United States Patent [19]

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[11] **3,791,380**

[45] **Feb. 12, 1974**

[54] **METHOD AND APPARATUS OF IMMOBILIZING A FRACTURED FEMUR**

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[22] Filed: **Dec. 13, 1971**

[21] Appl. No.: **207,594**

Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 883,255, April 13, 1970, abandoned.

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

[51] **Int. Cl.** **A61f 5/04**

[58] **Field of Search**.. 128/92 R, 92 A, 92 B, 92 BA, 128/92 BB, 92 BC, 92 C, 92 CA, 92 D, 92 G

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[57] **ABSTRACT**

The invention relates to a method and apparatus for immobilizing the fractured neck of a femur with the head portion of the femur by first aligning the head and neck through a guide wire and thereafter telescoping over the guide wire, a tubular body containing means for entry into the spongy portion of the head of the femur and thereafter applying pressure to the neck of a femur until re-ossification is attained.

9 Claims, 5 Drawing Figures

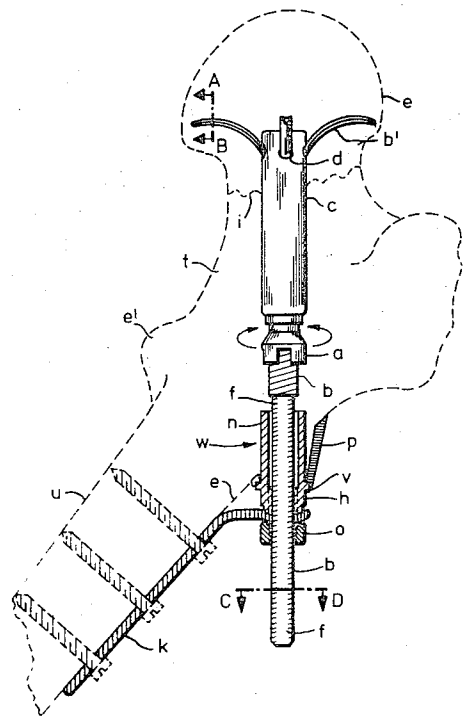

Fig. 1

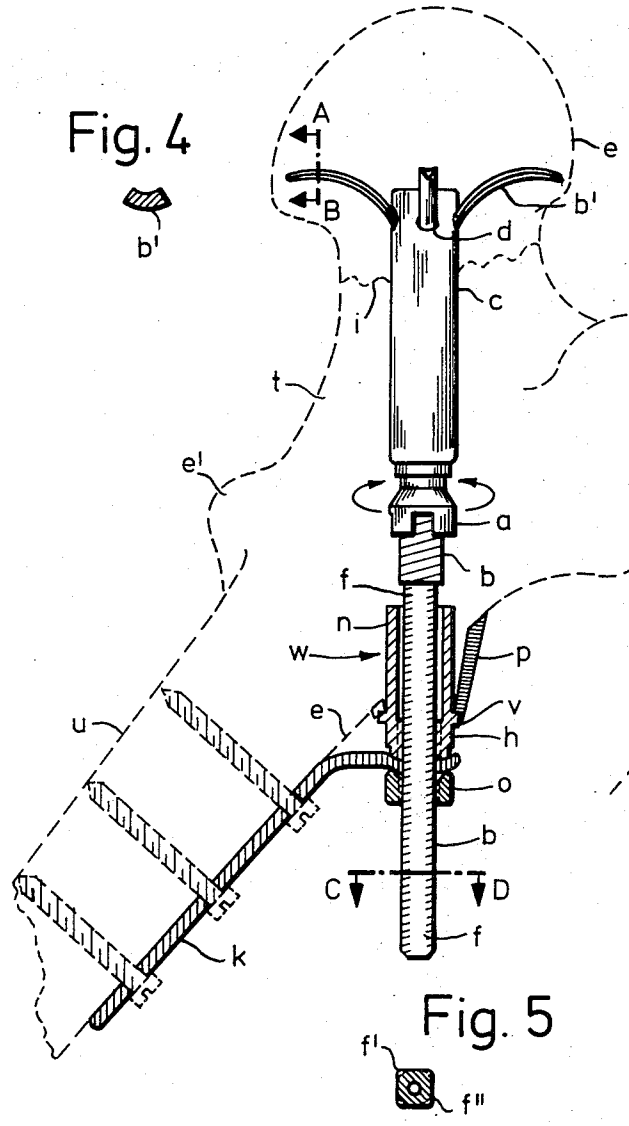

Fig. 2

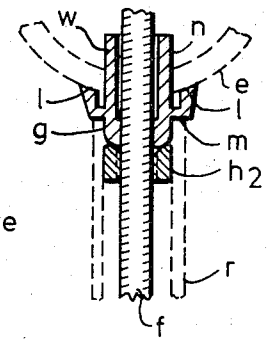

Fig. 3

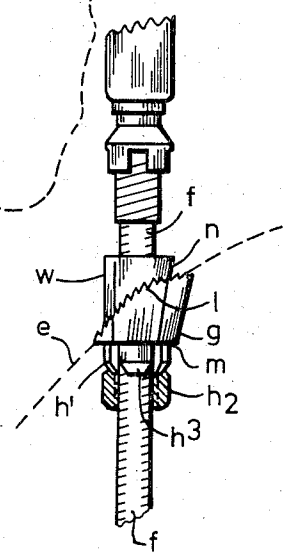

Fig. 4

Fig. 5

METHOD AND APPARATUS OF IMMOBILIZING A FRACTURED FEMUR

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of my copending application entitled PRESSURE-CLAW-NAIL FOR FEMUR-NECK FRACTURES, Ser. No. 883,255, filed Apr. 13, 1970 now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to a device for immobilizing fractures of the neck of a femur.

One device which is commonly used for immobilizing a fractured neck of a femur comprises a three-lamellae nail which is hammered into the neck of the femur through the fracture region. With this nail there is no compression of the bone fragments in the fracture region, since the head of the femur rests loosely against the nail. The spongy bone in the interior of the femoral neck does not permit such a nail to effect sufficient holding together of the bone fragments without movement while healing takes place. Any small movements produced in the fracture region may cause the development of a femoral neck pseudoarthrosis (second joint).

Another device used is a compression screw, but although the screw thread has a greater hold on the spongy bone than the aforementioned nail and exerts compression on the bone fragments, since the compression screw is not provided with lamella the femoral head fragment is not fully prevented from rotating relatively to that neck fragment which is continuous with the femoral shaft.

OBJECTS AND SUMMARY OF THE INVENTION

The main object of the present invention is to provide a device for immobilizing a fracture of the neck of a femur which is capable of effecting resilient compression of the bone fragments in the fracture region and of exerting a firm hold on the spongy bone so as to guard against rotation of the femoral head.

According to the present invention there is provided a device for immobilizing a fractured neck of a femur, the device including a tubular body member, four claw members which are mounted within the body member and which are movable simultaneously between positions in which the claw members are extended outwardly from, and are fully retracted into, the body member, the claw members being arcuate in cross section, being formed in such a manner as to press bone fragments of the neck of the femur together in the outwardly extended position when the device is in the neck of the femur and defining, in the fully retracted position, a part of a duct for a guide wire, which extends axially throughout the device, and means for maintaining the device in position in the fractured neck of the femur.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the invention may be more fully understood some embodiments in accordance therewith will now be described by way of example with reference to the accompanying drawing, in which

FIG. 1 is an enlarged view partially in cross section and partially in elevation of a device for treating a fracture of the neck of a femur, secured in position in a fractured neck of a femur which is shown in dotted lines;

FIG. 2 is a longitudinal section of a constructional detail of a modification of the device in FIG. 1;

FIG. 3 is a partially cross sectional elevation of a constructional detail of another modification of the device of FIG. 1;

FIG. 4 is a cross section along the line A–B of FIG. 1; and

FIG. 5 is a cross section along the line C–D of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawings there is shown, in FIG. 1, in dotted lines, the outline of the upper portion of a femur bone having a head *s*, a neck *t* and a shaft *u* with the outer hard surface of the femur being designated *e* and the inner spongy bone *e'*. The femoral neck *t* is fractured as represented diagrammatically by the dotted line *i*.

The device for immobilizing the fracture *i* e.g., in the position shown in FIG. 1, incorporates a tubular body member *c* having a nut *a* secured to one end thereof for rotation about the longitudinal axis of the member *c*. The nut *a* is internally threaded and engages with a threaded rod *b* which projects axially into the body member *c*. Claw members *b'* shown in an outwardly extended position are secured through a guide member (not shown) to the end of the rod *b* inside the body member *c*. The claw members *b'* are movable simultaneously between positions in which they are extended outwardly from, and fully retracted into, the body member through apertures *d*. The guide member engages in four axial grooves (not shown) formed in the inner wall of the body member *c* to prevent rotation of the claw elements relatively to the body member *c* during their movement.

Each of the claw elements *b'* is arcuate in cross section for reinforcing purposes as shown in FIG. 4.

Also, the claw members *b* are formed in such a manner as to press the bone fragments of the fractured neck of the femur together in the outwardly extended position, and define in the fully retracted position a part of a duct *f''* (see FIG. 5) extending axially throughout the deivce. The threaded rod *b* defines another part of the duct *f''*.

In the fully retracted position the claw members define a substantially square central aperture.

Integral with the threaded rod *b* is another rod *f* which, as will be apparent from FIG. 5 is substantially square shaped in cross section with each of its corners being of arcuate shape and being provided with a screw thread *f'*. The longitudinal surfaces of the rod *f* are smooth and are obtained by milling a screw-threaded rod. The rod *f* defines another part of the axial duct, *f''* for a purpose to be described.

The device further includes a sleeve *w* having a non-threaded portion *n* which projects into the femur when the device is in position in the femoral neck, a threaded nut portion h_1 which threadedly engages with the rod *f* in the manner shown and an annular flange *v*. In the construction of FIG. 1 the annular flange *v* is connected to a wedge portion *p* as by a ball joint (not shown) for permitting relative movement between the nut portion h_1 and the wedge portion *p* and to enable the wedge portion *p* to be firmly pressed against the

femur in a manner to be described. A counternut *o* is provided for securely locking the sleeve and the wedge *p* in the position shown in FIG. **1.** If the femoral shaft *u* has been splintered or fractured at the same time as the fracture *i*, then, as is known, a plate *k* may be secured to the shaft *u* in the manner shown to align and immobilize these bone fragments. In this instance the plate *k* is secured to the rod *f* by the counternut *o*.

In FIGS. **2** and **3** the construction of the sleeve *w* is modified, the wedge portion *p* being replaced by a toothed portion *g* which is integral with this modified sleeve *w*. The toothed portion *g* has teeth *l* which are made to bite into the femur during insertion of the device thereby ensuring secure fixing of the device in position in the femoral neck. The nut portion h_1 is replaced by a hollow clampable member having four resilient tooth-like segments h_3 which slidingly engage with the longitudinal side surfaces of the rod *f*. A second nut h_2 is screwed onto the rod *f* and exerts a clamping pressure on the segments h_3 thereby securing the sleeve *w* to the rod *f*. In FIG. **2,** the toothed portion *g* consists of circularly distributed teeth whereas in FIG. **3,** the toothed portion *g* is divided into two wedge shaped portions.

When a three-lamellae nail having an axial bore is used for immobilizing the fracture, a surgical operation is performed so that after the appropriate area of the femoral bone has been exposed a 2mm. ϕ guide wire is drilled into the femoral neck until, under X-ray observation, the wire is in the correct position. At this stage the three-lamellae nail is pushed over a projecting end of the guide wire and hammered through the fracture into the desired position.

Using either of the devices described, however, when the guide wire is in the correct position, a hole is bored in the femoral neck using a hollow crown drill which is guided by the guide wire. The drill is of a size which will permit fitting of the body member *c* in the bored hole without hammering. The hole depth required can be read from a scale on the outside of the crown drill. In order to fit the device in the femoral neck the sleeve *w* is removed from the rod *f*, and the body member *c*, with the claw members *b'* fully retracted, is pushed over the guide wire, the wire extending through the aperture defined by the free ends of the claw member and the duct *f''* defined by claw members *b'*, the rod *b* and the rod *f*. With the body member *c* in the position shown in FIG. **1,** for example, the rod *f* is held to prevent it from rotating, while by means of a suitable tool, the nut *a* is rotated in the direction which effects axial movement of the rod *b*, together with the rod *f*, so that the claw members *b'* are moved into the outwardly extended position shown in FIG. **1.** Rotation of the nut *a* is stopped when the free ends of the claw members have penetrated through the spongy bone *e'* and bite into the inner surface of the firm outer layer *e* (cortex) of the femoral head *s*. Depending upon the size of the femoral head the claw members can be extended in the range of 5 to 7 cm.

In either of the cases of FIGS. **2** and **3,** with the segments h_3 of the nut portion h_1 in engagement with the milled surfaces of the rod *f* the sleeve *w* is slid along the rod *f* or in the case of FIG. **1** the sleeve *w* is screwed along the rod *f*. The part *n* which is of the same diameter as the body member *c*, is thereby inserted into the bored hole until the wedge portion *p* or teeth *l* of the toothed portion *g* abut against the exterior of the femur as the case may be. In FIG. **2,** a box spanner *r* is fitted over the nut h_2 so that it abuts against the surface *m* of the toothed portion *g* which spanner can then be hammered until the required counterpressure is obtained. The spanner *r* is hammered until the teeth *l* of the portion *g* bite into the femur to prevent rotation of the device relative to the femur. Using the same spanner *r* the nut h_2 is threaded onto the rod *f* and is tightened, so that the tooth-like segments are clamped onto the rod *f* to secure the device in position. The device of FIG. **3** can be similarly positioned using a spanner such as *r*. In the case of FIG. **1,** the spanner *r* is slid over the rod *f*, engages with the nut portion h_1 of the sleeve w and is turned until the wedge portion *p* firmly abuts against the exterior of the femur to prevent any rotation of the device relative to the femur. In each case, the rod *f* is withdrawn slightly from the bored hole during securing thereby causing the bone fragments to be pressed firmly and resiliently against one another by means of the claw members *b'* which prevent any relative rotation and movement during healing and re-ossification. Where a plate *k* is required, the nut *o* is screwed onto the rod *f* to firmly secure the plate *k* in position. Without a plate *k* the nut *o* can be used as a counter-nut and cooperates with the nut portion h_1. The guide wire is then removed.

After tightening of the nut portion h_1 or nut h_2 as the case may be, the claw members *b'* exert a resilient effect, thereby closing any gap left between the bone fragments due to resorption prior to the operation.

When the fracture is healed and during a suitable operation the nut *o* and nut portion h_1 or h_2 as the case may be, are unscrewed, the sleeve *w* is withdrawn from the femur and the nut *a* is rotated in the direction which causes retraction of the claw member *b'* into the body *c* and the device can then be easily removed. The portion *n* of the sleeve *w* prevents total closing of the bone during healing thereby permitting easy withdrawal of the device after retraction of the claw members *b'*.

The devices described ensure that the bone is firmly held so that movement of the particular device in the bone, and relative movement of the bone fragments of the fracture is guarded against. The bone fragments are firmly pressed together thereby facilitating healing, and resorption of the bone fragments along the fracture line is prevented due to the resilient effect of the claw members. Thus, the bone fragments are firmly held together until re-ossification has taken place.

I claim:

1. A device for immobilizing a fractured neck of a femur comprising in combination: a guide wire; an elongated body provided with plural perforations in the perimeter thereof adjacent to one extremity thereof, said body being telescopable over said guide wire for guiding said body into position for the immobilization of the fractured femur, said body further including elongated threaded means adapted for longitudinal movement therewithin; extendable elements, said threaded means associated with said extendable elements arranged to be projected through said plural perforations; means carried on said threaded means for advancing and retracting said extendable elements; pressure applying means carried on said threaded means therebeneath; and first actuator means for moving said pressure applying means.

2. A device for immobilizing a fractured neck of a femur as claimed in claim **1,** wherein the elongated

body has an interior wall portion provided with spaced longitudinally extending grooves adapted to cooperate with a guide member.

3. A device for immobilizing a fractured neck of a femur as claimed in claim **1,** wherein the elongated threaded means is a body relatively square in cross section.

4. A device for immobilizing a fractured neck of a femur as claimed in claim **3,** wherein the angular intersecting corners only of the square body are threaded.

5. A device for immobilizing a fractured neck of a femur as claimed in claim **1,** wherein the pressure applying means includes a plurality of resilient segments.

6. A device for immobilizing a fractured neck of a femur as claimed in claim **1,** wherein second actuator means is adapted to cooperate with further means arranged to apply pressure radially of a femoral neck portion.

7. A device for immobilizing a fractured neck of a femur as claimed in claim **1,** wherein the pressure applying means further includes a toothed portion integral therewith.

8. A device for immobilizing a fractured neck of a femur as claimed in claim **6,** wherein the threaded rod means further includes a sleeve member interposed between the first and second actuator means.

9. In an improved method of utilizing an apparatus to immobilize a fractured neck of a femur, including the steps of

a. performing a surgical operation to gain access to the fractured region,

b. X-raying the fractured region to permit association of the head of the femur with the femoral neck portion,

c. inserting a guide wire through the shaft of the femoral neck and into the central spongy portion of the head of the femur which includes a cortex area,

d. telescoping a tubular body provided with a threaded portion over the guide wire and advancing it through the fractured region into the head of the femur,

e. advancing the threaded portion through the associated tubular body to extend a plurality of claw members from the tubular body through the spongy head of the femur until they enter the cortex thereof,

f. retaining the claws in said position until reossification is attained and

g. disassembling the immobilization apparatus from the femur and femoral neck portion by retracting the claws from the head of the femur and withdrawing the tubular body portion and guide wire.

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