Therapeutic devices and methods suitable for stretching the Achilles tendon. Each device includes a base portion and at least one wedge portion. The wedge portion has heel and toe ends, inside-foot and outside-foot edges, and an upper surface. The upper surface has a nonuniform elevation relative to the base portion as a result of the wedge portion having a fore-foot taper in the fore-foot direction and a lateral taper in the lateral direction, wherein the inside-foot edge has an increasing elevation toward the toe end. The wedge portion further has a nonconstant lateral width as a result of the toe end being wider than the heel end. The fore-foot and lateral tapers are sufficient so that placement of a user’s foot on the upper surface causes supination and locking of the foot and enables stretching of the Achilles complex.
ACHILLES AND FOOT ARCH STRETCHING DEVICES AND METHODS PERFORMED THEREWITH

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 61/164,975, filed Mar. 31, 2009, the contents of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] The present invention generally relates to therapy and physical fitness equipment, and more particularly to devices capable of stretching of the calf muscle-Achilles tendon unit.

[0003] The Achilles tendon connects the calf muscles to the heel of the foot. The calf muscles pull on the heel through the Achilles tendon, enabling propulsion of the human body through the foot for walking and jumping activities. The combined length of the calf muscles and Achilles tendon should be short enough to contract strongly and generate enough power for daily activities, and also permit sufficient stretching to allow about ten to twenty degrees of ankle dorsiflexion. If the calf muscles and Achilles tendon cannot stretch and allow ankle dorsiflexion to this extent, the midfoot and the forefoot see abnormal stresses leading to pain and conditions like plantar fasciitis, flat feet, posterior tibial tendon dysfunction, stress fracture, and arthritis.

[0004] The normal human foot is a dynamic structure that can function as a flexible unit capable of adapting to uneven support surfaces during weight bearing, as well as a rigid unit capable of forward propulsion through tightening of the calf muscles. The loosening and stiffening of the foot automatically occur as a result of locking and unlocking the midfoot during walking and running. The same mechanism can be used in a reverse fashion to lock the midfoot and stiffen the foot by maximally lifting the big toe (hallux) and its metatarsal bone away from the ground or the level of the fifth toe and its metatarsal bone (supination of the forefoot). One can also pronate the foot by elevating the fifth metatarsal relative to the first metatarsal, which results in unlocking the foot and stretching the arch of the foot.

[0005] The Achilles tendon can be stretched by daily activities and specific exercises that force the forefoot (toes and metatarsus) toward the leg. In adults, weight-bearing exercises are generally more useful for stretching the Achilles tendon, whereas in children stretching is typically best accomplished with the assistance of an adult. Dynamic splints that provide constant stretching of the tendon can be used by both adults and children. However, such devices achieve limited stretching of the Achilles tendon because stretching of the calf muscle-Achilles tendon unit is more effective if the foot acts as a rigid lever and transmits all the stretch to the Achilles. If the foot is not rigid, some of the stretching forces tend to stretch the arch of the foot and can create or worsen an existing flatfoot condition.

BRIEF DESCRIPTION OF THE INVENTION

[0006] The present invention provides therapeutic devices and methods suitable for stretching the Achilles tendon. The devices provide for supination of the forefoot to make the foot more rigid and allow better stretching of the calf muscle-Achilles unit.

[0007] According to a first aspect of the invention, a therapeutic device is provided that comprises a wedge portion and a base portion. The wedge portion has oppositely-disposed heel and toe ends in a fore-aft direction of the wedge portion, oppositely-disposed inside-foot and outside-foot edges in a lateral direction of the wedge portion, and an upper surface delineated by the heel and toe ends and the inside-foot and outside-foot edges of the wedge portion. The upper surface of the wedge portion has a nonuniform elevation relative to the base portion as a result of the wedge portion having a fore-aft taper in the fore-aft direction and a lateral taper in the lateral direction, wherein the inside-foot edge has an increasing elevation toward the toe end and the outside-foot edge has a substantially constant elevation in the fore-aft direction. The wedge portion further has a nonconstant lateral width in the lateral direction wherein the wedge portion has a toe width at the toe end thereof that is greater than a heel width at the heel end thereof. The fore-aft taper and the lateral taper are sufficient so that placement of a user’s heel on the upper surface at the heel end and the user’s toes on the upper surface at the toe end causes supination and locking of the foot and enables stretching of the Achilles complex.

[0008] According to further aspects of the invention, the device can be configured as a freestanding structure, in other words, the device does not require any additional external structure to support the device or enable the device to perform its intended function of supination and locking of the foot during stretching of the Achilles complex. As such, the base portion is adapted for placement on a surface of a floor or ground and the wedge portion enables weight-bearing stretching of the Achilles complex. The device can also be configured as a shoe wherein the wedge portion causes weight-bearing stretching of the Achilles complex when the user walks and runs while wearing the shoe, or configured as a splint wherein the nonuniform elevation of the upper surface of the wedge portion relative to the base portion is a result of the splint twisting the wedge portion, or configured as an apparatus comprising at least one strap attached to the base portion so that a user can pull the wedge portion to cause stretching of the Achilles complex.

[0009] Other aspects of the invention include stretching techniques using the devices described above. In each case, the device is specifically configured for stretching the Achilles complex of one foot, yet can also be switched to the opposite foot to pronate that foot and stretch the arch of the foot, for example, as a therapeutic treatment for high arched feet.

[0010] A technical effect of the invention is the ability of the devices to achieve greater stretching of the calf muscle-Achilles tendon unit as a result of the devices causing supination and locking of the foot, which results in the foot acting as a rigid lever that transmits essentially all of a stretching motion to the Achilles tendon. In this manner, the effectiveness of the stretching technique is increased to promote the ability of the calf muscles and Achilles tendon to stretch and allow ankle dorsiflexion, thereby reducing abnormal stresses within the midfoot and forefoot. Furthermore, stretching of the arch of the foot is minimized if not avoided, avoiding the creation or worsening of a flatfoot condition.

[0011] Other aspects and advantages of this invention will be better appreciated from the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIGS. 1 and 2 are end and side views, respectively, of a freestanding Achilles tendon stretching device in accordance with a first embodiment of this invention.
FIG. 3 is a perspective view of a freestanding Achilles tendon stretching device in accordance with a second embodiment of this invention.

FIG. 4 is a side view of a freestanding Achilles tendon stretching device similar to FIG. 3, but with the addition of a rocker feature at its lower surface.

FIGS. 5, 6, 7 and 8 show the device of FIG. 3 in combination with shoes (FIGS. 5 and 6), a splint (FIG. 7), and straps (FIG. 8) in accordance with additional embodiments of the invention.

FIGS. 9 through 11 are various views of an Achilles tendon stretching device and its components in accordance with a third embodiment of this invention.

DETAILED DESCRIPTION OF THE INVENTION

The Figures depict therapeutic devices that can be used to stretch the Achilles tendon in accordance with particular embodiments of the invention. For convenience, consistent reference numbers are used throughout the Figures to identify the same or functionally equivalent elements. Furthermore, to facilitate the description of the devices, the terms “fore,” “aft,” “side,” “upper,” “lower,” “right,” “left,” etc., will be used in reference to the perspective of a user during use of the devices, and therefore are relative terms and should not be otherwise interpreted as limitations to the construction of the devices or as limiting the scope of the invention.

FIGS. 1 and 2 represent a freestanding Achilles tendon stretching device 10 in accordance with a first embodiment of this invention. The device 10 is shown as having wedge portions 12 comprising a left wedge portion 12a and a right wedge portion 12b, which are essentially mirror images of each other. The wedge portions 12 are shown coupled to each other through a base portion 14 that comprises two risers 14a and 14b located adjacent heel and toe ends 16 and 18, respectively, of the wedge portions 12. The heel and toe ends 16 and 18 are oppositely-disposed in the fore-aft direction of their respective wedge portions 12. Each wedge portion 12 is further configured to have oppositely-disposed inside-foot and outside-foot edges 20 and 22 in a lateral direction of the wedge portion 12, and an upper surface 24 delineated by the heel and toe ends 16 and 18 and the inside-foot and outside-foot edges 20 and 22.

The upper surface 24 of each wedge portion 12 is shown to have a nonuniform elevation relative to the base portion 14 as a result of the size and shape of the risers 14a and 14b. In particular, the riser 14a adjacent the heel ends 16 of the wedge portions 12 is smaller than the riser 14b adjacent the toe ends 18 of the wedge portions 12, causing the wedge portions 12 to taper in both the fore-aft and lateral directions relative to a surface 26 on which the base portion 14 is supported, such that the inside-foot edge 20 has an increasing elevation toward the toe end 18, while the outside-foot edge 22 has a substantially constant elevation in the fore-aft direction. In addition, each wedge portion 12 has a nonconstant lateral width in the lateral direction as a result of the toe end 18 having a width that is greater than the width at the heel end 16. For example, the lateral width of each wedge portion 12 can nominally conform to a typical difference in the width of a human foot at the toes and heel. For this purpose, each wedge portion 12 may be sized for a specific range of foot sizes.

According to a preferred aspect of the invention, the fore-aft and lateral tapers of the wedge portions 12 are sufficient so that placement of one’s foot on one of the upper surfaces 24 of the wedge portions 12 causes supination and locking of the foot and enables stretching of the Achilles complex. As an example, the inside-foot edge 20 at the toe end 18 may be elevated about one to about four inches (about 2.5 to about 10 centimeters) above the outside-foot edge 22 as a result of the fore-aft and lateral tapers of each wedge portion 12. As evident from FIGS. 1 and 2, the elevation of the inside-foot edge 20 relative to the outside-foot edge 22 can be achieved with the outside-foot edge 22 located at the same level as the surface 26 supporting the device 10. Alternatively, it is foreseeable that the outside-foot edge 22 could be slightly elevated at the toe end 18 relative to the heel end 16.

In use, an individual can utilize either or both wedge portions 12 of the device 10. In either case, a user places his or her heel against the upper surface 24 at the heel end 16 of the wedge portion 12 and places his or her toes against the upper surface 24 at the toe end 18 of the wedge portion 12 to cause supination and locking of the foot and stretching of the Achilles complex. In the embodiment of FIGS. 1 and 2, in which the device 10 is resting on the support surface 26, the user is able to shift his or her weight to the foot to cause weight-bearing stretching of the Achilles complex. Though shown as mirror images of each other to achieve a similar stretching effect for each foot, the fore-aft and lateral tapers of the wedge portions 12a and 12b could differ to achieve a different degree of stretching for the left and right feet.

While each wedge portion 12 is specifically configured for stretching the Achilles complex of either the right or left foot, each wedge portion 12 can also be used on the foot opposite the intended foot to pronate the opposite foot and stretch the arch of that foot, for example, as a therapeutic treatment for high arched feet.

Various materials can be used in the construction of the device 10 shown in FIGS. 1 and 2, including but not limited to plastic, metal and wood materials and combinations thereof. Though represented as an assembly of individual components, the device 10 could be produced as a unitary body, such as by a molding process that results in the device 10 being a solid body whose lower part defines the base portion 14 and whose upper part defines the wedge portions 12a and 12b and their surfaces 24. The upper surface 24 of each wedge portion 12 can be defined by or covered by a slip-resistant material, or otherwise treated to have a slip-resistant surface texture (not shown). In addition or alternatively, the device 10 can be equipped with straps 28 or other means for individually securing the user’s foot or feet to the wedge portions 12.

The embodiments of FIGS. 3 through 11 share similarities with the embodiment of FIGS. 1 and 2, and therefore the following discussion of the remaining embodiments will focus primarily on aspects of these embodiments that differ from the first embodiment in some notable or significant manner. Other aspects of the additional embodiments not discussed in any detail can be, in terms of structure, function, materials, etc., essentially as was described for the first embodiment.

In the embodiment of FIGS. 3 through 8, one wedge portion 12 is represented as being a separate freestanding body that, while capable of being a mirror image of a second wedge portion (not shown), is not coupled to a second wedge portion. Furthermore, the wedge portion 12 and base portion 14 of the device 10 are formed as a unitary body, and the nonuniform elevation of the upper surface 24 of the wedge portion 12 relative to the base portion 14 is the result of the
wedge portion 12 having a nonuniform thickness defined by its fore-aft and lateral tapers. The wedge portion 12 of FIGS. 3 through 8 is well suited for being formed by molding, preferably from a hard plastic material. Though not shown, the embodiment illustrated in FIG. 3 can be secured to the foot with a strap similar to the embodiment of FIGS. 1 and 2, or secured in any other suitable manner such as with tape or bandage.

As evident from FIG. 3, the elevation of the inside-foot edge 20 relative to the outside-foot edge 22 is achieved with the outside-foot edge 22 being at least level above the surface 26 supporting the device 10. To promote the retention of the foot on the upper surface 24, a raised lip 30 is shown as being defined along the outside-foot edge 22. Use of the device 10 shown in FIG. 3 can be similar to that described for the embodiment of FIGS. 1 and 2. In particular, the device 10 can be used as a freestanding structure, in which case a user is able to place his or her heel against the upper surface 24 at the heel end 16 of the wedge portion 12, place his or her toes against the upper surface 24 at the toe end 18 of the wedge portion 12 to cause supination and locking of the foot, and then shift his or her weight to the foot to cause weight-bearing stretching of the Achilles complex. Similar to the embodiment of FIGS. 1 and 2, though the wedge portion 12 is specifically configured for stretching the Achilles complex of either the right or left foot, the wedge portion 12 can also be used to promote the opposite foot for the purpose of stretching the arch of that foot.

FIG. 4 shows an optional feature of the invention, in which the wedge portion 12 is equipped with a rocker feature 44 that can increase the stretching motion further by allowing the wedge portion 12 to be pitched fore and aft. The rocker feature 44 can be formed integrally with the base portion 14, such that the lower surface of the base portion 14 defines the rocker feature 4. Another option is to form the rocker feature 44 as a discrete accessory that can be attached to the lower (flat) surface of the base portion 14.

FIGS. 5 and 6 show alternative applications for the wedge portion 12 of FIG. 3 in which the wedge portion 12 is sized for placement in a shoe 40 (FIG. 5) or as an integral or attachable portion for the sole of a shoe 40 (FIG. 6). In either case, as a result of the wedge portion 12 being combined with a shoe 40, the user can don the shoe 40 to cause supination and locking of the foot in the shoe 40 to cause weight-bearing stretching of the Achilles complex.

Alternatively, the device 10 can be used in combination with a leg splint 42 (FIG. 7), in which case the nonconstant elevation of the surface 24 of the wedge portion 12 can be achieved as a result of the splint 42 serving as all or part of the base portion 14 to cause twisting of the wedge portion 12 to induce supination of the foot on which the splint 42 is installed and, as a result, continuous stretching of the Achilles tendon of that foot. Still another option for the device 10 of FIG. 3 is shown in FIG. 8, in which straps 31 are shown attached to the device 10 and whose ends can be grasped and pulled by a user to twist the wedge portion 12 to induce supination of the foot and cause stretching of the Achilles tendon of that foot. Finally, as with the embodiments of FIGS. 1 through 4, the wedge portions 12 of FIGS. 5 through 8 can also be used to promote the foot opposite the intended foot for the purpose of stretching the arch of that foot.

The wedge portions 12a and 12b are shown in FIGS. 9 to 11 as pivotally attached to the base portion 14, such as with hinges 32 either assembled to or formed integrally with the wedge portions 12a and 12b and base portion 14. The hinges 32 are located at the outside-foot edge 22 of each wedge portion 12a and 12b, while the remaining perimeter of each wedge portion 12a and 12b (defined by the heel and toe ends 16 and 18 and the inside-foot edge 20) is not coupled to the base portion 14. The wedge portions 12a and 12b have the lateral taper ascribed to the prior embodiments, though more so as the upper surface 24 of each wedge portion 12a and 12b is essentially triangular-shaped. The base portion 14 is represented as constructed of a face plate 14c attached to a frame 14d. The frame 14d provides the structural support for a pair of threaded rod and nut assemblies 34, by which rotation of each rod causes its corresponding nut to move linearly. As evident from FIGS. 9 to 11, an abutment member 36 is attached to each nut, such that rotation of the rod also causes the abutment member 36 to move linearly. Each rod and nut assembly 36 is oriented transverse to the fore-aft directions of the wedge portions 12a and 12b, which have tapered rails 38 that extend downward therefrom into the enclosure defined by the frame 14d. The rails 38 and abutment members 36 are sized and arranged so that each abutment member 36 can be linearly moved by a rod and nut assembly 36 into engagement with its rail 38 to cause the corresponding wedge portion 12a/12b to pivot relative to the base portion 14 and increase the elevation of its upper surface 24 relative to the base portion 14. Is should be apparent from the foregoing that other actuation mechanisms could be used in place of the rod and nut assembly 36, including pistons, expanders, jacks, and rack and pinion mechanisms.

While the invention has been described in terms of specific embodiments, it is apparent that other forms could be adopted by one skilled in the art. For example, the physical configuration of the wedges and foot plates could differ from that shown, and materials and processes other than those noted could be used. Therefore, the scope of the invention is to be limited only by the following claims.

1. A therapeutic device for the foot, the device comprising a wedge portion and a base portion, the wedge portion having oppositely-disposed heel and toe ends in a fore-aft direction of the wedge portion, oppositely-disposed inside-foot and outside-foot edges in a lateral direction of the wedge portion, an upper surface delineated by the heel and toe ends and the inside-foot and outside-foot edges of the wedge portion, a nonuniform elevation of the upper surface relative to the base portion as a result of the wedge portion having a fore-aft taper in the fore-aft direction and a lateral taper in the lateral direction wherein the inside-foot edge has an increasing elevation toward the toe end and the outside-foot edge has a substantially constant elevation in the fore-aft direction, and a nonconstant lateral width in the lateral direction wherein the wedge portion has a toe width at the toe end thereof that is greater than a heel width at the heel end thereof, whereby the fore-aft taper and the lateral taper are sufficient so that placement of a user’s heel on the upper surface at the heel end and
the user's toes on the upper surface at the toe end causes supination and locking of the foot and enables stretching of the Achilles complex.

2. The therapeutic device according to claim 1, wherein the inside-foot edge at the toe end is elevated about 2.5 to about 10 centimeters above the outside-foot edge as a result of the fore-aft taper and the lateral taper of the wedge portion.

3. The therapeutic device according to claim 1, wherein the base portion comprises a rocker feature that enables the wedge portion to be pitched fore and aft for increased stretching of the Achilles complex.

4. The therapeutic device according to claim 1, wherein the nonuniform elevation of the upper surface of the wedge portion relative to the base portion is a result of the wedge portion having a nonuniform thickness defined by the fore-aft taper and the lateral taper of the wedge portion.

5. The therapeutic device according to claim 1, wherein the wedge portion is a first wedge portion of the device and the device further comprises a second wedge portion that is a mirror image of the first wedge portion, the first and second wedge portions causing simultaneously supination and locking of both feet of the user and enabling stretching of the Achilles complexes of both feet of the user.

6. The therapeutic device according to claim 5, wherein the first and second wedge portions are not coupled to each other.

7. The therapeutic device according to claim 5, wherein the first and second wedge portions are coupled to each other.

8. The therapeutic device according to claim 1, wherein the upper surface of the wedge portion is a slip-resistant surface.

9. The therapeutic device according to claim 1, wherein the device is a freestanding structure, the base portion is adapted for placement on a surface of a floor or ground, and the wedge portion enables weight-bearing stretching of the Achilles complex.

10. The therapeutic device according to claim 9, further comprising means for securing the wedge portion to the foot.

11. The therapeutic device according to claim 9, further comprising means for adjusting the elevation of the wedge portion relative to the base portion.

12. The therapeutic device according to claim 11, wherein the adjusting means comprises a rail coupled to the wedge portion and an abutment member movable into engagement with the rail to cause the wedge portion to pivot relative to the base portion and increase the elevation of the upper surface of the wedge portion relative to the base portion.

13. The therapeutic device according to claim 1, wherein the device is a shoe and the wedge portion causes weight-bearing stretching of the Achilles complex when the user walks and runs while wearing the shoe.

14. The therapeutic device according to claim 13, wherein the wedge portion is a removable insert in the shoe.

15. The therapeutic device according to claim 13, wherein the wedge portion is a removable attachment to the bottom of the shoe.

16. The therapeutic device according to claim 13, wherein the wedge portion is an integral portion of a sole of the shoe.

17. The therapeutic device according to claim 1, wherein the device is a splint and the nonuniform elevation of the upper surface of the wedge portion relative to the base portion is a result of the splint twisting the wedge portion.

18. The therapeutic device according to claim 1, wherein the device is an apparatus comprising at least one strap attached to the base portion, the wedge portion being between first and second ends of the strap by which a user can pull the wedge portion to cause stretching of the Achilles complex.

19. A method of stretching of the Achilles complex using the device according to claim 1, the method comprising placing a heel of a user's foot against the upper surface at the heel end of the wedge portion and placing toes of the user's foot against the upper surface at the toe end of the wedge portion to cause supination and locking of the foot and stretching of the Achilles complex.

20. A method of stretching of the Achilles complex using the device according to claim 9, the method comprising placing a heel of a user's foot on the upper surface at the heel end of the wedge portion and toes of the user's foot on the upper surface at the toe end of the wedge portion to cause supination and locking of the foot, and then shifting weight of the user to the foot to cause weight-bearing stretching of the Achilles complex.

21. A method of stretching of the Achilles complex using the device according to claim 13, the method comprising donning of the shoe by a user to cause supination and locking of the foot, and then walking in the shoe to cause weight-bearing stretching of the Achilles complex.

22. A method of stretching of the Achilles complex using the device according to claim 17, the method comprising donning of the splint by a user by placing a heel of the user's foot on the upper surface at the heel end of the wedge portion and placing toes of the user's foot on the upper surface at the toe end of the wedge portion to cause supination and locking of the foot and stretching of the Achilles complex.

23. A method of stretching of the Achilles complex using the device according to claim 18, the method comprising placing a heel of a user's foot on the upper surface at the heel end of the wedge portion and placing toes of the user's foot on the upper surface at the toe end of the wedge portion, and then pulling on the first and second ends of the strap to cause supination and locking of the foot and stretching of the Achilles complex.

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