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(54) Title: A TOOL FOR CUSTOM-MADE INSTRUMENTS AND IMPLANT FOR ARTIFICIAL KNEE JOINT OF DOGS

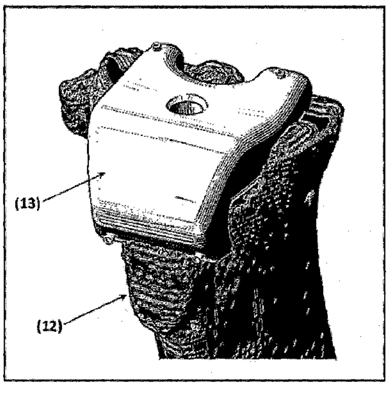

Figure 3-E Tibial Tool on a bone model, Isometric View

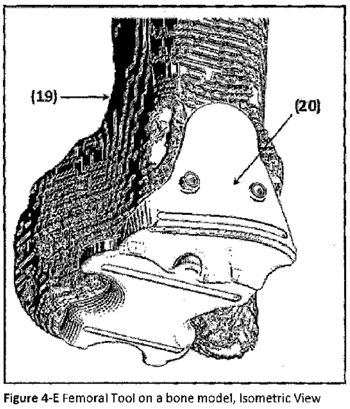

Figure 4-E Femoral Tool on a bone model, Isometric View

(57) Abstract: Total knee replacement is the standard treatment for advanced knee osteoarthritis. An improved method of treating an osteochondral defect for knee osteoarthritis of dogs is provided, which is a composite tissue for treating or preventing a disease, dis - order, or condition associated with an osteochondral defect with new technique. The new technique of custom made instruments and implants for dog and small animals is applied for different breeds of dogs regardless of their sizes and weights. The tool is a custom made instruments, which is based on capture of image based (CT or computed X-ray) to be transferred to electronic 3D model and apply 3D preoperative planning to design the tools are used to perform the knee surgery.

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A Tool for Custom-Made Instruments and Implant for Artificial Knee Joint of Dogs

Technical Field

Total knee arthroplasty (TKA) is a common procedure for human and it is the standard surgical treatment for severe arthritis. The standard technique for human knees is to perform the surgery using reusable instruments and on shelf implants that has 4-8 different sizes. In animals, there are different species and in the same animal there are different breads. For example, there could be more than 100 different breeds of dogs in a single country. Each bread has different sizes. This make impossible to have a large inventory of implant sizes to cover all variations. For this reason, this operation (TKA) is not common in animals.

Background of the Invention

The increased incidence of knee osteoarthritis calls for continuous development of surgical techniques and exploiting cutting-edge technology for improving knee replacement methods to obtain full physical fitness and knee joint health. The current total knee arthroplasty (TKA) technique is expensive and company specific, which is a significant disadvantage that limits the wide-spread application and availability of TKA. Further, the current technique is limited to the straight-forward knee replacement and not for complex cases of severe intra-/extra-articular deformity. TKA has been increasingly demanding in animals due to increased rate of accidents and osteogenic tumors.

Disclosure of Invention:

The invention is a tool for preparing a stifle for dogs undergoing TKA. This should provide knee prosthesis with universal applicability, fitting to the exact anatomical structure of the stifle. The universal tool would replace any commercially and currently available knee implant. It should also help in planning TKA and designing knee prosthesis for humans in the near future.

The current invention involves fabricating guiding and articulating components. The guiding components are known in literature as patient-specific instrumentation (PSI) which eliminates preoperative coupling with other surgical instruments (e.g., drills, sleeves, intramedullary rods and jigs). The preoperative plan is transferred to virtual and then physical components for accurate sizing, alignment and rotation. The bone-machining is carried out through specific paths which are multidirectional but accurately positioned to prevent any intersection. It helps to target bony surfaces directly away from cartilage or other soft tissues.

The articulating components should compose of 3 parts: 2 metallic parts (tibial and femoral) and 1 plastic part at their intersection which simulates the natural interosseous cartilage. They are tailored for each case specifically according to image-based 3D preoperative planning (CT, MRI or computed X-ray) which are converted to physical components using computer-aided manufacturing such as computer numerical control, additive manufacturing, rapid prototyping and 3D printing. These subject-specific components allow bone preparation and integration and can be placed in a unique and secure position.

Surgical simulation of bone cutting and prosthesis positioning is performed using virtual templates. The final prosthesis is manufactured and built of mesh, porous metallic material (cobalt chromium) to allow for osteointegration.

The same technique can be applied for other knee procedures such as unicompartmental, bicondylar and patellofemoral arthroplasty. It also serves in treating non-standard cases.

Description of patent

The current invention involves planning for TKA with the very early step through digital templating (through digital radiograph, CT scan and MRI) to design the prosthetic components of TKA virtually. The design should planned according to proper designation criteria including calculated magnification, angulation and alignment. This is the first step for preparing the subject's stifle for TKA.

The virtual deign is transformed into physical components which are the tool that is produced through medical rapid prototyping (aka, additive manufacturing or 3D printing). The physical components are thus tailored specifically for the subject according to the collected measures from radiographs. Simulation of surgery would lead to accurate positioning of the prosthetic components.

The tool should overcome the undersizing or overhang that usually take place with the currently used knee implants. The prosthetic components are the bone-like femoral and tibial parts (metallic components) and the middle plastic part that resembles natural knee cartilage.

This technology is suitable for any knee regardless of different shapes, configurations and anatomy. The prosthetic components are made of durable, biocompatible and hybrid materials containing metallic and composite parts which are produced through bone-machining steps including sizing, alignment, bone cutting and positioning.

Brief Description of Drawings

1) Tibial implant base
2) Tibial implant stem
3) Femoral implant central groove
4) Femoral implant stem
5) For femoral cuts
6) Front side fixation holes
7) Slit for proximal tibia cut

8) Top side fixation holes
9) Tibial tool front surface match
10) Tibial tool top surface match
11) Hole for making passage of stem
12) Tibia bone
13) Tibial tool body
14) Lug holes
15) Slit for distal femur cut
16) Femoral tool front surface match
17) Femoral tool top surface match
18) Slit for chamfer cut
19) Femur bone
20) Femoral tool body

References

1. US 2005/0055100 A1 (Lewis et al.) 10 Mar. 2005 (10/3/2005).
2. WO 2014198279 (HAFEZ, Mahmoud Alm EL Din) 18 Dec. 2014 (18/12/2014).
3. US8435246 B2 (Michael G. Fisher, Anthony K. Hedley, T. NEVINS, Kevin M. Cordes) 7 May 2013 (7/5/2013)

Claims

- A Tool for preparing an artificial knee joint for a dog and small animals while undergoing total knee arthroplasty (TKA) surgery.
- A method of planning and complete virtual surgery of TKA leading to the production of the tool mentioned in claim one
- The Tool consists of two parts; a femoral part and a tibial part
- The Tool is designed as a complete cutting guide that match the surface of the bone.
- Surface matching of the device relies on protruding locating surface that match bony surfaces
- This technology is suitable for knee replacement for different breeds of dogs regardless of its sizes.
- This technology does not need preoperative coupling with other surgical instruments such as drills or sleeves that are related to a particular company.
- This technology can replace the conventional instruments for TKA such as intramedullary, extra-medullary guides, sizing, rotation guides for both tibial and femur.
- The femoral implant unlike previous implants does not extend to the trochlea
- The femoral implant has a good anterior pegs and a central stem

Figure 1: Tibial Implant

All views (1-A, 1-B)

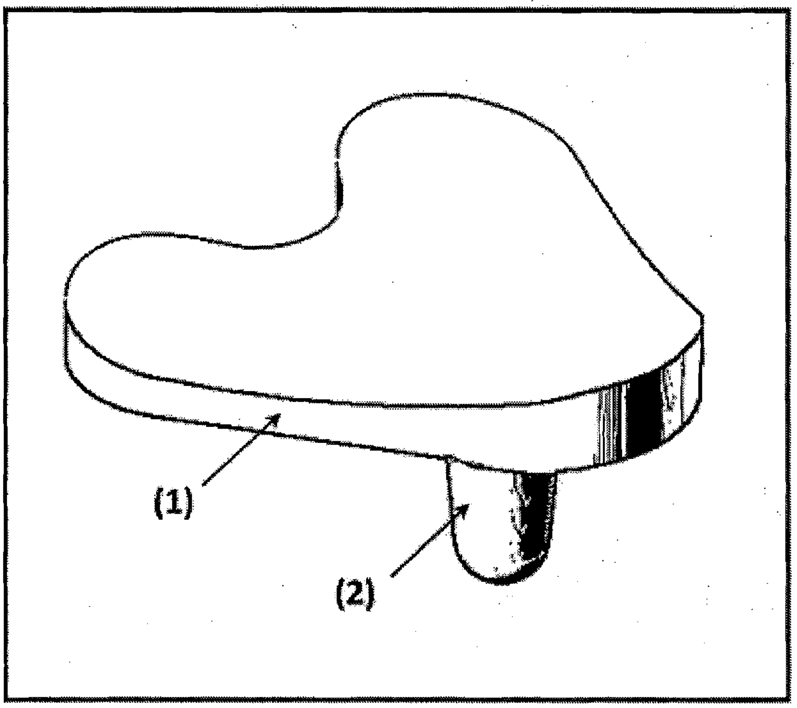


Figure 1-A Tibial Implant, Isometric View

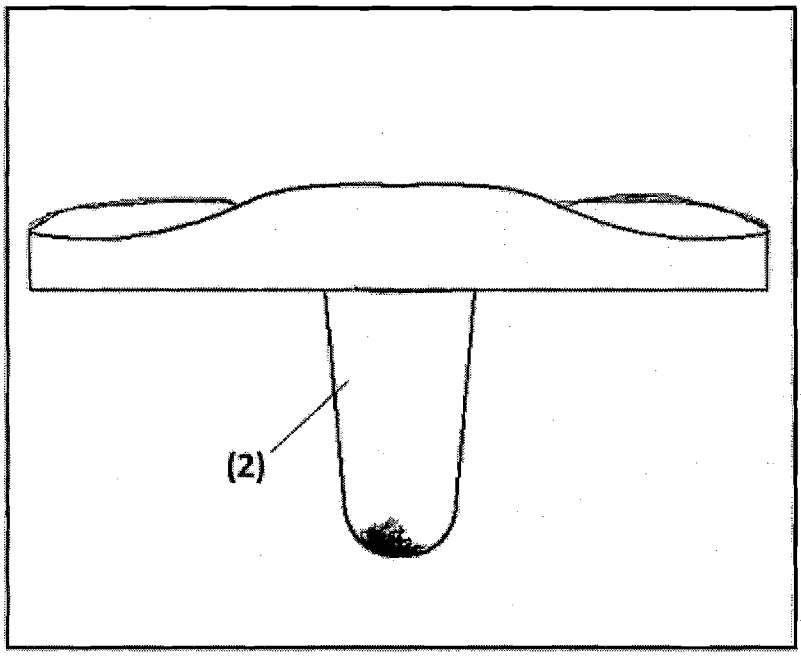


Figure 1-B Tibial Implant, Front View

Figure 2: Femoral Implant

All views (2-A, 2-B)

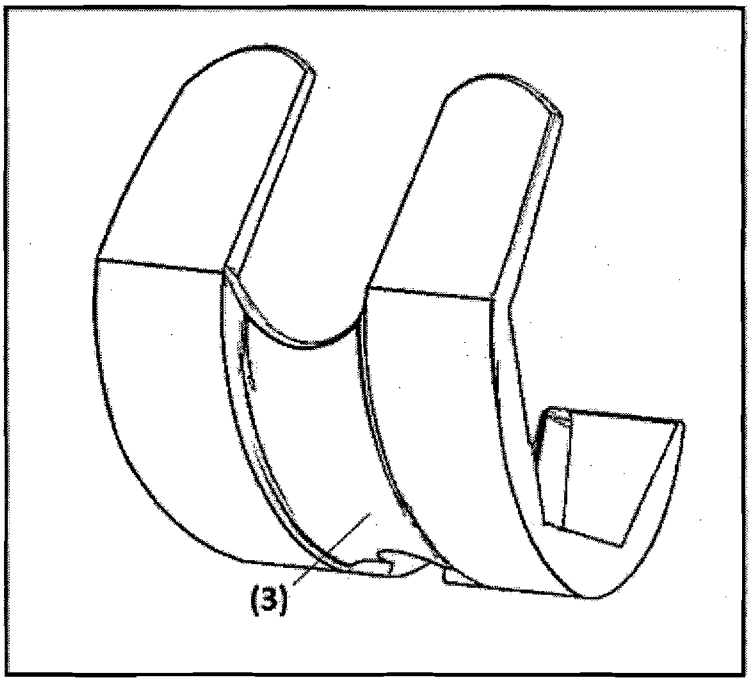


Figure 2-A Femoral Implant, Isometric View

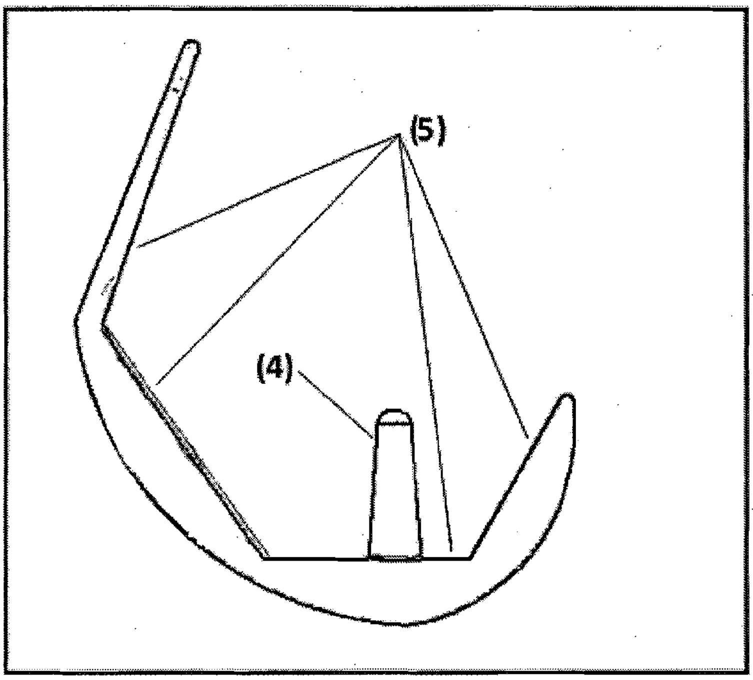


Figure 2-B Femoral Implant, Side View

Figure 3: Tibial Tool

All views (3-A, 3-B, 3-C, 3-D, 3-E, 3-F)

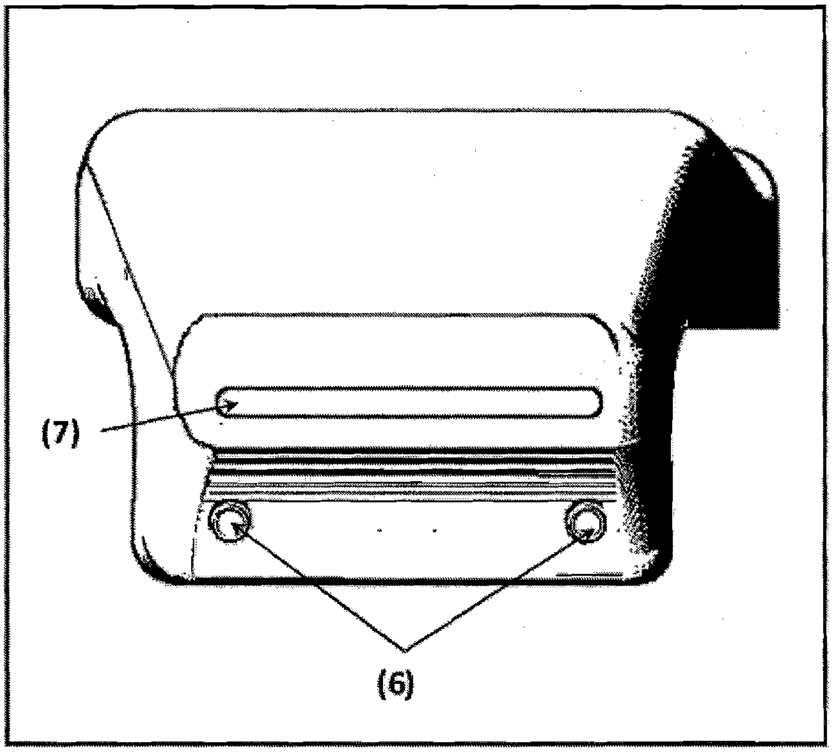


Figure 3-A Tibial Tool, Front View

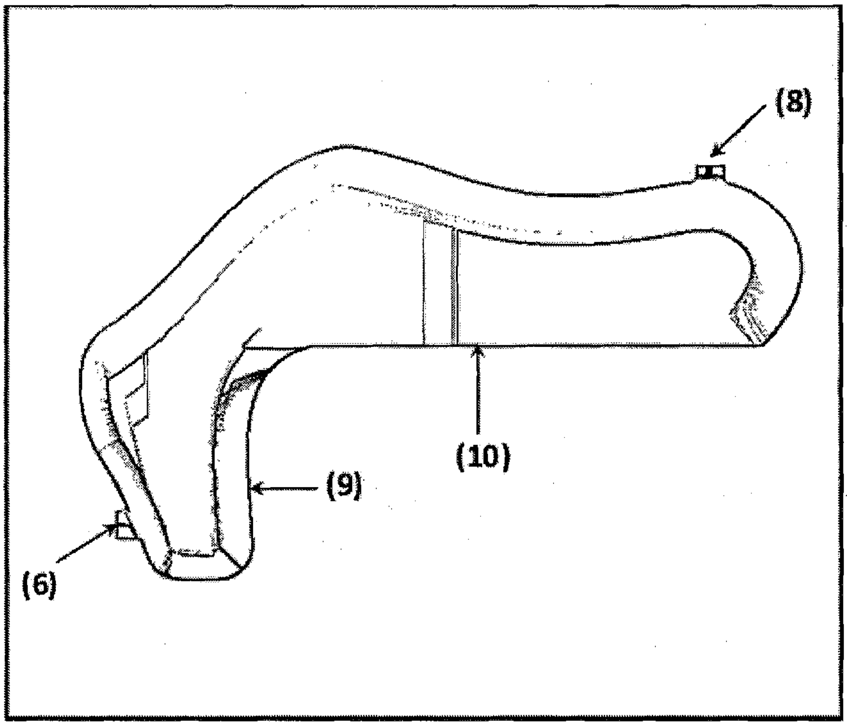


Figure 3-B Tibial Tool, Side View

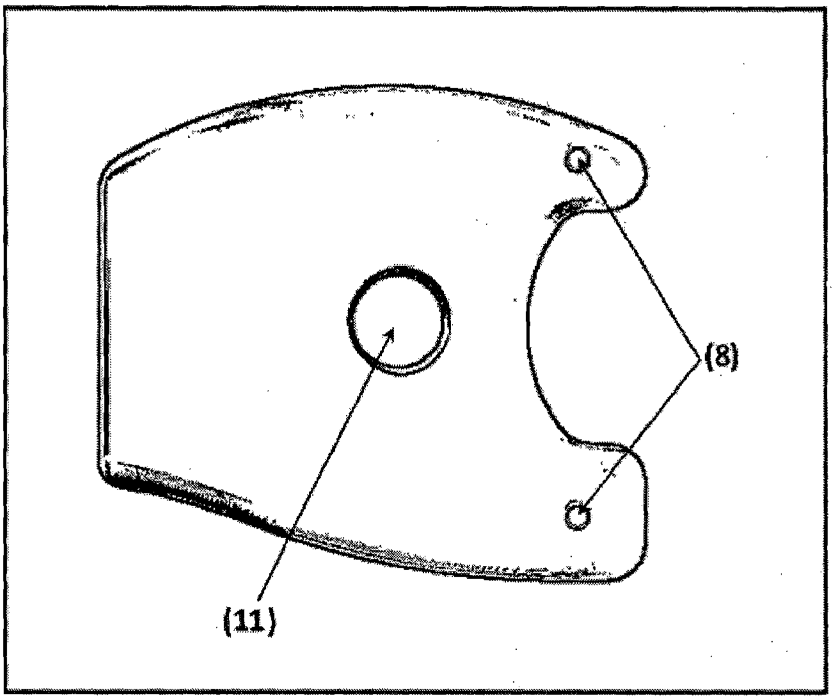


Figure 3-C Tibial Tool, Top View

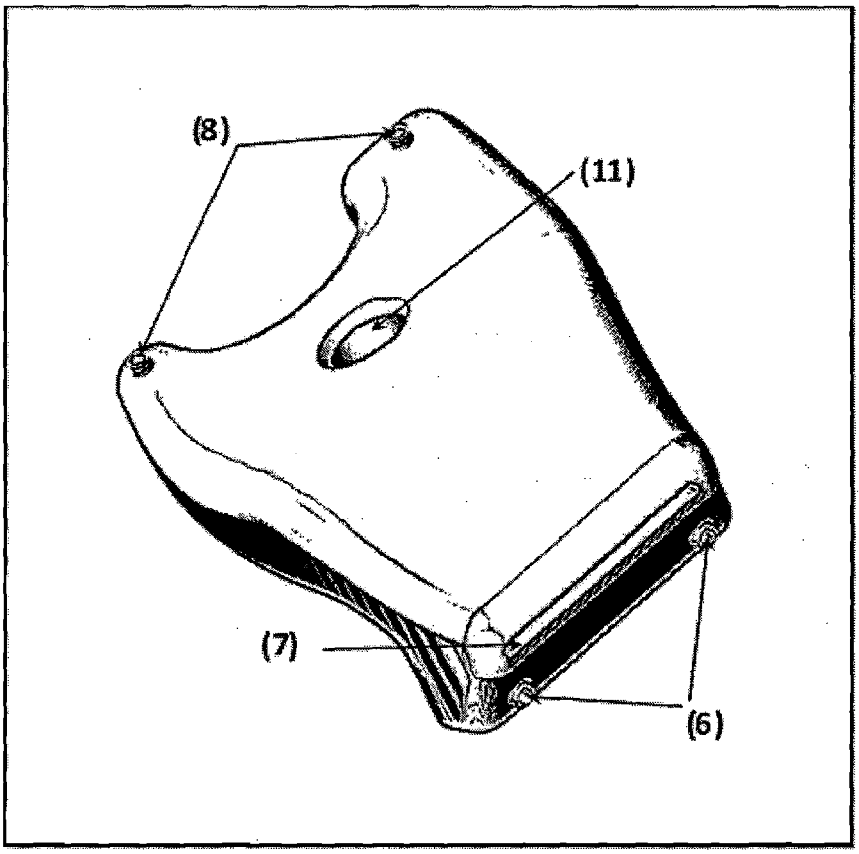


Figure 3-D Tibial Tool, Isometric View

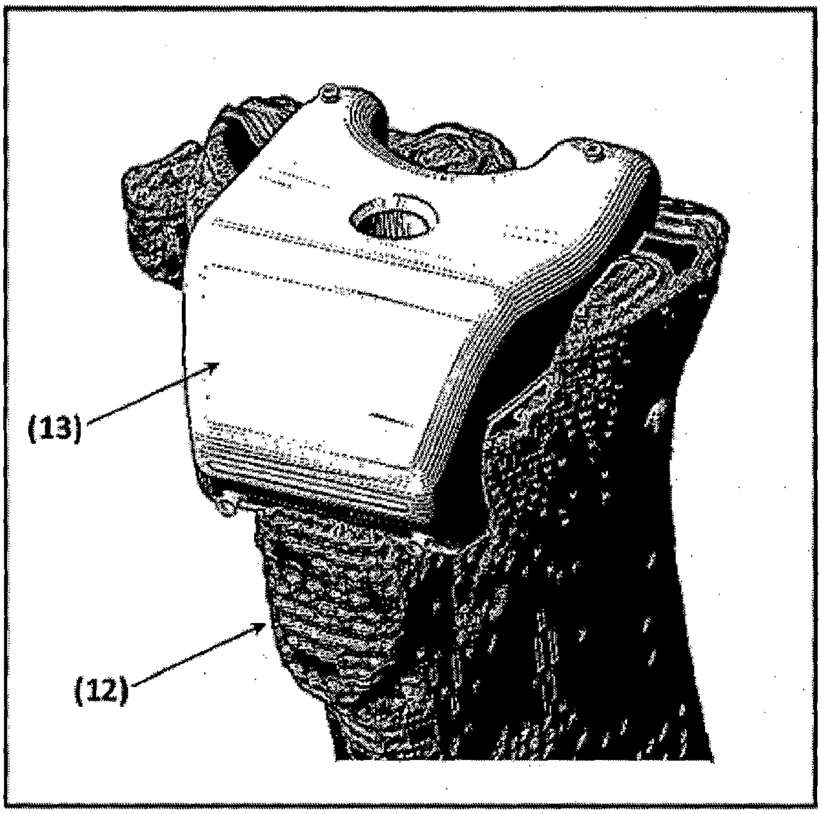


Figure 3-E Tibial Tool on a bone model, Isometric View

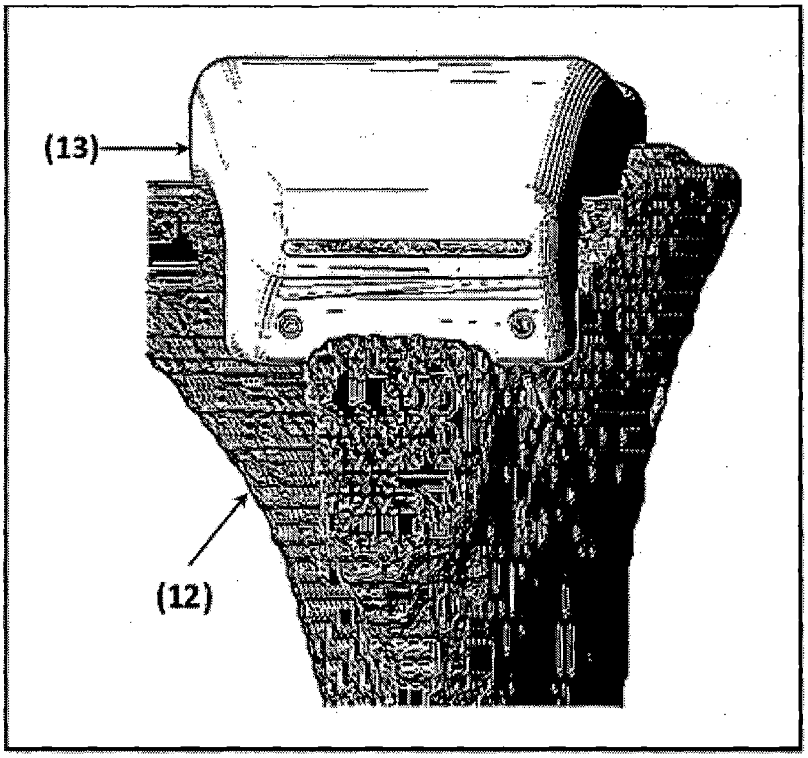


Figure 3-F Tibial Tool on a bone model, Front View

Figure 4: Femoral Tool

All views (4-A, 4-B, 4-C, 4-D, 4-E, 4-F)

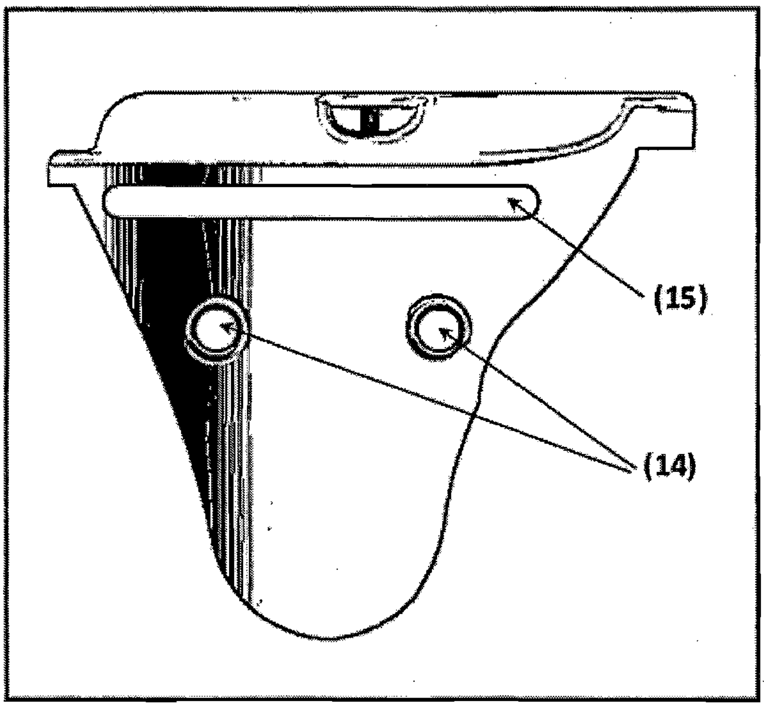


Figure 4-A Femoral Tool, Front View

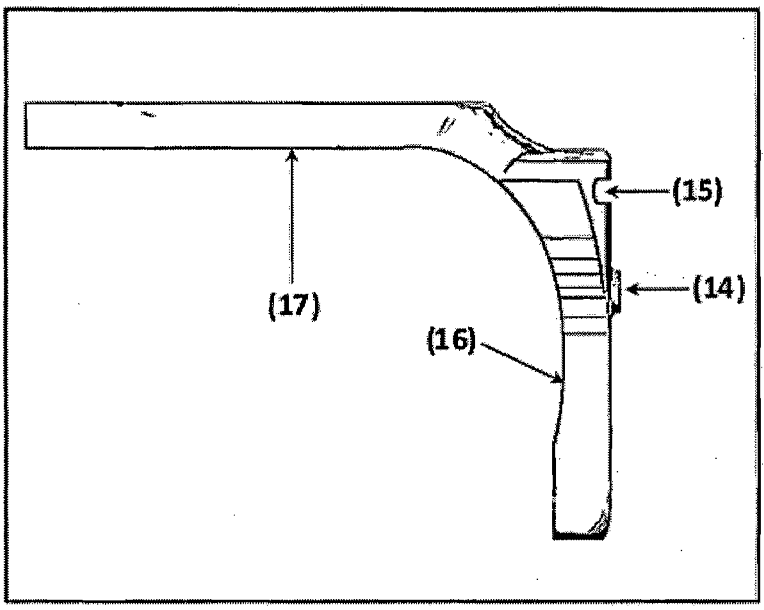


Figure 4-B Femoral Tool, Side View

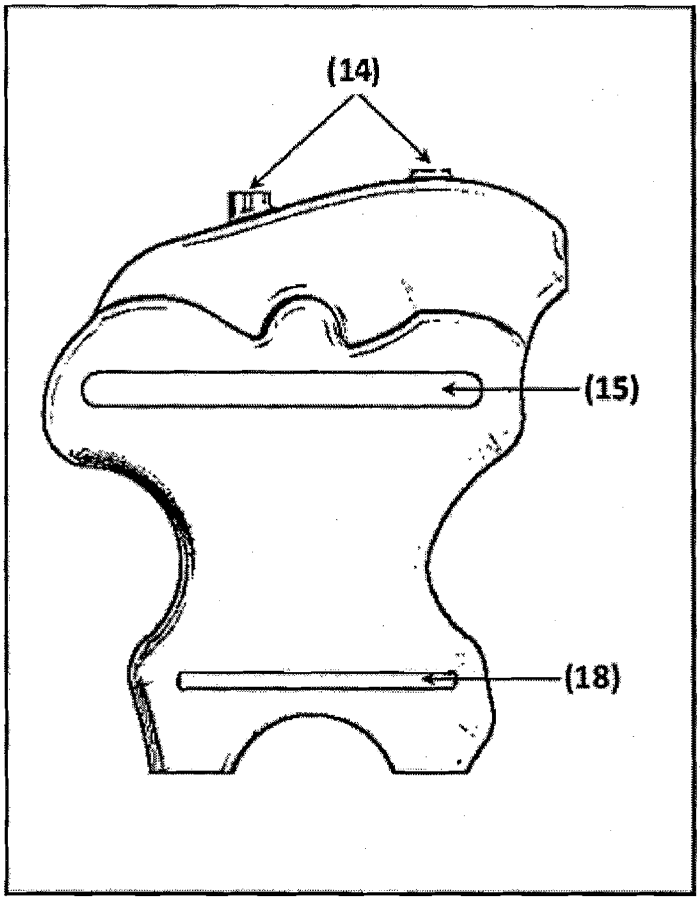
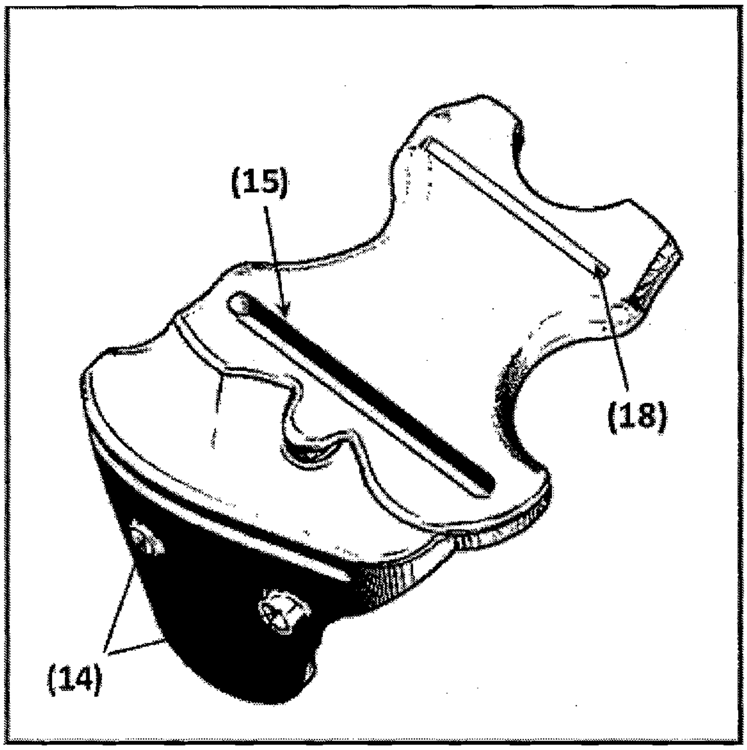


Figure 4-C Femoral Tool, Top View



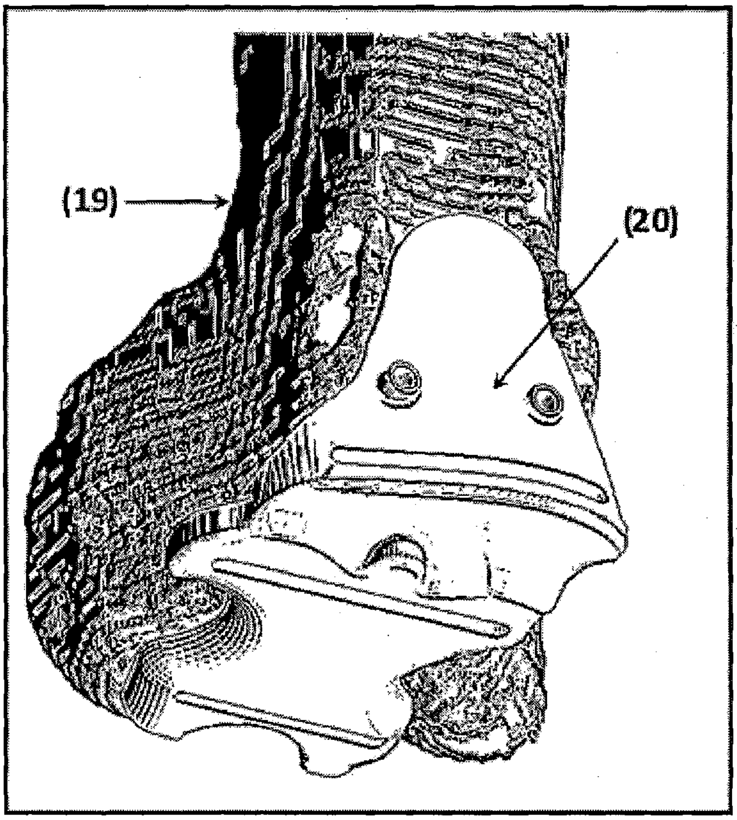


Figure 4-E Femoral Tool on a bone model, Isometric View

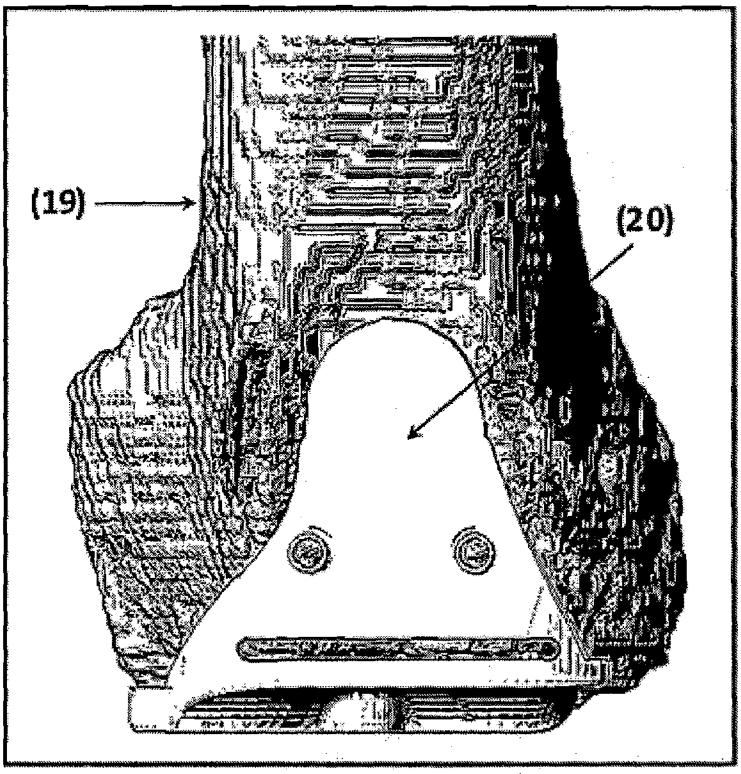


Figure 4-F Femoral Tool on a bone model, Front View