be retrained, or the client is simply not interested in attempting the retraining program, then a passive support is likely better than the effects of chronically overpronating. If the client is interested in strengthening the arch structure of the foot, then as this goal is being reached, gradually transitioning the client toward minimalist shoes can aid in the demand upon the musculature to strengthen.

CASE STUDY:

Kerrati is a 36 year-old manager who works at a retail store. She came in for wellness massage, but during the postural examination, the therapist noticed that Kerrati's right arch drops markedly upon weight-bearing. Further, her right iliac crest is low and she has a mild lumbar scoliosis (convexity to the right). Kerrati does not report experiencing pain in her right foot or elsewhere in her body.

After finding the overpronation, the therapist performed a palpatory exam and found tightness in Kerrati's plantar foot as well as myofascial TrPs in Kerrati's right-sided tibialis anterior, fibularis longus, gluteus medius, upper gluteus maximus, and piriformis. Tightness was also found in the musculature (erector spinae, transversospinalis, and quadratus lumborum) located in the concavity of the scoliosis, in the left low back. With palpation into these areas, Kerrati experienced tenderness and mild pain. Range of motion examination showed slightly decreased inversion of the right foot. The therapist also performed motion palpation assessment of the tarsal and metatarsal bones on the plantar side of the foot, and found restricted motion generally for the right foot compared to the left, especially when assessing mobilization of the tarsals from plantar to dorsal in direction.

Given the assessment of overpronation of Kerrati's right foot, along with the dropped iliac crest and compensatory scoliosis, the therapist recommended two one-hour massages per week for four weeks and one one-hour massage per week for the following four weeks. The therapist also referred Kerrati out to a fitness trainer with the request that the fitness trainer specifically focus on strengthening all the musculature that supports the arch structure of the foot.

With Kerrati lying supine, soft tissue manipulation was performed for the anterior and lateral compartments of the leg for approximately 5-10 minutes, gradually transitioning from mild to deeper pressure. Kerrati was then turned prone and soft tissue manipulation was performed for the posterior compartment of the leg and plantar foot for approximately 5-10 minutes, again gradually transitioning from mild to deeper pressure to access the deep musculature on the posterior side. This was followed by moist heat to the plantar foot and posterior leg for an additional 10-15 minutes while the therapist worked Kerrati's hip joint lateral rotation, abduction, and adduction musculature, as well as the lumbar spine musculature.

The therapist then stretched Kerrati's foot into supination and pronation, as well as plantarflexion and dorsiflexion. After stretching was done, the therapist performed arthrofacial stretching (Grade IV soft tissue joint mobilization) to Kerrati's foot, with emphasis placed on mobilizing the tarsal bones from the plantar to dorsal direction. With the remaining time, the therapist worked the client's other-side lower extremity.

Each session was carried out in a similar manner. As Kerrati gradually improved, increasing depth of pressure and assertiveness of stretching and joint mobilization was employed. Kerrati was given self-care stretches for her low back and her hip joint deep lateral rotators; and she was told to perform these stretches two to

The primary objective of manual therapy is to loosen the tight musculature and other taut soft tissues.

three times per day after a hot shower or other form of moist heat application. She was also recommended to perform the towel scrunching and marble pick-up exercises for her feet. Finally, proper posture at work and home was discussed, including the recommendation to find shoes with better arch support, with the long-term goal to transition toward minimalist shoes.

At the end of eight weeks, Kerrati's tarsal and metatarsal bones were much more mobile, and many of the TrPs in her leg, buttock, and low back were improved. Further, her tenderness to palpation in these regions was diminished approximately 80%. Kerrati is still working with her trainer, who is reporting that the strength of the targeted muscles is improving nicely.

For proactive self-care with the goal of continuing to improve the overpronation dysfunction of her right foot, Kerrati continues to receive clinical orthopedic massage once or twice each month and continues to work out with her trainer twice per week. Whether this plan will be successful toward entirely resolving her overpronation will take many months or longer to determine. However, catching this condition relatively early bodes well for improvement and is critically important to correct the compensatory postural changes above. ■



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