Feb. 21, 1967 G. R. CALLENDER, JR 3,304,937

DEROTATION BRACE FOR TIBIA DEFORMITIES

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Fig. 1

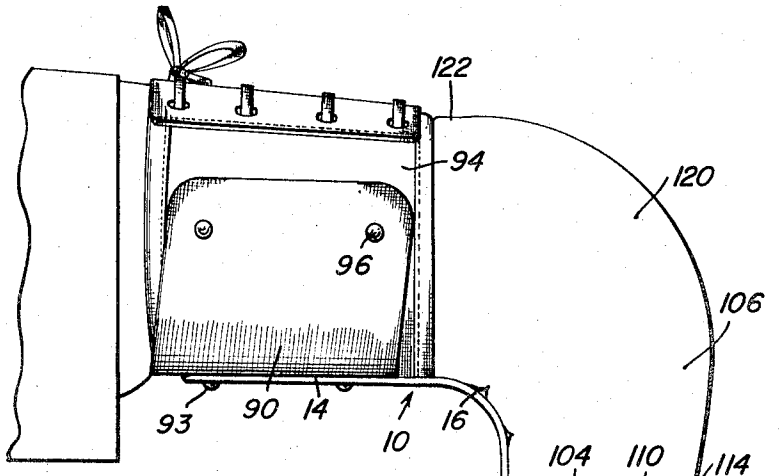


Fig. 4

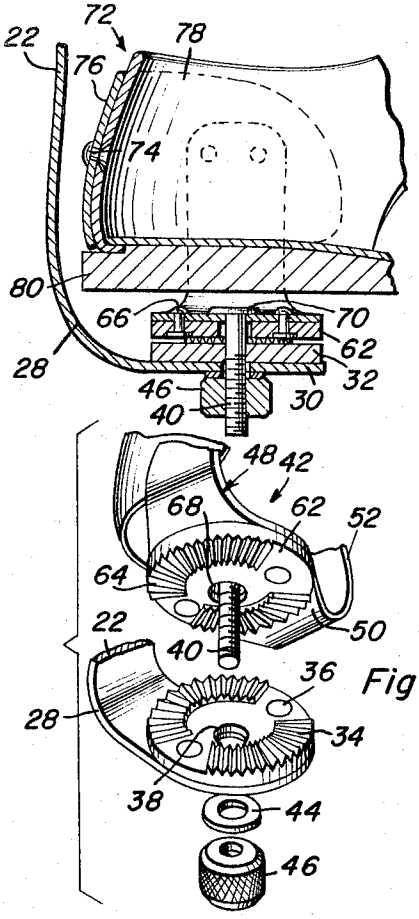


Fig. 5

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Fig. 2

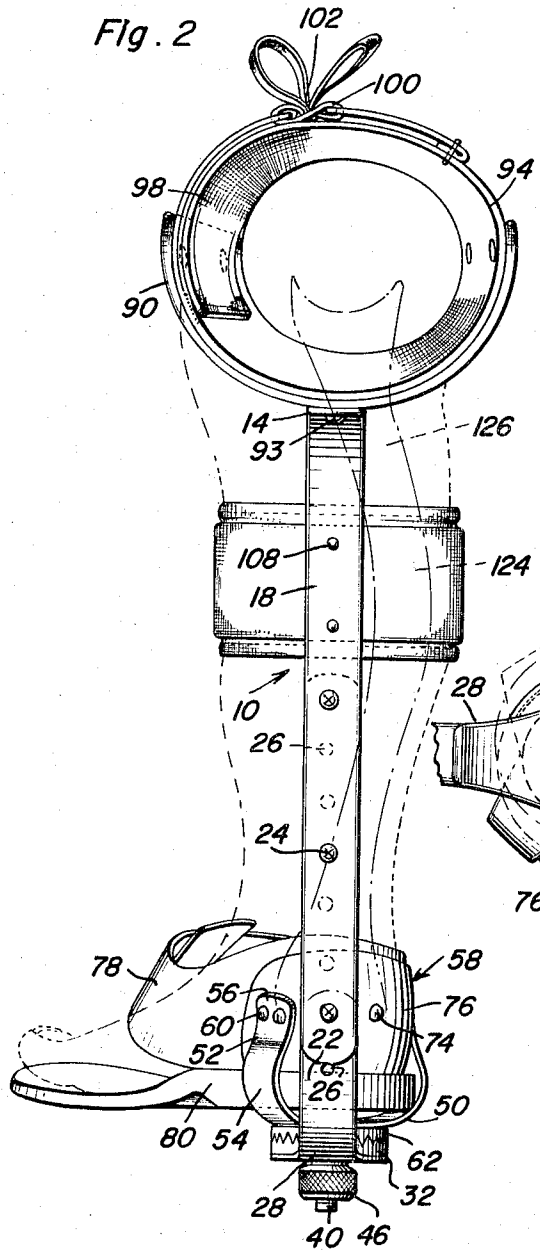
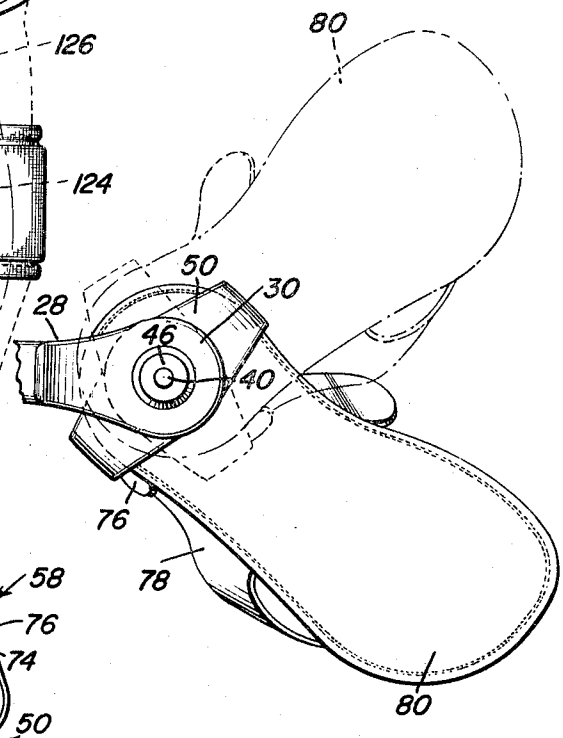


Fig. 3



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DEROTATION BRACE FOR TIBIA DEFORMITIES

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5 Claims. (Cl. 128—80)

The present invention generally relates to a brace for use in correcting a deformity of the lower leg bone or tibia especially in children.

Two components of this type of deformity are recognized, namely, the actual twisting of the bone about its longitudinal axis and its associated lateral bowing. In order to correct the deformity, both of the components of the deformity should be correct simultaneously. The brace of the present invention accordingly has for its object the simultaneous correction of the twisting of the bone and its associated bowing and is termed a derotation brace for correcting deformities of the tibia or the lower bone or bones of the leg where the bone is twisted such that the foot turns in or out.

The present invention generally consists of an elongated leg type of brace constructed so that it will hold the knee bent at a ninety degree angle and including a cuff at the upper end of a bar for attachment thereof to the thigh together with a cuff for attachment to the leg at the calf level in order to maintain the leg in proximity to the brace at the calf level. A foot piece is attached to the lower end of the bar in a manner which allows rotation of the foot free of the bar when loosened and capable of being tightened to hold the foot firmly in a fixed rotation position thereby obtaining correction of the deformity of bowing and of rotation by first rotating the foot piece to the point of resistance and waiting for the bone to respond to this stress. Similarly, the bowing of the leg is corrected by pressure from the calf cuff against the apex of the convexity of the leg bone or tibia. The simultaneous use of the derotation and the pressure at the apex of the convex curve of the bowing results in a progressive correction of the deformity.

Another object of the present invention is to provide a brace in accordance with the preceding paragraph which is simple in construction, easy to apply and remove, effective for its particular purposes and relatively inexpensive to manufacture.

These together with other objects and advantages which will become subsequently apparent reside in the details of construction and operation as more fully hereinafter described and claimed, reference being had to the accompanying drawings forming a part hereof, wherein like numerals refer to like parts throughout, and in which:

FIGURE 1 is a side elevational view of the brace of the present invention installed on the leg of a child;

FIGURE 2 is a posterior view in elevation illustrating the orientation of the components of the brace and illustrating in dotted line the positioning of the calf cuff in relation to the apex of the convex curve of the leg bone;

FIGURE 3 is a bottom plan view illustrating the rotational adjustment feature for varying the angular position of the foot;

FIGURE 4 is a detailed sectional view illustrating the construction of the connection between the bar and the derotation adjustment mechanism; and

FIGURE 5 is an exploded group perspective view of

the derotation connection between the bar and foot piece.

Referring now specifically to the drawings, the numeral 10 generally designates the brace of the present invention which includes an elongated rigid bar 12 having a top portion 14 underlying the thigh region of the leg. A ninety degree bend 16 is formed at the forward end of the top portion 14 of the bar 12 and an elongated vertically depending portion 18 extends downwardly from the bend 16. Attached to the vertically elongated portion 18 of the bar 12 is an L-shaped supporting bar 20 having a vertically elongated portion 22 overlapping and secured to the vertical portion 18 of the bar 12. A pair of screw-threaded fasteners 24 are provided for adjustably securing the vertical portion 22 to the vertical portion 18 in longitudinally adjusted position by virtue of there being provided a plurality of longitudinally spaced screw-threaded openings 26 in the vertical member 22 thereby enabling the effective vertical length of the brace to be adjusted. At the lower end of the vertical portion 22, there is provided a ninety degree bend 28 and a forwardly extending horizontal portion 30 generally circular in configuration and including a circular plate 32 rigidly affixed thereto and having a plurality of radial serrations 34 projecting from the top surface thereof. The serrations 34 are formed in diametrically opposed arcuate arrangements as illustrated in FIGURE 5 and the plate 32 may be secured to the horizontal member 30 by any suitable means such as by rivets 36 or the like. The horizontal member 30 and the plate 32 are each provided with an opening 38 for receiving a depending threaded bolt 40 on a foot receiving member 42. The lower end of the threaded bolt 40 receives a washer 44 and an externally knurled and internally threaded thumb nut 46 for ease of manipulation of the nut 46.

The foot receiving assembly includes a U-shaped bracket 48 having a bight portion 50 and a pair of upwardly extending legs 52 which are initially curved outwardly as at 54 and then curved inwardly and upwardly as at 56. The free ends of the U-shaped bracket 48 are attached to a U-shaped counter-stirrup 58 by a pair of rivets 60 or the like. The U-shaped counter-stirrup 58 is disposed horizontally and is curved to conform with and engage the heel enclosing portion of a shoe. The bottom of the bight portion 50 of the U-shaped bracket 48 is provided with a circular plate 62 having depending radial serrations 64 thereon for matching adjustable engagement with the serrations 34. The plate 62 is mounted on the bracket 48 by suitable rivets 66 or the like and the bolt 40 extends through an opening in the plate 62 designated by numeral 68 and also through the bight portion 50 of the bracket 48 and terminates in a head 70 engaging the top surface of the bight portion 50 of the bracket 48 in a rigid and secure manner thereby retaining the bolt in position.

As illustrated in FIGURE 4, a partial shoe generally designated by numeral 72 is attached to the stirrup 58 by virtue of a rivet 74 extending through the bight portion of the stirrup designated by numeral 76 and through the rear of the heel enclosing portion or counter 78 of the partial shoe 72. It is noted that the lower edge of the stirrup 76 overlies the peripheral edge of the outer sole 80 of the partial shoe 72 and conforms closely with the contour thereof.

The forward ends of the legs 82 of the stirrup 58 curve

slightly inwardly as designated by numeral **84** to conform with the curvature of the shoe upper or counter **78**. The forward end of the shoe upper is cut-away along a line designated by numeral **86** and the usual shoe lacings **88** are provided thus leaving the toe region **90** of the foot of the wearer free to eliminate toe deformation during correction of deformities in the lower leg bone or tibia.

On the top portion **14** of the bar **12**, there is provided a generally U-shaped rigid saddle or receiver **90** affixed to the top portion **14** by rivets **93** or the like. The saddle **90** preferably is of metal construction and has a cuff **94** of flexible canvas-like material or the like secured thereto as by rivets **96**. The saddle **90** is preferably covered with a canvas-like fabric and the cuff **94** is provided with an overlapping portion **98** secured in position by lacing **100** and a suitable knot **102**.

Below the ninety degree bend **16**, a U-shaped rigid saddle or receiver **104** is provided adjacent the calf of the leg **106** of the wearer. The saddle or receiver **104** is affixed to the vertical portion **18** by rivets **108** and is preferably constructed of metal and provided with a fabric canvas-like covering. A calf cuff **110** is attached to the saddle **104** by rivets **112** and the ends of the calf cuff overlap as at **114** and are secured in overlapping adjusted position by a buckle assembly **116** and a strap-like member **118** for securing the calf cuff **110** to the calf of the leg thus maintaining the leg **106** in ninety degree relationship to the thigh region **122** of the leg with the knee **120** defining the vertex of such angular relationship. Also, the calf cuff **110** is located at the apex **124** of the convex curvature of the lower leg bone or tibia **126** as illustrated in FIGURE 2.

The present brace is provided for an individual leg and may be used on an individual leg if that is all that is necessary to correct a deformity in one leg or it may be used in conjunction with another similar brace for correcting deformities in both legs. In any event, the legs are never connected together and each individual leg may be corrected by rotation of only the lower portion of the leg by virtue of the positioning of the knee **120** at a ninety degree angle. In the present brace, the correction force is applied through the longitudinal axis of the tibia **126** with the knee **120** in a flexed or ninety degree bent position in order that the entire derotation force is transmitted through the lower calf portion of the leg rather than through the entire leg structure to the hip (not shown). This brace further adds a corrective feature in the particular placement of the pressure pad or calf cuff **110** along the lateral aspect of the leg which affords correction of the bowing deformity of the lower leg or calf portion as at **124**, which is only possible in the bent knee position. This feature is clearly illustrated in the posterior view of FIGURE 2 wherein it is clear that the calf cuff **110** is closer to the upper end portion **14** of the rigid vertical brace bar means shown disposed vertically alongside the posterior of the calf portion of the leg. The lateral bowing of the leg bone may be somewhat exaggerated in FIGURE 2 in order to clearly illustrate the point where the point of pressure of the lateral portion of the calf cuff exerts a corrective force to the bowing of the lower leg.

The manner of attachment to the shoe may be varied. The one illustrated may be provided or there may be an arrangement in which the shoe is held in the counter stirrup by the use of a strap extending across the ankle region of the foot thus holding the shoe to the brace.

By using the brace of the present invention, correction of the deformity of bowing and of rotation is corrected by first rotating the foot piece to the point of resistance and waiting for the bone to respond to this stress. Similarly the bowing of the leg is corrected by pressure from the calf cuff against the apex of the convexity of curvature of the leg bone. The simultaneous use of the knee rotation and the pressure at the apex of the convex curve of the bowing results in a progressive correction of the deformity. With the present invention, the center of the axis of derotation is beneath the longitudinal axis of the tibia and the pressure point to afford derotation is placed near the sustentaculum tali which is slightly anterior to the axis of rotation and is roughly equidistant from the axis of rotation as in the oscalcis as it is placed in the heel counter.

By utilizing a shoe, this allows for the simultaneous correction of pes planus deformity. However, in order to prevent the possibility of the production of a valgoid deformity of the foot in the derotation of internal tibial torsion, the forefoot of the shoe is removed as illustrated. Since the pressure is placed basically at the sustentaculum tali there has been no incidence of the deformity of the valgus of the forefoot by the utilization of the present invention.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly all suitable modifications and equivalents may be resorted to, falling within the scope of the invention as claimed.

What is claimed as new is as follows:

1. A derotation leg brace for treatment of internal torsion or external torsion of the tibia bone comprising a rigid vertical brace bar means adapted to be positioned vertically alongside the posterior of the calf portion of the leg of a wearer, means carried by said vertical brace bar means adapted to embrace the leg of a wearer at the calf portion and dispose the vertical brace bar means in positive position, said vertical brace bar means having a rigid upper end portion disposed at a substantially 90 degree angle thereto and extending rearwardly therefrom and adapted to underlie the thigh portion of a wearer's leg with the leg being bent at approximately a 90-degree angle at the knee, means carried by the upper end portion adapted to embrace the thigh portion of the leg of a wearer, said vertical brace bar means having a rigid lower end portion disposed at a substantially 90-degree angle thereto and extending forwardly therefrom in an opposite direction from the upper end portion, said lower end portion being adapted to underlie the heel of the foot of a wearer's leg, means adapted to embrace and support the hindfoot portion of a wearer's foot, means mounting the hindfoot support means to the lower end portion of the vertical brace bar means for rotation about a vertical axis spaced from the vertical brace bar means and parallel thereto so as to be in substantial vertical alignment with the tibia bone of a wearer's leg and directly beneath the shaft of the tibia bone and means for locking the hindfoot support means in selected positions of rotation relative to the said lower end portion.

2. The invention of claim **1**, wherein said means adapted to embrace the leg of a wearer at the calf portion is a cuff-like arrangement located on the vertical brace bar means closer to the upper end portion than the lower end portion and adapted to embrace the calf portion at the apex of the convex curvature of the tibia bone.

3. The invention of claim **2**, wherein said vertical brace bar means is adjustable lengthwise along its longitudinal axis between the upper and lower end portions.

4. The invention of claim **1**, wherein said means mounting the hindfoot support means for rotation includes a bracket means carried by the hindfoot support and underlying the same and carrying bolt means including a bolt shank passing through a vertical opening in the lower end portion of the vertical brace bar means.

5. The invention of claim **4**, wherein said locking means includes a circular plate carried by the bracket means and through which the bolt shank of the bolt means passes and a complementary circular plate provided on the lower end portion and through which the bolt shank passes, said plates having complemental faces formed with

interlocking radial serrations and the bolt means includes a locking nut arrangement on the bolt shank below the lower end portion for locking the plates together with their serrated faces in interlocked disposition.

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