

## WIRING BONE PLATE FOR INTERNAL FIXATION OF FRACTURE

### FIELD OF THE INVENTION

The present invention relates to a bone plate used for fracture treatment, particularly to an improved bone plate which enables fixation of a bone in the case of a wedge or comminuted fracture.

### BACKGROUND OF THE INVENTION

As is well known, several methods of fracture treatment have been developed.

Until middle of 20th Century, conservative treatment prevailed. With the advancement of anesthesiology, antibiotics and biomechanics, the conservative treatment has been replaced by operative treatment in many case. The operative treatment has definite advantages compared with conservative treatment because accurate reduction and early mobilization minimize fracture complications and promote healing.

In planning the operation, the surgeon must decide which material to use for internal fixation. There are several kinds of internal fixator. But until now, plating with screws is most often the first choice, followed by intramedullary nailing.

With the aid of biomechanical research, the bone plate has gone through substantial development recently. The plate has become variable in shape and design, more inert to the human body, and better in strength and endurance, thereby making it easier to perform the operation. Nowadays, the majority of the plates are designed for self compression with sufficient strength and variable shape using several kinds of alloy, such as Stainless Steel, Vitallium, Titanium and so on.

The surgeon can select nearly every length, width and shape of the plate, such as wide, narrow, T- shape, L- shape, condylar, anatomical, blade, barrel, and so on.

However, in spite of these various shapes and designs, some difficulties and problems still exist in performing internal fixation with the plate in certain cases. All of these plates are designed to be fixed to the bone with screws. However, the situation sometimes occurs where a surgeon is unable to insert the screws. These situations include comminuted fracture, wedge fracture, fracture aligned in the same direction as the direction of the screw insertion, and a fracture distal to the hip prosthesis or intramedullary nailing. In these cases, the surgeon requires additional wiring for rigid fixation.

If wiring is needed, there are two practical operative procedures : one is wiring first and the other is wiring last. To reduce the fracture, it can be rigidly bound using only the wire because the wire does not move easily on the bare bone.

Then, as the next step to fix the fracture, the plate is placed on the bone on which the wire had been wound. However, the plate cannot be in tight contact with the bone because contact of the plate with the bone is interrupted by the wires disposed between the plate and the bone.

Therefore, in actual operative procedure, first the plate is placed on the broken bone so that the plate is in tight contact with the bone, then a wire is wound over the plate and the bone together.

However, wiring over the plate also has many problems using conventional self compression plate. The first problem is that rigid fixation cannot be attained because of the thickness and hardness of the plate. As shown in Fig 10, the large gap (s) between the bone and the plate inhibits rigid fixation. The wire and the plate can move separately with respect to each other. This motion results from disengagement among the wire, the plate and the bone, which has a variable diameter of the bone along its longitudinal direction, especially in the metaphyseal-diaphyseal junction. This slippage of wire causes instability of the fracture site and results in delayed union or non-union.

## SUMMARY OF THE INVENTION

It is an object of the present invention to provide an improved wiring bone plate which can firmly fix the bone plate onto the fracture, even comminuted fracture, wedge fracture, fracture aligned in the same direction as that of the screw insertion, and fracture distal to a hip prosthesis or intramedullary nailing.

In accordance with the invention, there is provided a bone plate for internal fixation of a fracture by wiring, said plate having front and rear surfaces and side surfaces, and a plurality of transverse wire holes extending through said plate from one side surface to the other side surface thereof; said plate being further provided with ~~at least~~ a plurality of screw holes extending through the plate from the front to the rear surface thereof.

The wire hole can hold the wire inserted into it, thus enable the bone plate to be fixed onto the fracture satisfactorily, even if the screw fixation is impossible, such as in the wedge fracture, the comminuted fracture, and fracture with prosthesis or intramedullary nailing.

Another advantage is that it makes the operative procedure easier by maintaining the reduction without intervening screw insertion.

## THE BRIEF DESCRIPTION OF DRAWINGS

The present invention will now be described in greater detail, by way of example, with reference to the drawings in which:

Fig 1 is a perspective view of the wiring bone plate embodying the present invention,

Fig 2 is a drawing of the use of the wiring bone plate embodying the present invention prior to an operation,

Fig 3 is a side-sectional view of the broken bone fixed with the wiring bone plate, screws and the wire, after an operation,

Fig 4 is a transverse sectional view taken along line IV-IV in Fig 3,

Fig 5 is a drawing of fracture fixation using the bone plate embodying the present invention when the fracture occurred distal to the hip prosthesis,

Fig 6a and 6b are drawings showing internal fixation using the bone plate embodying the present invention in case of wedge (6a) and comminuted (6b) fracture,

Fig 7 is a perspective view of the bone plate according to the prior art,

Fig 8 is a drawing showing the use of the the bone plate according to the prior art before an operation,

Fig 9 is a side elevation view showing wiring method using a prior art bone plate in case of multiplane fracture line(4),

Fig 10 is a transverse section view along with line I-I in Fig 9,

Fig 11a and 11b are side elevation views showing wiring method using a prior art bone plate in the case of wedge (a) and comminuted (b) fracture.

#### DETAILED DESCRIPTION OF THE INVENTION

Fig 1. is perspective view of the wiring bone plate embodying the present invention. The plate 1 is formed as a long metallic strip composed of a plurality of screw holes 2 pierced through from the front side 3 to rear side 4 with some space longitudinally thereof, and a plurality of transverse wire holes 5 pierced through the both lateral side 6 in each of spaces between the screw holes 2.

That is, this plate 1 has additional transverse holes 5 for wire passage between the screw holes 2 on the conventional self compression bone plate 1.

Fig 2. shows schematic drawing before applying this new plate 1 to the fracture site. The plate 1 whose length is long enough for rigid fixation is placed on the bone 8 across the fracture line  $\ell$ . Usually three (3) to four (4) screw fixation should be performed proximal 8a and distal 8b to the fracture line  $\ell$ . Thus, in simple fracture there is no problem stabilizing the broken bone 8 using only the plate 1 and the screws 7. However, in certain cases, only with the plate 1 and the screw 7,

the broken bone 8 can not be fixed rigidly.

Fig 3 and 4 show one example of the case where the broken bone 8 cannot be rigidly fixed only the plate 1 and the screws 7. In case of spiral and comminuted fracture, the direction of some part of the fracture line  $\lambda$  is same as that of the screw insertion and the fragments 8c are too small to make screw holes there-within.

In such cases, during drilling and screw insertion, the fracture results in more fragmentation, and finally, rigid fixation cannot be attained.

Fig 5 is a drawing of fracture fixation using the bone plate 1 embodying the present invention in a fracture distal 8b to the hip prosthesis or a fracture with an intramedullary nail 9. Screw fixation is impossible because of the intramedullary nail 9 in the bone 8. In this case, by using both a wire 10 and the wiring bone plate 1 embodying the present invention, the fracture 8 can be rigidly fixed without screw fixation.

The wire 10 is inserted through the wire hole 5 of the plate 1, wound around the bone 8 and tightly tied to it. Then, since the gap (s) between the bone 8 and the plate 1 is short and the wire 10 is inserted into the wire hole 5 of the plate 1, the tension of the wire 10 can be kept constant and no wire slippage is permitted.

Fig 6a and 6b are postoperative drawings using the wiring plate 1 embodying the present invention in case of the wedge and comminuted fracture. Generally during operative procedure, after reducing comminuted fracture, the fracture fragment 8c must be cramped with a bone clamp or a bone forcep so as to maintain reduction of the comminuted fracture fragment 8c. Then, in the case of using the prior art bone plate, in order to drill screw holes 2a in the bone 8 and fix the plate 1 onto a reduced fracture 8 with the screw 7, the clamp or the forcep must be released. At this time, the setting of reduction is lost.

By using the wiring plate 1 embodying the present invention, however, it is not

necessary to drill the screw holes 2a in the reduced fracture to fix the plate 1 onto the fracture 8. The wiring bone plate 1 can hold the fracture 8 in a reduced state firmly by only wiring without releasing clamping of the bone clamp or the bone forcep. As shown in Fig 5, the portion 1a of the plate 1 placed over the proximal part 8a of the fracture 8(into which the screw holes 2a can not be drilled because of the intramedullary nail 9 inserted by the hip prosthesis) is tied up by means of only the wire 10, and another portion 1b of the plate 1 placed over the distal part 8b of the fracture is fixed up by means of the screws 7.

In addition, as shown in Fig 6, sometimes the screw hole 2a cannot be drilled in the comminuted part 8c of the fracture. In this case, the comminuted part 8c is also tied up with the bone plate 1 by means of only the wire 10, and both ends of the comminuted part 8c of the fracture are fixed to the bone plate 1 by means of the screws 7.

Since the wire 10 is inserted through the wire hole 5 of the plate 1 and wound around the circumference of the broken bone 8, the plate 1 is tightly contacted with the fracture 8. If the wire 10 is to be moved along the bone 8, the plate 1 into which the wire 10 is inserted through the wire hole 5 must be simultaneously moved. Therefore, the wire 10 cannot be moved along the longitudinal direction of the bone 8, and the wire 10 can hold both the plate 1 and the fracture 8 with constant engagement force.

The size of the wire hole 5 can be sufficient for double wiring of a broad plate or single wiring of a narrow plate, but not too large to weaken the strength of the plate. This wiring plate 1 has many advantages. The first is that rigid fixation can be attained as the gap (s) between the plate 1 and the bone 8 is decreased. The second is that wiring can be applied everywhere, because there is no wire slippage, although the diameter of bone 8 varies substantially along the longitudinal direction of the bone 8. The third is that this plate 1 can be fixed more rigidly with the femur fracture with the hip prosthesis or medullary nailing than with any

other prior bone plate.

In addition to the foregoing, this bone plate 1 has one more advantage when performing internal fixation. At the first step of operative procedure, the fracture fragment 8c is reduced. At the second step, the bone plate 1 is fixed with the screws 7 while maintaining the reduced state of the fracture fragment 8c with a bone forcep or a bone clamp. But these apparatuses sometimes hinder the screw insertion because they are very bulky. Transient release of these apparatuses for screw fixation causes loss of reduction especially in case of comminuted fracture. When using the bone plate 1 embodying the present invention, there can be excellent maintenance of reduction by rigid wiring without the bone clamp or the bone forcep. So, without using the bone clamp or the bone forcep, the plate 1 can be easily fixed onto the broken bone 8 with only the wire 10 in the portion of the comminuted fracture and fracture with a prosthesis or intramedullary nail, and the other part of the broken bone except the above portion is fixed using only the screws 7.



#### CLAIMS

1. A bone plate for internal fixation of a fracture by wiring, said plate having front and rear surfaces and side surfaces, and a plurality of transverse wire holes extending through said plate from one side surface to the other side surface thereof; said plate being further provided with a plurality of screw holes extending through the plate from the front to the rear surface thereof.
2. A bone plate according to claim 1 in which at least one of the wire holes is of dimensions such as to permit, in use, two lengths of wire to be passed therethrough, side by side.
3. A bone plate according to claim 1 or 2 in which at least one of the wire holes is of dimensions such as to permit, in use, only a single length of wire to be passed therethrough.
4. A bone plate for internal fixation of a fracture by wiring, the bone plate being substantially as hereinbefore described with reference to Figures 1-6 of the drawings.