

[54] POSTOPERATIVE LUMBRICAL BAR AND BRACE

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[58] Field of Search ..... 128/77, 26, 87 R; 128/87 A; 272/67

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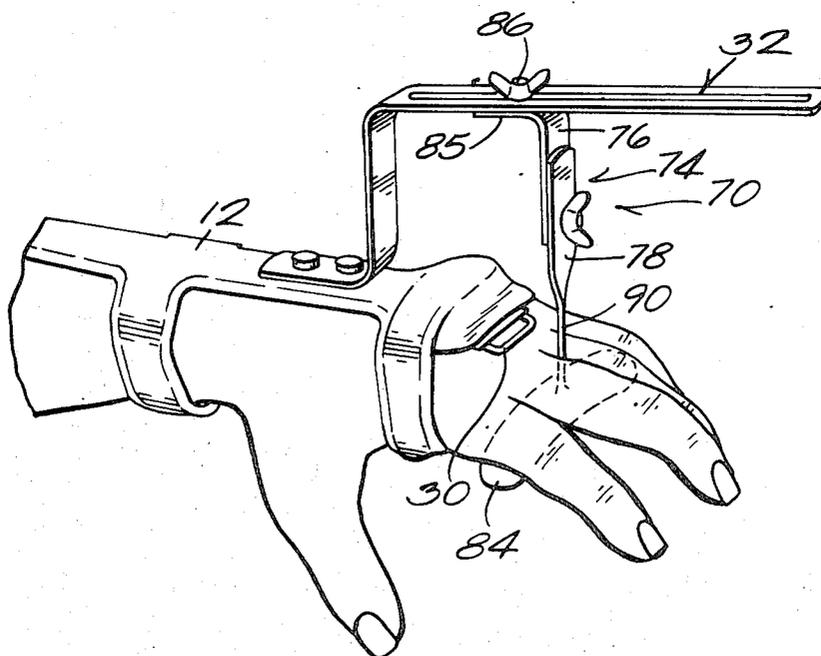
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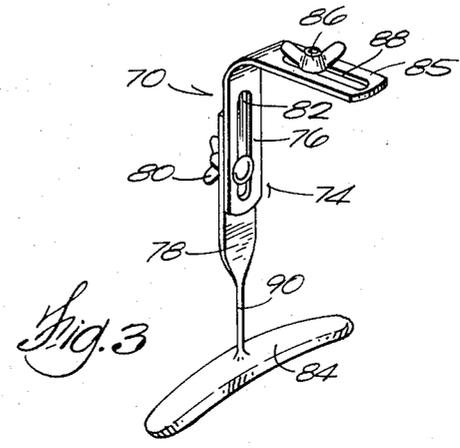
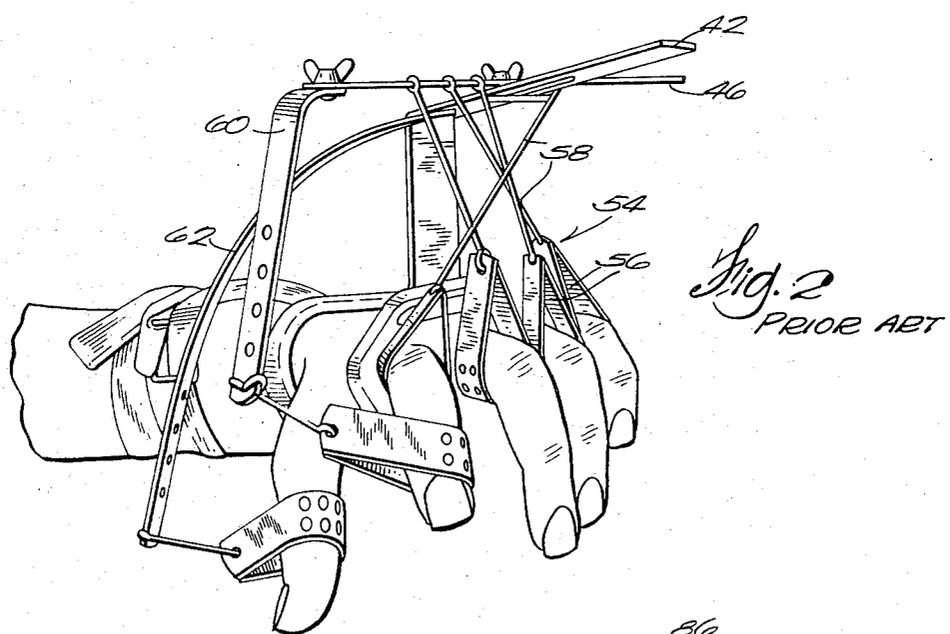
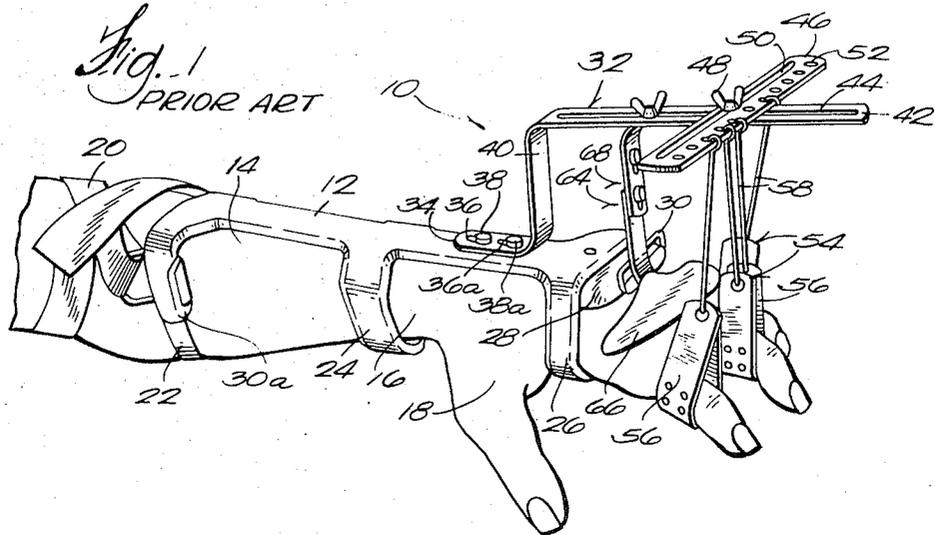
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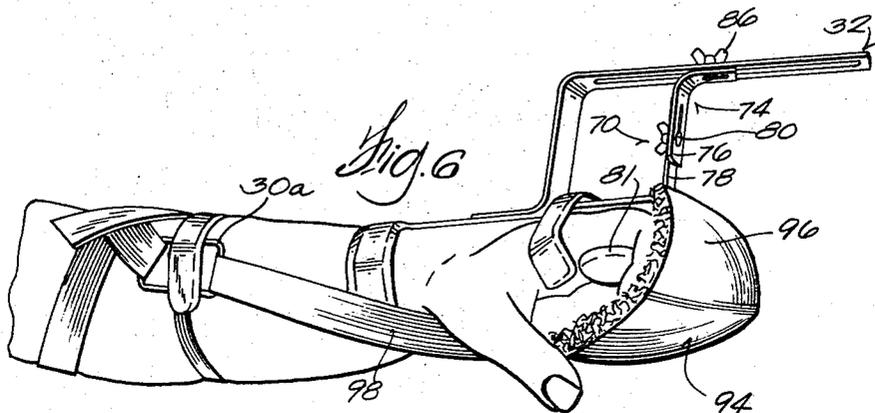
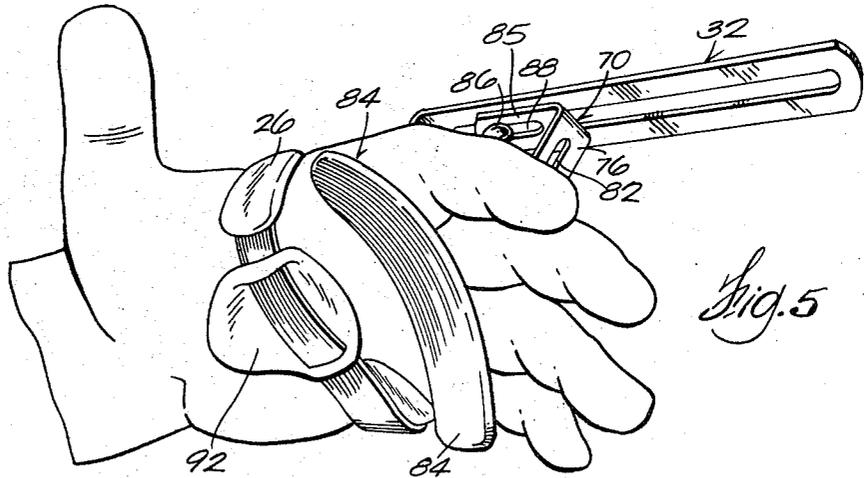
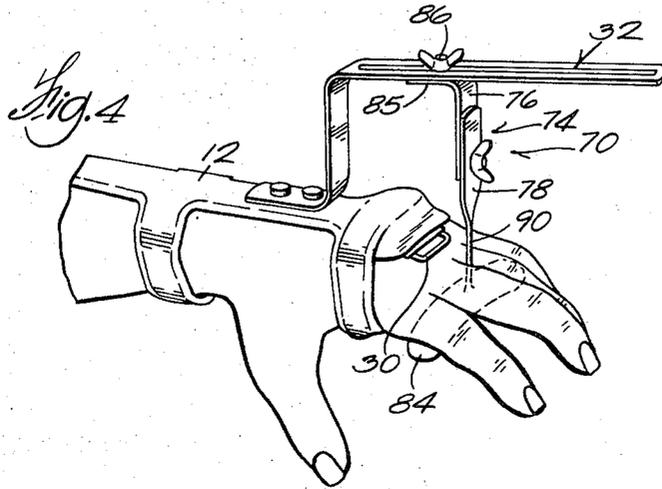
[57] ABSTRACT

The lumbrical bar includes a stem attached at its upper end to the longitudinal bar of a dorsal splint and a transverse pad at its lower end to provide support of one or more of the proximal or distal phalanges. The stem is adjustable to permit placement of the pad above or below the fingers without rotating the splint. The stem includes a narrow neck portion to permit extension between two adjacent fingers. A palmar pad or flexion cuff can be utilized with the bar to provide flexion of the fingers.

7 Claims, 6 Drawing Figures







## POSTOPERATIVE LUMBRICAL BAR AND BRACE

### BACKGROUND OF THE INVENTION

#### I. Field of Invention

This invention relates to a dynamic postoperative brace, and more particularly to an improved reversible lumbrical bar.

#### II. Description of the Prior Art

The medical profession has been constantly challenged in developing methods and means for the restoration of a hand disabled by unstable, stiffened, or dislocated joints. The functional efficiency of hand adaptation patterns depends upon muscle balance and the integrity of the skeletal system. Loss of joint function is extremely common in rheumatoid arthritis. Instability of joints, stiffness, and nonpositioning lead to a gradual and disastrous decline in the functional ability of the hand. This loss of hand use may occur early in the lives of those afflicted and will severely limit them in their quest for economic and personal independence.

Recently, advances in surgical techniques have significantly improved the possibilities for restoration of hand function. Reconstructive surgical procedures currently in use that allow motion are, principally: neurectomies, osteotomies, pseudarthroses and anthroplastys. The advent of flexible implants for internal stabilization of finger joint arthroplasty for example has opened up new possibilities for successful reconstructive surgery of the hand. One such successful implantable prosthetic joint is described in Applicant's earlier issued U.S. Letters Pat. No. 3,462,765 entitled SURGICALLY IMPLANTABLE PROSTHETIC JOINT, issued Aug. 26, 1969.

The development of a dynamic brace has facilitated early postoperative motion in many of the cases utilizing a prosthetic implant. Such a brace has greatly improved the anatomical and functional results obtained from such surgery. Successful arthroplasty requires stability, mobility and freedom from pain. Generally, in a resection, soft tissues must be released sufficiently to correct the frequently associated contracture, subluxation or angulation deformities. Adequate release is followed by an unstable joint in the early postoperative period. By using the prosthetic implant of the type described in the above identified patent, the implant acts as an internal splint that separates incongruous bone ends, decreases the tendency for recurrent subluxation, and provides a mold for the development of the new joint capsule. Once the released ligaments and scars have healed, they will stabilize the joint in a fashion similar to normal ligaments.

The postoperative condition however, is of the utmost importance in order to provide good eventual mobility. If motion is restricted during the healing phase, there will be poor mobility. Controlled motion however during the healing period will train the new capsule to have sufficient looseness for flexion and extension with sufficient tightness in the medial-lateral plane for rotational and angular stability. Thus, various types of adjustable dynamic braces have been developed to encourage the joint to move in desired planes and to prevent recurrences of deformity during the early postoperative course. The brace prevents undue stretching of associated reconstructed tendons and ligaments. It also assists the extensors and flexors of the digits, which are

frequently weak due to long-standing deformity, accompanying tenosynovitis and fibrosis.

The dynamic brace has three major functions: (1) to provide complete and adjustable correction of residual deformity, (2) to control motion in the desired range, and (3) to assist flexor and extensor power in assuring an adequate alternation of complete extensor and flexor ranges of joint movement.

One of the adaptations of a dynamic brace is a lumbrical bar utilized to supply proximal or distal interphalangeal support as a result of a metacarpophalangeal articulation reconstruction. Care must be taken when using a lumbrical bar because in many cases, the proximal phalanx has a tendency to subluxate palmarwards on the metacarpal if too much force is applied. One disadvantage of existing braces and lumbrical bars is that the entire brace requires rotation about the arm depending on whether the upper or lower portion of the interphalangeal requires support. Thus, there is a constant need for continual improvements in this type of apparatus, and more specifically, in a lumbrical bar which provides support from either side without having to rotate the entire brace.

### SUMMARY OF THE INVENTION

The basic dynamic brace for metacarpophalangeal articulation reconstruction is a dorsal splint which provides a stable base for outriggers and support for the weak or deficient wrist joint. A longitudinal bar is supported by the splint and spaced above and beyond the front portion of the splint. The longitudinal bar includes areas such as a plurality of openings or an elongated slot to permit one or more subassemblies to be attached thereto at preselected locations relative to the splint. One of the subassemblies attachable to the longitudinal bar is a lumbrical bar for providing top or bottom support of one or more of the proximal or distal interphalangeal.

In accordance with the invention, the lumbrical bar includes a stem portion with an attachment means at one end for rigidly connecting the bar to the longitudinal bar and a transverse pad at the other end spaced from the longitudinal bar for supportive engagement of one or more of the proximal or distal interphalangeal. The stem portion includes a narrow neck portion extending from the pad to permit insertion of the neck portion between a pair of adjacent fingers whereby said pad is positionable above or below the phalanx. The attachment means is adjustable to permit selection of the degree of extension of the pad from the longitudinal bar.

In a narrower aspect of the invention, a palmar pad can be utilized in combination with the lumbrical bar to prevent the proximal phalanx to subluxate palmarwards. In other narrower aspects of the invention, a transverse bar to which finger slings are attached is fitted onto the dorsal arm. The slings are preferably of soft plastic with multiple perforations and are connected to the bar with rubber bands. Small radially placed outriggers may be added for correction of the pronation deformity often present in the index and middle fingers. A longer outrigger bar can be used to increase thumb abduction. Preferably, all of these outriggers are attached to the longitudinal bar by thumb screws and the position of the transverse bar can be adjusted in all three planes. When weakness of the flexors

is present, a flexion cuff is used to insure that the joint is carried through an adequate range of motion.

One of the significant advantages of the invention is to permit proper rigging of the hand by a dynamic brace conducive to proper healing. The utilization of the lumbrical bar of the invention allows upper or lower support of the phalanges without requiring rotation of the dorsal splint thereby greatly increasing the overall utility of the brace.

#### DESCRIPTION OF THE DRAWINGS

FIGS. 1 and 2 are fragmentary views in perspective illustrating a dynamic brace of the prior art;

FIG. 3 is a perspective view of the lumbrical bar of the invention;

FIGS. 4 and 5 illustrate in perspective, utilization of the lumbrical bar illustrated in FIG. 3 for supporting the proximal interphalangeal from the posterior side; and (illustrated

FIG. 6 is a perspective view illustrating the utilization of the lumbrical bar of the invention in combination with a flexion cuff.

#### DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings in detail, and particularly FIG. 1, a dynamic brace 10 of the prior art is illustrated. The basic brace is a dorsal splint 12 adapted to fit conventionally over the anterior or posterior portion of the forearm 14, wrist 16 and hand 18. The splint is preferably made of a durable relatively stiff leather or leather substitute and includes an elbow strap 20, arm straps 22, 24 and palm strap 26. Elbow strap 20 helps prevent distal migration of the brace and may be placed as a "figure-eight" around the arm. The remaining straps secure the splint in position along the length of the arm. Strap 22, like elbow strap 20, is highly flexible and lightweight while straps 24 and 26 are preferably integral with the splint and made of the same or similar material. Preferably, straps 24 and 26 include Velcro stripping to permit quick, easy and adjustable opening and closing of the straps.

The undersides of splint 12 include a soft padded material (not shown) to reduce discomfort and wear on the arm. An enlarged header pad 28 is affixed to the underside of the distal end of splint 12 to provide relief for the anterior portion of the hand. A clip 30 is mounted to the distal end of pad 28 to provide an anchor support for a flexion cuff which will be described hereinafter.

Removably anchored to splint 12 near its distal end is a longitudinal support bar 32 which supports a number of outriggers and subassemblies. Longitudinal support bar 32 is characterized by a first portion 34 which is adapted to secure the support to the dorsal splint. Portion 34 includes a pair of key-shaped openings 36, 36a adapted to releasably nest with a pair of posts 38, 38a having enlarged heads. Posts 38, 38a are anchored to the dorsal splint and the enlarged head portions are adapted to fit through the larger portion of openings 36, 36a at which point the longitudinal support bar 32 is moved longitudinally along the dorsal splint so that the header portions of posts 38, 38a are latched over the support bar portion 34 through the smaller portions of openings 36, 36a. Support bar 32 also includes a vertical portion 40 which extends normal to portion 34 and spaces the longitudinal extension portion 42 of

support bar 32 above the dorsal splint over the patient's hand to permit securement of the outriggers and subassemblies. The longitudinal portion 42 of support bar 32 includes a longitudinally extending elongated opening or slot 44 to which various subassemblies may be arbitrarily positioned relative to the hand for attaching various outriggers etc.

One of the subassemblies utilized is a transverse bar 46 which extends in various selected positions transverse to longitudinal portion 42 of support bar 32. Transverse bar 46 is preferably anchored to support bar 32 by a threaded screw and wing nut assembly 48 which is positioned through elongated slot 44 and the longitudinally extending elongated slot 50 provided in transverse bar 46. The utilization of two elongated slots 44 and 50 extending transverse to each other in accordance with the operation of the brace permits a wide variety of positions of the transverse bar 46 relative to the hand or fingers of the patient. In addition to elongated slot 50, transverse bar 46 includes a plurality of openings 52 which are spaced from each other and elongated slot 50 along the length of transverse bar 46. These openings are primarily intended for receipt of one or more finger slings 54 which include a soft plastic saddle portion 56 suspended and tensioned relative to transverse bar 46 by rubber bands 58.

Small radially placed outriggers such as outrigger 60 (FIG. 2) may be added for correction of the pronation deformity often present in the index or middle finger. A longer outriggering bar 62 (FIG. 2) may be used to increase thumb abduction. All of these outriggers are attached with thumb screws.

A second subassembly utilized is a conventional lumbrical bar 64 which is utilized for patients who need pre- or post-operative proximal interphalangeal joint extension. Care must be taken in the use of this device in patients who have had recent metacarpophalangeal joint arthroplasties because in these cases there will be a tendency to sublux palmarwards the proximal phalanx on the metacarpal if too much force is applied. The conventional lumbrical bar 64 includes a transverse pad 66 attached to a two-piece stem 68 which is slidable for adjusting the length, the upper end of which is attached by a thumb screw to the longitudinal support bar 32. One of the principal disadvantages of the conventional lumbrical bar is that in order to provide support to the bottom of the fingers (i.e., opposite that shown in FIG. 1) the entire brace must be rotated about the arm thereby preventing other desired digital bracing.

Referring now to FIG. 3, a new and improved lumbrical bar 70 is illustrated in accordance with the invention. This lumbrical bar is somewhat similar to that described previously in that it includes a two-piece stem 74 comprising an upper stem portion 76 and a lower stem portion 78 interconnected by one or more thumb screws 80 which are receivable through an elongated slot 82 in the upper stem portion 76. This provides easy and quick lengthwise adjustment of the position of transverse pad 84 which is attached to the lower terminal end of lower stem portion 78. The upper terminal end 85 of upper stem portion 76 is formed at right angles to the stem 74 and along with a thumb screw 86 an elongated slot 88 is adjustably attached to the longitudinal support bar 32 so that it can be positioned for support as shown in FIG. 1.

The lower stem portion 78 includes a necked down portion 90 which extends upwardly from pad 84 a distance at least equal to the overall diameter of a large finger. Neck portion 90 is extremely thin relative to the overall dimensions of stem 74 so that it can be easily positioned between adjacent fingers of a hand to permit pad 84 to be positioned beneath the fingers for support without requiring any change in the configuration of the brace to which it is attached. The shape of pad 84 also varies from that described previously in that it has a slight annular or arcuate shape to facilitate its bottom surface being placed on the upper portion of the fingers for support thereof while its upper surface is likewise accommodating to support the bottom portion of the fingers of a hand. When the fingers are extended as shown in FIG. 4 or bunched as shown in FIG. 6, they are curved slightly as shown. Thus, the radius of curvature of pad 84 extends vertically from a point beneath the pad. With reference to FIG. 4, lumbrical bar 70 of the invention is illustrated in the position where it provides support against the lower portions of the fingers. The thinness of neck portion 90 permits it to fit comfortably between two adjacent fingers.

Several distinctive advantages are provided by being able to support the lower portions of the fingers through the utilization of a lumbrical bar 70 without having to shift the brace relative to the arm. One of the advantages (illustrated in FIG. 5) is that it permits the utilization of a palmar pad 92 to maintain arch on the hand while at the same time preventing downward flexing of the portions of the fingers being supported by lumbrical bar 70. The palmar pad 92 is preferably comprised of a hollow leather structure filled with silicone gel, the pad being connected to strap 26 as shown in FIG. 5.

A second important advantage of the lumbrical 70 provided by the invention is the fact that lower support may be provided to a portion of the fingers in combination with the utilization of a flexion cuff 94 illustrated in FIG. 6. The flexion cuff is comprised of a sheepskin pad 96 which is attached at one end to clip 30 shown in FIG. 4 and wrapped around the anterior portions of the fingers to bend them appropriately with the bottom and proximal end of pad 96 being attached to a second clip 30a secured to strap 22 as illustrated in FIG. 1. The flexion cuff is applied as an assist in improving the flexion of the proximal interphalangeal joints. It is used to obtain passive finger flexion in cases of flex or weakness. The elbow strap 98 helps prevent distal migration of the brace. It can also be placed as a figure eight around the arm (not shown) in which case the sheepskin cuff 94 is attached to the dorsal molds and around the digits and is drawn into flexion by a Velcro strap which is run through a loop on the proximal portion of the brace. With this cuff, the finger joints can be passively brought into flexion for prescribed periods of time during the day.

The improved lumbrical bar 70 now permits joint extension from below in a dynamic brace utilized for alternative bracing such as outriggers, palmar pads and flexion cuffs. The adjustment and positioning thereof is extremely simple and it is attached to a conventional longitudinal support bar. The utility of the brace, however, is vastly improved.

Although but one embodiment has been shown and described in detail, it will be obvious to those having ordinary skill in this art that the details of construction

of this particular embodiment may be modified in a great many ways without departing from the unique concepts presented. It is therefore intended that the invention is limited only by the scope of the appended claims rather than by particular details of construction shown, except as specifically stated in the claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In a dynamic brace for metacarpophalangeal articulation reconstruction having a dorsal splint attachable to the forearm and extending to a point to be located with respect to the hand beyond the wrist for support thereof; a longitudinal bar mounted to said splint and having a portion spaced from said splint and extending therewith to a position to be over the hand; and a lumbrical bar attached to said longitudinal bar for supporting the metacarpal; the improvement comprising said lumbrical bar having a means at one end attaching said lumbrical bar to said longitudinal bar, a transverse pad at the other end of said lumbrical bar for supportive engagement of one or more of the proximal or distal interphalanges, said attaching means being adjustable to permit selection of the degree of extension of said pad along said longitudinal bar, and a stem portion extending from said attachment means to said pad, said stem including a narrow necked down portion that is thinner than the overall dimensions of the remainder of said stem extending from said pad and sized to permit comfortable positioning of said necked down portion between adjacent fingers whereby said pad is positionable proximally or distally against the bottom portions of said interphalanges.

2. The improved brace according to claim 1 wherein said transverse pad has a generally arcuate curvature, the radius of curvature extending vertically from a point beneath the pad.

3. The improved brace according to claim 1 wherein said stem is comprised of an upper and lower part slidably attached to each other to vary the length of said stem, said lower part including said neck portion at the lower end thereof.

4. The improved brace according to claim 1 wherein said brace further includes a pad secured to said splint for supporting the palm when said lumbrical bar is extended so that said transverse pad is adapted to be positioned beneath the metacarpophalangeal for support thereof.

5. The improved brace according to claim 1 wherein said brace further includes a flexion cuff for wrapping around the anterior portions of the patient's fingers when said lumbrical bar is extended so that said transverse pad is positionable beneath the metacarpophalangeal for support thereof, said cuff being interconnected to said splint.

6. A lumbrical bar comprising a stem having means for preselecting the desired length thereof; one end having means for rigidly connecting said stem to a support means; the other end having a transverse pad connected thereto for engaging and supporting the interphalanges from above or below, said stem having a narrow necked down portion that is thinner than the overall dimensions of the remainder of said stem extending from said pad and sized for comfortable positioning between two adjacent fingers of the patient so that said pad can support said interphalanges from above or below without moving said support means.

7. The lumbrical bar according to claim 6 wherein said pad has a generally arcuate curvature, the radius of curvature extending vertically from a point beneath the pad.