Understanding Equinus

This profound causal agent is commonly overlooked and under-treated.

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Goals and Objectives

After completing this CME, the reader should:

1) Understand the definition of equinus.

2) Understand the evaluation of equinus.

3) Understand the treatment of equinus based on evidence based medicine.

4) Become more aware of the role of equinus in foot and ankle pathology.

5) Include equinus treatment as part of a global treatment plan, when indicated.

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*Following this article, an answer sheet and full set of instructions are provided (pg. 166).—**Editor***

Equinus has been described as "the most profound causal agent in foot pathomechanics and is frequently linked to common foot pathology," and also has been described as "the greatest symptom producer of the human foot;" yet it is commonly overlooked and under-treated. The importance of equinus cannot be overstated, and its management is crucial to treating of the underlying pathology of all the following foot and ankle conditions as

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documented in the literature:

Heel spur syndrome/plantar fasciitis, Achilles tendinopathy, posterior tibial tendon dysfunction, diabetic foot ulcers, Charcot neuropathy, metatarsalgia, Morton's neuroma, lesser MPJ pathologies—PDS, capsulitis, hallux valgus, hammer digit syndrome, ankle fracture/sprains, Sever's disease, pediatric flatfoot deformity, osteoarthritis forefoot/midfoot, 1st ray hypermobility, pes plano valgus, hallux limitus, sesamoiditis, lateral column syndrome, Freiberg's infarction, and forefoot callus. So, if equinus is so prevalent, how come there is often a failure in recognition, association to pathology, and treatment of this condition?

There are several factors at play that all lead to this underappreciation and lack of treatment with equinus. It all starts with the definition of equines, as there is no standard definition. The next crucial factor is the lack of appreciation of the relationship between equinus and the above-listed pathologies. Finally, the lack of treatment is related directly to ineffectual conservative management of the condition. Let's take a journey through equinus to fully understand the condition, and hopefully therefore bring to it the respect it is due.

Anatomy

Most pathologies of the foot and ankle start with anatomy. The anatomy of the triceps surae consists of the gastrocnemius, soleus, and plantaris muscles. The gastrocnemius muscle originates on the posterior aspect of the femoral condyles and posterior knee capsule with the medial head being the larger of the two, and descending further distally. The gastrocnemius muscle crosses the knee, ankle, and subtalar joints. This is a very important factor; the multi-joint crossing is directly related to the most common form of equinus, gastrocnemius equinus. The aponeurosis of the gastrocnemius muscle is anterior to the muscle. Its primary blood supply is from the popliteal and sural arteries, and it is innervated by the tibial nerve. The gastrocnemius primary act to supply power for propulsion, knee flexion, and plantarflexion of the ankle joint (Figure 1).

There is a well-documented zone of hypovascularity 4-5 cm proximal to the insertion of the Achilles tendon.

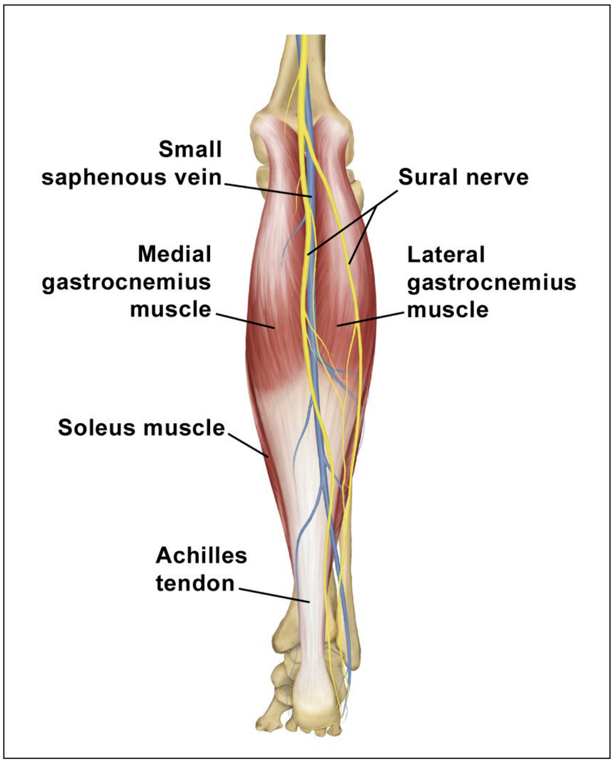

Figure 1: Posterior view of the GSC complex and related anatomical structures.

The gastrocnemius muscle crosses the knee, ankle, and subtalar joints.

The soleus originates on the posterior aspect of the head of the fibular, the middle one-third of the medial border of the tibia, the soleal line, and the interosseous membrane. The aponeurosis of the soleus is posterior to the muscle. The soleus only crosses the ankle and subtalar joints. The soleus is innervated by the tibial nerve and its arterial supply is that of the tibial, peroneal, and sural arteries. The primary function of the sural artery is to stabilize the leg onto the foot and plantarflex the ankle joint.

The plantaris tendon originates medial and superior to the lateral head of the gastrocnemius muscle at the lateral head of the femoral condyle, coursing lateral to the gastrocsoleal complex and medial to it. The plantaris tendon can be absent 7 % of the time.

The Achilles tendon is the continuation of the aponeurosis of the gastrocnemius and soleus merging together. forming the largest, thickest, strongest tendon in the body, approximately 15 centimeters long. The tendon inserts into the middle one-third of the posterior aspect of the calcaneus with the plantaris tendon inserting medial to the Achilles tendon. There is a retrocalcaneal bursa between the Achilles tendon and the calcaneus. The fibers of the Achilles tendon rotate laterally approximately 90° so that the gastrocnemius fibers insert primarily laterally and the soleus fibers insert primarily medially. The tendon is surrounded by a tendon sheath which allows gliding of the tendon, and below this sheath is the paratenon, which protects and nourishes the tendon. The vascular

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supply of the Achilles tendon is from the myotendonous junction, the paratenon, and the calcaneal periosteum. There is a well-documented zone of hypovascularity 4-5 cm proximal to the insertion of the tendon.

Figure 2: The Silfverskiold test is used to evaluate for equinus. This demonstrates evaluation of the dorsiflexion of the ankle joint with the knee extended.

Figure 3: Evaluation of the ankle joint dorsiflexion with the knee bent removes the pull of the gastrocnemius muscle and allows the practitioner to determine whether equinus is gastrocnemius equinus or gastroc-soleal equinus.

Definition

After understanding the anatomy, the definition becomes the next most crucial factor and is surprisingly difficult, especially among different specialties. The definition of equinus ranges from -10° to + 22° in the literature, with +10° as a consensus of thirteen different studies. Sgarlato[36] in *The Journal of American Podiatric Medical Association* in 1975 first described the definition as +10° with the subtalar joint in neutral position and the midtarsal joint locked.

Pseudoequinus

There are two primary types of equinus—muscular and osseous, with subgroups of each kind. In the muscular group there can be either spastic or non-spastic equinus. Either of these subgroups of spastic or non-spastic equinus can further be broken down into gastrocnemius or gastro-soleus equinus. The osseous forms of equinus include: anterior tibiotalar exostosis (best seen on a lateral charger view on X-ray), distal tibial-fibular osseous bridging from prior trauma, pseudoequinus and combined equinus. Pseudoequinus occurs in the cavus foot structure where ankle joint dorsiflexion occurs to dorsiflex the forefoot, which is plantarflexed to the rearfoot. The ankle dorsiflexion used to do this then limits the amount available for normal ambulation, therefore the term pseudoequinus. The combined equinus is just a combination of one type of muscular and osseous equinus.

Clinical Evaluation

Evaluation of equinus clinically is one of the primary stumbling blocks between professions that inhibit effective communication. The Silfverskoild test is what is used to determine the type of equinus. In this examination, the subtalar is placed in neutral position and the midtarsal joint is locked by supination of the forefoot. The ankle is dorsiflexed maximally with the knee in full extension and then checked with the knee in flexion (Figures 2 and 3). If the ankle joint dorsiflexes greater than 90° with both the knee extended and flexed, there is no equinus. If the ankle joint dorsiflexes greater than 90° with the knee flexed by less than 90° with the knee extended, the result is gastrocnemius equinus. If the ankle dorsiflexion is less than 90° with both the knee flexed and extended, then it can either be gastroc-soleus equinus or osseous equinus. This is determined by the quality of the end range-of-motion and with a charger dorsiflexion stress lateral ankle x-ray. A soft end range-of-motion is more likely a gastroc-soleus equinus, especially if no anterior ankle impingement is noted on the x-ray.

If the ankle joint dorsiflexes greater than 90° with the knee flexed by less than 90° with the knee extended, the result is gastrocnemius equinus.

Biomechanics of Equinus

Understanding the biomechanics of equinus is crucial to getting an appreciation of the devastation it has on the foot pathomechanics. The center of pressure is about 6 cm anterior to the ankle, roughly over the dorsal 2nd metatarsal-cuneiform joint. This would make us fall forward in normal standing, but that reaction is is negated by the pull of the plantarflexors. The triceps surae has been documented to be the primary plantarflexor of the ankle joint and therefore offsets the anteriorly displaced center of pressure. It has further been demonstrated with equinus that the center of pressure moves about 3 cm distally and 3 mm laterally (Figures 4 and 5).

The important concept lies in the relation of the subtalar axis to the center of pressure and the subtalar axis to the insertion of the Achilles tendon. The Achilles tendon inserts

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medially to the subtalar axis and its distance from the axis is about the same as the laterally placed center of pressure to the subtalar axis in a foot with a normal subtalar axis and no equinus. The medial position of the Achilles creates a supinatory moment, while the lateral center of pressure due to ground reactive forces (GFR) creates a pronatory moment. These two cancel each other out, providing a rectus foot structure.

When equinus is present, the distal and lateral positioning of the center of pressure in relation to the subtalar axis creates an increased pronatory effect on the foot due to GRF, which is not offset by the supinatory effect of the Achilles tendon. When the subtalar joint axis is more medially deviated, such as in a pronated foot, this further distances the center of pressure from the subtalar axis, causing even more pronatory deformity due to GRF. The opposite occurs in the supinated foot, where the subtalar joint axis is more laterally deviated to the point where even the center of pressure is on the subtalar axis, medial to the subtalar axix or just lateral to the subtalar axis. This puts both the Achilles and center of pressure in supinatory moments (or at least is a lesser pronatory moment than the supinatory moment of the Achilles tendon) due to GRF—therefore making a cavus foot worse over a period of time due to increased rearfoot varus, peroneal pathology, and subtalar instability.

Johnson and Christensen[17] examined the effects of equinus on first ray pathomechanics using cadaver weight-bearing models in their landmark series on first ray pathomechanics. Sensors were applied to each of the individual bones making up the medial column of the foot. Loading of the Achilles tendon was applied and then three-dimensional data were recorded for each segment of the medial column. The results showed plantarflexion of the talus and navicular, and dorsiflexion of the medial cuneiform and 1st metatarsal occurring through the naviculacuneiform joint. This occurs due to dampening of the effect of the peroneal longus tendon eversion of the medial cuneiform that leads to locking of the midtarsal joint. This lack of midtarsal joint locking leads to the above described medial column instability. This study showed that the effect of equinus is not a stretching of the plantar ligaments over a period of time that leads to first ray instability but, in fact, is a dampening of the peroneus longus function that leads to first ray hypermobility.

An important question that is often overlooked in the biomechanical discussion of equinus is the effect of pronation on the GSC.

An important question that is often overlooked in the biomechanical discussion of equinus is the effect of pronation on the GSC. Kevin Kirby, DPM says via personal communication, “accommodative shortening of the GSC will occur with prolonged medial deviation of the STJ axis and flattening of the medial arch of the foot.”

Sgarlato[36] described three types of compensation for equinus. The uncompensated equinus deformity manifests itself as a toe walker due to lack of ankle joint dorsiflexion and/or MTJ pronation to get the heel down to the ground. This accounts for about only 1% of equinus cases. In the partially compensated equinus deformity, the heel is on the ground but the tibia does not achieve 10 degrees of flexion to the ground. This results in an early heel-off gait pattern. When the equinus deformity is fully compensated, the result is the severely pronated, hypermobile foot with heel contact to ground and the tibia achieving more than 10 degrees of flexion to the ground. Heel-off in the fully compensated equinus deformity is normal.

The proximal pathologies associated with equinus are numerous and easily overlooked due to the profound distal pathologies that often overshadow these proximal deformities. Lumbar lordosis, hip flexion, knee flexion, genu recurvatum, and hamstring contractures have all been attributed to equinus. The more obvious distal pathologies that directly result from

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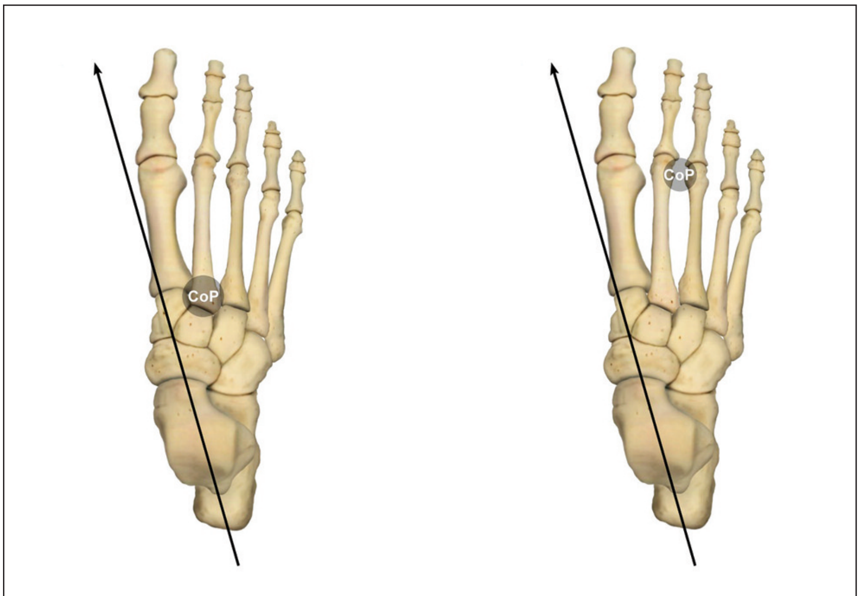

Figures 4 & 5: The center of pressure is located as shown on the left drawing approximately 6 cm distal to the ankle joint. With equinus deformity the center of pressure moves distal and lateral further away from the subtalar joint axis as shown on the right drawing.

Figure 6: In this side view of the EQ/IQ brace, you can see the hinge to be placed at the knee joint. When the brace crosses the knee joint, it allows for stretching of the entire GSC. The hinge allows for the brace to engage just the soleus if taken down or the entire GSC if left intact.

or have a relationship to equinus will be discussed with some of the well-documented literature.

In Hill's[15] article, the incidence of equinus with pathological conditions was studied by examining 209 new patient visits over a six week period of time. Twenty-nine patients were excluded from the study because they did not meet study criteria. Of the remaining 174 patients, six had normal ankle joint dorsiflexion, leaving 168 of the patients exhibiting equinus. Three of the patients had gastrocnemius equinus and 165 had GSC equinus. Their definition for equinus was less than 3-degrees dorsiflexion with knee extension. Their findings were that 96.5% of the patients with foot and ankle pathology exhibited equinus.

In Mueller's study, the forefoot pressures decreased 31% and the rearfoot pressures increased by 34%.

DiGiovanni[8] in the *Journal of Bone and Joint Surgery* (2002) examined ankle joint dorsiflexion in symptomatic patients and a control group, and the reliability of goniometer testing. The ankle joint dorsiflexion with the knee extended averaged 4.5 degrees in the symptomatic group and 13.1 degrees in the control group. The percentage of symptomatic patients with less than 5 degrees dorsiflexion was 65% and the control group was 24%, while the amount with less than 10 degrees dorsiflexion was 88% and 44%, respectively. The correct diagnosis via a goniometer, confirmed with an equinometer for the less than 5 degree group, was 76% for the symptomatic group and 94% for the control group, while the 10 degree group diagnosis was correct 88% and 79%, respectively.

This study has helped to clarify the definition of equinus, which has a wide range of definitions in the literature, with the most common definition being 10 degrees of dorsiflexion with the knee extended and the subtalar joint in neutral position and the midtarsal joint locked. This was originally described by Sgarlato[36] in *JAPMA* 1975. According to DiGiovanni's[8] findings, with ankle joint dorsiflexion of less than 5 degrees, the correct diagnosis was made 76% of the time in the symptomatic group, and the incorrect diagnosis was avoided in 94% of the time in the control group. I believe the standard definition for equinus should therefore be 5 degrees of ankle joint dorsiflexion with the knee extended based on the findings of this study. Arriving at a standard definition is crucial for equinus and is the first step to standardized treatment protocols.

Patel and DiGiovanni[25] found that 83% of plantar fasciitis cases were associated with equinus.

Aronow's[1] study was one of the first to not only explore the changes on forefoot and rearfoot pressures associated with equinus, but also to examine the midfoot changes as well. A load was applied to the GSC and then to just the gastrocnemius muscle, and then the changes in pressures were measured. In the GSC group, the rearfoot pressures decreased (18%) and the midfoot (38%) and forefoot (59%) increased. In the gastrocnemius group, the rearfoot pressures decreased (16%) and the midfoot (32%) and forefoot (50%) increased. These numbers were very consistent with other studies on the effect of equinus and forefoot pressure changes, such as Jones[18] in *The American Journal of Anatomy* in 1941 and Ward[43] in *The Journal of the American Podiatric Medical Association* in 1998. When the loads were removed, the pressures on the forefoot decreased 32% and the rearfoot pressures increased 32%. These additional findings were similar to those of Mueller[22] in *The Journal Bone and Joint Surgery* 2003, who measured the effect of a tendo-Achilles lengthening on pressure changes in the foot. In Mueller's study, the forefoot pressures decreased 31% and the rearfoot pressures increased by 34%.

Plantar Fasciitis and Equinus

The relationship with plantar fasciitis and equinus is well documented in the literature, with an estimated 2,000,000 cases of plantar fasciitis per year in the United States. Patel and DiGiovanni[25] found that 83% of plantar fasciitis cases were associated with equinus. Cheung, et al.[3] showed that equinus caused twice the amount of strain on the plantar fascia

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as body weight. This reaffirmed the close relationship between plantar fasciitis and equinus. Any treatment plan for plantar fasciitis must include equinus management.

Treatment of equinus can be broken down into either conservative care or surgical care. As with most pathologies, conservative care should be attempted initially. The two main forms of conservative care are manual stretching and bracing.

Radford, et al.[28] in a meta-analysis showed that calf muscle stretching provided a small but statistically significant increase in ankle joint dorsiflexion. Their analysis showed that 15 to 30 minutes per day provided the greatest amount of ankle joint dorsiflexion (3.03 degrees) for each of the three groups. Grady and Saxena[12] in their study had patients stretch once per day over a six-month period of time for 30 seconds, 2 minutes, or 5 minutes with the knee extended. The increase in ankle joint dorsiflexion for each group was 2.15, 2.3, and 2.7 degrees, respectively. These totals were not statistically significant, but when one takes into account the minimal amount of stretching done daily, the results are actually encouraging.

Hill[15] discussed the problems with manual stretching stating, "Active stretching requires detail in teaching the proper technique, and must be done at least four times a day at five-minute to eight-minute sessions. The most serious mistakes patients make during their previous attempts at stretching are inadequate stretch time and abducted foot position during the stretch. It is critical that the foot be adducted 10 degrees during the stretching to lock the subtalar-midtarsal joints for maximum benefit at the calf."

Night splints have long been the only mode of bracing for equinus treatment, but there are several flaws with them. First, they are designed to be used at night while sleeping and the most common sleeping position with these braces is on the side with knees bent. This means that the gastrocnemius muscle is not being stretched. Remembering that the gastrocnemius muscle crosses both the knee and ankle, it is most often the contracted structure. This accounts for the ineffective nature of night splints. Based on our personal experience, compliance with night splints is also very poor. These two factors led to the mediocre results attributed to night splints as described in the Evans[9] study, which showed only 6 of 20 patients achieving 10 degrees of dorsiflexion with the use of night splints.

According to Hill, It is critical that the foot be adducted 10 degrees during the stretching to lock the subtalar-midtarsal joints for maximum benefit at the calf.

EQ/IQ Brace

The answer we have developed to address ineffectual manual stretching and the failures of night splints is the EQ/IQ brace. This brace does not need to be slept in. We recommend using it 30 minutes in the morning and 30 minutes in the evening (15 stretching the GSC, and 15 minutes stretching the soleus). Let's discuss features of the EQ/IQ brace from proximal to distal. There is an above-the-knee extension with a hinge at the knee (Figure 6). The extension allows the knee to be locked into extension to stretch the gastrocnemius muscle. The hinge can be released to allow for ease of application and isolated stretching of the soleus. There is also a hinge at the ankle joint which allows the treating physician to set exactly the amount of dorsiflexion desired based on the patient's biomechanical exam (we see maybe 5 degrees the first month, going up to 10 degrees the second month, and if needed 15 degrees the third month).

The hinge goes from -30 degrees to +30 degrees, in 5 degree increments (Figure 7). As podiatrists, we measure everything from x-ray angles to forefoot varus position. Yet we slap on a night splint and tell our patients to pull as tight as they can. This makes no sense to us; we should have more control and precision over the treatment of this condition. We have made this brace ambulatory with a negative heel rocker sole, which allows ambulation with a fixed dorsiflexed position. The rocker soles are removable and come in different soles to match the amount of ankle joint dorsiflexion (i.e., 5, 10, and 15 degrees). There is an adjustable wedge that goes under the hallux to engage the windlass mechanism, which supinates the rearfoot and also puts additional stretch on the plantar fascia. The supination of the rearfoot is important as it puts the foot in the most desirable position for stretching of the GSC. These wedges come in various degrees (i.e., 35, 50, and 65 degrees) and Velcro to the foot bed (Figure 8). We made varying degrees of wedges to allow for those with hallux limitus or rigidus. The femoral and tibial uprights are adjustable for leg and thigh length and should be set by the physician. Finally, the standard foot beds will fit a small/medium size, but it can be replaced to an extended version that will fit a large/extra-large size.

A study by Evans showed only 6 of 20 patients achieving 10 degrees of dorsiflexion with the use of night splints.

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The time period we recommend is based on recommendations for manual stretching from the meta-analysis by Radford[28], but doubled. Most manual stretching is recommended to be done about 30 minutes per day. An hour a day is reasonable from a compliance standpoint, compared to 6 to 8 hours at night while disturbing the patient's sleep. The ambulatory component of the brace is important also. We foresee patients getting dressed in the morning while then putting on the brace and then stretching while performing their morning rituals. A similar scenario would play itself out for the evening stretching. Additionally, the ambulatory nature of the brace provides an active stretching component as well as a static stretching component. A final consideration is that this is not a brace that patients will be able to buy at a drug store or on the Internet. We have had patients complain about the expense of a night splint when they can find the same thing for about 20% of what is charged for the brace. This is a technical device that must be set, monitored, and adjusted by a physician. This brace will have a significant positive impact on a practice management component of your practice. Most importantly, it will provide you a better way to treat the most significant producer of foot and ankle pathologies—equinus deformity.

The surgical approach to equinus is well documented in the literature and focuses mainly on two different procedures, the tendo-Achilles lengthening (TAL) or gastrocnemius recession.

Surgical Approaches to Equinus

The surgical approach to equinus is well documented in the literature and focuses on mainly two different procedures, the tendo-Achilles lengthening (TAL) or gastrocnemius recession. The TAL approach most commonly utilized is the Hoke triple hemisection. This procedure employs three stab incisions starting one centimeter proximal to the insertion of the GSC, with two medial incisions and one lateral incision between the two medial incisions. The tendon is sectioned through the central portion and incised in the respective direction of the stab incisions. The tendon then slides to a lengthened position. This procedure is not without potential complications, such as under-lengthening, or much worse, over-lengthening.

The gastrocnemius recession is one of our favorite procedures and is well documented in the literature. We prefer the Bauman intramuscular approach to lengthening of the gastrocnemius aponeurosis. This provides controlled, sequential lengthening. The incision is placed at the medial aspect of the calf, midway between the posterior calf and anterior border of the tibia. The incision is typically 3-4 cm long and is deepened to the level of the deep fascia. The fascia is incised, revealing the gastrocnemius and soleus muscle bellies. Using a finger to identify the natural separation between the aponeurosis of the two muscles, an anal speculum is inserted to spread them apart. The foot is dorsiflexed with the knee extended, and a long-handled #15 blade is used to cut the proximal portion of the gastrocnemius aponeurosis, including the intramuscular septum. This is a complete release from lateral to medial. The foot is dorsiflexed and the positioned examined. If inadequate dorsiflexion is noted, a second more distal (1 cm distal to the initial release) incision is recommended over a soleus recession (this is based on the study by Herzenberg and Lamm[14] in *Foot and Ankle International* 2007.) The pre-operative group had 1 degree of ankle joint dorsiflexion with the knee extended, and after gastrocnemius recession, single and double dorsiflexion increased significantly (9 and 15 degrees, respectively). Adding a soleus recession only increased dorsiflexion by one degree—thus it is more effective to perform a double gastrocnemius recession.

The treatment of equinus alone has shown to be effective for foot symptomatology without doing anything to the pathology within the foot. Maskill, et al.[21] examined the effect of an isolated gastrocnemius recession on 29 patients (34 feet) that failed six months of conservative therapy. The measure was the visual analog scale (VAS) and there were three categories of patients (plantar fasciitis, midfoot pain, and arch pain). The VAS scores pre-operatively and post-operatively were as follows for each group: plantar fasciitis 8.1 to 1.9, midfoot pain 7.5 to 2.2, and arch pain 9.3 to 3.3. These drastic pain scale changes were the result of only a gastrocnemius recession without doing anything to the foot.

Equinus is an underlying factor in most of the pathologies associated with the foot and ankle and must be addressed either conservatively or surgically as part of the overall treatment plan for any condition associated with it. If the equinus deformity is left untreated, the condition is never fully treated and outcomes are not as high as they should be. Education of patients to the importance of equinus treatment in their overall treatment plan must be discussed to ensure compliance and the highest overall outcomes. **PM**

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Dr. DeHeer is in private practice in Central Indiana. He is the team podiatrist for the Indiana Pacers and the Indiana Fever and is on the editorial Board of Podiatry Today. He is the inventor of the EQ/IQ brace, President and Founder of Wound Care Haiti, and a medical missionary. Dr. DeHeer is President of the Indiana Podiatric Medical Association and continuing education chairperson. He is recipient of the 2011 APMA Humanitarian of the Year Award.

CME EXAMINATION

SEE ANSWER SHEET ON PAGE 167.

1) The triceps surae consists of the following muscles:
   - A) Gastrocnemius
   - B) Soleus
   - C) Plantaris
   - D) All of the above

2) The gastrocnemius crosses which of the following joints?
   - A) Knee
   - B) Ankle
   - C) Subtalar
   - D) All of the above

3) Which of the following is NOT an action of the gastrocnemius?
   - A) Dorsiflex the ankle joint
   - B) Supply power for propulsion
   - C) Flex the knee
   - D) Plantarflex the ankle joint

4) Which of the following joints does the soleus cross?
   - A) Ankle
   - B) Knee
   - C) Subtalar
   - D) A & C

5) The zone of hypovascularity of the Achilles tendon is located:
   - A) 4-5 cm proximal to the insertion of the tendon
   - B) 7 cm proximal to the insertion of the tendon
   - C) 1 cm proximal to the insertion of the tendon
   - D) At the insertion of the tendon

6) Muscular equinus includes:
   - A) Spastic equinus
   - B) Non-spastic equinus
   - C) Distal tibial-fibular osseous bridging
   - D) A & B

7) Osseous equinus includes:
   - A) Anterior spurring of the ankle joint
   - B) Distal tibial-fibular osseous bridging
   - C) Pseudoequinus
   - D) All of the above

8) There is a gastrocnemius equinus when:
   - A) The ankle joint dorsiflexes greater than 90 degrees with the knee extended
   - B) The ankle joint dorsiflexes less than 90 degrees with the knee extended
   - C) The ankle joint dorsiflexes greater than 90 degrees with the knee flexed
   - D) B & C

9) The _________ test is used to determine the type of equinus.
   - A) Silfverskoild
   - B) Coleman block
   - C) Hubscher
   - D) Jack's

10) The proximal pathology NOT associated with equinus is:
   - A) Hamstring contractures
   - B) Quadriceps contractures
   - C) Genu recurvatum
   - D) Lumbar lordosis

11) Which of the following is NOT seen in a partially compensated equinus?
   - A) Early heel-off gait pattern
   - B) The heel is on the ground
   - C) Toe walking
   - D) Tibia does not achieve 10 degrees of flexion to the ground

12) The most common definition of equinus is 10 degrees of dorsiflexion with:
   - A) The knee extended
   - B) The subtalar joint in neutral
   - C) The midtarsal joint locked
   - D) All of the above

13) According to the study by Aronow, when a load was applied to the gastrocnemius muscle, which of the following did NOT happen?
   - A) Rearfoot pressures decreased
   - B) Midfoot pressures decreased
   - C) Midfoot pressures increased
   - D) Forefoot pressures increased

14) According to the study by Mueller, which occurred as an effect of a tendo-Achilles lengthening?
   - A) Forefoot pressures increased
   - B) Forefoot pressures decreased
   - C) Rearfoot pressures decreased
   - D) Rearfoot pressures remained the same

15) What percentage of plantar fasciitis cases was associated with equinus in the study by Patel and DiGiovanni?
   - A) 95%
   - B) 100%
   - C) 83%
   - D) 50%

Continued on page 166

Continuing Medical Education

CME EXAMINATION

16) Hill states that it is important to do which of the following when stretching the calf muscles:

A) Adduct the foot 10 degrees
B) Abduct the foot 10 degrees
C) Keep the foot at 0 degrees
D) Stretch for 30 seconds

17) According to Evans' study, how many patients (out of 20) achieved 10 degrees of dorsiflexion with the use of night splints?

A) 10
B) 15
C) 16
D) 6

18) What is the recommended stretching time period using the EQ/IQ brace?

A) 30 minutes per day
B) 30 minutes twice per day
C) 60 minutes twice per day
D) 6-8 hours while sleeping

19) Based on the study by Herzenberg and Lamm, which of the following is most effective?

A) A double gastrocnemius recession
B) A soleus recession
C) A single gastroc recession
D) A single gastroc with the addition of a single soleus recession

20) A meta-analysis by Radford, et al. showed that calf muscle stretching provided:

A) A decrease in ankle joint dorsiflexion
B) No change in the amount of ankle dorsiflexion achieved
C) An increase in ankle joint dorsiflexion
D) An increase in knee flexion

See answer sheet on page 167.

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EXAM #7/12
Understanding Equinus
(DeHeer)

Circle:

1.	A	B	C	D	11.	A	B	C	D
2.	A	B	C	D	12.	A	B	C	D
3.	A	B	C	D	13.	A	B	C	D
4.	A	B	C	D	14.	A	B	C	D
5.	A	B	C	D	15.	A	B	C	D
6.	A	B	C	D	16.	A	B	C	D
7.	A	B	C	D	17.	A	B	C	D
8.	A	B	C	D	18.	A	B	C	D
9.	A	B	C	D	19.	A	B	C	D
10.	A	B	C	D	20.	A	B	C	D

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