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(54) Title: FULLY ANATOMICAL POLY-AXIAL LOCKING DISTAL RADIUS PLATE DESIGNED FOR QUADRUPEDS

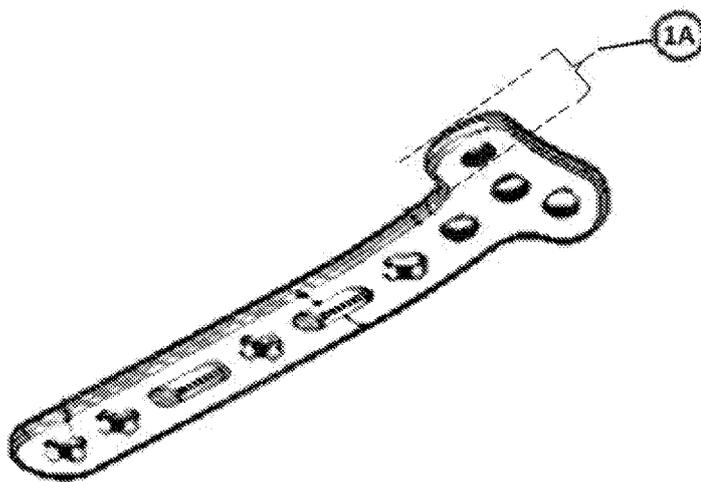


Figure - 6

(57) Abstract: The present invention relates to a fully anatomical poly-axial locking distal radius plate that is fully anatomical, and capable of being locked at different angles, and developed to be used in distal radius fractures of quadrupeds which occur as one of many consequences of traumatic events including road accidents, falling from height, firearm injuries, etc. The present invention particularly relates to a fully anatomical multi-directional locking plate system to be used in the field of medicine and designed in compliance with the bone structure in order to eliminate painful bone deformities as well as joint deformities in distal radius region, stemming from traumatic arthritis, fractures and similar reasons in quadrupeds and particularly in feline and canine animal groups.



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FULLY ANATOMICAL POLY-AXIAL LOCKING DISTAL RADIUS PLATE
DESIGNED FOR QUADRUPEDS

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Technical Field of the Invention

The present invention relates to a fully anatomical poly-axial locking distal radius plate that is fully anatomical, and capable of being locked at different angles, and developed to be used in distal radius fractures of quadrupeds which occur as one of many consequences of traumatic events including road accidents, falling from height, firearm injuries, etc.

15 The present invention particularly relates to a fully anatomical multi-directional locking plate system to be used in the field of medicine and designed in compliance with the bone structure in order to eliminate painful bone deformities as well as joint deformities in distal radius region, stemming from traumatic arthritis, fractures and similar reasons in quadrupeds and particularly in feline and canine animal groups.

Prior Art

25 Trauma-related fracture cases are occasionally encountered in various bones of quadrupeds. One of these fracture cases is distal radius fractures. Distal radius and ulna fractures usually occur as a consequence of falling from heights. The fact that soft tissues situated in this region are insufficient for providing the necessary protection increases the risk for these fractures to become compound fractures. Distal radius fractures involve; Salter-Harris fractures, joint fractures, distal metaphyseal and epiphyseal fractures of the distal growth plate of the radius. Stabilization is usually achieved

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by using bandages, crossed Kirschner wires, external fixators, plates, and lag screw. Generally, animals feel severe pain in the respective region due to an injury on the surface of the bone, which consequently causes animals to become incapable of meeting their daily needs. Specific prosthetic applications carried out in order to respond to patients' symptoms may eliminate these difficulties. Prostheses utilized in orthopedic practices may be described as implants placed inside or to the surface of the bone through surgery in order to substitute a diseased joint or a joint which has lost its integrity.

Various prostheses are utilized in the state of the art in order to repair the damage originating from critical bone defects, tumoral or traumatic, and degenerative cases occurring in the distal radius of quadrupeds. A fully anatomical plate that is in full compliance with the anatomical structure of radius, and can increase the movement room of the animal by proportionately distributing biomechanical and static loads on the bone by means of being locked to the bone at different angles, is not available in applications known in the state of the art.

One of the methods employed in distal radius plate applications in the state of the art is cross pinning method. In cross-pinning method, osteosynthesis may be performed by angulating the joint with a 90° angle and inserting Steinmann pin or at least two Kirschner pins crosswise from the distal end of the radius towards the proximal thereof. In the cross-pinning method, fixation is tried to be performed by means of two or more fine Kirschner pins inserted from the medial and lateral of the wrist joint to the radius shaft, mandatorily designated points coincide with medial and lateral collateral ligaments on both surfaces as points of entry. This fortifies the

possibility of damaging the carpal tunnel nerve line. Furthermore, the requirement for using fine and flexible pins dictates performing a splinting procedure subsequent to fixation, wherein said splinting procedure induces joint
5 contracture. Additionally, pin surfaces that remain outside of the bone surface generate granulation tissues as said pin surfaces rub against peripheral tissues of the wrist joint. Formation of granulation tissues is a crucial factor that affects joint mobility negatively.

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Another method utilized in distal radius plate applications in the state of the art is straight pinning method. In the straight pinning method, the joint capsule is cut open, and a pin is linearly inserted to the radius shaft on the radius
15 joint surface. Straight pinning method causes synovial fluid to discharge since the joint capsule is cut open for the purpose of gaining access to the pin insertion point. Furthermore, due to the fact that the pinning entry point is directly the joint attrition surface, it fails to absorb the
20 tension factors herein, and accordingly, causes internal fractures to occur in the form of bone blocks. Additionally, it further results in impairment on the joint surface since the pinning entry point is created by puncturing the cartilage tissue.

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Yet another method utilized in distal radius plate applications in the state of the art is the plate method. Although approximating the joint surface is desired in the
aforementioned plate method, this particular method implies
30 trying to grab the fractured distal fragment by a single screw, thereby preventing the distal fragment from remaining stable.

Nowadays, as it is disclosed above, various surgical treatment methods are employed in proximal radius fractures. However,

following the searches conducted in the state of the art, no system or patent application was determined pertaining to a system such as the inventive fully anatomical poly-axial locking distal radius plate which improves patients' quality of life by ideally simulating (close to reality) motions of the radius bone, and has a design that perfectly imitates the anatomy of the radius in the treatment of distal radius fractures of quadrupeds.

10 Objects of the Invention

The present invention relates to developing a novel fully anatomical poly-axial locking distal radius plate which ensures bone union in segmental and non-segmental distal radius fractures of quadrupeds by means of fixing the bone in order to eliminate problems existing in the state of the art.

The main object of the present invention is to minimize the rate of complications that may potentially develop in the treatment of proximal radius fractures, which include non-union, union delay or avascular necrosis by utilizing a fully anatomical distal radius plate that is fully compatible with the distal radius bone of quadrupeds, and to ensure the point load distribution by connecting the inventive fully anatomical distal radius plate to the patient through poly-axial locking.

Another object of the present invention is to prevent the potential nerve injuries by being away from the neural lines, and without interfering with the functionality of both the joint capsule and other systemic structures. Furthermore, the present invention is capable of shortening the durations for application as well as for surgery, thereby making a substantial contribution to shortening treatment durations.

Another object of the present invention is to balance the load distribution by performing a fixing process with at least three screws at the distal radius lateral condyle region, thereby aligning the entirety of loads received in the direction of the elbow joint with cortex and performing a linear load transfer thereof through balanced cortex strength by means of the fully anatomical structure of the present invention. This provides a reduction in loads being received on the screw and/or the plate.

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The present invention provides superiority over other surgical treatment methods known in the state of the art by facilitating the implementation of surgical operations for the entirety of segmental or non-segmental fractures occurring in distal radius bone of quadrupeds, minimizing soft and osseous tissue damage, shortening the durations for surgical operations, reducing infection risks and skin irritation of prosthesis to minimum, and allowing for early functional use of the operated extremity. Additionally, the present invention further permits the operated joint to perform its motions early, provides enhanced functional results and responds to all complications.

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Detailed Description of the Invention

In order to achieve aforementioned objects of the present invention the inventive fully anatomical poly-axial locking distal radius plate and components thereof designed in compliance with the bone structure of quadrupeds and to be used in the reconstruction of defects that occur in distal radius bones of quadrupeds for any reason are illustrated in annexed figures,

30

wherein;

- FIGURE 1 illustrates the top view of the radius bone.
- FIGURE 2 illustrates the top view of the radius bone distal radial caput angle.
- 5 FIGURE 3 illustrates the top view of the radius bone radial condyle horizontal angle.
- FIGURE 4 illustrates the side view of the radius bone radial shaft transition area.
- FIGURE 5 illustrates the rear view of the radius bone ulnar shaft.
- 10 FIGURE 6 illustrates the bottom oblique view of the inventive fully anatomical poly-axial locking distal radius plate radial application area.
- FIGURE 7 illustrates the frontal view of the inventive fully anatomical poly-axial locking distal radius plate radial application seat area.
- 15 FIGURE 8 illustrates the radial medial condylar application angle of the inventive fully anatomical poly-axial locking distal radius plate.
- 20 FIGURE 9 illustrates the side view of the inventive fully anatomical poly-axial locking distal radius plate.
- FIGURE 10 illustrates the radial shaft translation angle of the inventive fully anatomical poly-axial locking distal radius plate.
- 25 FIGURE 11 illustrates the ulnar shaft in the inventive fully anatomical poly-axial locking distal radius plate.

30 **Reference Numerals**

1. Bone Radial Application Area
 - 1A. Plate Radial Application Area
2. Bone Radial Application Seat Area

- 2A. Plate Radial Application Seat Area
3. Bone Radial Medial Condylar Application Angle
 - 3A. Plate Radial Medial Condylar Application Angle
4. Bone Distal Radial Caput Angle
 - 4A. Plate Distal Radial Caput Angle
5. Bone Radial Shaft Translation Angle
 - 5A. Plate Radial Shaft Translation Angle
6. Bone Radial Condyle Horizontal Angle
 - 6A. Plate Radial Condyle Horizontal Angle
- 10 7. Bone Ulnar Shaft
 - 7A. Plate Ulnar Shaft
8. Poly-axial Locking Holes

The present invention is a newly designed "Fully Anatomical Poly-axial Locking Distal Radius Plate" that is both fully anatomical, and may be locked to the dorsal of the distal radius at different angles, and developed to be used in distal radius fractures of quadrupeds occurring as one of many consequences of traumatic events including road accidents, falling from height, firearm injuries, etc.

Distal radius bone of quadrupeds along with feline and canine animal groups has a multidirectional and angulated structure. Reasons including; forces generated by the loads being received at the distal radius bone, and variations in gait phases originating from the variability of the distal radius angularity in animals, and the fact that they carry 60% of their body weight on the forelimb, also including the fact that their orthogonal tread angle is approximately 110° render implementing any other application impossible. Therefore, joint portions that may adjust to all angular variabilities located on the distal radius bone in a fully anatomical manner are required to be able to create a plate that is in full compliance with patients' anatomy.

Angular variabilities that are located on the distal radius bone, and are significant for the inventive fully anatomical poly-axial locking distal radius plate are as follows; bone radial application area (1) which is the distance between the outer half-conical form of the bone and the symmetrical form thereof created inside the plate, as illustrated in Figure 1, bone radial application seat area (2) located at the middle bottom surface of the bone as illustrated in Figure 1, bone radial medial condylar application angle (3) which is the curved structure at the bottom right portion of the bone as illustrated in Figure 1, bone distal radial caput angle (4) which is the region angulated outwardly by remaining between the beginning of the bone joint surface and start line of the bone radial shaft translation area (5) as illustrated in Figure 2, bone radial shaft translation angle (5) which is the bone surface form that starts at the point where the bone distal radial caput angle (4) ends, and extends upwardly, as illustrated in Figure 4, bone radial condyle horizontal angle (6) which functions as a joint stopper by being in the middle of joint surfaces as illustrated in Figure 3, and bone ulnar shaft (7) which is the bone surface form between the distal joint area and the midline as illustrated in Figure 5.

Respective laboratory works were conducted on the radius bones of aforementioned animal group, and accordingly minimum and maximum measurements pertaining to aforementioned angles and areas were determined. Concordantly, obtained results were optimized by means of both theoretical and practical applications, and used in the production of the inventive fully anatomical poly-axial locking distal radius plate. Angle and area values that are important for the present invention are as follows; plate radial application area (1A) with a length in a range between 17-23 mm, as illustrated in Figure 6, having measurements thereof corresponding to the bone radial

application area (1), plate radial application seat area (2A) with a width in a range between 18.9-25.3 mm, as illustrated in Figure 7, having measurements thereof corresponding to the bone radial application seat area (2), plate radial medial condylar application angle (3A) with an angle in a range between 16.1°-21.8°, as illustrated in Figure 8, having measurements thereof corresponding to the bone radial medial condylar application area (3), plate distal radial caput angle (4A) with an angle in a range between 11.5°-15.5°, as illustrated in Figure 9, having measurements thereof corresponding to the bone distal radial caput angle (4), plate radial shaft translation angle (5A) with an angle in a range between 2.1°-2.8°, as illustrated in Figure 10, having measurements thereof corresponding to the bone radial shaft translation angle (5), plate radial condyle horizontal angle (6A) with an angle in a range between 1.6°-2.2°, as illustrated in Figure 9, having measurements thereof corresponding to the bone radial condyle horizontal angle (6), and plate ulnar shaft (7A) having a length in a range between 17-23 mm, as illustrated in Figure 11, having measurements thereof corresponding to the bone ulnar shaft (7). Furthermore, poly-axial locking holes (8) situated on the inventive fully anatomical poly-axial locking distal radius plate, as illustrated in Figure 8, are designed to have specific angular hole structures so as to ensure that the passageway of fixed poly-axial screws is compatible with the anteversion of the radial neck. Poly-axial screws inserted at specific angles through poly-axial locking holes (8) pass through target points and ensure fracture fragment compression and/or fixation. Distal end, and body holes of the present invention are supported with an internal cone-shaped circular mechanism that can ensure locking at different angles in cases where locking is desired to be performed by using locking cortical screw. The mechanism has an even-symmetric form together with the

locking cone-shaped screw head and is locked by means of at least four grooves on each surface thereof. Thus, a fully anatomical contact surface is obtained by means of the present invention which is produced in line with all of aforementioned mean measurement values, and it is locked by means of angulated screws which allow biomechanical load distribution on the axial basis instead of performing single plan screwing in bone fixation procedure. It is ensured that bone achieves a speedy recovery, that postoperative ailments stemming from plate implantation are prevented, and that motions of the radius bone are simulated in the best way possible by means of distributing biomechanical and static forces evenly on the radius bone of the patient.

Plate radial application area (1A) and plate radial application seat area (2A), which are located on the inventive fully anatomical poly-axial locking distal radius plate, allow the plate to perform semicircular motion. However, when the locking of the internal mechanism is commenced by means of the screw head, internal mechanism performs diameter enlargement through the grooved area that permits diameter enlargement. Roughened area on the outer surface of the internal mechanism, and the other roughened area on the internal conical hole area of the plate are interlocked with one another, thereby getting fixed based on the reverse conical principle. Said fixation is designed to be at a height capable of occurring omnidirectionally with an angle of 60° , and full locking is achieved on outer surfaces when the screw head and the mechanism reach to the same height. Thus, not only a fully anatomical contact surface is obtained, but also locking is performed by means of angulated screws which allows for distributing biomechanical loads on the axial basis instead of performing single-plan screwing in bone fixation procedure.

Since the present invention is anatomically shaped, the inventive fully anatomical poly-axial locking distal radius plate fits perfectly to the bone in a fully compatible manner with anatomical curvatures on the dorsal distal radius bone of
5 the patient, thereby ensuring the anatomy of the patient rapidly returns to its original form.

CLAIMS

1. A prosthesis used in surgeries of distal radius fractures occurring in animals **characterized in that**, it comprises;
- 5 • at least one plate radial application area (1A),
- at least one plate radial application seat area (2A),
- at least one plate radial medial condylar application angle (3A),
- at least one plate distal radial caput angle (4A),
- 10 • at least one plate radial shaft translation angle (5A),
- at least one plate radial condyle horizontal angle (6A),
- at least one plate ulnar shaft (7A),
- at least one specially angulated poly-axial locking
- 15 hole (8) located in the proximal of plate.
2. Plate radial application area (1A) according to Claim 1 **characterized in that**, it has a length in a range between 17-23 mm.
3. Plate radial application seat area (2A) according to Claim
- 20 1 **characterized in that**, it has a width in a range between 18.9-25.3 mm.
4. Plate radial medial condylar application angle (3A) according to Claim 1 **characterized in that**, it is in a range between 16.1° - 21.8° .
- 25 5. Plate distal radial caput angle (4A) according to Claim 1 **characterized in that**, it is in a range between 11.5° - 15.5° .
6. Plate radial shaft translation angle (5A) according to Claim 1 **characterized in that**, it is in a range between 2.1° - 2.8° .
7. Plate radial condyle horizontal angle (6A) according to
- 30 Claim 1 **characterized in that**, it is in a range between 1.6° - 2.2° .
8. Plate ulnar shaft (7A) according to Claim 1 **characterized in that**, it has a length between 17-23 mm.

9. A prosthesis used in surgeries of distal radius fractures occurring in animals according to Claim 1 **characterized in that,** it has curvatures in compliance with the anatomy of the distal radius dorsal bone.



Figure - 1



Figure - 2



Figure - 3

2/5

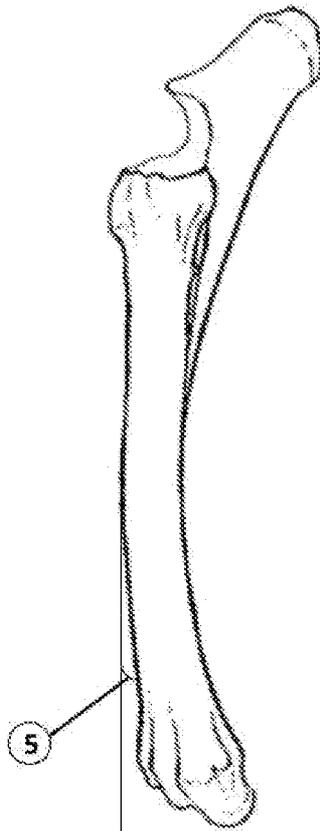


Figure - 4

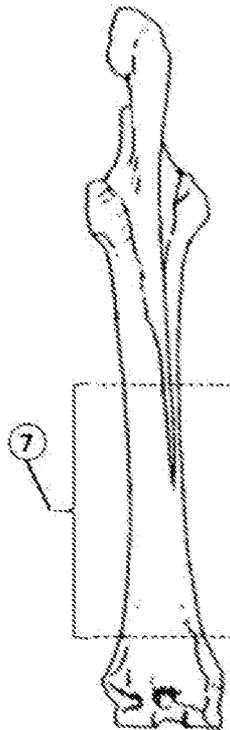


Figure - 5

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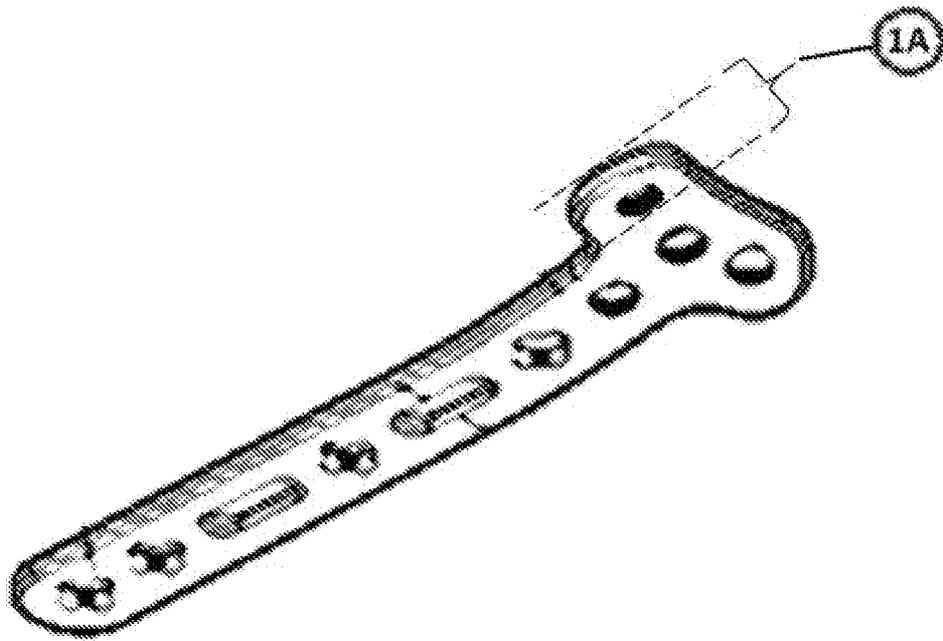


Figure - 6

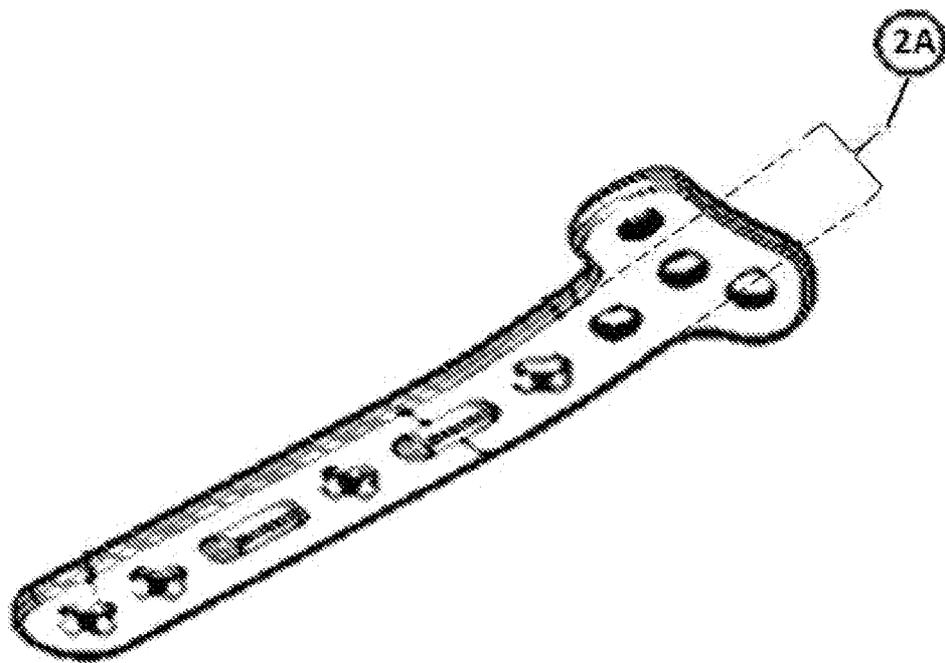


Figure - 7

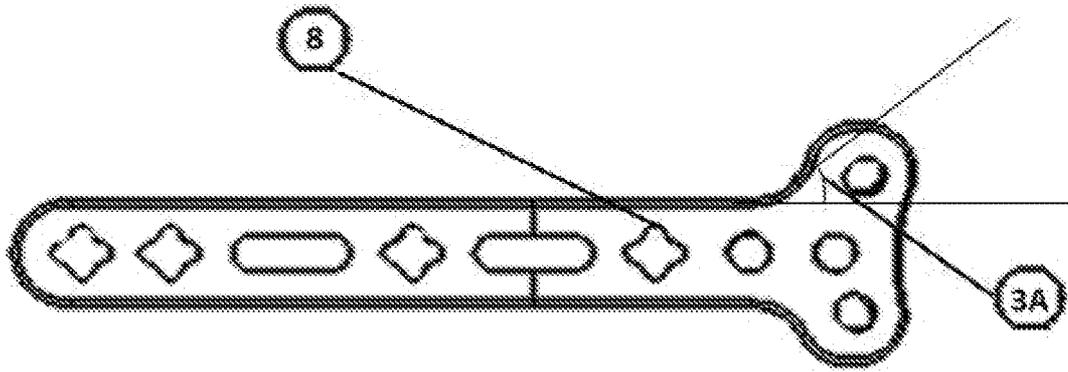


Figure - 8

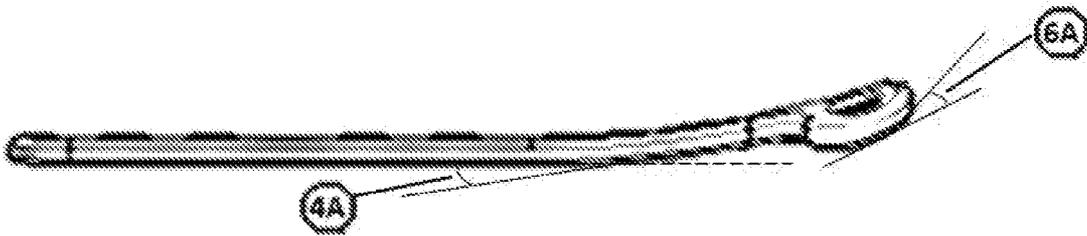


Figure - 9

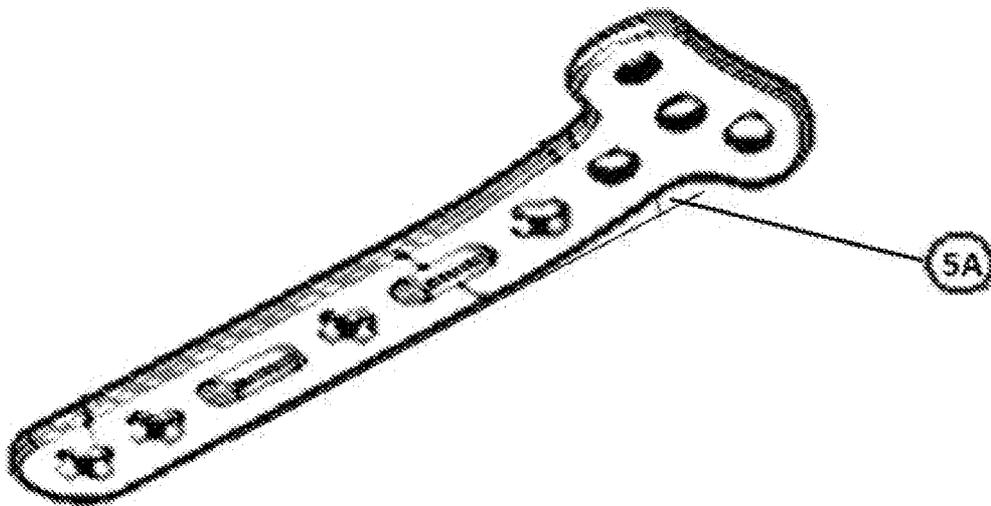


Figure - 10

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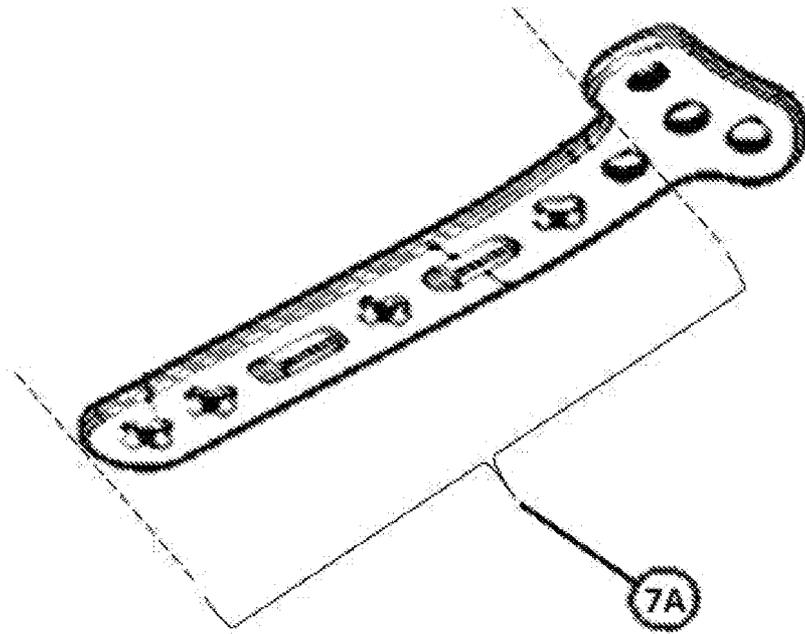


Figure - 11

INTERNATIONAL SEARCH REPORT

International application No.

PCT/TR2020/050288

A. CLASSIFICATION OF SUBJECT MATTER		
A61B 17/80 (2006.01)i; A61B 17/56 (2006.01)i; A61F 2/38 (2006.01)i A61B 17/8061, A61B 17/8057 (CPC)		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) A61B; A61F		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Published patent and utility model applications of Turkey, 2005-2020		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO Abstract & Fulltext Databases, WPI Data & Keywords: quadruped, animal, cat, dog, pet, feline, canine, mammal, poly-axial, fracture, distal, plate, radius, ulnar, bot, forearm, radial, prosthesis, implant, angle, angular, caput, shaft, curve, concave, convex, thread, screw, surgery, operation, lock, hole, bone, önkol, kemik, hayvan, kedi, köpek, vida, kırık, ameliyat, protez, açığı, ulna		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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X	US 2007088360 A1 (DEPUY PRODUCTS INC [US]) 19 April 2007 (2007-04-19) especially abstract; description paragraphs 37-38, 43-45; figs. 1, 3, 5	1,9
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X	WO 2012050424 A1 (LEONG SAI YEONG [MY]; TAN BOON CHEONG [MY]; TAN BEE KEONG [MY]) 19 April 2012 (2012-04-19) especially abstract; description pages 10-11, 13-14; figs. 1, 3, 5	1,9
A	EP 3453350 A1 (GLOBUS MEDICAL INC [US]) 13 March 2019 (2019-03-13) especially abstract; description paragraphs 31-32, 41, 65; figs. 1A, 6A, 10B	1-9
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input checked="" type="checkbox"/> See patent family annex.		
<p>* Special categories of cited documents:</p> <p>“A” document defining the general state of the art which is not considered to be of particular relevance</p> <p>“E” earlier application or patent but published on or after the international filing date</p> <p>“L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>“O” document referring to an oral disclosure, use, exhibition or other means</p> <p>“P” document published prior to the international filing date but later than the priority date claimed</p> <p>“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone</p> <p>“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art</p> <p>“&” document member of the same patent family</p>		
Date of the actual completion of the international search 11 September 2020		Date of mailing of the international search report 11 September 2020
Name and mailing address of the ISA/TR Turkish Patent and Trademark Office (Turkpatent) Hipodrom Caddesi No. 13 06560 Yenimahalle Ankara Turkey Telephone No. (90-312) 303 11 82 Facsimile No. +903123031220		Authorized officer Mustafa Güney ÇALIŞKAN Telephone No. +903123031219

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

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