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(54) Title: BONE PLATE

(57) Abrégé/Abstract:
The bone plate (1) comprises a top side (2) and a bottom side (3), a first end (11), a second end (12) and several plate holes (4) configured between the two ends (11, 12) receiving bone screws and connecting the top side (2) to the bottom side (3). Two of the plate holes (4) are constituted by a combination of two mutually different and partly overlapping boreholes (5, 6). The first (5) of the two boreholes is circular cylindrical and is fitted with an inside thread (7) and comprises a cylinder axis (9). The second (6) of the boreholes comprises a cone axis (10) and tapers from the top side (2) to the bottom side (3) to constitute a frustrum of cone. The second (6) of the two boreholes is fitted with an inside thread (8). The cylinder axis (9) is a distance other than zero from the cone axis (10).

ABSTRACT

The bone plate (1) comprises a top side (2) and a bottom side (3), a first end (11), a second end (12) and several plate holes (4) configured between the two ends (11, 12) receiving bone screws and connecting the top side (2) to the bottom side (3). Two of the plate holes (4) are constituted by a combination of two mutually different and partly overlapping boreholes (5, 6). The first (5) of the two boreholes is circular cylindrical and is fitted with an inside thread (7) and comprises a cylinder axis (9). The second (6) of the boreholes comprises a cone axis (10) and tapers from the top side (2) to the bottom side (3) to constitute a frustrum of cone. The second (6) of the two boreholes is fitted with an inside thread (8). The cylinder axis (9) is a distance other than zero from the cone axis (10).

English translation of the International Patent Application No. PCT/CH2003/000712 entitled "Bone Plate" in the name of Synthes GmbH

Bone Plate

The present invention relates to a bone plate defined in the preamble of claim 1.

Foremost said bone plate is intended to fix forefoot osteotomies, in particular hallux valgus osteotomies. Such osteotomies or their fixations should obey the following criteria:

-- being angularly fixed,

-- match the corresponding size of the correction,

-- being minimally invasive.

An implant in the form of a clamp is known from the patent documents WO 00/06036 and AT 000937U2 and is used intramedullarily. Said clamp offers the advantage of minimal invasiveness for intramedullary fixation; however the implant per se is not angularly fixed. The correction depends on the various crimps by which the clamp is presented. Accordingly the clamp is minimally invasive but cannot fix small corrections.

The FRIGG patent publication WO 01/54601 discloses a bone plate with combined holes, i.e., two mutually penetrating plate boreholes. This combined hole incurs the drawback that only one of the two plate boreholes comprises a partial, inside thread and that, consequently, an angularly fixed, rigid anchoring of a bone screw is possible only in that single plate borehole.

The objective of the present invention is palliation. The invention's goal is to create a bone plate which is applicable both intramedullarily and extramedullarily and which allows angular and minimally invasive fixation of both small and large corrections.

The invention attains its objective using a bone plate defined by the features of claim 1. Said bone plate meets all the above listed requirements, namely:

(a) Being angularly fixed:

The bone plate is bilaterally adequately angularly fixed by mans of two slots in the shank and two slots in the head zone of the metatarsal bone. Furthermore, on account of two cylindrical threads within the plate in the shank zone and by locking this plate using two screws, said plate is protected also against rotation as well as being shifted within the medullary cavity.

(b) Fixation according to the size of the correction:

This feature is implemented using the target bail. The small MT head shall be shifted to the desired extent in the lateral direction. Thereupon the plate is inserted or hammered in position along the small head and then is screwed tight.

(c) Minimal invasiveness:

Sawing is carried out through an incision that is just wide enough to pass the saw blade. However said incision is large enough to insert the plate. The holes to screw in place the plate in the shank zone may be bored thereupon through the skin.

(d) Small corrections also are possible:

Small corrections not exceeding the cortical edge of the medullary space may be fixed extramedullarily using this plate. In this procedure the plate is slightly bent in relation to the correction and moved under the skin. The second part of the holes used to lock the shank are fitted with a conical thread and are intended for extramedullar, angular fixation. The holes may be felt when the plate is being moved under the skin. The incision between the two plates will then suffice to reach both holes.

Using the "combined hole" of the bone plate of the present invention, and preferably two of such holes being configured in the lower, proximal bone plate part, the said bone plate may be used both intramedullarily and extramedullarily.

The "combined hole" consists of a cylindrical and a conical portion each fitted with at least a partial thread. The cylindrical portion is used for intramedullar fixation and is locked by the shank thread of a bone screw. The conical portion is used for extramedullar bone plate application also to lock the bone plate, in this instance a socket head screw being used,

resulting in a so-called "internal fixator". The small metatarsal head being the element being displaced, a selection in fixation (intramedullary, extramedullary) is not significant in this case. Therefore the two plate holes in the upper, distal zone of the bone plate correspond to the conventional, angularly fixed plate holes (circular cylindrical or conical inside thread holes).

A targeting element is required to fix the bone plate of the invention in intramedullary manner, to allow to accurately lock the bone plate in the bone. Simultaneously however this targeting element shall enable both precisely placing the bone plate and to act as a hammer tool.

No targeting element is required for extramedullary fixation because the bone plate holes can be sensed underneath the skin. The two "combined holes" preferably configured at the bone plate's proximal end are so close to each other that they can be reached by using one incision and by displacing the skin.

The term "inside threads" denotes not only helical structures but also rib-shaped structures that may act as threads.

The bone plate defined in claim 1 offers the advantage of entailing only little material waste when being manufactured. Another advantage is enabling a shorter bone plate, resulting in less invasiveness.

In a particular embodiment mode of the present invention, the plate hole consisting of two mutually overlapping boreholes is configured at the first bone plate end.

The first bone plate end is tapering in one preferred embodiment mode. As a result the bone cavity will be more easily accessed and, as regards the extramedullary case, the bone plate will be more easily moved underneath the skin.

In another embodiment mode of the present invention, the inside thread of the first borehole is multiple, for instance being a double thread. This feature provides faster seizing when turning a socket head screw. The inside thread of the second borehole also may be multiple, preferably double.

In another embodiment mode of the present invention, the cylinder axis and the cone axis of the two overlapping boreholes run essentially parallel to each other. The distance A between the axes of the cylinder and cone preferably shall be larger than 0.1 mm.

In a particular embodiment mode of the present invention, the bone plate comprises at least two boreholes constituted by a combination of two different and partly overlapping boreholes. Preferably a further borehole extends the first two boreholes but does not consist itself of two partly overlapping boreholes. The plate holes adjoining the composite holes may be cylindrical or conical, with or without inside threads.

The bone plate comprises a compression hole in a further embodiment mode of the present invention.

In still another embodiment mode of the present invention, the second bone plate end is Y-shaped. On occasion the fragment to be fixed will be too short to allow fixation with two consecutively located holes. In such a case a Y-shaped bone plate end offers the advantage that each arm of the Y comprises one hole.

Preferably one or even both of the two arms of the Y-shaped end comprises a compression hole. A combined hole also may be used, that is, a combination of s compression hole and a locking hole. Again only one of the two kinds of holes (compression or .locking hole) may be used.

A compression hole combined with a locking hole at the other Y arm offers the advantage that bone plate compression may take place before the second hole is used for angular fixation.

In a further embodiment mode of the present invention, the top and and the bottom sides of the bone plate are curved. Typically the curved top side and bottom side correspond to the surfaces of circular cylinders $C_{topside}$ and $C_{bottomside}$.

Preferably the top side (2) and the bottom side (3) exhibit different curvatures. If the bone plate is used intramedullarily as well as extramedullarily, the different curvatures of top

and bottom sides allow optimally matching the intramedullar surface of the medullary space on one hand and on the other hand the bone extramedullar surface.

In one particular embodiment mode of the present invention, the radius $R_{topside}$ of the circular cylinder $C_{topside}$ is at most 40 %, preferably at most 40 % of the radius $R_{bottomside}$ of the circular cylinder $C_{bottomside}$.

The invention and its further developments are elucidated below in relation to the partly schematic Figures of several illustrative embodiments.

Fig. 1 is a topview of the bone plate of the invention comprising two combined holes, and

Fig. 2 is a longitudinal section of the bone plate of Fig. 1 in the area of one of the combined holes.

The bone plate 1 shown in Figs. 1 and 2 comprises a top side 2. a bottom side 3 facing the bone, a first end 11, a second end 12 and four plate holes which shall receive the bone screws and which are configured between the two ends 11, 12 and connect the top side 2 to the bottom side 3.

The two plate holes 4 near the first end 11 are constituted by two different and partly overlapping boreholes 5, 6. The first (5) of the two boreholes is circular cylindrical and comprises a cylinder axis 9 and an inside thread 7. The second (6) of the two boreholes tapers from the top side 2 toward the bottom side 3 to subtend a cone frustrum and it comprises a conical axis 10 and an inside thread 8. The cylinder axis 9 and the cone axis 10 run parallel to each other and are a distance A = 2 mm apart.

Of the two plate holes 4 constituted by the overlapping boreholes 5, 6, the terminal one is configured near the first and tapering end 11 of the bone plate 1.

The plate holes 4 adjoining the combined holes are conical, angularly fixed and comprise an inside thread 8.

The embodiments of the present invention for which an exclusive property or privilege is claimed are defined as follows:

1. A bone plate comprising:

an upper surface;

a lower surface;

first and second ends; and

at least one combination hole disposed between the first and second ends, the hole passing through the upper and lower surfaces and configured and dimensioned for receiving at least one bone fastener,

wherein the at least one combination hole is formed by first and second different, partially overlapping bores, the first bore having a cylindrical shape defining a central cylinder axis and extending from the upper surface to the lower surface, and the second bore tapering from the upper surface to the lower surface and having a frusto-conical shape defining a central cone axis, the cylinder axis spaced a non-zero distance from the cone axis.

2. The bone plate of claim 1, wherein the first and second bores each include at least partial internal threads.

3. The bone plate of claim 1, wherein the combination hole is located nearer the first end of the bone plate than the second end.

4. The bone plate of claim 1, wherein the first end of the bone plate is tapered.

5. The bone plate of claim 2, wherein the first bore includes multiple lead threads.

6. The bone plate of claim 2, wherein the second bore includes multiple lead threads.

7. The bone plate of claim 1, wherein the cylinder axis and the cone axis are substantially parallel.

8. The bone plate of claim 1, wherein the distance between the cylinder axis and the cone axis is greater than 0.1 mm.

9. The bone plate of claim 1, further comprising at least two combination holes.

10. The bone plate of claim 1, further comprising a non-threaded compression hole.

11. The bone plate of claim 1, wherein the second end of the plate is Y-shaped.

12. The bone plate of claim 11, wherein the second, Y-shaped end of the plate includes two arms, and at least one of the arms includes a non-threaded compression hole.

13. The bone plate of claim 1, wherein the upper and lower surfaces are curved.

14. The bone plate of claim 13, wherein the curved upper and lower surfaces are each partially cylindrically-shaped.

15. The bone plate of claim 14, wherein the curvature of the upper surface is different than the curvature of the lower surface.

16. The bone plate of claim 15, wherein the partially cylindrically-shaped upper surface has a first cylinder radius R_{upper} and the partially cylindrically-shaped lower surface has a second cylinder radius R_{lower}, where R_{upper} is less than or equal to 50% of R_{lower}.

17. The bone plate of claim 16, wherein R_{upper} is less than or equal to 40% of R_{lower}.

FIG 1

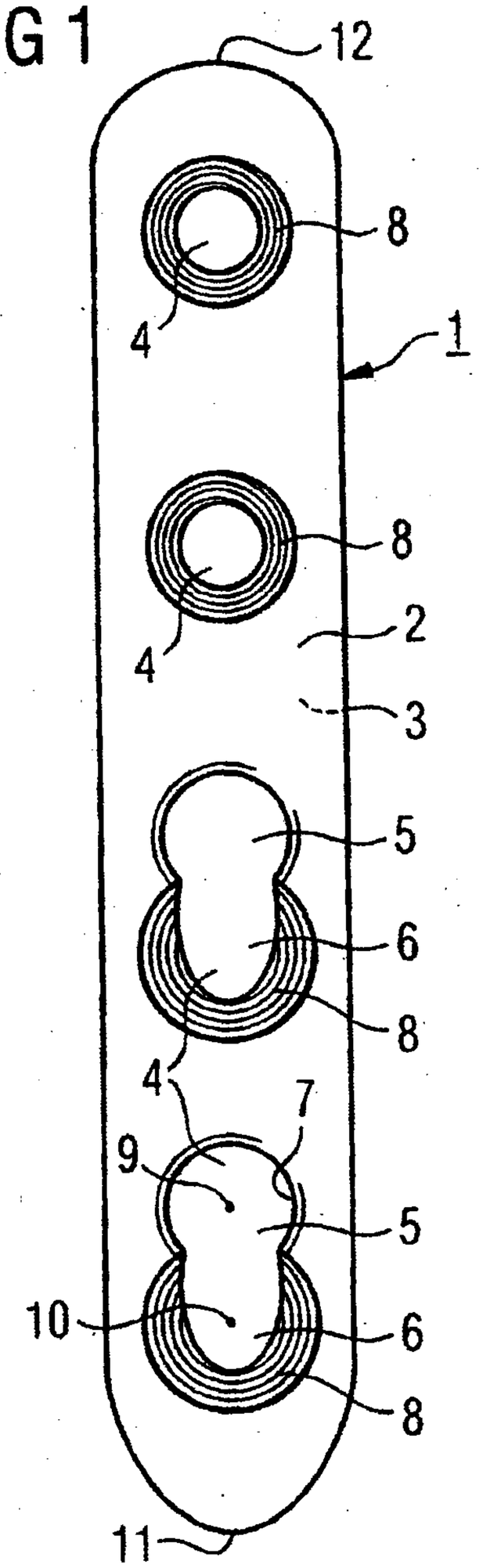

FIG 2