United States Patent [19]

Halloran

[11] **3,717,146**

[45] **Feb. 20, 1973**

[54] THREADED INTRAMEDULLARY COMPRESSION AND FIXATION DEVICE

[76] Inventor: **William X. Halloran,** 440 Fair Drive, Costa Mesa, Calif. 92626

[22] Filed: **Feb. 1, 1971**

[21] Appl. No.: **111,206**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 765,608, Oct. 7, 1968, abandoned.

[52] **U.S. Cl.** ..... **128/92 BC**

[51] **Int. Cl.** **A61b 17/18,** A61f 5/04

[58] **Field of Search** ..... 128/92 BB, 92 BC, 92 R

[56] **References Cited**

UNITED STATES PATENTS

2,526,959	10/1950	Lorenzo	128/92 BB
2,821,979	2/1958	Cameron	128/92 BC
2,825,329	3/1958	Caesar	128/92 R
3,334,624	8/1967	Schneider et al.	128/92 R

FOREIGN PATENTS OR APPLICATIONS

1,031,128	3/1953	France	128/92 BC

OTHER PUBLICATIONS

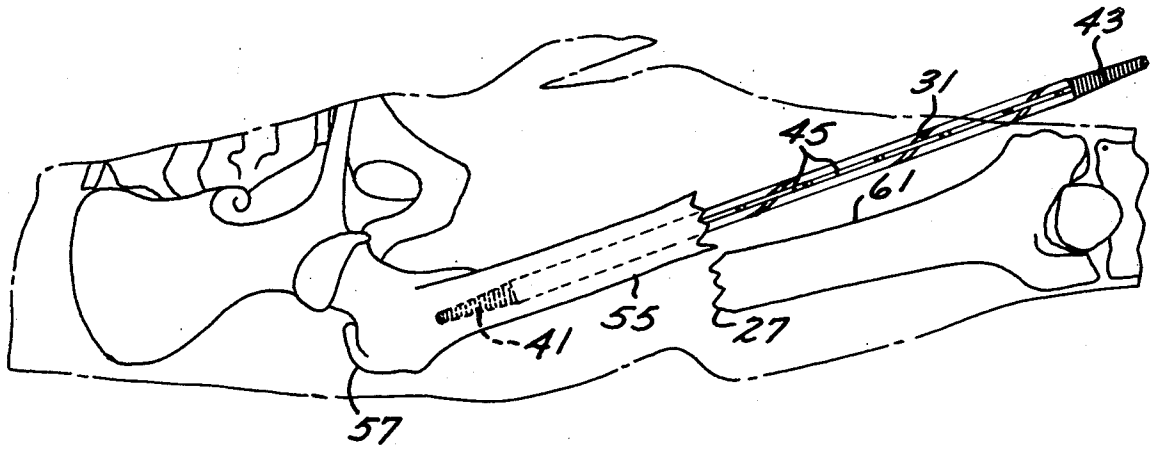
Advertisement of De Puy Mfg. Co. In Jour. Bone and Joint Surg., Vol. 38 A, No. 4, July 1956. Page 32.

Primary Examiner—Channing L. Pace
Attorney—Fulwider, Patton, Rieber, Lee & Utecht

[57] **ABSTRACT**

An intramedullary compression and fixation device for compressing a long bone of a predetermined length which has been fractured medially to form first and second bone segments. The compression and fixation device includes an elongated intramedullary rod of sufficient length to project from one end of the bone past the fracture site and which is formed with a cross section of sufficient size to substantially occupy the cross section of the medial portion of the medullary canal of the bone. Peripheral thread means are formed on such rod and are of sufficient size to engage the cancellous bone forming the interior wall of the medullary canal to drive the rod axially in such canal upon rotation of the rod. Coupling threads are formed on one end of the rod for connection with an intramedullary rod driver-retractor device whereby an opening may be formed in one end of the bone and the end of the rod opposite the one end passed through the open end, the driver-retractor device engaged with the coupling threads and such device rotated to screw the rod through the one bone segment and into the second bone segment to thereby span the fracture and maintain the bone segments in fixed relationship with respect to one another.

10 Claims, 7 Drawing Figures



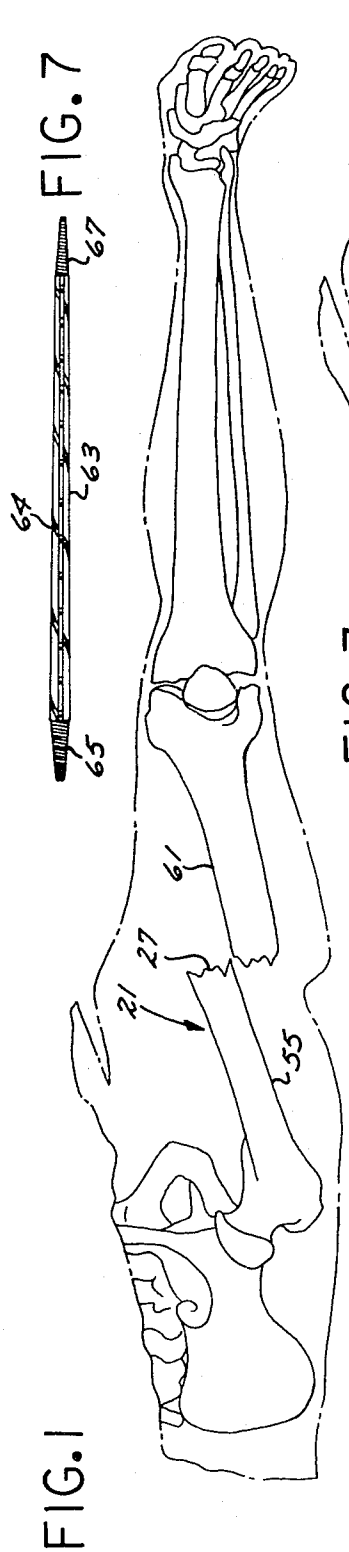


FIG. 1

FIG. 7

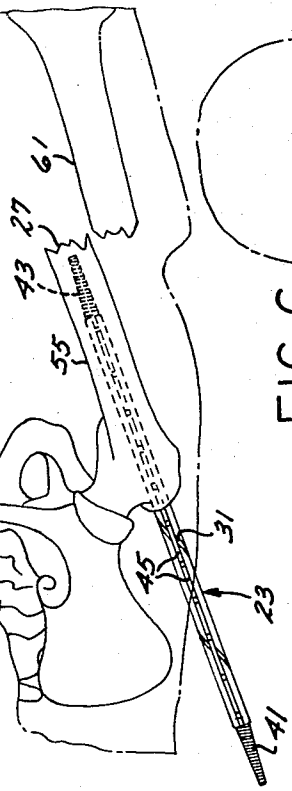


FIG. 3

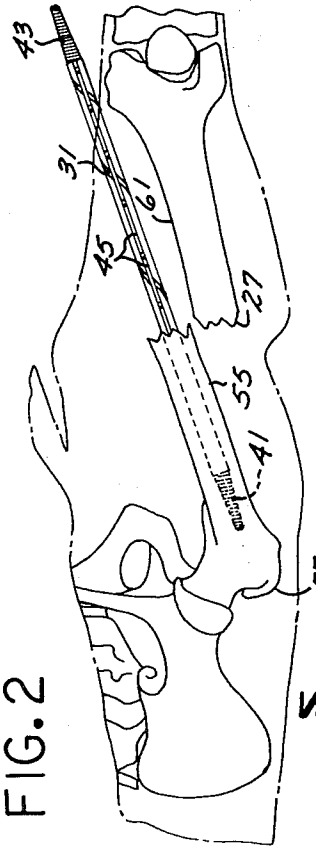


FIG. 2

FIG. 6

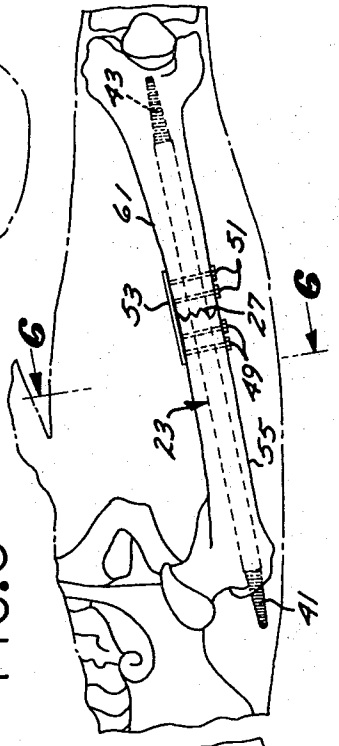


FIG. 5

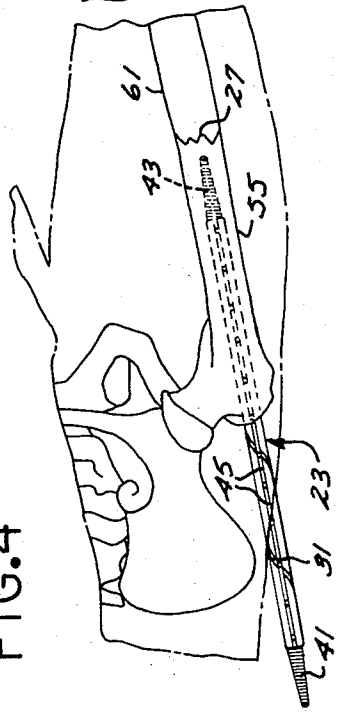


FIG. 4

INVENTOR.
WILLIAM X. HALLORAN M.D.
BY Fulwider, Patton, Rieber, Lee and Utecht
ATTORNEYS

THREADED INTRAMEDULLARY COMPRESSION AND FIXATION DEVICE

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of Ser. No. 765,608, filed Oct. 7, 1968, and now abandoned.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to intramedullary fixation and compression devices.

2. Description of the Prior Art

In treating the fractures of long bones, it is desirable to provide intramedullary fixation to prevent transverse shifting of the bone segments with respect to one another and to also provide longitudinal compression to compress the bone segments together at the fracture site. A particularly serious shortcoming of prior art bone setting devices is that they force the surgeon at the time of the operation to elect between use of an intramedullary fixation rod or else use of a compression device disposed externally of the bone thereby failing to provide both fixation and compression.

It has been common practice to provide intramedullary fixation rods which are formed throughout their lengths with unthreaded peripheries for conveniently being driven telescopically into the medullary canal of a fractured bone. Devices of this type are shown in U. S. Pat. Nos. 2,136,471; 2,998,007; and 3,334,624. While the devices shown in these patents serve to provide adequate fixation, they inherently prevent simultaneous installation of known bone compression devices. While threaded screws have been proposed for use in a patient's trochanter as shown in U. S. Pat. No. 2,526,959, no intramedullary rods have been proposed which would realistically serve for use in a long bone such as a femur, tibia or radius.

SUMMARY OF THE INVENTION

The threaded intramedullary compression and fixation device of present invention is characterized by an intramedullary rod for use with a fractured long bone and of sufficient length to project from the fracture site to one end of such bone. The rod is of sufficient cross section at the fracture site to project entirely across the cross section of the medullary canal and is formed on its exterior at the fracture side with thread means for engaging the opposite walls of the medullary canal so the fracture can be compressed by a conventional compression device and such rod inserted to cause the thread means to engage the walls of the medullary canal to hold the bone segments on opposite sides of the fracture in fixed spaced relationship to maintain such fracture in compression after the conventional compression device has been removed.

An object of the present invention is to provide an intramedullary compression and fixation device which offers the advantages of intramedullary fixation as well as the advantages of concurrently maintaining the fracture in compression.

Another object of the present invention is to provide a threaded intramedullary compression and fixation device of the type described which incorporates an intramedullary rod that projects out one end of the bone so a surgeon may have convenient access thereto for subsequent removal.

These and other objects and the advantages of the present invention will become apparent from the following detailed description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top view of a fractured femur in which a threaded intramedullary compression and fixation device embodying the present invention may be used;

FIG. 2 is a partial top view similar to FIG. 1 and showing a threaded intramedullary compression and fixation device embodying the present invention being inserted in the proximal femural bone segment;

FIGS. 3, 4 and 5 are similar to FIG. 2 showing progressive steps of reducing the fracture;

FIG. 6 is a horizontal sectional view, in enlarged scale, taken along line 6—6 of FIG. 5; and

FIG. 7 is a top view of a second embodiment of the threaded intramedullary compression and fixation device of present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIGS. 1, 5 and 6, the threaded intramedullary compression and fixation device of present invention may conveniently be used to reduce a fractured femur, generally designated 21, and includes a threaded intramedullary rod, generally designated 23, which is of sufficient length to project from the lower extremity of the medullary canal 25 of such femur upwardly past the site of the fracture 27 to project from the upper end of such femur as shown in FIG. 5. Referring to FIG. 6, the intramedullary rod 23 is of sufficient cross section to project fully across the cross section of the medial portion of the intramedullary canal 25 and is formed with elongated bone-engaging threads 31 for engagement with the cancellous bone 33 forming the interior wall of such medullary canal 25. Thus, an incision may be made adjacent the fracture site 27 and the upper end of the intramedullary rod 23 inserted through such incision and into the lower end of the upper, or proximal segment of the fractured femur 21 and a driver-retractor device (not shown) connected with the lower end of the rod 23 and such rod rotated to cause the threads 31 to engage the cancellous material 33 and draw the rod 23 upwardly in the medullary canal to project from the upper end of the femur 21. An incision may then be made in the buttock of the patient to permit the upper extremity of such rod to project from the buttock as shown in FIG. 3 until the lower extremity of such rod is fully drawn into the lower end of the proximal femur segment. The driver-retractor device (not shown) may then be disconnected from the lower extremity of the intramedullary rod 23 and the fracture 27 set and a compression device employed to place the fracture site in compression. With the fracture site maintained in compression, the driver-retractor device may be coupled with the upper end of the intramedullary rod 23 and such rod rotated to drive the lower extremity thereof downwardly into the distal femur segment to position such rod in spanning relationship with the fracture site 27 to hold the bone segments in fixed spaced relationship to maintain such fracture in compression.

The intramedullary rod 23 shown in FIGS. 2–6 is intended for use in an adult male and is approximately 19 inches in length and is one-half inch in diameter. It has been found that the cylindrical shape of such rod provides desirable load carrying characteristics which enable such rod to withstand the loads applied thereon by patients under normal conditions.

The threads 31 are formed by a groove that is approximately one-tenth of an inch deep and forms a 5 inch lead such that when the rod is turned 1 full turn it will feed into the intramedullary canal 25 5 full inches. For practical purposes the lead of such threads should be no less than one-half inch.

The opposite ends of the intramedullary rod 23 are tapered to thereby define pointed extremities and such extremities are formed with coupling threads 41 and 43, respectively, for connection with mating threads of a conventional intramedullary rod driver-retractor device. It is particularly important that such rod include coupling threads on both ends thereof so the rod can be installed in a retrograde fashion as will be described hereinafter.

Referring to FIGS. 2 and 5, the intramedullary rod 23 is formed throughout its length with a plurality of longitudinally extending, through, transverse passages 45 adapted for receipt of transversely extending compression plate screws 49 and 51 to thereby enable a compression plate 53 to be secured to the exterior of the femur 21 after such rod has been inserted therein.

In operation, when a patient that has fractured a long bone, such as a femur, is examined it is usually determined that the bone segments are offset at the fracture side as shown in FIG. 1. Consequently, it is convenient for the surgeon to make an incision at the fracture site and insert the intramedullary rod 23 from such site in a retrograde manner.

In operation, the surgeon selects a rod 23 of sufficient length to project throughout the length of the medullary canal of the fractured bone and to project from one end thereof. For a fractured femur, the surgeon can make an incision on the interior side of the thigh to expose the fracture site 27 and the upper end of the rod 23 may be inserted in such incision and fed into the lower end of the medullary canal formed in the proximal femur segment 55. A conventional driver-retractor device is coupled with the coupling threads to guide insertion of the intramedullary rod into the proximal segment 55 and to facilitate rotation of the intramedullary rod to cause the threads 31 to engage the cancellous bone 33 to cause such rod to be fed into the bone segments 55 as it is rotated. When the upper end of the rod 23 reaches the trochanter 57 forming the upper extremity of the femur 21, continued rotation of such rod will apply a breaking force to the wall of such trochanter to thereby punch a hole therein for egress of the upper extremity of the rod 21. If necessary, a moderate amount of hammering may be done on the driver-retractor to facilitate breakthrough of the upper end of the rod 23. As the rod 23 is driven upwardly through the top wall of the trochanter 57, the surgeon will locate a resulting rise in the patient's buttock and by merely making a ¾ inch incision will allow such rod to project upwardly through such incision to project from the buttock. Continued rotation of the rod 23 will cause it to continue its travel upwardly in the medullary canal of the proximal femur segment 55 until the lower end of such rod is entirely drawn into the lower extremity of the segment 55.

The surgeon may then set the fracture 27 by placing the proximal femur segment 55 in axial alignment with the lower femur segment 61 as shown in FIG. 4. As a practical matter, the natural tightening of the patient's thigh muscles which results from the trauma of the fracture is, in many cases, sufficient to provide a substantial amount of compression at the fracture site thereby eliminating the necessity of any additional external compression.

However, if additional external compression is desired, a conventional compression device may have its clamps applied to the bone segments 55 and 61 and the segments then drawn together to maintain the fracture site 27 in compression while the rod 23 is screwed downwardly into the lower segment 61. In either case disposition of the rod 23 in spanning relationship with the fracture 27 while such fracture is compressed will result in such fracture being held in compression after the thigh muscles have relaxed and the compression device has been removed.

Alternatively, the compression plate 53 may be applied in a conventional manner by using short screws which project only into the adjacent wall of the femur 21 rather than entirely through the femur as is the case for the bolts 49 and 51.

Assuming that the surgeon elects to rely on the natural compression provided by the taut thigh muscles, the driver-retractor device is coupled with the coupling threads 41 on the upper end of the rod 23 and such rod rotated in a direction to cause it to be driven downwardly in the upper femur segment 55 and into the distal femur segment 61. As the lower extremity of the rod 23 engages the distal segment 61, the threads 31 will engage the cancellous bone 33 thereof to, in effect, tap the medullary canal and draw such rod 23 downwardly as rotation of such rod is continued.

It is particularly important that when insertion of the intramedullary rod 23 is completed, the upper coupling threads 41 remain projecting from the trochanter 57 so a surgeon may have convenient access thereto by merely making a subsequent incision in the patient's buttock and may engage his driver-retractor with such threads and rotate the rod 23 to screw it out of the medullary canal. This feature becomes particularly important when complications arise which make removal mandatory and enables such removal to be accomplished without making a new break to obtain access to such rod.

If the surgeon elects to also apply external compression to the fracture 27, he may conveniently do so by merely X-raying the thigh to determine the disposition of the transverse through passages 45 and may then drill holes in alignment with a selected one of such passages for passage of the bolts 49. The compression plate 53 may then be placed in position and the bolts 49 inserted. A conventional compression device may then be secured to the free end of such plate 53 and to the distal femur bone segment 61 and such compression device actuated to draw bone segments 55 and 61 together to place the fracture 27 under even greater compression. While the compression device holds such fracture in compression, holes may be drilled in the femur in alignment with a selected passage 45 for

receipt of the bolts **51**. The bolts **51** may then be inserted and tightened to thereby maintain the fracture site **27** under compression after the compression device is removed. The incisions may then be closed and recovery of the patient will be commenced.

The threaded intramedullary compression and fixation device shown in FIG. **7** is similar to that shown in FIGS. **2–6** except that it includes an intramedullary rod **63** that includes elongated threads **64** and is tapered from its upper end **65** to its lower end **67**. Consequently, such rod may conveniently be inserted from the upper end of the fractured femur **21**. In operation, a surgeon using the rod **63** to reduce a fractured femur will first set the fracture and then make an incision in the patient's buttock and will then operate through such incision to drill a hole in the top of the trochanter **57**. The rod **63** may then be inserted and an intramedullary rod driver-retractor device connected with the upper end **65** thereof to rotate such rod and cause it to feed downwardly into the upper femur segment and into the lower femur segment to engage the threads **64** with the cancellous bone to thereby tap the medullary canal and draw such rod into spanning relationship with the fracture site to thereby maintain the bone segments in fixed longitudinal spaced relationship.

From the foregoing description it will be apparent that the threaded intramedullary compression and fixation device provides an intramedullary rod which may conveniently be installed in a retrograde fashion and which will provide both fixation and longitudinal compression.

I claim:

1. In a threaded intramedullary compression and fixation device for compressing a long bone having a medullary canal of a predetermined length and cross section and which has been fractured medially to form first and second bone segments, the improvement comprising:

an elongated intramedullary rod of sufficient length to project from one end of said bone past said fracture and formed with a fixation area having a cross section of sufficient size to project substantially across the transverse cross section of the medial portion of said medullary canal;

peripheral bone-engaging thread means on said fixation area of sufficient size to engage cancellous bone forming the wall of said medullary canal in the area of said fracture site; and

coupling means on one end of said rod whereby rod driver-retractor device may be coupled with said coupling means and after said fracture has been set and while it is held compressed, said compression and fixation device may be inserted into said intramedullary canal from one end thereof and said driver-retractor device rotated to engage said thread means with said cancellous bone forming said intramedullary canal thus resulting in said rod spanning said fracture site with said thread means engaging said cancellous bone in both said bone segments to hold said segments in fixed relationship to maintain said fracture compressed.

2. A threaded intramedullary compression and fixation device as set forth in claim **1** wherein said rod is of sufficient length to project substantially the full length of said bone.

3. A threaded intramedullary compression and fixation device as set forth in claim **1** wherein said rod includes a plurality of through, transverse, screw-receiving passages for receiving transverse screws inserted through the wall of said bone.

4. A threaded intramedullary compression and fixation device as set forth in claim **1** for use in a femur wherein said rod is of sufficient length to project substantially the full length of said femur.

5. A threaded intramedullary compression and fixation device as set forth in claim **1** wherein said rod is regularly shaped in its longitudinal direction.

6. A threaded intramedullary compression and fixation device as set forth in claim **1** wherein said rod is greater than three-eighths of an inch in cross section and is at least 15 inches long.

7. A threaded intramedullary compression and fixation device as set forth in claim **1** wherein said rod is one-half inch in cross section and 19 inches long.

8. A threaded intramedullary compression and fixation device as set forth in claim **1** that includes coupling means on the end of said rod opposite said one end for connection with an intramedullary rod driver-retractor device.

9. A threaded intramedullary compression and fixation device as set forth in claim **1** wherein said thread means forms a lead greater than 1 inch.

10. A threaded intramedullary compression and fixation device as set forth in claim **1** that includes:

an exterior compression plate for securement to the exterior of said bone; and

transverse screws for being connected with said plate whereby said plate may be positioned on the exterior of said bone and said transverse screws inserted through the wall of said bone and through said transverse passages on opposite sides of said fracture and coupled with said plate to assist in holding said bone segments in spaced fixed relationship.

* * * * *