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METACARPAL SPLINT

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2 Sheets-Sheet 2

Fig. 6.

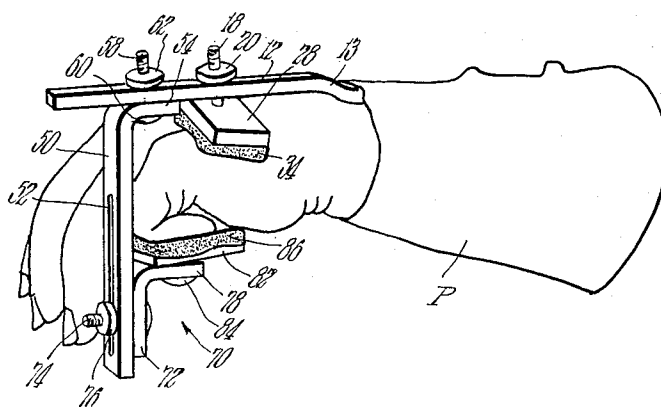
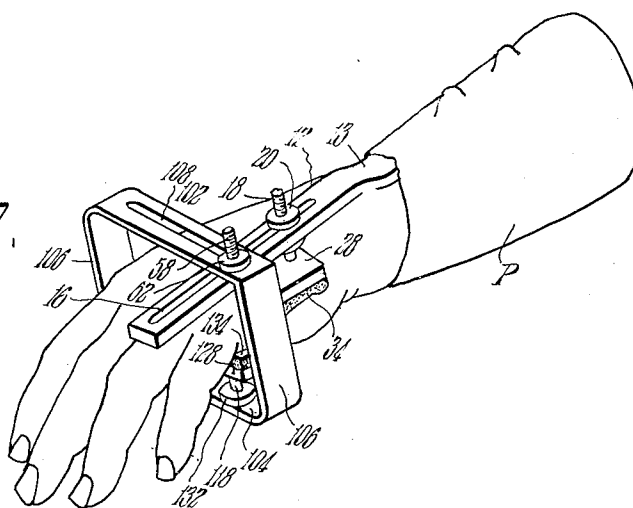


Fig. 7.



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2,520,035

METACARPAL SPLINT

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My invention relates to improvements in adjustable splints and is directed more specifically to the provision of an apparatus to be utilized for the retention of fractured metacarpal bones in a fixed position after reduction of the fracture.

It is a principal object of my invention to provide an apparatus for the treatment of all types of fractures involving the last four metacarpal bones.

It is another object of my invention to provide a simple and inexpensive device to effect the immobilization and maintenance of anatomical restoration of position of a reduced fracture.

A still further object of my invention is to provide an instrument of the class above described which anatomically and physiologically answers the purpose of both the surgeon and the general practitioner.

Deformities of the hand often occur as the result of improper immobilization of a fractured metacarpal once it is reduced. These fractures are characteristically found among young or middle-aged men as they are usually the result of pugilistic encounters, or close hand to hand combat with the enemy in time of war. They may also be caused by a direct fall or an indirect trauma such as being struck by an object, shell fragment, bullet or the like.

The neck of a metacarpal, same being the smallest and weakest portion of the bone, is the most common site of the fracture. The fracture is more frequently transverse in character. The resulting deformity is that of a depression of the head with dorsal angulation of the fragments. The more dorsal the striking force against the head, the greater the depression of the knuckle. The more direct the force on the head in the longitudinal axis of the metacarpal, the greater the degree of impaction. A tangential striking force results in a depression of the head with impaction and angulation of the fragments.

Normally the interosseous and lumbrical muscles insert into a loose aponeurotic sleeve over the dorsum of the proximal phalanx just distal to the metacarpo-phalangeal joint. Contracture of these two muscles results in flexion of the metacarpo-phalangeal joint.

Following a fracture of the metacarpal, with depression of the metacarpal head, the directional pull of these muscles is altered and the proximal phalanx is pulled into hyperextension. The greater the flexion deformity of the metacarpal, the more will be the hyperextension pull of the lumbrical and interosseous muscles, the shorter will be the relative length of the flexor

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profundus and sublimis tendons, and the greater will be the flexion deformity of the interphalangeal joints.

This deformity in the laborer interferes with his grasp of an implement. The inability to flex the affected finger completely, results in weakness of the flexion power of the adjacent fingers. The prominent head of the metacarpal in the palm of the hand may cause pain when an object such as a tool is grasped. The depression of the knuckle, the prominence on the dorsum of the hand, the hyperextension at the metacarpo-phalangeal joint and the flexion deformity at the interphalangeal joints are cosmetically objectionable to women.

A ball or roll of gauze in the palm of the hand does not counteract but rather emphasizes the angulating pull of the lumbrical and interosseous muscles thereby increasing the deformity. Skeletal traction of any form or skeletal fixation introduces the danger of infection. When plaster is used, it is too difficult to determine the exact amount of pressure necessary to maintain the position of the fragments. Too much pressure will result in pressure sores during the swelling stage which ensues within a few hours following the reduction. Too little pressure will result in reangulation when the swelling subsides. Constant immobilization of the flexed proximal interphalangeal joint, as advocated by Jahss, for a period sufficient to see callous on the X-ray film, often results in a flexion deformity.

The instrument to be described is devised for all types of fractures involving the lateral four metacarpal bones. This includes all types of simple and compound fractures.

With the fracture once reduced, the operator will find that very little upward pressure on the head of a metacarpal and downward pressure over the distal end of the proximal fragment is necessary to maintain the corrected position. However, an upward force cannot be made at this time on the plantar surface of the metacarpal head, since pressure of any consequence on the intervening flexor tendon sheath would irritate its membrane and result in thickening and adhesions. In order to eliminate pressure over the flexor tendon sheath, the metacarpo-phalangeal and first interphalangeal joints are flexed to form right angles. This places the base of the proximal phalanx beneath the head of the metacarpal. Very slight pressure exerted upwards against the head of the flexed proximal phalanx results in elevation of the metacarpal head and easily maintains the corrected position of the

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fragments. The amount of pressure necessary is merely the equivalent of overcoming the angulation deformity caused by the pull of the interosseous and lumbrical muscles.

These fractures were originally treated with a metal splint, using the flexed finger throughout the entire period of immobilization. At that time it was necessary to see the patient every second or third day in order to extend the proximal interphalangeal joint and thus avoid a flexion contracture. An attempt was then made to eliminate the necessity of seeing the patient so frequently.

After the first three to five days, the swelling of the soft tissues and the spasm of the traumatized interosseous and lumbrical muscles has subsided. Therefore it was felt that slight amount of upward pressure on the ventral surface of the metacarpal head at this time would not irritate the flexor tendon sheath. A square attachment, which will be described, was then devised which applied the upward pressure directly beneath the metacarpal head. This proved to be very satisfactory, but one difficulty was encountered. The splint, being constructed of metal, obstructed adequate visualization of the fragments on the roentgenogram. Hence, on subsequent cases, the splint was constructed of a plastic material, and proved more satisfactory since it was radiolucent.

An attempt was then made to combine both instruments into one in order to simplify replacement of the vertical arm with the square attachment. This is accomplished by using a simple attaching means which is adapted for securement to both the vertical and the square attachment as will presently be observed.

Attention is directed to an earlier patent #2,357,323, issued to me on September 5, 1944, wherein was disclosed by me a simple and inexpensive device designed to effect the immobilization and maintenance of anatomical restoration of a reduced fracture. In this patent, I disclosed an apparatus for the treatment of simple transverse and impacted fractures of the lateral four metacarpal bones which employed the principle of pressure pads to maintain the position of the fragments after closed reduction and could be easily applied and adjusted without fear of pressure sores, infection, loss of position, or deformities.

With the foregoing and various other novel features and advantages and other objects of my invention as will become more apparent as the description proceeds, the invention consists in certain novel features of construction and in the combination and arrangement of parts as will be hereinafter more particularly pointed out in the claims hereunto annexed and more fully described and referred to in connection with the accompanying drawings wherein:

Fig. 1 is a top plan view of one of the arrangements of my invention;

Fig. 2 is a side elevational view of the device shown in Fig. 1;

Fig. 3 is a top plan view of another of the arrangements of the apparatus of my invention;

Fig. 4 is a side elevational view of the device shown in Fig. 3;

Fig. 5 is a sectional view through one of the pressure bodies of my invention;

Fig. 6 is a perspective view showing one of the arrangements of my invention in cooperation with a patient's hand; and

Fig. 7 is a perspective view showing the other

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of the arrangements of my invention in cooperation with a patient's hand.

Referring now to the drawings more in detail in which similar characters of reference indicate corresponding parts in all the views, my invention will now be fully described.

An elongated rigid bar member is generally designated by 10 and is formed of a plastic or other suitable material.

Preferably the member 10, as well as all other components of the invention which will be described, with the exception of the soft pad members, are made of plastic. With the employment of metal, adequate visualization on the roentgenogram is obstructed. Plastic, being radiolucent, is much more satisfactory.

The member 10 has at one end a straight distal or metacarpal portion 12 and has at the other end a forearm supporting portion 14.

The plane of the forearm supporting portion 14 is offset relative to the plane of the metacarpal portion 12 substantially as shown in Figs. 2 and 4 and the portions are connected by a wrist or carpal portion 13. The wrist portion is angularly disposed relative to the distal portion 12 and the forearm portion 14 so as to form an angle of approximately 150 degrees with the metacarpal portion 12 and an angle of approximately 210 degrees with the forearm portion 14.

The member 10 is of such configuration as to overlie conveniently the hand, wrist and arm of the patient, all for purposes as will shortly be understood.

The metacarpal portion 12 of the member 10 is provided with a longitudinally extending slot 16 intermediate its ends for the reception of a screw 18 which may be held rigidly in any desired fixed position within the slot 16 by the locking action of a pair of nuts 20 and 22, the nut 20 being threaded upon the screw upwardly of the member 10 and the nut 22 being threaded upon the screw downwardly of the member 10, whereby the nuts 20 and 22 may be adjusted relative to each other so as to embrace the member 10 in any desired relation.

A pressure body is provided and comprises the screw 18 which has a ball member 24 at its lower extremity, same being freely receivable in an enlarged socket 26 centrally disposed in one side of a pressure plate 28. The member 28 is covered by a cap member 30 which is secured thereto and has an opening therethrough which is of less dimension than the socket 26 in the member 28 and which receives the screw 18 therethrough so as to produce a loose jointed relationship between the screw 18 and the pressure plate 28 all as is shown in Fig. 5.

Fixed to the opposite side of the plate 28 is a pad or cushion member 34 which contacts the upper surface of the patient's hand when in use. The member 34 may be made of any soft resilient material such as rubber or the like.

The pressure body may be horizontally adjusted relative to the member 10 by the sliding of the screw 18 along and within the longitudinal slot 16 and may be vertically adjusted by means of the relative positioning of the nuts 20 and 22 on the screw 18, all to the end that the desired pressure of the pad 34 upon the upper surface of the hand may be primarily located and secondarily regulated relative thereto all for purposes presently to be described.

The forearm supporting portion 14 is provided with a plurality of projections or studs 40; ex-

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tending upwardly from the upper surface thereof.

When the device is in use, as a plaster of Paris bandage is wrapped around the combined bar member 10 and the distal portion of the forearm of the patient, the studs 40 are engaged thereby so as to prevent slippage of the member 10 relative to the hand, wrist, and forearm and to retain the same in the desired fixed position. Greater binding area for the plaster of Paris bandage is afforded by the provision of the studs 40 as may be seen and appreciated by reference to Figs. 6 and 7.

An elongated vertical finger supporting or phalangeal member 50 is provided and consists of a rigid bar member having a longitudinally extending slot 52 intermediate its ends.

The upper end portion of the member 50 is provided with a leg 54 extending angularly from the main body portion of the member 50 and said leg is provided with a centrally disposed opening therethrough for the reception of a screw 58 having a head 60 and threadedly engageable with a nut 62.

The phalangeal member 50 is adapted to be fixed rigidly to and generally at right angles to the member 10 by means of the screw 58, receivable not only through the opening 56 of the leg 54 but also through the longitudinal slot 16 of the metacarpal portion 12, which screw 58 is held in any desired position by the tightening of the nut 62 in threaded engagement therewith.

An advantage in the arrangement of the members 10 and 50 as separate components is that one may be pivoted relative to the other so as to suit better each patient's individual requirements as will presently be observed to be so desirable. That is to say, the members 10 and 50 may be held in positions angularly disposed as to each other as for example may be observed in Figs. 1 and 2. This arrangement helps to compensate for the variations in the differing sizes and shapes of hands of different people and thus aids better approximation of the phalangeal of the fractured metacarpal in each individual case.

The longitudinal slot 52 of the phalangeal member 50 provides for the attachment of an adjustable bracket generally designated by 70.

The bracket is composed of a base member 72 slidably engageable with the member 50 by means of a bolt or threaded projection 74 whereby the member 70 may be rigidly retained in any desired position relative to the member 50 within the limits of the longitudinal slot 52, all by tightening a nut 76 threadedly engageable with the member 74.

The upper surface 78 of the bracket 70 is provided with a centrally disposed opening therethrough for the reception of a bolt or threaded projection 80 extending downwardly from a supporting plate member 82.

The member 82 is disposed upon the upper surface 78 of the bracket 70 and is held relative thereto by means of the bolt 80 and a nut 84 threadedly engageable therewith.

Upon the upper surface of the supporting plate member 82 is mounted a pad or cushion member 86 which may be made of a soft yielding material such as felt, rubber, or the like so as to offer a soft contacting surface for the fingers of the patient for reasons as will shortly be observed.

The position of the bracket 70 relative to the phalangeal member 50 and the position of the plate member 82 relative to the bracket 70 may

be adjusted by the separate means heretofore explained so that the finger or fingers of the patient may rest comfortably upon the pad member 86.

The members 82 and 86 may, if desired, be of greater length than width and may be disposed relative to the fingers so as to accommodate more than one finger thereon as shown in Fig. 6.

The vertical member 50 is used usually for the first three to five days of treatment of the simple but complex type of metacarpal fractures and may be quickly and conveniently detached from the member 10 as will presently be observed.

A square supporting member generally indicated by 100 is also provided and comprises a rectangular shaped bar member having an upper bar 102, a lower bar 104, and a pair of side bars 106 and 106.

The member 100 may be substituted for the member 50 when it is desired by the operator to continue immobilization of the fragments yet to alter the position of the finger or phalangeal portion from the flexion to the extended and free position.

The upper and lower bars 102 and 104 respectively are provided with longitudinally extending slots 108 and 110 respectively intermediate their ends.

The screw 58 having the head 60 formerly associated with the member 50 is receivable through the slot 108 of the upper bar 102 and also through the slot 16 of the member 10, and is adapted to hold the members 10 and 100 in any desired position relative to each other by means of the nut 62 threadedly engageable therewith.

Thus it will be observed that the bar member 10 and the square member 100 may be rigidly held in various positions relative to each other and relative to the arm and hand of the patient to suit the particular needs of each individual case.

The member 100 may be pivoted relative to member 10 so that one is angularly disposed relative to the other. This feature is especially desirable when the patient puts on or takes off a piece of clothing which has to be slipped on over the arm as in the case of a sleeve of a coat. By a slight angular adjustment of the member 100, the operation may be performed with ease.

Similarly as shown in the case of the pressure body shown in Fig. 5, a supporting body is provided and comprises a screw 118 which has a ball member at its upper extremity, same being freely receivable in an enlarged socket of a supporting plate 126, which member has a cap member (not shown) secured thereto and has a centrally disposed opening therein for receiving the ball of the screw 118 therethrough so as to produce the same adjustable and loose jointed relationship between the screw 118 and the supporting plate 128 as between the members 18 and 28 in Fig. 5. This is essential in order to allow for slight variations in the size and shape of the hand and to maintain at the same time an even distribution of force throughout the entire contact surface.

Fixed to the upper side of the plate 126 is a pad or cushion member 134 which contacts the palmar surface of the patient's hand at the metacarpal head. The member 134 may be made of any soft yielding material such as felt or the like.

The screw 118 may be held rigidly in any desired position horizontally along the slot 110 by the locking action of a pair of nuts 136 and 138, the nut 136 being threaded upon the screw up-

wardly of the member 104 and the nut 138 being threaded upon the screw downwardly of the member 104 all to the end that the nuts 136 and 138 may be adjusted relative to each other so as to embrace tightly or loosely the member 104 as may be desired.

The screw member 118 may, likewise, be adjusted vertically of the member 100 so as to be brought into and out of engagement with the patient's hand, all as desired.

The member 100 is used during the later period of treatment in some simple fractures, or during the entire course of treatment in simple or compound fractures of the metacarpal.

Another advantage in the arrangement of members 10 and 50 as separate components is that the vertical member 50 may be removed and the member 100 may be substituted therefor. In this manner, the metacarpal may be immobilized with the phalangeal portion or the finger held in extension rather than flexion.

This apparatus is also applicable in the treatment of transverse, oblique, or spiral simple fractures of the lateral four metacarpal bones. It is also of value in compound fractures, war injuries, malunited fractures following open operation and bone grafting, and also following operative intervention for ununited fractures of any portion of the lateral four metacarpal bones of either hand.

Modifications of the device such as increasing the width or length of the pressure plates 28, 82 and 126 for use in cases where more than one metacarpal bone is fractured may be made without departing from the scope and spirit of the invention.

The invention may be embodied in other specific forms without departing from the essential characteristics thereof. Hence, the present embodiments are therefore to be considered in all respects merely as being illustrative and not as being restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all modification and variations as fall within the meaning and purview and range of equivalency of the appended claims are therefore intended to be embraced therein.

What is desired to claim and secure by Letters Patent of the United States is:

1. An adjustable splint for use in maintaining a fractured metacarpal bone in anatomical alignment after reduction comprising in combination, an elongated bar member having a metacarpal portion and a forearm portion at its opposite ends and a carpal portion intermediate its ends, a vertically extending phalangeal member pivotally securable to one end of said bar member, an adjustable pressure body depending downwardly in slidable relationship from said bar member and adapted to be adjusted so as to press against the dorsal surface of a patient's hand proximal to the fracture site, an adjustable support member in perpendicularly disposed slidable relationship with said phalangeal member for movement into and out of a position of support for the second row phalanx associated with

the fractured metacarpal, and a square member depending downwardly of and pivotally securable to said bar member and having an adjustable cushioned supporting plate member for upward pressure against the palmar surface of a patient's hand.

2. An adjustable splint for use in maintaining fractured metacarpal bones in anatomical alignment after reduction comprising in combination, a frame member for securement to the forearm of the patient, a pivotable vertical phalangeal member depending from the forward end of said frame member, an adjustable pressure body depending downwardly from said frame member and adapted to contact the dorsal surface of the metacarpal region of a patient's hand proximal to the fracture site, a vertically and angularly adjustable bracket member connected to said phalangeal member and adapted to retain the fingers of the fractured metacarpals flexed into the palm of the hand, means associated with said frame member adapted to retain the device in a fixed position relative to a plaster of Paris cast, and a square member adapted for pivotal securement to said frame member and depending downwardly therefrom.

3. An adjustable splint for use in maintaining a fractured metacarpal bone in anatomical alignment after reduction comprising in combination, a single elongated bar member having a metacarpal portion and a forearm supporting portion at its opposite ends, said bar member having a longitudinal slot in the metacarpal portion thereof, a pressure body having an upstanding supporting element adjustably receivable in the slot of said bar member and a pressure element depending downwardly therefrom beneath said bar member for exerting pressure against the dorsal surface of a patient's hand proximal to the fracture site, an elongated rectangular frame formed from opposite and adjacent longitudinal and transverse members, one of said longitudinal members having a longitudinal slot intersecting with the longitudinal slot in said bar member, locking means receivable at the intersection of the slots of said bar member and the said one longitudinal member for adjustably holding the same in securement relative to each other, and an adjustable supporting plate member pivotally secured to the other of said longitudinal members for movement into and out of a position of support for exerting upward pressure against the palmar surface of a patient's hand.

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REFERENCES CITED

The following references are of record in the file of this patent:

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Number	Name	Date
1,885,448	Jones	Nov. 1, 1932
2,357,323	Goldberg	Sept. 5, 1944

OTHER REFERENCES

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