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(54) **Title**: PATIENT-SPECIFIC PARTIAL KNEE GUIDES AND OTHER INSTRUMENTS

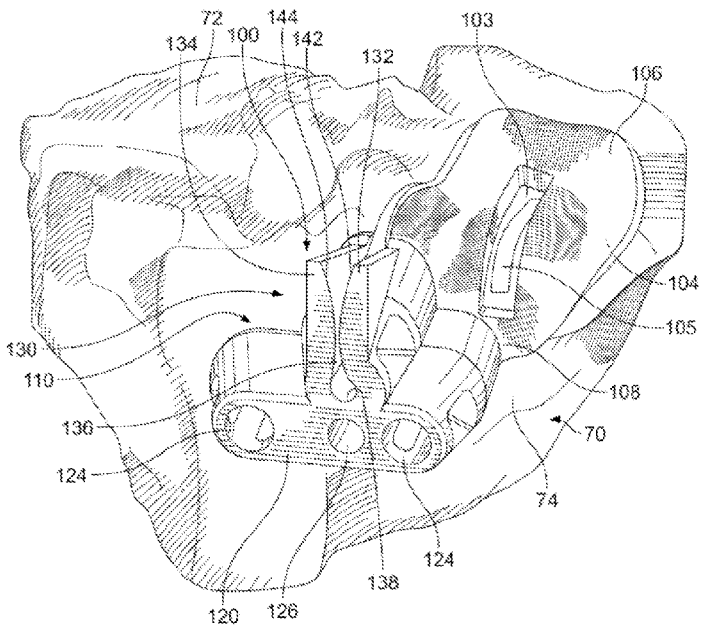

FIG. 3

(57) **Abstract**: A patient-specific unicompartmental tibial guide (100) has a patient-specific body (102) with an inner surface (104). The inner surface is preoperatively configured to nestingly conform and mate in only one position with an anterior portion and a proximal portion of a tibial bone (70) of a specific patient. The tibial guide includes a vertical resection channel (136) having a variable width preoperatively configured for guiding a vertical resection through the proximal portion of the tibial bone.

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PATIENT-SPECIFIC PARTIAL KNEE GUIDES AND OTHER INSTRUMENTS

INTRODUCTION

[0001] The present teachings provide various patient-specific guides and other instruments for partial or unicompartmental knee arthroplasty. Various patient-specific femoral and tibial partial knee guides and related instruments are provided. The patient-specific guides are designed and constructed preoperatively based on three-dimensional digital images of the patient's knee joint and/or other joints. The digital images of the patient's joint can be reconstructed from medical scans of the patient using commercially available CAD (Computer Aided Design) and/or other imaging software.

SUMMARY

[0002] This section provides a general summary of the disclosure, and is not a comprehensive disclosure of its full scope or all of its features.

[0003] The present teachings provide various patient-specific surgical kits for unicompartmental or partial knee arthroplasty. The surgical kit can include a patient-specific unicompartmental tibial guide that has a patient-specific body with an inner surface. The inner surface is preoperatively configured to nestingly conform and mate in only one position with an anterior portion and a proximal portion of a tibial bone of a specific patient. The tibial guide includes a vertical resection channel having a variable width preoperatively configured for guiding a vertical resection through the proximal portion of the tibial bone. In some embodiments, the variable width varies in a coronal plane relative to the patient, or in an axial plane or in both coronal and axial planes.

[0004] In some embodiments, the surgical kit includes a patient-specific unicompartmental tibial guide including a vertical resection channel having a first width formed between first and second flanges of the tibial guide. The surgical kit includes at least one cutting insert having a first plate receivable in the vertical resection channel and changing the first width of the resection channel to a second width smaller than the first width. A plurality of cutting inserts having different widths can be included in the surgical kit.

[0005] The present teachings also provide various methods for unicompartmental knee arthroplasty. In one embodiment, the method includes mounting a patient-specific tibial guide on a tibial bone, and nestingly mating and registering a patient-specific inner surface of the tibial guide onto a corresponding anterior surface of the tibial bone and a corresponding proximal surface of a proximal plateau of the tibial bone. A vertical tibial resection of the proximal plateau can be made through a vertical resection channel of the tibial guide. The vertical resection channel has variable width along an anatomic plane of the patient.

[0006] In another embodiment, the method includes mounting a patient-specific tibial guide on a tibial bone and selecting one of a plurality of cutting inserts having different widths. A plate extending from the cutting insert is inserted into a vertical resection channel and changes the width of the vertical resection channel to a reduced width. A vertical tibial resection of the proximal plateau can be made through the reduced width.

[0007] In another embodiment, the method includes mounting a patient-specific femoral guide on a femoral bone and coupling a tibial sizing gauge to a distal opening of a guiding formation of the femoral guide. The tibial gap is measured using the tibial sizing gauge and a tibial resection block is coupled to the tibial sizing gauge. A vertical resection of the tibia is made at a distance determined by the tibial sizing gauge.

[0008] Further areas of applicability will become apparent from the description provided herein. The description and specific examples in this summary are intended for purposes of illustration only and are not intended to limit the scope of the present disclosure.

DRAWINGS

[0009] The drawings described herein are for illustrative purposes only of selected embodiments and not all possible implementations, and are not intended to limit the scope of the present disclosure.

[0010] FIG. 1 is a perspective view of a patient-specific tibial guide according to the present teachings and showing a coronal view of a cutting guide;

[0011] FIG. 1A is a perspective view of another patient-specific tibial guide according to the present teachings and showing a coronal view of a cutting guide;

[0012] FIG. 2 is a perspective axial view of another patient-specific tibial guide according to the present teachings and showing an axial view of a cutting guide;

[0013] FIG. 2A is a detail of a vertical resection guiding surface of a patient-specific tibial guide according to the present teachings;

[0014] FIG. 3 is an environmental perspective view of the patient-specific tibial guide of FIG. 1;

[0015] FIG. 4 is a perspective view of a patient-specific tibial guide according to the present teachings;

[0016] FIGS. 5-7 are various perspective views of a patient-specific femoral guide in use with a tibial gauge according to the present teachings;

[0017] FIG. 8 is an environmental view of the patient-specific femoral guide and tibial gauge of FIG. 7 shown in use with a tibial block;

[0018] FIG. 9 is a perspective view of an instrument assembly showing the coupling of the tibial gauge to the tibial block of FIG. 8;

[0019] FIG. 10 is a perspective view of the patient-specific femoral guide of FIG. 5 shown with a femoral drill template; and

[0020] FIG. 11 is a perspective view of an exemplary unicompartmental knee replacement implant assembly.

[0021] Corresponding reference numerals indicate corresponding parts throughout the several views of the drawings.

DETAILED DESCRIPTION

[0022] Example embodiments will now be described more fully with reference to the accompanying drawings. Example embodiments are provided so that this disclosure will be thorough, and will fully convey the scope to those who are skilled in the art. Numerous specific details are set forth such as examples of specific components, devices, and methods, to provide a thorough understanding of embodiments of the present disclosure. It will be apparent to those skilled in the art that specific details need not be employed, that example

embodiments may be embodied in many different forms and that neither should be construed to limit the scope of the disclosure. In some example embodiments, well-known processes, well-known device structures, and well-known technologies are not described in detail.

[0023] The present teachings provide various patient-specific guides and associated instruments for partial or unicompartmental knee arthroplasty. Various patient-specific femoral and tibial alignment guides, drill templates, cutting inserts and associated instruments are provided. The patient-specific guides are designed and constructed preoperatively based on three-dimensional digital images of the patient's knee joint and/or other joints. The digital images of the patient's joint can be reconstructed from medical scans of the patient using commercially available CAD and/or other imaging software.

[0024] In the context of the present teachings, patient-specific guides, including alignment and/or resection guides are generally configured to match the anatomy of a specific patient in one or more respects. Each patient-specific guide has a patient-specific anatomy-engaging surface that is configured as a mirror or negative or complementary surface that can conformingly contact and match a corresponding bone surface of the patient (with or without cartilage or other soft tissue).

[0025] In this respect, the patient-specific guide can nestingly mate and register in only one position with the corresponding joint surface (with or without articular cartilage) of the specific patient replicating complementarily at least a portion of the joint surface. A patient-specific alignment guide can include custom-made (patient-specific) guiding formations, such as, for example, guiding holes for sutures or K-wires or for inserting pins or other fasteners in configurations determined by a surgeon-approved pre-operative plan. In some embodiments, patient-specific alignment guides can also be configured as patient-specific resection guides and include patient-specific cutting guides, such as cutting slots, edges or other guiding formations for guiding a cutting tool to perform preoperatively planned resections of the joint.

[0026] The patient-specific guides can be designed preoperatively using computer-assisted image methods based on three-dimensional images of the patient's knee anatomy reconstructed from MRI, CT, ultrasound, X-ray, or

other three- or two-dimensional medical scans of the patient's anatomy and in some cases complemented with digital photography methods and/or anthropometry databases. Various CAD programs and/or software can be utilized for three-dimensional image reconstruction, such as software commercially available, for example, by Materialise US, Plymouth, Michigan.

[0027] In the preoperative planning stage for arthroplasty, imaging data of the relevant anatomy of a patient can be obtained at a medical facility or doctor's office, using one or more of medical imaging methods described above. The imaging data can include various medical scans of a relevant portion of the patient's anatomy, as needed for joint modeling. For knee joint arthroplasty, images of all the knee joint and, optionally, images of the femoral head or hip joint and ankle joint for mechanical axis determination can be taken. An initial preoperative plan can be prepared for the patient in image space and can include planning and determination for joint resections, custom implant design or non-custom implant selection, sizing and fitting and designing patient-specific alignment and/or resection guides and other instruments for guiding the joint resections, drilling holes for locating pins or other fasteners and for other guidance during the surgical procedure.

[0028] Various patient-specific instruments and pre-operative planning procedures are disclosed in commonly assigned and co-pending U.S. Patent Application No. 11/756057, filed on May 31, 2007, now U.S. Patent Publication No. 2007/0288030; U.S. Patent Application No. 12/211407, filed September 16, 2008, now U.S. Patent Publication No. 2009/0024131; U.S. Patent Application No. 11/971390, filed on January 9, 2008, now U.S. Patent Publication No. 2008/0312659; U.S. Patent Application No. 11/363548, filed on February 27, 2006, now U.S. Patent No. 7,780,672; U.S. Patent Application No 12/025414, filed February 4, 2008, now U.S. Patent Publication No. 2008/0114370; U.S. Patent Application No 12/571969, filed October 1, 2009, now U.S. Patent Publication No. 2010/0087829 and U.S. Patent Application No 12/955361, filed November 29, 2010, now U.S. Patent Publication No. 2011/0071533. The disclosures of the above applications are incorporated herein by reference.

[0029] The patient-specific guides of the present teachings can be made of any biocompatible material, including metal or plastic. Generally, the

patient-specific alignment and/or resection guides can be single use, disposable instruments made of lightweight materials, including polymers. The patient-specific guides can be manufactured by machining or by various stereolithography methods, selective laser sintering, fused deposition modeling or other rapid prototyping methods. In some embodiments, computer instructions of tool paths for machining the patient-specific guides can be generated and stored in a tool path data file. The tool path data can be provided as input to a CNC mill or other automated machining system.

[0030] Briefly, various embodiments of patient-specific tibial guides 100 for unicompartmental (unilateral or partial) knee arthroplasty for the left or the right knee are illustrated in FIGS. 1-3. FIG. 4 illustrates another embodiment of a patient-specific tibial guide 100 used in combination with a cutting insert 200. FIGS. 5-9 illustrate a patient-specific femoral alignment guide 300 and associated instruments for use in knee arthroplasty, including a tibial sizing gauge 400 and a tibial clamp or tibial connector 600 for coupling the tibial sizing gauge 400 to a tibial resection guide or block 700 (FIGS. 8 and 9). A femoral drill template 350 for use with the patient-specific femoral alignment guide 300 is shown in FIG. 10. FIG. 11 illustrates an implant assembly 500 for partial knee arthroplasty. It should be noted that although unicompartmental knee arthroplasty using the devices of the present teachings can be performed on either the lateral or medial compartments of the knee, current surgical practice may be restricted to the medial compartment of the knee.

[0031] Referring to FIGS. 1-4, various tibial guides 100 for partial knee arthroplasty are illustrated. The tibial guide 100 includes a patient-specific body 102 having a patient-specific undersurface or inner surface 104 designed during the preoperative plan to conform unilaterally to proximal and anterior portions of a tibial bone 70 (either with or without articular cartilage) of the patient in only one position, as shown in FIG. 3. The patient-specific body 102 includes a proximal portion 106 engageable with a surface of a proximal plateau 72 of the tibial bone 70 and an anterior portion 108 engageable with an anterior surface 74 of the tibial bone 70. The patient-specific body 102 can include a window 103 in the form of an elongated slot. The tibial guide 100 is illustrated on a medial side of the right knee in the embodiment of FIG. 3.

[0032] With continued reference to FIGS. 1-4, the tibial guide 100 includes a drill/resection block 110 coupled to the patient-specific body 102 and having a drill guide portion 120 and a resection guide portion 130. The drill guide portion 120 can be unitarily (monolithically) attached to the patient-specific body 102 and formed as one piece. The drill guide portion 120 can include first and second registration formations in the form of tapered or cylindrical bores 124 for registration with a tibial drill insert (not shown, but described in Provisional Application No. 61/496177, filed June 13, 2011, which is incorporated herein by reference). The drill guide portion 120 can also include a cylindrical clearance bore or hole 126 configured to receive and provide clearance for a corresponding cylindrical tubular of a tibial drill template.

[0033] With continued reference to FIGS. 1-4, the resection guide portion 130 of the tibial guide 100 includes a vertical resection channel 136 for guiding directly or indirectly a vertical resection, i.e., a resection parallel to the direction of gravity when the tibial guide 100 is mounted on the patient's tibial bone. The vertical resection can be on a sagittal plane. The vertical resection channel 136 can terminate at a safety hole 138 that provides a safety stop for the vertical resection. Specifically, a stop pin (not shown) can be inserted into the safety hole 138 to limit the depth of the vertical resection and prevent over-resection through the vertical resection channel 136.

[0034] Different types of guiding formations for the vertical resection are illustrated in FIGS. 1-4, corresponding to different embodiments of the guidance provided by the vertical resection channel 136. Referring to FIG. 1, for example, the vertical resection channel 136 can be formed between first and second flanges 132, 134 that extend from the resection guide portion 130 of the partial tibial guide 100. The first and second flanges 132, 134 have opposing inner surfaces 142, 144 that are curved and form a variable coronal width "w" for the vertical resection channel 136, as viewed in a coronal plane. As shown in FIG. 1, the inner surfaces 142, 144 are concave toward one another such that the vertical resection channel 136 has a coronal width w (as viewed in a coronal plane) that decreases from the entrance 131 of the vertical resection channel 136 toward the safety hole 138. In some embodiments, the width w may reach a minimum and then increase somewhat before merging into the safety hole 138.

In this respect, a cutting tool, such as a blade or saw, can be easily inserted through the wider entrance 131 and guided between the narrowing convex surfaces 142, 144 of the vertical resection channel 136. A side window 105 communicating with the vertical resection channel 136 may also be provided on the resection guide portion 130 for visualization and/or tissue/debris clearance.

[0035] Referring to FIG. 1A, in another embodiment, the vertical resection channel 136 may be formed between pluralities of opposite convex surfaces 145, 147, as viewed in a coronal plane. In this respect, the coronal width w of the vertical resection channel 136 can increase and decrease repeatedly in an alternating manner from the entrance 131 to the safety hole 138. Accordingly, the resection channel-facing surface of each flange 132, 134 can be piecewise convex.

[0036] Referring to FIG. 2, in another embodiment, the vertical resection channel 136 may be formed between pluralities of opposite convex surfaces 149, as viewed in an axial plane. In this respect, the axial width w' of the vertical resection channel 136 can increase and decrease repeatedly in an alternating manner in the sagittal direction as viewed in an axial plane. In some embodiments, the alternatingly (in an alternating manner) variable axial width w' of FIG. 2 can be integrated with the alternatingly variable coronal width w shown in FIG. 1A producing a plurality of curved surfaces 141 arranged as cells of a two-dimensional array, as shown in FIG. 2A.

[0037] The alternatingly variable coronal and/or axial widths w, w' can provide a tactile feedback to the surgeon during the vertical resection of the tibia, reduce binding of the cutting tool and reduce heat generation during cutting. Additionally, the alternatingly variable coronal and/or axial widths w, w' allow for tighter tolerances for guiding the cutting tool.

[0038] Referring to FIG. 4, in another embodiment, the vertical resection channel 136 can have a constant width "D" in the coronal and axial plane, formed between first and second opposing planar surfaces 152, 154 of the corresponding first and second flanges 132, 134. The width D can be selectively changed to a different and reduced (smaller) width "d" by using one or more removable cutting inserts 200. Each cutting insert 200 can have a U-shape and include an open channel 206 formed between first and second plates

210, 212 of the cutting insert 200. The first plate 210 can have a lesser thickness or width than the second plate 212 for reducing space requirements when placed outside the vertical resection channel 136 of the patient-specific tibial guide 100. The open channel 206 can receive at least a portion of either the first or the second flange 132, 134 and supported thereon. In the exemplary illustration of FIG. 4, the cutting insert 200 is shown mounted on the first flange 132. Each cutting insert 200 can have a different thickness "t" between first and second outer planar surfaces 202, 204. The distance between the second surface 204 of the cutting insert 200 and the planar surface 154 of the second flange 134 determines the reduced width d of the vertical resection channel 136. Similar considerations apply when the cutting insert 200 is mounted on the second flange 134. In some embodiments, a plurality of cutting inserts 200 having different thicknesses can be provided in a patient-specific kit that also includes the patient-specific tibial guide 100. The surgeon can trial and select intraoperatively a particular cutting insert 200 that can provide a surgeon-selected width d for guiding the vertical resection when combined with the patient-specific tibial guide 100. The cutting inserts 200 can be made of any biocompatible materials, including plastic materials and metals. Metal cutting inserts 200 may be selected for additional rigidity.

[0039] Referring to FIGS. 5-8 and 10, an exemplary partial femoral alignment guide 300 is integrated with a tibial sizing gauge 400 for guiding minimally invasive partial knee arthroplasty (PKA) and determining the tibial gap according to the present teachings. The partial femoral alignment guide 300 is patient-specific and includes a body 302 with a three-dimensional patient-specific undersurface or inner surface 304 designed during the preoperative plan to conform unilaterally, i.e., to only one of the medial and lateral surfaces/femoral condyles 82, 84 of the femoral bone 80 (either with or without articular cartilage) of the patient in only one position, as shown in FIG. 5. The body 302 and the inner surface 304 can extend from a distal portion 312 over one of the lateral or medial femoral condyles to an anterior portion 314. The femoral alignment guide 300 can also include an elongated viewing window 318.

[0040] With continued reference to FIGS. 5-10, an elongated guiding formation 308 can extend generally from the distal portion 312 of the body 302.

The guiding formation 308 defines an elongated slot 306 with a tapered inner peripheral wall 310 for registering a femoral drill insert or template 350, as shown in FIG. 10. The femoral drill template 350 can be in the form of an insert with an outer tapered peripheral wall 322 that can mate with the inner tapered peripheral wall 310 of the elongated slot 306 for registering to the partial femoral alignment guide 300. The femoral drill template 350 can include a number of guiding holes 354 of different sizes (diameters) and spacing at a patient-specific location and configuration relative to the femoral alignment guide 300. A plurality of femoral drill templates 350 with guiding holes 354 of different sizes and spacing can be provided, as described in Provisional Application No. 61/496177, filed June 13, 2011 and incorporated herein by reference. Depending on the procedure, the surgeon can determine intraoperatively which femoral drill template 350 to use and where to drill corresponding holes in the bone for locating and supporting a femoral resection block.

[0041] Referring to FIG. 10, the femoral drill template 350 can include a block portion 356 having an engagement feature, such as one or two outer slots 328 on opposite sides of the block portion 356, for coupling with a femoral alignment verification instrument (not shown). Intraoperatively, the surgeon can mount the partial femoral alignment guide 300 on the specified knee and condyle of the patient in a unique position based on the preoperative plan for the patient. The femoral drill template 350 can be fitted over the elongated slot 306, and holes for guiding pins can be drilled into the femoral bone 80. A resection block can be positioned over the pins for performing various femoral resections. The surgical technique can then follow standard procedures, such as, for example, the surgical technique associated with the Oxford® Partial Knee, which is commercially available by Biomet Manufacturing Corp., Warsaw, Indiana.

[0042] Referring to FIGS. 5-9, the guiding formation 308 can have a profile of an open channel or a U-shape with a distal opening 320 through the wall 310. The distal opening 320 is configured to receive and engage an extension 410 of the tibial sizing gauge 400. The tibial sizing gauge 400 includes a curved portion 402 with a femoral condyle-engaging surface 404 and an elongated portion 406 that can be coupled to a tibial resection block 700 while connected to the femoral alignment guide 300, as shown in FIGS. 8 and 9. A

plurality of tibial sizing gauges 400 having curved portions 402 with different thicknesses for determining the tibial gap can be provided. A tibial sizing gauge 400 with a thickness of 1mm, for example, can be first inserted into the femoral alignment guide 300 and then followed successively by tibial sizing gauges 400 of 2mm and 3mm, if the knee joint tissues and ligaments are too lax. In some embodiments, the femoral condyle-engaging surface 404 can be patient-specific and designed during the pre-operative plan of the patient to mate as a mirror or negative surface of the femoral condyle of the patient.

[0043] Referring to FIGS. 8 and 9, after a particular tibial sizing gauge 400 is selected for keeping the knee tissues appropriately tensioned, the tibial sizing gauge 400 is coupled to the femoral alignment guide 300 and to a tibial resection block 700 using a clamp or other connector 600. The connector 600 includes a block element 610 and a cam device 620 with a handle 630. The tibial sizing gauge 400 is coupled to the connector 600 using a set screw or other locking element 614 that can pass through an end aperture 709 and be moved along an elongated slot 408 of the elongated portion 406 of the sizing gauge 400. The locking element 614 secures the tibial sizing gauge 400 against the block element 610 of the connector 600. The block element 610 has a U-shaped opening 612 that receives a first arm 622 of the cam device 620 of the connector 600. The tibial resection block 700 can be received in an opening 626 formed between a surface 618 of the block element 610 and a second arm 624 of the cam device 620 and positioned such that a shaft 710 of the tibial resection block 700 is parallel to the long axis of the tibia 70. The tibial resection block 700 can be secured with one or more pins or fasteners 711 passing through corresponding apertures 703 of the tibial resection block 700.

[0044] With continued reference to FIGS. 8 and 9, after the tibial resection block 700 is secured on the tibia 70, a vertical tibial cut can be made using the tibial resection block 700 at a location determined by the position of the tibial sizing gauge 400 relative to the femoral alignment guide 300. In some embodiments, the vertical tibial cut can be guided by a vertical surface 611 of the block element 610. The position of the vertical surface 611 can be predetermined by configuring the coupling of the tibial sizing gauge 400 to the block element 610 such that the vertical surface 611 is at a preoperatively

determined location on the knee joint for the specific patient when the tibial sizing gauge is attached to the femoral alignment guide 300. In other embodiments, an indicator of predetermined length can be attached to the tibial sizing gauge 400. The indicator can be used to guide a cutting blade or, alternatively, mark the location of the vertical cut on the tibial resection block 700. In some embodiments, the indicator can be a focused light beam or a laser that can project a guiding line of light on the tibia and/or the tibial resection block 700.

[0045] The connector 600 and the tibial sizing gauge 400 can be removed after the vertical tibial cut is made. The femoral drill template 350 can then be inserted into the elongated slot 306 of the femoral alignment guide 300 and locating holes can be drilled into the femoral bone 80 through the guiding holes 354 of the femoral drill template 400. The femoral alignment guide 300 and femoral drill template 350 can then be removed. A horizontal tibial plateau resection can be made using the tibial resection block 700, and the tibial resection block removed. A femoral resection block can be mounted on the femoral bone 80 using the locating holes drilled through the femoral drill template, as described in U.S. Patent Application No. 13/097,145, filed April 29, 2011, which is incorporated herein by reference.

[0046] Summarizing, the present teachings provide various patient-specific unicompartmental alignment and resection guides, drill templates, drill inserts and other instruments for partial knee arthroplasty including the femoral and tibial bones. Further, the instruments provided can be used to perform first a vertical resection of the proximal medial tibial plateau followed by a horizontal resection to remove the proximal medial tibial plateau in preparation of a unicompartmental tibial implant. Surgical kits including various combinations of patient-specific unicompartmental alignment and resections guides, femoral drill templates, tibial sizing gauges, non-custom resection blocks and corresponding custom or non-custom implants can be prepared for a specific patient and surgeon. Non-custom unicompartmental or partial knee implants are, for example, commercially available from Biomet Manufacturing Corp., Warsaw, Indiana. An exemplary unicompartmental implant assembly 500 is illustrated in FIG. 11. The unicompartmental implant assembly 500 includes a femoral

component 510, a tibial component 520 and a meniscal bearing 530 with corresponding articulating surfaces 516, 522 and 532. The femoral implant 510 can include fixation stems or pegs 512, 524. Similarly, the tibial implant can include a fixation keel 524.

[0047] The foregoing description of the embodiments has been provided for purposes of illustration and description. It is not intended to be exhaustive or to limit the disclosure. Individual elements or features of a particular embodiment are generally not limited to that particular embodiment, but, where applicable, are interchangeable and can be used in a selected embodiment, even if not specifically shown or described. The same may also be varied in many ways. Such variations are not to be regarded as a departure from the disclosure, and all such modifications are intended to be included within the scope of the disclosure.

CLAIMS

What is claimed is:

1. A surgical kit for unicompartmental knee arthroplasty comprising:

a patient-specific unicompartmental tibial guide having a patient-specific body with an inner surface preoperatively configured to nestingly conform and mate in only one position with an anterior portion and a proximal portion of a tibial bone of a specific patient, the tibial guide including a vertical resection channel having a variable width preoperatively configured for guiding a vertical resection through the proximal portion of the tibial bone.

2. The surgical kit of claim 1, wherein the variable width varies in a coronal plane relative to the patient.

3. The surgical kit of claim 1, wherein the variable width varies in an axial plane relative to the patient.

4. The surgical kit of claim 1, wherein the variable width varies in a coronal plane and in an axial plane relative to the patient.

5. The surgical kit of claim 1, wherein the vertical resection channel is formed between first and second curved surfaces of corresponding first and second flanges of the tibial guide.

6. The surgical kit of claim 5, wherein the first and second curved surfaces are convex towards one another.

7. The surgical kit of claim 6, wherein the first and second curved surfaces are piecewise convex in a coronal plane relative to the patient.

8. The surgical kit of claim 6, wherein the first and second curved surfaces are piecewise convex in an axial plane relative to the patient.

9. The surgical kit of claim 6, wherein the first and second curved surfaces are piecewise convex in coronal and axial planes relative to the patient.

10. The surgical kit of claim 1, wherein the tibial guide includes a drill guide portion preoperatively configured for drilling first and second anterior holes into the tibial bone for guiding a horizontal tibial resection.

11. The surgical kit of claim 10, wherein the drill guide portion is unitarily attached to the patient-specific body.

12. The surgical kit of claim 1, wherein the vertical resection channel ends in a safety hole formed between first and second resection flanges, the safety hole configured to receive a stop pin limiting a depth of the vertical resection.

13. The surgical kit of claim 1, further comprising a unitary patient-specific unicompartmental femoral guide having a patient-specific body with an inner surface preoperatively configured to nestingly conform and mate in only one position with an anterior portion and a distal portion of a distal femoral bone of a specific patient, the femoral guide including an elongated slot with a tapered inner wall.

14. The surgical kit of claim 13, further comprising a femoral drill template having a tapered outer portion configured to be received in the elongated slot and first and second guiding holes configured for drilling holes into the femoral bone to support a resection block.

15. The surgical kit of claim 1, further comprising a knee implant assembly for partial knee arthroplasty.

16. A surgical kit for unicompartmental knee arthroplasty comprising:

a patient-specific unicompartmental tibial guide having a patient-specific body with an inner surface preoperatively configured to nestingly

conform and mate in only one position with an anterior portion and a proximal portion of a tibial bone of a specific patient, the tibial guide including a vertical resection channel having a first width formed between first and second flanges of the tibial guide; and

a cutting insert having a first plate receivable in the vertical resection channel and changing the first width of the resection channel to a second width smaller than the first width.

17. The surgical kit of claim 17, wherein the cutting insert includes an open channel formed between the first plate and a second plate.

18. The surgical kit of claim 17, wherein the first and second plates have different thicknesses.

19. The surgical kit of claim 16, further comprising additional cutting inserts configured for changing the first width of the resection channel to corresponding and different widths.

20. The surgical kit of claim 16, wherein the tibial guide includes a drill guide portion preoperatively configured for drilling first and second anterior holes into the tibial bone for guiding a horizontal tibial resection.

21. A method for unicompartmental knee arthroplasty comprising:

mounting a patient-specific tibial guide on a tibial bone;

nestingly mating and registering a patient-specific inner surface of the tibial guide onto a corresponding anterior surface of the tibial bone and a corresponding proximal surface of a proximal plateau of the tibial bone; and

making a vertical tibial resection of the proximal plateau through a vertical resection channel of the tibial guide, the vertical resection channel having variable width along an anatomic plane of the patient.

22. The method of claim 21, wherein the anatomic plane is a coronal plane.

23. The method of claim 21, wherein the anatomic plane is an axial plane.

24. A method for unicompartmental knee arthroplasty comprising:

mounting a patient-specific tibial guide on a tibial bone;

nestingly mating and registering a patient-specific inner surface of the tibial guide onto a corresponding anterior surface of the tibial bone and a corresponding proximal surface of a proximal plateau of the tibial bone;

selecting one of a plurality of cutting inserts having different widths;

inserting a plate extending from the selected cutting insert into a vertical resection channel of the tibial guide;

changing the width of the vertical resection channel to a reduced width; and

making a vertical tibial resection of the proximal plateau through the reduced width.

25. A method for unicompartmental knee arthroplasty comprising:

mounting a patient-specific femoral guide on a femoral bone;

nestingly mating and registering a patient-specific inner surface of the femoral guide onto a corresponding anterior surface and a corresponding distal surface of the femoral bone;

coupling a tibial sizing gauge to a distal opening of a guiding formation of the femoral guide;

measuring a tibial gap;

coupling a tibial resection block to the tibial sizing gauge; and

guiding a vertical resection of the tibia at distance determined by the tibial sizing gauge.

26. The method of claim 25, further comprising:

removing the tibial sizing gauge;

inserting a femoral drill template into the guiding formation of the femoral guide; and

drilling locating holes into the femoral bone through the femoral drill guide.

27. The method of claim 26, further comprising:

guiding a horizontal resection of the tibia using the tibial resection block.

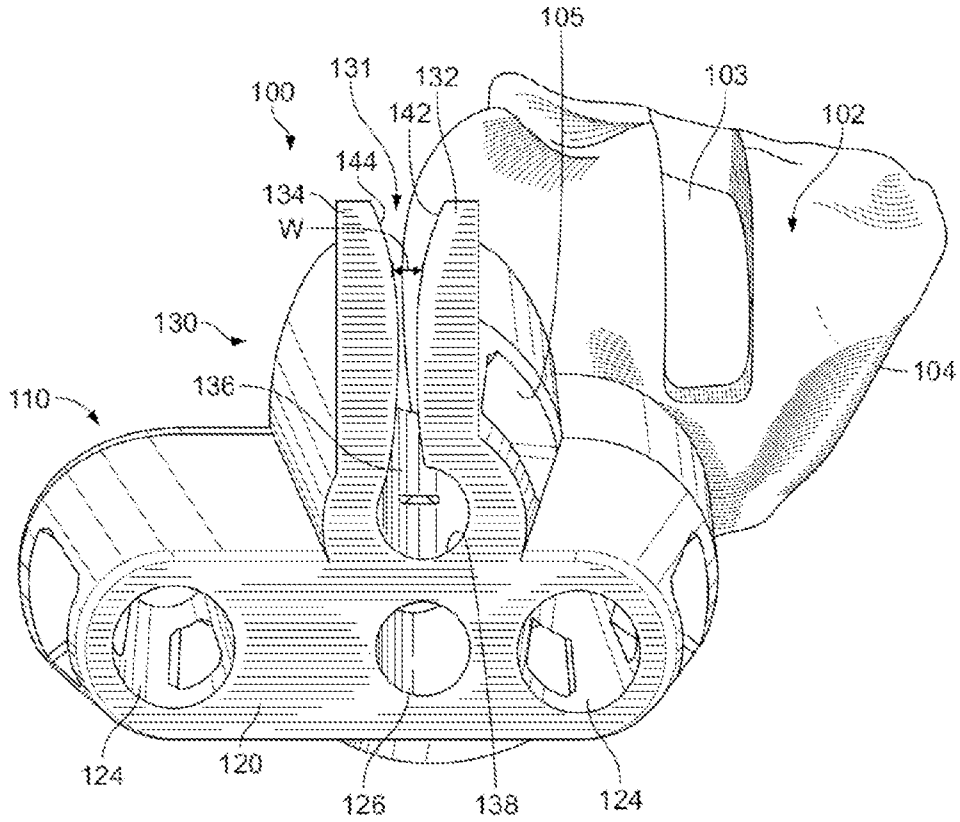
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FIG. 1

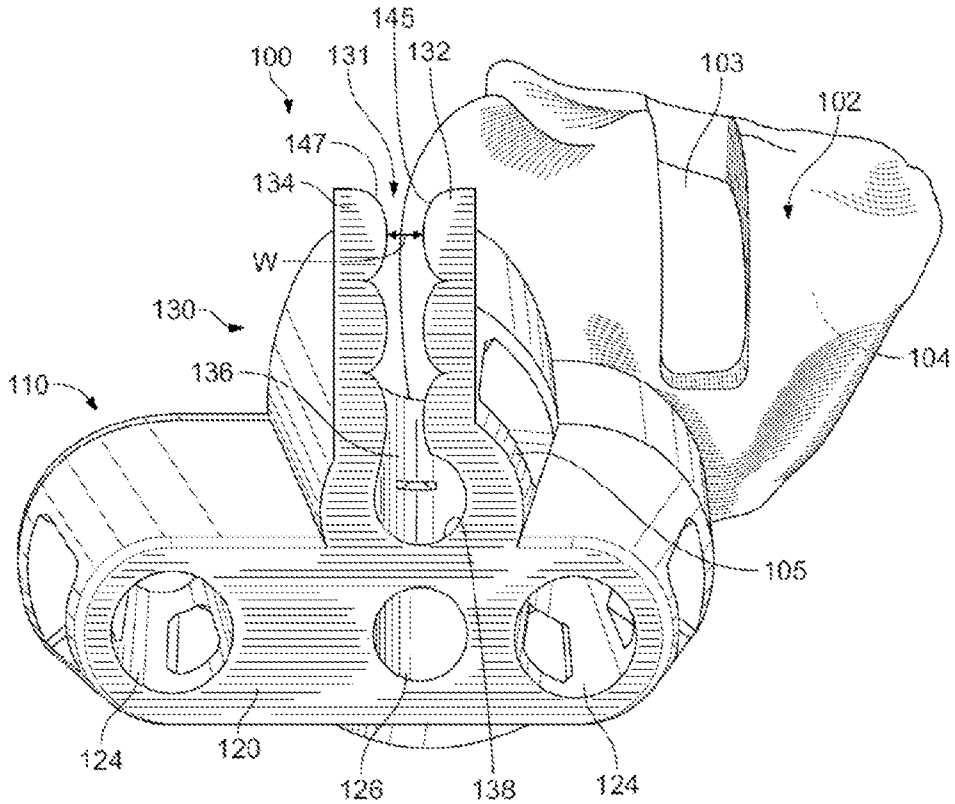
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FIG. 1A

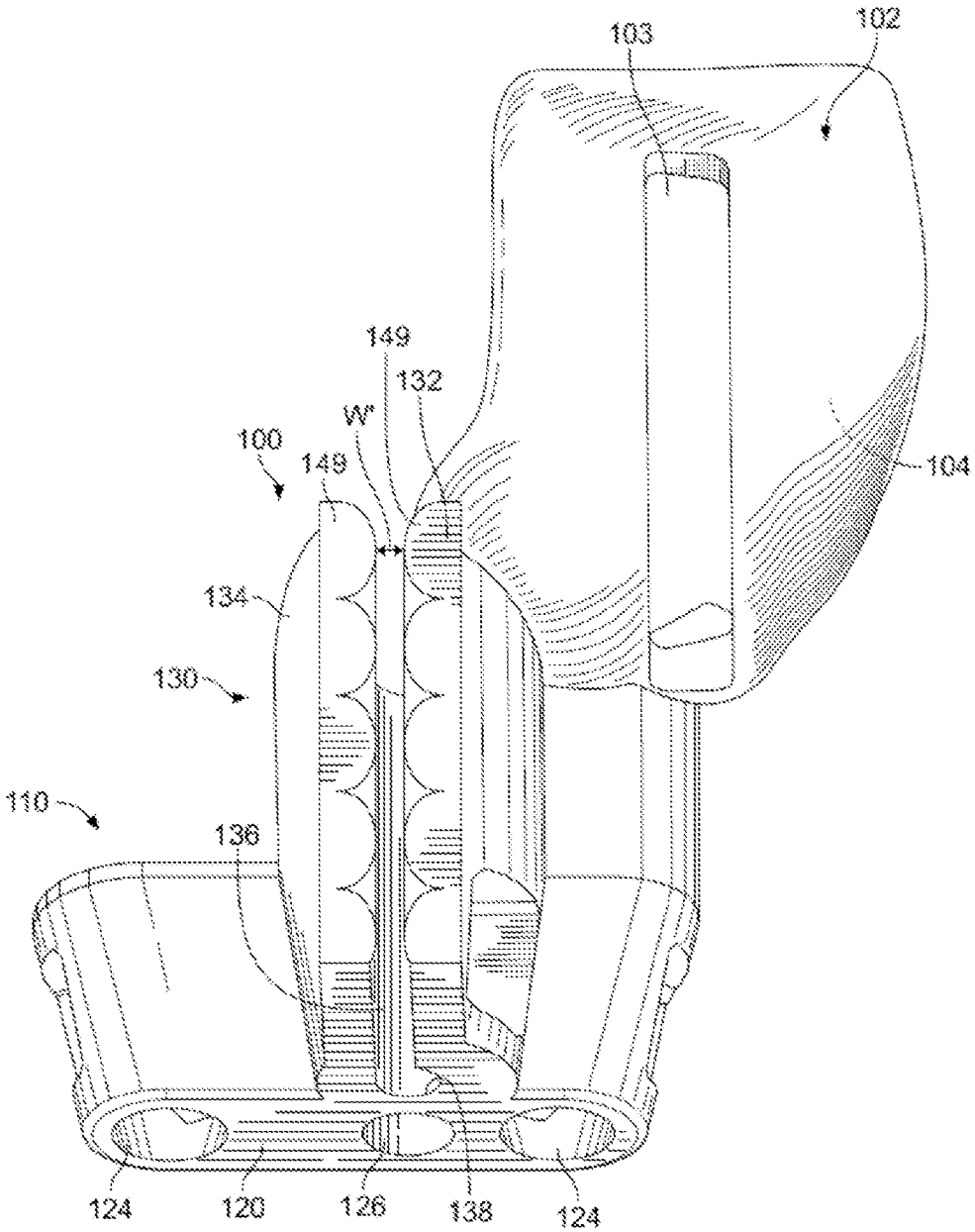

FIG. 2

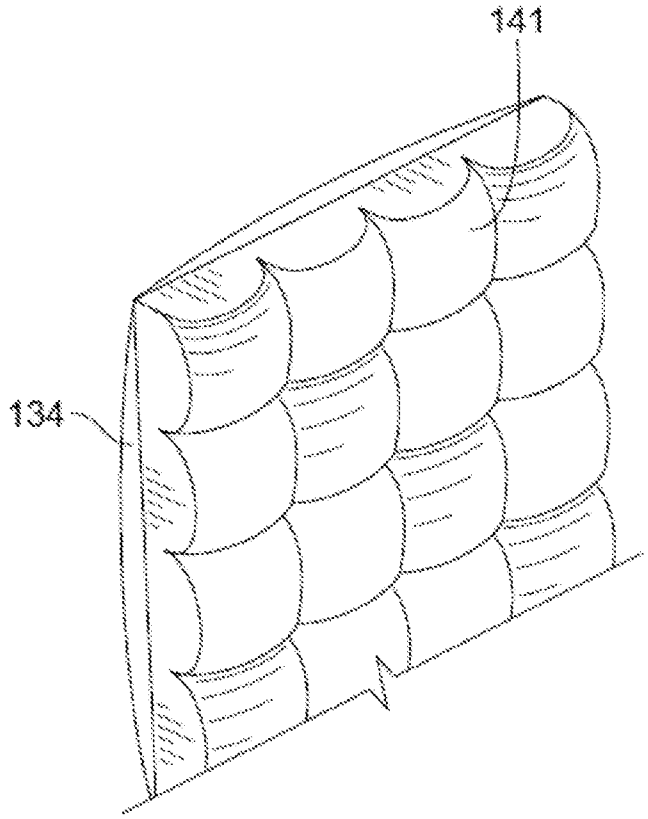

FIG. 2A

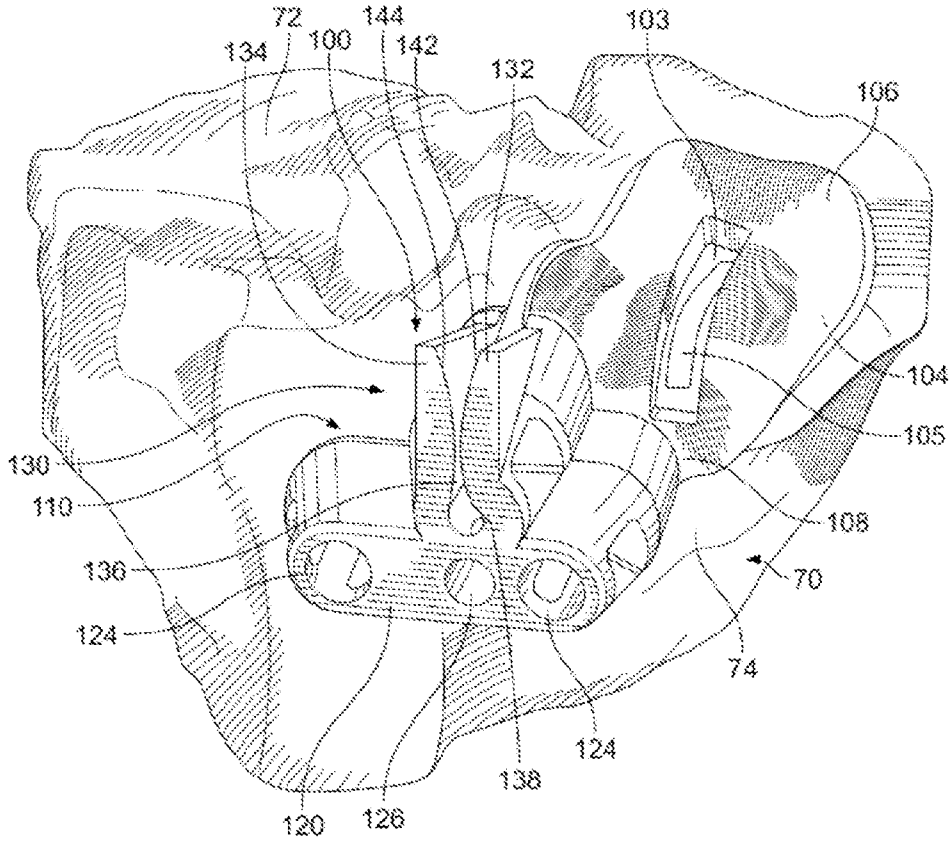
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FIG. 3

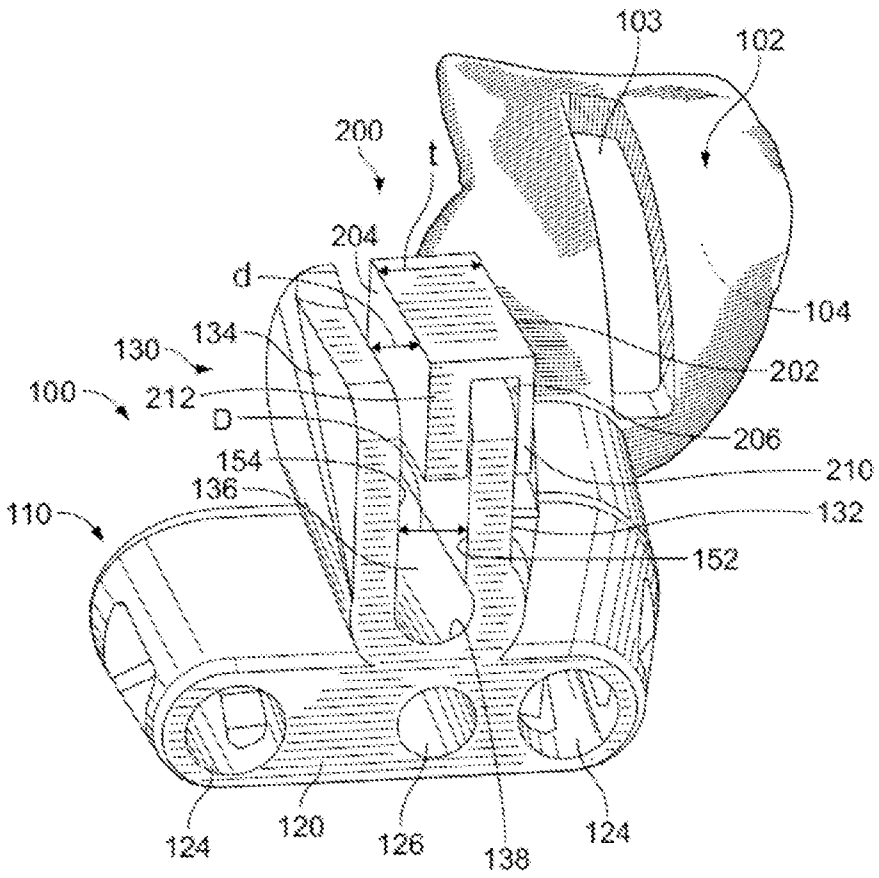
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FIG. 4

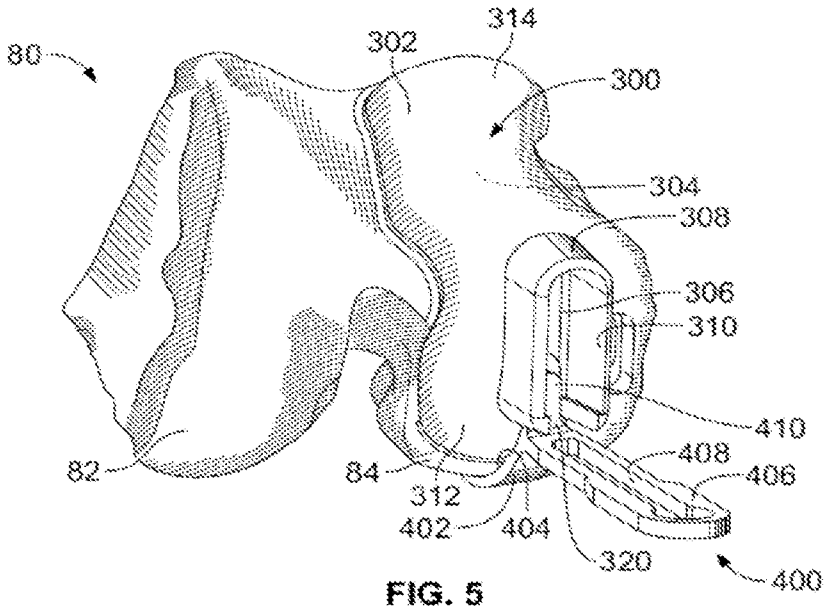
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FIG. 5

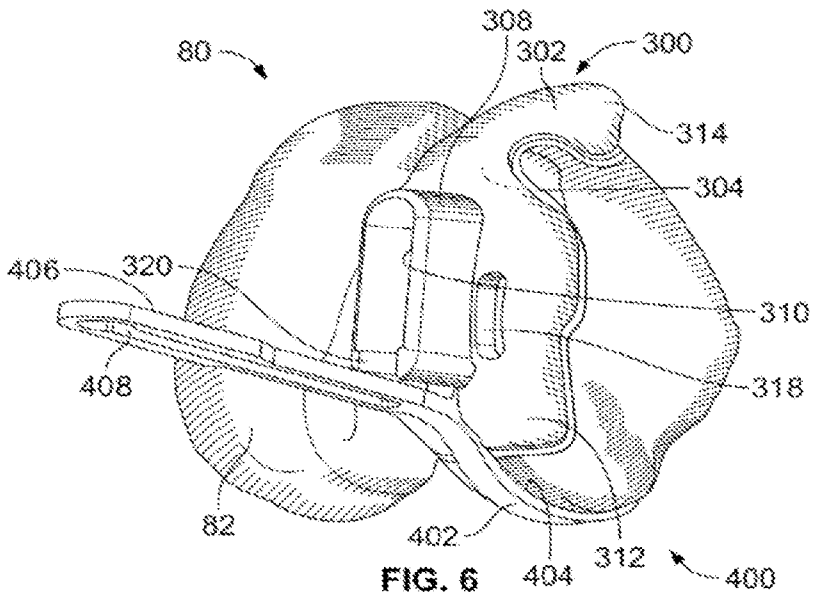
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FIG. 6

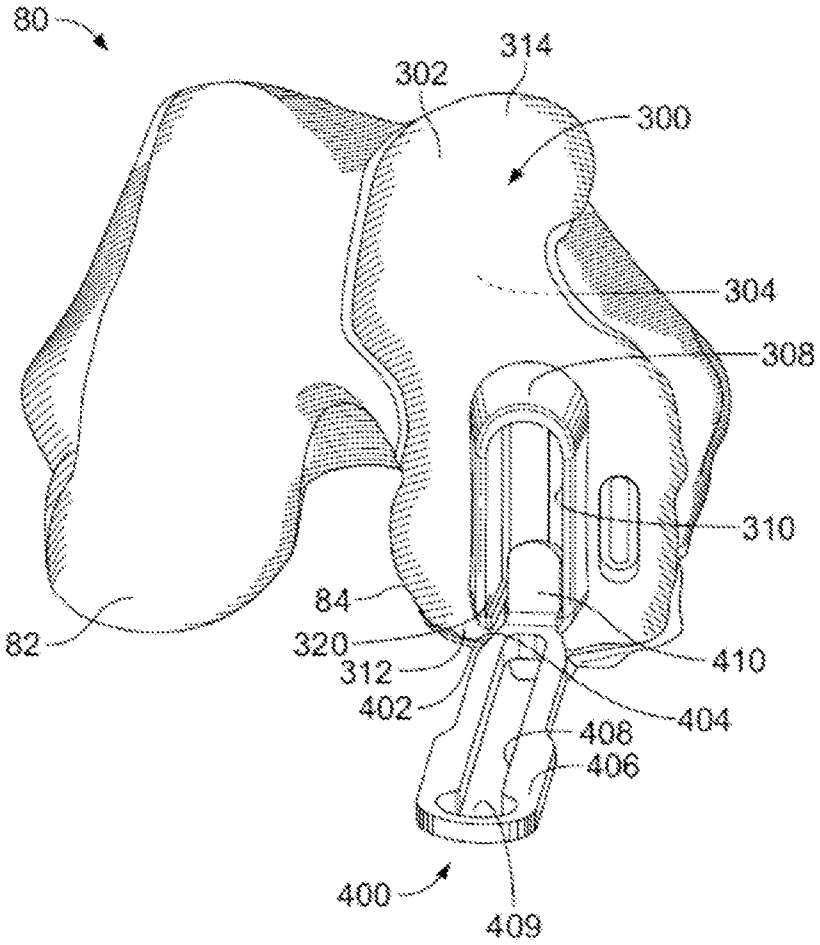
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FIG. 7

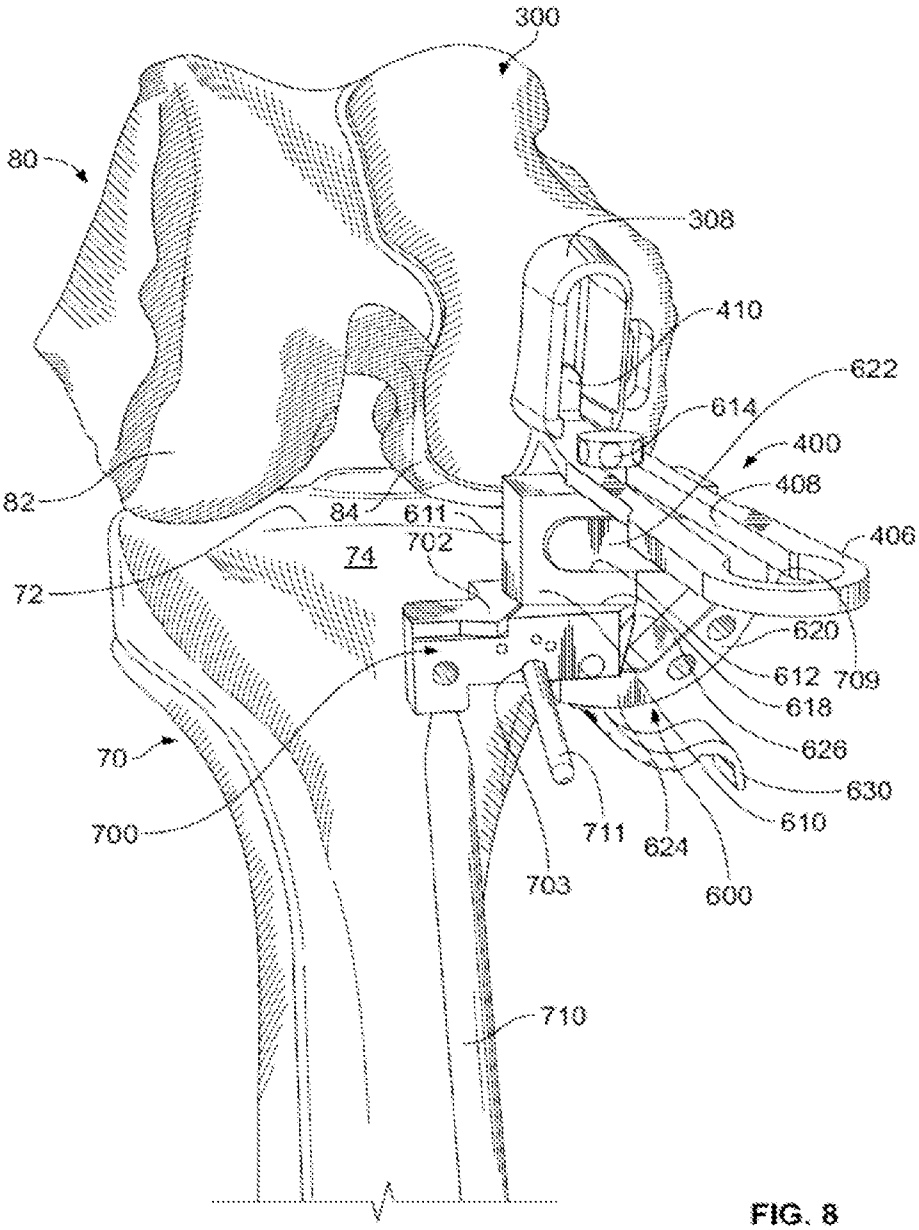
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FIG. 8

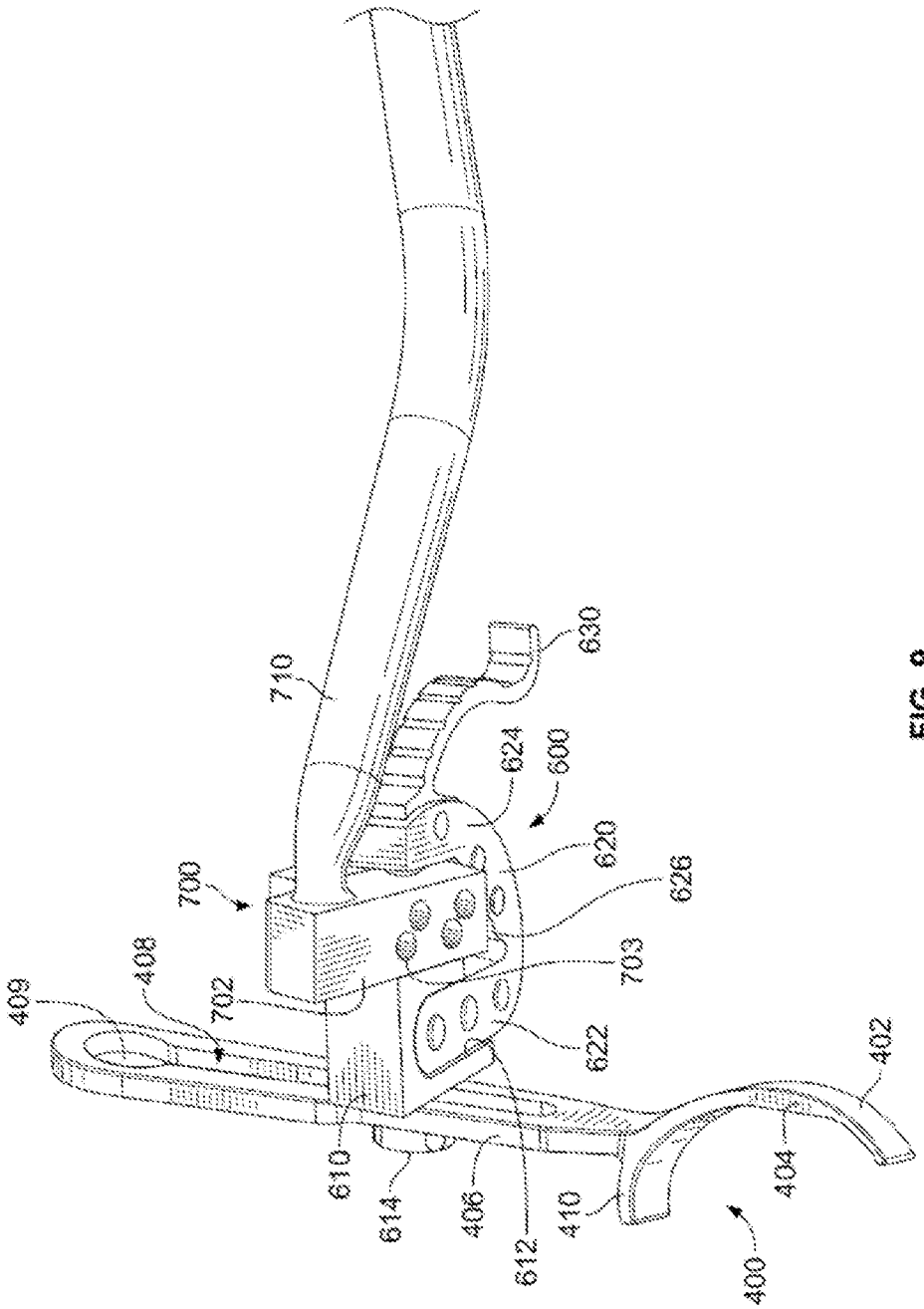
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FIG. 9

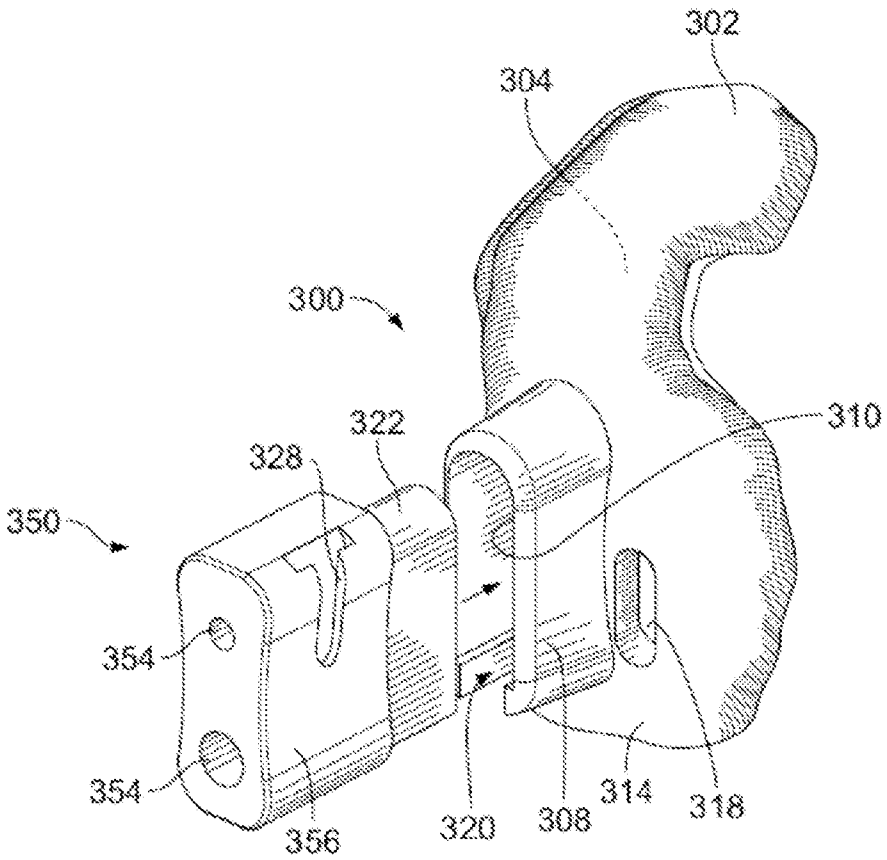

FIG. 10

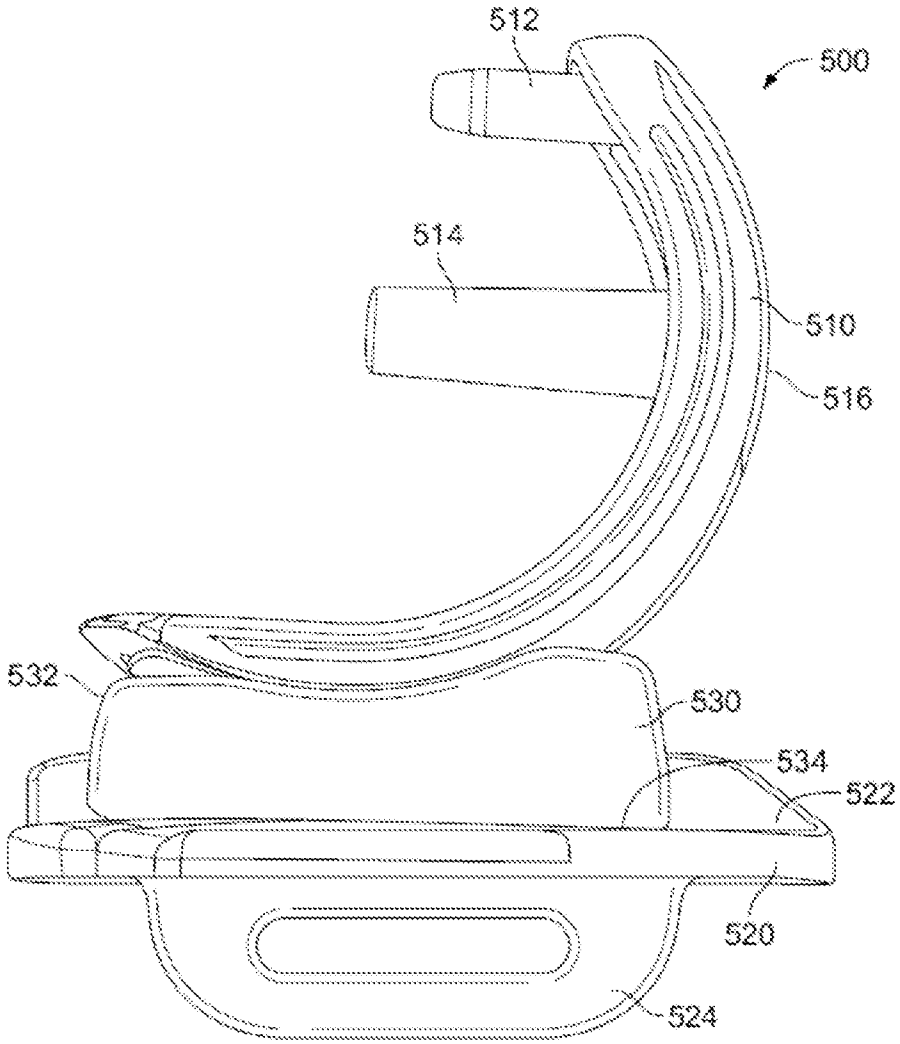

FIG. 11

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2013/057097

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61B17/15 A61B17/17
ADD.

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2 447 702 A (UNIV LEEDS [GB]) 24 September 2008 (2008-09-24) page 27, line 27 - page 29, line 3 figures 4c,4e	1,3,5, 10,11
Y	US 2008/275452 A1 (LANG PHILIPP [US] ET AL) 6 November 2008 (2008-11-06) paragraph [0056] - paragraph [0060] figure 1	1,2,5, 10-12
Y	WO 2008/091358 A1 (SMITH & NEPHEW INC [US]; NADZADI MARK E [US]; SCIFERT CHRIS F [US]; KR) 31 July 2008 (2008-07-31) paragraph [0040] paragraph [0044] - paragraph [0045] paragraph [0049] - paragraph [0051] figures 1,4	1,2,5, 10-12

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"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)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"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

"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

"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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
8 October 2013	14/10/2013

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Storer, John

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Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2013/057097

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2008/015599 A1 (D ALESSIO JERRY [US] ET AL D ALESSIO II JERRY [US] ET AL) 17 January 2008 (2008-01-17) paragraph [0104] - paragraph [0106] figures 48-53 -----	1

2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2013/057097

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. [X] Claims Nos.: 21-27
because they relate to subject matter not required to be searched by this Authority, namely:

Rule 39.1(iv) PCT - Method for treatment of the human or animal body by surgery.

2. [ ] Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. [ ] Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. [ ] As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. [ ] As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. [ ] As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. [ ] No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

[ ] The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

[ ] The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

[ ] No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2013/057097

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