FEMUR-SETTING SURGICAL DEVICE

United States Patent

ABSTRACT: A surgical device for use in the internal fixation of a fracture in the upper region of the femur including an elongated member having a portion extending through the fracture and a head, a bone plate having an upper portion and a shank portion adapted to be secured to the shaft of the femur. The upper portion of the plate has an opening for the reception therein of the head. There is provided a connecting member positionable on the outer side of the upper portion and engageable with the head to maintain the head within the opening while permitting universal angular movement between head and upper portion. Additionally the device includes a selectively operable locking means between the connecting member and upper portion for fixing the head and upper portion to selective angular positions.
1. Field of the Invention

The present invention relates to means and methods for fixation of fractures in the upper extremity of the femur and like.

More particularly, this invention pertains to the reduction of bone fractures and particularly to improved apparatus to be used in the reduction and immobilization of hip fractures. The invention is concerned with medical apparatus and has particular reference to the field of fracture surgery especially pertaining to the repair of breaks occurring in the extremity of the femur or thigh bone of the human skeleton.

2. Description of the Prior Art

A number of techniques have heretofore been devised using special devices for securing fixation of the upper portions of the femur so as to prevent displacement of the head of the femur relative to the shaft. These are designed for fractures which occur in the head or neck of the femur or in the intertrochanteric region. An example of one of these devices is the Smith-Petersen nail which has three longitudinal and radially projecting fins joined along the longitudinal axis of the nail and inclined at 120° to each other which provides a measure of fixation of the fracture. In connection with intertrochanteric fractures, it has been proposed that a thin metal plate be secured to the shaft of the femur below the fracture area by hip screws and that three bone screws fitted into spaced apertures in the plate be threaded into the femur through the neck and into the head of the bone. It has also been proposed to drive fixation pins of very small diameter from the outside of the femur shaft through the neck and head of the femur and into the proximal cortex of the head. This has, however, not been proposed in conjunction with a fixation nail, the fixation pins being merely inserted through the fractured area individually without carefully defined relation to each other and in no orderly method, and they are not attached to anything that secures the fixation at the lateral cortex or outside of the shaft.

While the surgical device of this invention is described for use in connection with fractures of the femur, the general principles thereof may have application in the fixation of other bone fractures. When a fracture of the neck of the femur occurs, it is essential to the welfare of the patient that the fixation screw be applied in the proper direction to be of maximum effectiveness and not cause pain to the patient or result in a stiff joint. Thus, depending upon the particular character of the head of the femur, the relationship of the screw with respect to the shaft of the femur may vary.

Heretofore, in devices of the character with which my invention is concerned, the fixation or bone-piercing nail or screw and its extension arm which is secured to the shaft of the femur for holding the screw in position have been in fixed angular relationship to each other. Because of the variable angular position of the screw with respect to the femur shaft it has been necessary in such fixed angular devices to apply the extension arm to the femur in a makeshift manner or in a manner such that strains may be set up causing improper fixation.

Such prior art devices for use in the internal fixation of fractures in the upper region of the femur are generally disclosed in U.S. Pat. Nos. 2,414,882, 2,441,765, 2,500,370, 2,526,959, 2,627,835 and 3,002,514. Applicant's invention herein disclosed is an improvement over such prior art surgical devices, as shown for example in the above mentioned patents.

SUMMARY OF THE INVENTION

Therefore, it is an object of this invention to provide an improved method and means for fixation of fractures in the upper regions of the femur, specifically in the neck, for immobilizing the fracture against shear and torsion forces while allowing for adsorption at the fracture site and contact compression thereof.

Another object of the present invention is to provide an improved fixation device for fixation of fractures in the upper regions of the femur which maintain the fixation elements at the desired predetermined angle.

Still another object of the subject invention is to provide an improved means whereby severed parts of a femur may be urged together without danger of their moving out of their proper relative positions, thus assuring a more rapid union of the severed faces.

A further object of this invention is to provide a simple and inexpensive device used particularly in connection with the internal fixation of fractures in the neck of the femur.

Yet another object of the invention is to provide a device for the fixation of fractures of the femur in which the angle of the screw or nail with respect to the extension arm by which the screw or nail is held in position may be universally varied to accommodate the particular conditions encountered, and then later secured in the proper position.

Still another object of the subject invention is to provide an improved device for the fixation of fractures of the femur in which the screw or nail thereof is connected to an extension arm or plate for holding the screw in position by a universal joint whereby the angular positions of the screw or nail and plate are universally variable with respect to each other to accommodate the device to the particular conditions encountered in the fixation of the fracture.

In general these objects are attained by providing an improved surgical device for use in the internal fixation of a fracture in the upper region of the femur, which comprises an elongated member having a portion extending through the fracture and a head portion, and a bone plate including an upper portion and an elongated shank portion adapted to be secured to the shaft portion of the femur by attaching members extending into the femur shaft. The upper portion of the bone plate extends outwardly at an acute angle from the general plane of the shank portion. The device is additionally provided with selectively lockable universal means associated with the upper portion of the bone plate and head portion of the elongated member for attaching the head portion to the upper portion in selected angular positions.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features which are believed to be characteristic of this invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and method of operation, may best be understood by reference to the following description taken in connection with the accompanying drawings, in which:

FIG. 1 is a side elevational view of the hip pinning device of the invention showing the same in use on a fractured hip;
FIG. 2 is a partial cross-sectional view showing the details of the same;
FIG. 2A is a partial cross-sectional view showing the device in a different position;
FIG. 3 is an end view of the cap nut or plate of the device;
FIG. 4 is a perspective view of one of the set screws of the device;
FIG. 5 is a partial cross-sectional view showing a second embodiment of the device;
FIG. 6 is a plan view of the screw of the device;
FIG. 7 is a plan view of the plate of the device;
FIG. 8 is a cross-sectional view taken along line 8-8 of FIG. 7;
FIG. 9 is an elevational view taken along line 9-9 of FIG. 6; and
FIG. 10 is a cross-sectional view taken along line 10-10 of FIG. 7.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

With detailed reference to the drawings, and in particular to FIG. 1 thereof, the hip-pinning device 10 of this invention is
depicted in connection with and in use on a femur or thigh bone 12.

Before proceeding with the detailed description of the present invention, clarity in and understanding thereof will perhaps be advanced by first referring to the femur or thigh bone 12, on which the invention is expressly intended to be used. The present invention is concerned only with the upper extremity of the thigh bone or femur which comprises a rounded head 14 which articulates within the cavity within the hip bone (shown in dotted lines) and which is joined to a shaft portion 16 by a constricted neck 18, the latter portion of which lies adjacent to and more or less the circumferential curvature of femur shaft portion 16 (See FIG. 10,) and when considered in side elevation is substantially straight for the major portion of its length with the upper terminus or end curved outwardly therefrom (See FIG. 8) giving plate 24 a shape-conforming more or less closely to the profile configuration of that part of the thigh bone's outer face which includes the lower portion of the greater trochanter 20 and extends for a substantial distance along the shaft proper 16.

As can be seen in FIG. 7, the elongated portion 25 of plate 24 adapted to be placed along shaft portion 16 of the femur is provided with a series of spaced and staggered smaller openings 26. Openings or holes 26 are provided for screws, such as at 28 in FIG. 1, for attaching plate 24 to shaft portion 16 of the thigh bone. Openings or holes 26 are countersunk, as at 30, to provide for the heads 32 of screws 28. The upwardly or outwardly curved portion 34 of plate member 24 is provided with an opening 36 adapted to receive thereto into the rounded head portion 38 of screw 40. The sides of opening 36 are sloped or beveled such that the outer diameter of the opening 36 is smaller than the inner diameter of the opening at 44. Opening 36 is dimensioned such that the rounded end portion 38 of screw 40 never quite passes through opening 36, see in particular FIGS. 2 and 5. As previously described the elongated portion 25 of plate 24 is slightly curved to conform to the more or less circumferential curvature of shaft portion 16 of hip bone 12, as in particular FIG. 10.

As hereinabove stated, screw 40, of the lag type, includes a head portion 38 which is rounded, a shank portion 46 extending between head portion 38 and a threaded portion 48. Threaded portion 48 is provided with threads 50 having thin and sharp crests 52 and deep and wide troughs 54 such that considerable force can be exerted axially of the neck of the femur to pull the bone elements together, as the threads have considerable contact area throughout the thigh bone. Threaded portion 48 of the lag screw 40 ends in a relatively blunt end 56 such that an opening or passageway 58 can extend throughout the length of bolt 40 along the center thereof, the purpose of which will be explained more fully hereinbelow. The head portion 38 and a part of shank portion 46 of lag screw 40 has a reamed-out or larger opening or passageway 60 extending therethrough and thereinto. That portion of opening or passageway 60 extending through head portion 38 is internally threaded at 62 to accommodate and receive the threaded portion of a cap or plate-like cap member 64 for screw 40, see FIG. 1. The head portion 38 of lag screw 40 is further provided with an elongated slot 66 by which the bolt and particularly the head thereof may be gripped by a proper instrument to manipulate and screw the same into the femur and through the parts thereof across which the fracture may extend, see in particular FIG. 1.

Cap nut or plate member 64 includes a dishlike portion or flange portion 68, screw portion 72 and an elongated dishlike portion or extension 70 which fits within opening 60 in head 38 and shank portion 46 of screw 40. Neck portion 70 of cap member 68 is provided with threads at 72 which engage the threaded portion 62 within head portion 38 of lag screw 40, such that the nut or cap 68 can be secured to screw 40. The dish portion 68 of cap or nut 64 is provided with a series of six equally spaced holes 74 along the perimeter thereof and spaced outwardly of neck portion 70. Spaced holes 74 are provided with threads, as at 76, to accommodate small setscrews 78, see FIG. 4, which fit into and through holes 74. Setscrews 78 are provided with a rounded forward end 80 which engage with the upwardly or outwardly turned portion 34 of plate member 24 to securely fix the positioning of cap member 64 and lag screw 40 with respect to plate 24. Setscrews 78 are further provided with threads 82 which engage the threads 76 of openings 74 to secure setscrews 78 within the openings 74, and with axial hexagonal openings 84 for insertion of an Allen wrench therein, to operate and manipulate the setscrew thereby advancing or retracting the same within threaded opening 74.

Lag screw 40, and in particular its rounded head portion 38, is free to move into and out of, but not through, opening 38 within end portion 34 of plate member 24 until the nut or cap member 64 is secured to the head portion 38 of the screw 40. Once cap 64 is attached or secured to head portion 38 of lag screw 40, the screw 40 then becomes releasably connected or fixed to portion 34 of plate member 24, but not fixed or secure in regards to pivoting or angular displacement between the two. This is to say that, once cap member 64 has been secured to head portion 38 of lag screw 40, the head portion 38 cannot move out of opening 38 within plate 24 but the same may pivot or be angularly displaced therein in what may be described as a universal movement or joint action between head portion 38 and portion 34. Only when setscrews 78 are tightened to firmly engage end portion 34 of plate member 24 does lag screw 40 become pivotally or angularly fixed with respect to plate 24. This is to say that, upon the tightening and engagement of setscrews 78 with portion 34 of plate 24, head portion 38 will be prevented from further angular or pivotal movement within opening 38. Therefore it is readily seen that, the angle between lag screw 40 and portion 34 of plate 24 can be universally varied by proper adjustment of setscrews 78.

As can be seen in FIG. 2 the axis of screw 40 is approximately perpendicular to portion 34 of plate member 24, while in FIG. 2A the axis of screw 40 has been varied at a small angle 86 from the perpendicular to portion 34 of plate member 24 by the proper adjustment of setscrew 78.

With particular reference to FIG. 5 now, a second embodiment of the pinning device of this invention is shown therein. In this embodiment the same plate member 24, having an upwardly or outwardly turned portion 34 with a hole or opening 36 extending therethrough, is used, as in the embodiment depicted in the other figures. Lag screw 88 is somewhat different, in its head portion 90, from lag screw 40 of the other embodiment, as depicted in FIG. 6. Lag screw 88 does include a shank portion 92 and a central or axial opening or passageway 94 extending throughout its length. Rounded head portion 90 of lag screw 88 includes an elongated slot 96 similar to slot 66 of lag screw 40 and for similar and like purposes. The head portion 90 of lag screw 88 is provided with a neck portion or elongated extension 98 extending from the top thereof outward in a direction opposite to the shank and threaded portion of the screw. Elongated extension 98 is provided with threads such that the dishlike nut or cap member 100 may be readily attached to the head portion 90 of lag screw 88. Nut or plate-like cap member 100 is provided with threads 102 for engaging with the upwardly or outwardly turned portion 34 of plate member 64, with the major difference being that its center portion is provided with an axial opening or passageway 102.
extending therethrough, to receive thereto and therethrough the threaded extension portion 98 of head portion 90. Cap member 100 is provided with a series of spaced holes or openings, as at 104, which are adapted to receive and hold in place setscrews 106 thereto and therethrough. Setscrews 106 are operable to be advanced or retracted within openings 104 by means of a properly sized Allen wrench. Setscrews 106 are provided with tapered 108 and rounded 110 end portions to engage with portion 34 of plate member 24. Once the rounded head portion 90 of lag screw 88 has been positioned in and partially through opening 36 within plate member 24, cap or nut member 106 may be attached thereto by means of threaded 103 thereon and the corresponding threads of elongated portion 98 of screw head 90, to secure head portion 90 of the screw generally within opening 36 of the plate member. In this positioning and disposition of cap member 100 and screw 88, head portion 90 thereof is held in opening 36 in a generally pivota ble and generally universally manipulatable universal manner. The angular position of lag screw 88 with respect to portion 34 of plate member 24 is fixed, only after setscrews 106 are manipulated to firmly engage portion 34 of the plate member. By means of the series of equally spaced setscrews 106 the angular disposition of lag screw 88 with respect to plate member 24 is universally variable and adjustable.

In the treatment of fractures, with the apparatus of the present invention, the reduction of fractures is effected with the assistance of fluoroscopic or X-ray equipment. When the reduction has been effected the bone fragments are in approximately the positions in which they are shown in FIG. 1.

The first step in the mobilization of a fracture (after an incision has been made, in order to enable plate member 24 to be placed next to the bone) is to stabilize the bone fragments present by engagement of the lag screw 40. This is accomplished through the use of one or two guide wires or rods (not shown), which are inserted into the neck of the femur at an appropriate angle, i.e., one of the guides being in line with the axis of the neck in order that the screw 40 may be inserted into the neck using this one wire as a guide. The use of two wires stabilizes the fracture and the wires prevent relative movement of the bone fragments during insertion of screw 40. The guide wires may be inserted into the bone in conventional manner and to a depth somewhat greater than the length of the screws that is to be used. The guide wires, however, should not pierce the head of the femur.

After the bone fragments have been stabilized a reamer is placed over the guide wire which is to act as a guide for screw 40 and the bone is reamed through the neck portion thereof and into the head portion. The reamer is provided with an axial passageway of sufficient diameter to permit the guide wire or pin to pass freely therethrough, such that the reaming can be effected while the guide pin or wire is in position. In this way the pins cooperate to inhibit or prevent rotative movement of the fragments during the reaming operation.

After the bone has been reamed the reamer is removed.

Next the lag screw 40 is inserted over the guide wire or pin about which the reaming has taken place with the guide wire passing through the axial opening or passageway 58 within the screw, and the screw is driven into the bone fragments with an appropriate wrench or other suitable tool adapted to engage the head portion thereof and within elongated slot 66 thereof. The screw 40 is rotated and advanced until the head portion 38 thereof becomes positioned closely adjacent the outer side of the upper portion of femur shaft 16, to draw the bone fragments adjacent fracture 23 tightly together and maintain them in fixed position.

Now plate member 24 is positioned along shaft portion 16 of the femur bone with the head portion 38 of screw 40 being positioned in and partly through opening 36 thereof, and the nut or cap member 64 is attached to the head portion 68 of lag screw 40. A number of holes are then drilled in shaft portion 16 of the femur opposite openings 26 in the elongated portion 25 of the plate member 24 to accommodate screws 28, thereby attaching plate member 24 to femur shaft portion 16. The holes drilled into shaft portion 16 should have a diameter slightly less than the diameter of screws 28, to thereby insure a more perfect fit and yet not result in splitting of the bone. Screws 28 are screwed all the way in to bring the elongated portion 25 of plate member 24 against shaft portion 16 of the femur bone. Finally, the angle between the screw 40 and the upper portion 34 of plate 24 is fixed by adjusting and tightening setscrews 78 against portion 34 of plate member 24.

During the major portion of the aforesaid treatment the guide wires or pins assist in anchoring the bone fragments and inhibit or prevent relative movement therebetwe en. After the fractured bone has been immobilized these guide wires or pins may be left in the bone, or one or both may be withdrawn.

While only certain preferred embodiments of this invention has been shown and described by way of illustration, many modifications will occur to those skilled in the art and it is, therefore, desired that it be understood that it is intended in the appended claims to cover all such modifications as fall within the true spirit and scope of this invention.

We claim:

1. A surgical device for use in the internal fixation of a fracture in the upper region of the femur comprising in combination an elongated member having a portion adapted to extend through the fracture and a head portion, a plate bone including an upper portion and a elongated shaft portion adapted to be secured to the shaft portion of the femur by attaching members extending into the femur shaft, said upper portion extending outwardly at an angle from the general plane of said shank portion, selectively lockable universal means associated with said upper portion and head portion attaching said head portion to said upper portion of said plate in selected angular positions, said selectively lockable universal means including an opening extending through said upper portion of said bone plate for the reception thereto of said head portion of said elongated member, said universal means further including a cap nut positioned adjacent the outwardly facing surface of said upper portion of said plate adjacent said opening, said cap nut including a threaded portion and a flange portion, said flange portion having a dimension greater than the dimension of said opening, said threaded portion of said cap nut being threadedly engaged with said head portion of said elongated member, said universal means further including selectively operable locking means extending between and contacting said flange portion and said upper portion adjacent said opening therein for selectively locking said head portion with respect to said upper portion of said plate in selected angular positions.

2. In the surgical device as defined in claim 1 wherein said head portion of said elongated member is round, and wherein said opening extending through said upper portion of said bone plate is rounded, the effective diameter of said rounded head portion being greater than the diameter of said bone plate opening.

3. In the surgical device as defined in claim 2 wherein said opening within said upper portion of said bone plate includes a tapered peripheral portion forming an inwardly facing seat for the rounded head portion of said elongated member.

4. In the surgical device as defined in claim 1 wherein said head portion of said elongated member includes an inwardly directed longitudinally extending threaded passageway, said cap nut threaded portion being defined by an externally threaded and longitudinally extending neck portion connected to said flange portion, said neck portion of said cap nut being threadedly engaged within said passageway of said head portion thereby retaining said head portion within said opening of said upper portion.

5. In the surgical device as defined in claim 1 wherein said head portion of said elongated member includes an outwardly directed longitudinal extension having external threads, said threaded portion of said cap nut being defined by an internally threaded longitudinally extending passageway, said threaded extension of said elongated member being threadedly engaged within said passageway of said cap nut thereby retaining said head portion within said opening of said upper portion.
6. In the surgical device as defined in claim 1 wherein said selectively operable locking means includes a plurality of spaced set screws threadedly positioned in and through said flange portion of said cap nut, said set screws being adapted and arranged to engage said upper portion of said bone plate adjacent and spacedly around said opening thereby fixing the angular position of said head portion with respect to said upper portion in selective angular positions.

7. In the surgical device as defined in claim 4 further comprising a plurality of spaced set screws threadedly positioned in and through said flange portion of said cap nut, said set screws being adapted and arranged to engage said upper portion of said bone plate adjacent and spacedly around said opening thereby fixing the angular position of said head portion with respect to said upper portion in selective angular positions.

8. In the surgical device as defined in claim 8 further comprising a plurality of spaced set screws threadedly positioned in and through said flange portion of said cap nut, said set screws being adapted and arranged to engage said upper portion of said bone plate adjacent and spacedly around said opening thereby fixing the angular position of said head portion with respect to said upper portion in selective angular positions.

9. A surgical device for use in the internal fixation of a fracture in the upper region of the femur comprising in combination an elongated member having a portion adapted to extend through the fracture and a spherical-shaped head of a predetermined diameter, a bone plate including an upper portion and an elongated shank portion adapted to be secured to the shaft portion of the femur by attaching members extending into the femur shaft, said upper portion extending outwardly at an angle from the general plane of said shank portion, said upper portion having an opening extending therethrough of a dimension less than said predetermined diameter for the reception thereof of said spherical head, a connecting member positioned adjacent the outwardly facing surface of said upper portion and adjacent said opening and having a dimension greater than the dimension of said opening, said connecting member connected to said spherical head to maintain said head within said opening while permitting universal angular movement between said head and said upper portion, and selectively operable locking means adjustable connected to and carried by said connecting member and engaged outwardly against said upper portion for selectively locking said head with respect to said upper portion in selected angular positions.

10. In the surgical device as defined in claim 9 wherein said selectively operable locking means includes a plurality of spaced set screws threadedly positioned in and through said connecting member, said set screws being individually adjustable and adapted and arranged to engage said upper portion of said bone plate adjacent and spacedly around said opening thereby fixing the angular position of said head portion with respect to said upper portion in selective angular positions.

11. A surgical device for use in the internal fixation of a fracture in the upper region of the femur comprising in combination an elongated member having a portion adapted to extend through the fracture and a head portion, a bone plate including an upper portion and an elongated shank portion adapted to be secured to the shaft portion of the femur by attaching members extending into the femur shaft, said upper portion extending outwardly at an angle from the general plane of said shank portion, and selectively lockable universal means associated with said upper portion and head portion for attaching said head portion to said upper portion of said plate in selected angular positions, said universal means including a connecting member attached to said head member, said universal means further including a plurality of selectively operable locking members spaced around said head portion and carried by said connecting member, said locking members engaging outwardly against said upper portion for selectively locking said head portion with respect to said upper portion in selected angular positions.