FIG. 1

FIG. 2

FIG. 3

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The invention relates in general to surgical instruments and more particularly to a surgical bone pin for internal fixation of fractured bones.

The most frequent application of the bone pin of this invention is to fractures of the femoral neck and to intertrochanteric or sub-trochanteric fractures of the femur. The fracture of these bones, particularly in older people, is very often unresponsive to treatment that involves reducing the fracture and maintaining the contacting surfaces in proper intimate contact for a long period of time in anticipation of the fractured bone part knitting or healing.

The primary purpose sought by substantially all methods and devices employed in the treatment of hip fractures is to obtain a perfect setting of the fractured bone parts as soon as possible after injury with as little shock as possible to a probably already badly injured patient and to prevent movement of any type of the fractured area that would disrupt the healing thereof with as little further inflammation of the surrounding flesh as possible.

Many mechanical methods and devices have been contrived ranging from the setting of the bone parts and the six to eight week application of a large cast which generally immobilizes the patient also, to the use of surgical clamping devices utilized to draw and hold the fractured bone parts together and with the fractured area including quite often the complete hip and leg area held immobile with or without extensive casts.

Surgical clamping devices hereofused require an arrangement which includes a base plate or strap to be secured to the outer surface of the bone, or a contoured washer and nut assembly positioned and disposed outwardly of the bone surface. Not only does this necessitate the operative laying open of a large amount of flesh to properly secure the devices, but the outwardly protruding surfaces of these securing devices provide a constant source of irritation to the flesh during and after the healing and knitting process of the bone.

Clamping arrangements also include the use of a single large and heavily threaded lag or clamp screw applied internially of the bone in a direction transverse to the plane of the fracture in drawing and holding the parts together for healing. This involves imposing bursting type strains upon the bone parts and occupies a great deal of volume of the bone structure which reduces the healing area. Also it has been found with such devices as a so-called nail or lag screw that such does not impart the permanency desired and quite often fails to hold the surfaces of the fractured bones in their correct positions so that proper healing can be accomplished. Too often a single clamping device, while preventing movement in one plane, permits appreciable movement in a different plane. Further, the amount of time and force required in positioning these securing or clamping devices often upset the perfect union of the fractured bone after it had been reduced, as where the clamping action is applied or imperfectly administered when the mating fractured surfaces are out of alignment. In addition, there is usually such a large amount of muscular tissue cut that immobilization of the fracture must be accomplished completely by extensive casts on the hip and leg.

It is therefore the primary object of this invention to provide an improved surgical bone pin of small size which can be used in plural relation and eliminates the shortcomings of previous devices of this character yet stabilizes fractured bone parts in positive position with accuracy without the necessity of a major operation causing additional shock to the patient and necessitating large incisions in the patient's leg.

A specific object of this invention is to provide an improved surgical bone pin that internally immobilizes the fractured area, that is, the head of the femur with part of the neck and the trochanteric section of the shaft with part of the neck, in such a way as to prevent movement thereof in any direction.

Another object of this invention is to provide an improved surgical bone pin which is disposed entirely within the fractured area with no portion thereof extending outwardly from the bone surface to irritate or disturb the cooperation of flesh resting against the bone surface.

A further object of this invention is to provide an improved surgical bone pin which is readily positioned in numerals and at different angles within the bone with a minimum of time and effort and requiring for each an incising opening in the flesh only slightly larger than the outside diameter of the pin.

A still further object of this invention is to provide an improved surgical bone pin which is permanently placed within the bone in numbers to immobilize the fractured mating surfaces to eliminate possibility of movement therebetween.

Another object of this invention is to provide an improved method of immobilizing fractured mating surfaces by cross pinning the line of fracture in a plurality of different directions.

A still further object of this invention is to provide an improved surgical bone pin which is simple in design, rugged in construction, relatively inexpensive to manufacture and requires a minimum of components to completely immobilize mating bone fracture surfaces.

A further object of this invention is to provide an improved method of immobilizing the mating surfaces of a fractured bone which eliminates the necessity of wearing an extensive cast for long periods and yet permits partial and ambulatory use of the fractured bone within a few days after immobilization of the fracture.

Further and more specific objects and advantages of the invention will be apparent from the following detailed specification and drawings in which:

FIG. 1 is a fragmentary sectional view through the upper end portion of the femur showing a fracture of the neck of the femur with a plurality of the surgical bone pins of this invention cross pinning the line of fracture;

FIG. 2 is a cross sectional view in side elevation of the surgical bone pin of this invention;

FIG. 3 is an end view of the surgical bone pin illustrated in FIG. 2;

FIG. 4 is a fragmentary partially sectioned view in side elevation illustrating the position of the first portion of the pin within the medullary canal with the drill shaft partially removed;

FIG. 5 is a fragmentary partially sectioned view in side elevation illustrating the positioning of the second portion of the pin which threadably engages the first portion with a driving member in near engagement therewith; and

FIG. 6 is a fragmentary partially sectioned view in side elevation illustrating the two portions of the bone pin in the final secured position within the bone structure with the guide wire removed.

Pin Construction

Referring in detail to the drawings, the surgical bone pin of this invention comprises an anchoring portion...
and head portion 12 which are threadably secured together. The anchoring portion 10 provides external coarse right hand threads 14 along the entire length thereof with a pyramidal shaped drill tip 16 formed at one end. Right hand threads 18 are formed on an internal surface of the portion 10 and extends substantially the length thereof. A left hand thread 20, of reduced major diameter is concentrically formed with the threads 18 extending more deeply into the drill tip 16. The anchoring portion 10 is preferably formed from a stainless steel with all surfaces thereof having a high quality satin or mirror-like finish.

The head portion 12 provides an inner end section 22 of reduced diameter having external threads 14 and forms thereto which threadably engages the internal thread 18 of the anchoring portion 10 in permanent assembly. An outer section 26 of the head portion 12 formed integrally therewith provides a smooth outer surface that is cylin- drical, or slightly tapered inwardly, of a diameter sub- stantially the same as the major diameter of threads 14 on the anchoring portion 10 so as to be received in the opening left by the insertion of the anchor portion. The outer end 28 of the outer section has a pair of cross slots 30 formed therein and provides a central opening 32 which extends the entire length of the head portion 12 and is of a diameter slightly greater than said major diameter of the threads 14. The portion 10, similar to the portion 10, is preferably formed from a stainless steel with all surfaces and edges thereof having a high quality finish. Several of these pins are inserted as shown in FIG. 1 in crisscross fashion and with each of the head portion 12 is pre-cut to the desired length as with head portions 12, 12a and 12b wherein the end 28 is recessed below the outer surface 34 of the bone when the head portion is fully threaded into the anchoring portion 10 for permanent assembly.

Procedure of Installation

Referring now to FIGS. 1, 4, 5 and 6 it is to be noted that the illustrations show the patient as having a fracture in the neck portion of the femur. In the drawings, the head of the femur is indicated by the numeral 36, the broken neck portion by the numeral 38 and the fractured facing surfaces of the bone by numerals 40 and 42 shown diagrammatically separated for a better understanding of the drawings. The patient is placed on an operating table or fracture table and carefully positioned to place the femur in the most desirable position for proper relocation or "setting" of the fracture. Positioning is determined by location and type of fracture which is indicated by X-rays of the fracture area. Accuracy of reducing the fracture to a normal position is highly essential and desirable and it is preferably continually observed by means of a fluoroscope during the reduction of the fracture. Once the fracture surfaces are properly repositioned or set by manipulation, the entire fracture area is immobilized by placing a cast about the body and leg with an opening about the hip to permit access thereto in positioning the bone pins. The patient is of course given an anesthetic to further insure immobilization of the fracture area. Having checked the setting or positioning of the fracture surfaces to see that they are properly orien- tated and that the fracture area is completely immobilized, the surgical bone pins are then inserted.

The anchoring portion 10 is threadably secured to a drill shaft 44 as shown substantially in FIG. 4, the drill shaft is formed from similar material as the bone pin, which is in turn securely gripped by a chuck assembly of a small hand operated electrical drill (not shown). A guide wire 46 extends through the drill shaft and thread- ably engages the internal LH threads 20 in the tip 16 of the anchoring portion 10. The anchoring portion is then pierced through the flesh to proper contact points with the bone and then drilled or ground through the hard bone shell and well into the head 36 of the femur through the porous structure. Depth of penetration can be determined by X-rays and observation through the fluoroscope. The drill tip 16 readily provides the interpenetration of the hard shell and the external threads 14 come to rest in the porous structure to provide anchoring means that holds the portion 10 in position. As readily shown in the drawings, the anchoring portion extends past the fracture line well into the femur head. Having satisfactorily embedded the anchoring portion 10, the drill shaft 44 is disengaged therefrom and removed by sliding it outwardly over the guide wire 46.

The head portion 12, having then been cut to the proper length, is then slid over the guide wire 46 to threadably engage the anchoring portion 10. A driving tool 48, designed to fit over the guide wire 46 and to interlock in the slots 30 on the end 28 of the head portion 12, is used to rotate the head portion into a tight physical engagement with the anchoring portion 10. The driving tool is then removed, sliding outwardly over the guide wire 46 and then the guide wire is dis- engaged and removed. The left hand threads 20, in which the guide wire threadably engages, permits dis- engagement of the guide wire without backing out of the anchoring portion 12 since the direction or rotation to disengage will have a tendency, if the proper movement at 50 is followed, to further embed the anchoring portion in the femur head 36.

This procedure is then repeated by placing another pin 12a through the line of fracture with the direction or line of the second pin being offset and angularly positioned with respect to the line of the first pin. In like manner, a third pin 12b may, if required, be offset and angularly positioned relative to the first and second pins. Thus, by cross pinning the fracture, it is quite obvious that it is impossible for the fractured surfaces 40 and 42 to move in any direction relative to one another.

The pins, having been properly positioned, provide no clamping action to draw the fractured surfaces into forced contact but provide only a positive holding means to prevent any movement of one surface relative to another and to maintain them in a natural surface to surface contact as they were positioned at the time of reducing the fracture.

The surgical bone pins of this invention are relatively small in cross section with three of the pins comprising a total cross sectional area equal to, if not less than, the area occupied by clamping devices of the prior art. Being spaced apart from one another, the pins occupy only a minute portion of the overall area of the fracture and in no way affects the knitting process of the bones. By providing the proper length of the head portion 12, the pins may be permanently installed without protruding past the outer surface of the bone, thus eliminating any possible irritation of the bone contacting flesh.

The patient is retained in the cast from twenty-four to forty-eight hours at which time the cast may be removed permitting the patient to walk while partially supporting the weight by use of a cane or crutch. Shortly there- after, a period of two or three weeks, complete weight may be supported on the fractured bone.

To those skilled in the art, the advantages of the bone pin of this invention are readily apparent. The only penetration into the flesh is the small openings formed by the drill to permit entrance of the pin. This eliminates additional shock pain to the patient and lessens the chance for infection. The offset and angular positioning of the pins eliminates the possibility of movement between the fractured surfaces in any direction and provides additional support in conjunction with the surrounding muscles to support the weight brought to bear along the line of fracture. The pins are of a permanent nature, thus
eliminating the necessity of laying open the flesh a second time to remove the securing member as in previous devices. Both ends of the pin are preferably recessed below the outer surface of the bone to eliminate any protruding members to continually irritate the surrounding flesh. One of the primary advantages being that the patient does not have to lie in bed with a burdensome, extensive cast for six to eight weeks, but may be up and around in a couple of days and have full use of the fractured member within a couple of weeks.

The invention may be subject to numerous modifications well within the purview of the inventor who only intends to be limited to a liberal interpretation of the specification and appended claims.

What is claimed is:

1. A surgical bone pin for the internal fixation of fractured bones comprising an anchoring member having a drill tip formed at one end with external threads along the entire outer surface for firmly embedding in the bone structure adjacent the fracture and internal threads formed along the length thereof terminating adjacent said tip, said tip having a threaded aperture formed therein concentric with and in communication with said internal threads for engagement with a guide rod, a cylindrical head member having an outside diameter substantially the same as the greater diameter of the external threads on said anchoring member and having a length extending from said anchoring member through the fracture with the outer end thereof recessed below the outer surface of the bone, and external threads formed on the inner end portion of the head member whereby the two members when secured together maintain the fractured surfaces in proper orientated position and prevent movement therebetween.

2. A surgical bone pin for the internal fixation of fractured bones comprising an anchoring member having a hollow internally threaded drill tip formed at one end with external threads along the entire outer surface for firmly embedding in the bone structure adjacent the fracture and ending in a shoulder, a cylindrical head member having a uniform outside diameter throughout its length substantially the same as the greater diameter of the external threads on said anchoring member and having a length for abutting said shoulder and extending from said anchoring member through the fracture with the outer end thereof recessed below the outer surface of the bone, said end having cross slots formed therein for receipt of a driving member, and external threads formed on the inner end portion of the head member to engage with the internal threads formed in the anchoring member whereby the two members are secured in shoulder abutting position to maintain the fractured surfaces in proper orientated position and prevent movement therebetween.

3. A surgical bone pin for the internal fixation of fractured bones comprising an anchoring member having a drill tip formed at one end with external right hand threads along the entire outer surface for firmly embedding in the bone structure adjacent the fracture, and internal right hand threads formed along the length thereof terminating adjacent said tip, said tip having an aperture with left hand threads formed therein concentric with and in communication with said internal threads for engagement with a guide rod, a cylindrical head member having an outside diameter substantially the same as the greater diameter of the external threads on said anchoring member and having a length extending from said anchoring member through the fracture with the outer end thereof recessed below the outer surface of the bone, said head member having an aperture centrally formed through the length thereof for sliding receipt over the guide rod, and external right hand threads formed on the inner end portion of the head member whereby the two members when secured together maintain the fractured surfaces in proper orientated position and prevent movement therebetween.

4. A method for the fixation of fractured bones comprising reducing the fracture to properly orientate the fractured surfaces, immobilizing the fractured area to prevent movement of the orientated surfaces, drilling through the fractured surfaces with and threadedly embedding anchoring members at different angles past the fractured surfaces, and threadably engaging head members of uniform diameter throughout with the anchoring members in rigidly squared relationship through the line of fracture and terminating within the confines of the bone to retain the fractured surfaces in the orientated position to prevent movement therebetween in any direction during the healing process.

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