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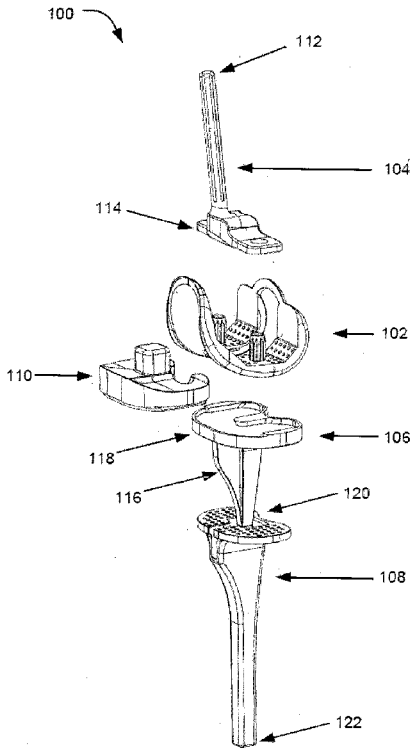
(54) Title: KNEE JOINT PROSTHESIS



(57) Abstract: A knee joint prosthesis (100) is described. In accordance with an implementation, the knee joint prosthesis (100) comprises a femoral component (102), a tibial component (106) interfacing with the femoral component (102) through an insert (110), and a tibial coupling component (108) coupled with the tibial component (106), at a distal end (120) of the tibial component (106), for coupling with a tibial bone. The tibial coupling component (108) comprises a base (602) to support the tibial component (106), and an elongate member (606) coupled to an under-surface (608) of the base (602). The elongate member (606) is coupled to the base (602) through an intermediate portion (614). The intermediate portion (614) has a variable width, about a longitudinal axis of the elongate member (606), for weight distribution and load transfer.

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KNEE JOINT PROSTHESIS

TECHNICAL FIELD

[0001] The present subject matter relates, in general, to orthopedic joint prostheses and, particularly but not exclusively, to knee joint prostheses.

BACKGROUND

[0002] Orthopedic joint prostheses are commonly used to repair and/or replace damaged bone and joints in the human body. One commonly used orthopedic joint replacement is a knee joint prosthesis. Since the knees support nearly the entire upper body weight of human, they are vulnerable to variety of ailments and injuries. Common ailments and injuries include osteoarthritis, rheumatoid arthritis, genetics, degenerative changes of knee joints, avascular necrosis (AVN), and fractures to the knee joints. Knee replacements can be considered to increase the ability of the knees to perform normally and/or to relieve pain.

BRIEF DESCRIPTION OF THE FIGURES

[0003] The detailed description is described with reference to the accompanying figures. The use of the same reference number in different figures indicates similar or identical items. The features, aspects and advantages of the subject matter will be better understood with regard to the following description, and the accompanying drawings.

[0004] Figure 1 illustrates an exploded view showing various components of a knee joint prosthesis, in accordance with an implementation of the present subject matter.

[0005] Figures 2(a), 2(b), and 2(c) illustrate different perspective views of a femoral component, in accordance with an implementation the present subject matter.

[0006] Figures 3(a), 3(b), and 3(c) illustrate different perspective views of a femoral component, in accordance with an implementation of the present subject matter.

[0007] Figures 4(a), 4(b), and 4(c) illustrate different perspective views of a femoral coupling component, in accordance with an implementation of the present subject matter.

[0008] Figures 5(a), 5(b), and 5(c) illustrate different perspective views of a tibial component, in accordance with an implementation of the present subject matter.

[0009] Figures 6(a) and 6(b) illustrate different perspective views of a tibial coupling component, in accordance with an implementation of the present subject matter.

[0010] Figures 7(a), 7(b), and 7(c) illustrate different perspective views of an insert, in accordance with an implementation of the present subject matter.

[0011] Figures 8(a), 8(b), and 8(c) illustrate different perspective views of an insert, in accordance with an implementation of the present subject matter.

[0012] Figures 9(a) and 9(b) illustrate a patellar component for the knee joint prosthesis, in accordance with an implementation of the present subject matter.

DETAILED DESCRIPTION

[0013] A knee joint is similar to a pivotal hinge joint, which permits flexion, extension, and lateral rotation at the joint. Artificial knee joints are designed with the view of their longevity, maintaining natural kinematics of the knee, and providing sufficient flex for the knee.

[0014] A knee joint prosthesis typically includes a femoral component, a tibial component, an insert, and a patellar component. The femoral component is made of metal and fits at a distal part of the femur bone, and the tibial component is also made of metal and fits at a proximal part of the tabia bone in a human body. The distal and proximal parts are referred and referenced with respect to the human body from the top towards the bottom. The tibial component typically has a flat platform onto which the insert fits. The insert may be understood as a plastic spacer positioned between the femoral component and the tibial component. The insert provides a surface against which the femoral component articulates. Further, the patellar component is a dome-shaped piece, typically of polyethylene, that performs the function of a knee cap. The functionalities and performances of these components of the knee joint prosthesis depend upon their design, placements and spatial orientations, both individually and together in combination. An irregular placement, orientation, or fit of one or more components in the patient's anatomy can adversely affect in restoring the functions of the knee joint.

[0015] Further, the components of knee joint prostheses after the knee replacement may wear down with time and age which may affect the functionality and performance of the knee joint and may cause pain at the joint. Also, with the knee replacements, parts of natural bones may deteriorate with time and age. In such cases, revision surgeries are performed to replace dysfunctional components of the joint, or to improve the functionality of the knee joint. Typically, for the revision surgeries, coupling components are additionally used in the knee joint prosthesis. The coupling components are coupled at the femoral and the tibial components, and are inserted in the femur bone and the tibial bone, respectively, for providing the complete knee joint prosthesis.

[0016] Conventional knee joint prostheses with such coupling components, often used in revision surgeries, provide substantially poor weight distribution and load transfer from the femur bone to the tibial bone across the knee joint. This poses problems to the patients with substantially high body weight, and may affect the alignment of the components of the knee joint prostheses with the axis of body weight.

[0017] Conventional knee joint prostheses also pose problems of restricting natural kinematics. The capability of knee to bend with higher degree of flexion, extension, and lateral rotation may get restricted with a typical knee joint prosthesis. Therefore, the patient may find it difficult to perform complete and normal range of movements with conventional knee joint prosthesis.

[0018] Further, conventional knee joint prostheses may be designed in such a way that they may be restricted to group of people from same age group, gender and same ethnic background. Also, a patient who has undergone a knee replacement surgery may take substantial time to recover completely from the surgery. The time taken in mobilizing a knee joint after its replacement with convention prosthesis is substantially high.

[0019] The present subject matter describes a knee joint prosthesis for a knee joint replacement in a human body. The knee joint prosthesis of the present subject matter comprises multiple modular components that can be mechanically coupled together. The configuration, the size and/or the geometry of the modular components of the knee joint prosthesis provide for a substantially improved weight distribution and a substantially smooth transmission of pressure across the knee. The knee joint prosthesis of the present subject matter also has improved natural kinematics and flexion. The improvements in the weight distribution, pressure transfer, kinematics and flexion facilitate in preservation of soft tissues in and around the knee joint of the patient and also in preservation of natural healthy bones.

[0020] The knee joint prosthesis includes a femoral component, a tibial component, and an insert between the femoral and tibial components. In an implementation, the knee joint prosthesis includes a femoral coupling component. The femoral coupling component, at one end, has a coupling element. The coupling element of the femoral coupling component has a dome-shaped profile with legs that couple with the femoral component. Such geometry of the coupling element of the femoral coupling component provides a substantially uniform weight distribution at the knee joint and provides a substantially uniform load transfer from the upper part of the body to the lower part of the body across the knee joint.

[0021] In an implementation, the knee joint prosthesis includes a tibial coupling component. The tibial coupling component has an anatomically-shaped elongate member

which can be inserted and accommodated in the intramedullary canal of a tibial bone. The tibial coupling component also has a base that interfaces with the tibial component. An intermediate portion of the tibial coupling component, which couples the base and the elongate member, has a variable width about a longitudinal axis of the elongate member. In an implementation, the intermediate portion has a contoured outer profile such that its width, about the longitudinal axis of the elongate member, decreases gradually in a direction from the base to the elongate member. In an example, the intermediate portion is configured as butterfly wings integrating with the base and the elongate member. Such geometry of the tibial coupling component provides a substantially uniform weight distribution at the knee joint and provides a substantially uniform load transfer from the upper part of the body to the lower part of the body across the knee joint.

[0022] In an implementation, the elongate member of the tibial coupling component has a cavity at one end. The base of the tibial coupling component has an opening which extends to the cavity. The cavity receives extensions of the tibbial component through the opening in the base. Such configuration provides a modular and a stable coupling between the tibial component and the tibial coupling component, which in turn facilitates in providing a substantially improved load transfer across the knee joint.

[0023] The femoral component has two condyles that articulate with the insert. The two condyles have a substantially constant intercondylar distance between them. The two condyles, from one of their ends and up to a portion, are joined. The two condyles, from the other ends and up to the left over portion, have an opening therebetween. In an implementation, the ends of the two condyles, with the opening, are connected with an intercondylar bridge. The femoral component with the intercondylar bridge can be used in a knee replacement surgery where the natural posterior cruciate ligament (PCL) has to be sacrificed.

[0024] In an implementation, the intercondylar bridge is arc-shaped. The arc is away from the condyles. In said implementation, the insert has a groove configured to accommodate the intercondylar bridge as the femoral components moves over the insert. The arc-shaped intercondylar bridge and the corresponding groove in the insert facilitate in providing substantially improved natural kinematics and substantially higher degree of flexion and rotation to the knee joint prosthesis.

[0025] Further, as the components of the knee joint prosthesis are modular in nature, the components can be coupled with each other with substantial ease. Also, with the modular configuration, the components are not specific to one knee joint prosthesis. The one or more

components are compatible and can be modularly coupled for use with other components across different knee joint prostheses. The modular configuration facilitates in reducing the size of inventory of the components of the knee joint prostheses.

[0026] These and other advantages of the present subject matter would be described in greater details in conjunction with the following figures. It should be noted that the description and figures merely illustrate the principles of the present subject matter.

[0027] For the purposes of the description herein, the words distal and proximal, and the related words, are referred and referenced with respect to the human body from the top towards the bottom.

[0028] Figure 1 illustrates an exploded view of a knee joint prosthesis 100, according to an implementation of the present subject matter. The knee joint prosthesis 100 includes a femoral component 102, a femoral coupling component 104, a tibial component 106, a tibial coupling component 108, and an insert 110. The femoral coupling component 104, from its proximal end 112, is inserted and fixed to the femur bone (not shown) of a human thigh. The femoral coupling component 104, at its distal end 114, is coupled to the femoral component 102. The femoral component 102 articulates, i.e., moves, over the insert 110 to provide bends to the knee joint. The insert 110 is a spacer element or a cushion, inserted between the femoral component 102 and the tibial component 106. The tibial component 106 has an inverted conical portion 116 extending distally from the proximal end 118 of the tibial component 106. The tibial component 106, from its distal end 120, is coupled to the tibial coupling component 108. The tibial coupling component 108, from its distal end 122, is inserted and fixed to the tibial bone (not shown). The femoral coupling component 104 and the tibial coupling component 108 have their respective designs and geometries which provide a substantially uniform weight distribution at the knee joint prosthesis and provides a substantially uniform load transfer from the upper part of the body to the lower part of the body across the knee joint. Each component of the knee joint prosthesis 100 illustrated in Figure 1 is further illustrated and described in greater detail in the description hereinafter.

[0029] Figure 2(a) illustrates a femoral component 102-1, according to an implementation of the present subject matter. Figure 2(b) and Figure 2(c) show different perspective views of the femoral component 102-1. The femoral component 102-1 is shaped in the form of the distal part of the femur bone. For this, the femoral component 102-1 has two condyles 202-1 and 202-2, collectively referred to as condyles 202 and individually referred to as the condyle 202. The condyles 202, through their articulating surfaces 204-1 and 204-2, interface and articulate with the insert 110. The articulating surfaces 204-1 and

204-2 are polished such that the friction between the condyles 202 and the insert 110 is minimum and the articulation with the insert 110 is substantially smooth. Further, each of the condyles 202 has a posterior surface 206-1, 206-2 which is rough at least in an elevated region to provide better fixation of the femoral component 102-1 with a cancellous bone. In an example, the posterior surface 206-1, 206-2 at least in a region has indents or spots 208 to provide roughness for the fixation. The femoral component 102 may be fixed with the femur bone using a cement, such as PMMA (Poly Methyl MethAcrylate).

[0030] The femoral component 102-1 is designed in such a way that it can accommodate the femoral coupling component 104. The femoral component 102 -1 has two pegs 210-1 and 210-2 (collectively referred to as the pegs 210), one each on the posterior surface 206-1, 206-2 of the condyles 202. The femoral coupling component 104 is coupled with the pegs 210 to establish the coupling with the femoral component 102-1. Each of the pegs 210 has a substantially circular cross-section with a diameter ranging from about 7 mm to about 10 mm. Each of the pegs 210 has a length ranging from about 12 mm to about 18 mm, for fixation with the femoral coupling component 104. In an implementation, the pegs 210 have serrations on their curved surface through which the femoral component 102-1 may fit into the femoral condyles of the femur bone. The pegs 210 are inserted into the femoral condyles of the femur bone to ensure smooth transmission of pressure from the femur bone to the knee joint and also to minimize bone loss.

[0031] The condyles 202 of the femoral component 102-1 have a substantially constant intercondylar distance therebetween to accommodate the insert 110 of all sizes. Further, the condyles 202 are connected through an intercondylar connector 212 that extends from a first end 214 of the condyles 202 up to a portion as shown in Figure 2(b). The left over portion between the condyles 202, from a second end 216 up to the intercondylar connector 212, has an opening 218. The intercondylar connector 212 provides a grooved profile between the articulating surfaces 204-1 and 204-2 of the condyles 202 to allow the femoral component 102 to articulate with the insert 110. The opening 218 provides for a stable movement of a patella component and provides functioning of quadriceps tendon of the knee joint.

[0032] Further, for each of the condyles 202, a region 220-1, 220-2 of the posterior surface 206-1, 206-2 at the base of the pegs 210 and a region 222-1, 222-2 of the posterior surface 206-1, 206-2 adjacent to the region 220-1, 220-2 is angled with respect to each other. The angle is in a range from about 130 degrees to about 140 degree, which improves the range of flexion of the knee joint without sacrificing excess bone from the femur bone. In an

implementation, the angle is about 136 degrees. Also, the condyles 202 have variable thicknesses in portions, which facilitate in providing mechanical strength and smooth movement of the femoral component 102-1 and hence the knee joint prosthesis 100. Further, the portion of the condyles 202 near the first end 214 is kept thinner than other portions in order to help easy wound closure and reduce loss of bone. Most of the female patients have very thin femoral condyles of the femur bone near the first end 214 of the condyle 202. Thus, a thinner portion of condyles 202 near the first end 214 facilitates in reducing the pressure on the wound closure at the femoral condyles. Also, the femoral component 102-1 with thinner portion near the first end 214 can be equally used for both male and female patients.

[0033] The femoral component 102-1 has an intercondylar bridge 224 interconnecting the condyles 202 at the second end 216. The intercondylar bridge 224 is made of a same material as that of the condyles 202. The knee-joint prosthesis 100 with the femoral component 102-1 having the intercondylar bridge 224 can be used in conditions where posterior cruciate ligament (PCL) is removed during knee surgery. Further, the intercondylar bridge 202 is of an arc shape, as shown in Figure 2(a). The arc shape of the intercondylar bridge 224 assists in providing improved mobility of at knee joint, while the femoral component 102-1 is articulating with the insert 110.

[0034] Further, in the femoral component 102-1, the condyles 202 on their inner sides near the opening 218 have notches 226. In the perspective view of the femoral component 102-1 shown in Figure 2(b), only one of the notches 226 on the condyle 202-2 is visible, and the other on the condyle 202-1 is not visible. Such notches 226 facilitate in easy extraction of the femoral component 102-1 in the cases where the femoral component 102-1 is to be removed.

[0035] In one implementation, the femoral component 102 is without an intercondylar bridge. Figure 3(a) illustrates a femoral component 102-2 without the intercondylar bridge, according to an implementation of the present subject matter. Figure 3(b) and Figure 3(c) show different perspective views of the femoral component 102-2. The geometry and other features of the femoral component 102-2 of Figures 3(a) to 3(c) are similar to the previously discussed femoral component 102-1 of Figures 2(a) to 2(c). The femoral component 102-2 without an intercondylar bridge is used in conditions where the PCL is not removed or sacrificed during the knee surgery.

[0036] Figure 4(a) illustrates a femoral coupling component 104, according to an implementation of the present subject matter. Figure 4(b) and Figure 4(c) show the perspective views of the femoral coupling component 104. The femoral coupling component

104 is used to provide further structural strength to the femur bone, and may be used in case of a revision surgery.

[0037] The femoral coupling component 104 has a stem 402. The stem 402 which is insertable in the femur bone from the proximal end 112 of the femoral coupling component 104. In an implementation, the stem 402 has a thickness in a range from about 10 mm to about 14 mm, and a length in a range from about 80 mm to about 160 mm to be accommodated in the femur bone. The stem 402 is textured, i.e., it has threads or serrations, on its circumferential surface. Such texturing of the surface allows for reduction in thermal damages and in fat embolism during the insertion of the stem 402 into the femur bone.

[0038] The femoral coupling component 104 at its distal end 114 has a coupling element 404. The femoral coupling component 104 couples with the femoral component 102 through the coupling element 404. The coupling element 404 has a central portion 406 which is dome-shaped. The coupling element 404 has two legs, a first leg 408-1 and a second leg 408-2 (collectively referred to as legs 408) extending from the central portion 406. The legs 408 are extending from the central portion 40 6, away from each other in the opposite direction, are lying substantially in a same plane.

[0039] Further, as shown in Figure 4(b), each of the legs 408 has a hole 410-1, 410-2 (collectively referred to as holes 410). The legs 408 are engaged with the pegs 210 of the femoral component 102 through the holes 410 to couple the femoral coupling component 104 with the femoral component 102. The dimensions of opening of the holes 410 are such that the pegs 210 of the femoral component 102 can pass through the holes 410. In an implementation, the peripheral shape of the holes 410 is similar to the cross-sectional shape of the pegs 210. The pegs 210 are passed through the holes 410, and the legs 408 are fixed at the posterior surface 206-1, 206-2 of the condyles 202 using a cement, such as PMMA.

[0040] In an implementation, the stem 402 is integrally connected to the central portion 406 of the coupling element 404. The dome-shape profile of the central portion 406 and the coupling of the femoral coupling element 104 and the femoral component 102 through the legs 408 extending out from the central portion 406, provide for a uniform transfer of load from the femur bone to the tibial bone across the knee joint. The transfer of load is uniform even in the cases of a substantial bone loss in the femoral condyles.

[0041] Further, in the femur coupling component 104, the stem 402 is inclined with respect to the coupling element 404 to capture the natural angle of the femur bone. In an implementation, the stem 402 is inclined posteriorly at a predefined angle ranging from about 4 degrees to about 8 degrees. Also, in an implementation, the stem 402 is inclined at a

predefined angle ranging from about 4 degrees to about 6 degrees in the outward direction with respect to the knee. Depending upon the knee (right or left knee), the stem 402 is inclined towards the right or left side of the knee. For the left knee the stem 402 is inclined outwards on the left side of the knee, and for right knee the stem 402 is inclined outwards on the right side of the knee. Such angles of stem 402 of the femoral coupling component 104 allows for even pressure transmission from the femur bone to the tibial bone and, thus, the femoral coupling component 104 can be used even in the case of a substantial bone loss in the femoral condyles.

[0042] Further, in an implementation, the femoral coupling component 104 has a slopy posterior surface 412 at the coupling element 404. The slopy surface 412 has an angle, also called a valgus slope, in a range from about 130 degree to about 140 degree with respect to the plane in which the legs 408 are lying. The slopy surface 412 of the femoral coupling component 104 interfaces with the femoral component 102 between the regions 222-1 and 222-2 of the condyles 202. In an implementation, the valgus slope is about 136 degrees, same as the angle between the region 220-1, 220-2 and the region 222-1, 222-2 of the posterior surface 206-1, 206-2 of the condyles 202.

[0043] In an implementation, the femoral coupling component 104 has a slope anteriorly ranging from about 85 to about 105 degrees and a slope superiorly ranging from about 40 to about 50 degrees.

[0044] Figure 5(a) illustrates a tibial component 106, according to an implementation of the present subject matter. Figure 5(b) and Figure 5(c) show the perspective views of the tibial component 106. The tibial component 106 has a supportive flange 502 and the conical portion 116 extending distally from the supportive flange 502. The supportive flange 502 is kidney-shaped which may resemble an upper part of the tibial bone surface. The supportive flange 502 has a rough under-surface 504 which facilitates in coupling the tibial component 106 with the tibial coupling component 108. The rough under-surface 504 may have indents and spots.

[0045] The tibial component 106 interface with the insert 110. The insert 110 is coupled on the supportive flange 502. In an implementation, the supportive flange 502 has a skirting 506 at its periphery to hold and securely couple the insert 110. The insert 110 is slid and locked onto the supportive flange 502 of the tibial component 106. The insert 110 is snug fit on the tibial component 106, which facilitates in minimizing the wear at the interface and micro-movements between the insert 110 and the tibial component 106. In an

implementation, the insert 110 may a peripheral shape same as that of the tibial component 106.

[0046] Further, the tibial component 106 couples with the tibial coupling component 108 through the conical portion 116. The conical portion 116 has a fixation stem 508 and a supportive element 510 juxtaposed to each other. The fixation stem 508 is positioned anteriorly with respect to the supportive element 508. The fixation stem 508 has an anterior edge 512 which is angled posteriorly at a predefined angle is a range from about 4 degrees to about 10 degrees. This angle is measured from a vertical axis drawn from the plane of the supportive flange 502. The angled anterior edge 512 enables the tibial component 106 to take an anatomical shape of the tibial bone and minimize the chances of breakage of the anterior tibial cortex at the time of the knee surgery.

[0047] The supportive element 510 is shaped and configured such that it facilitates in providing a uniform distribution of load across the knee joint and in minimizing the bone loss of the tibial bone. The supportive element 510 also provides substantially higher rotational stability of the tibial component 106.

[0048] The tibial component 106 has increased anterior-posterior distance on both medial and lateral surface, which provides for improved articulation area for the femoral component 102 and which helps in increasing the range of movements and reducing the wear of insert. In other words, with the tibial component 106, the area of articulation on the tibial component 106 is increased, such that if the insert 110 is inserted the area of contact between the femoral component 102 and the insert 110 is increased throughout the range of movement of the femoral component 102 over the tibial component 106. With the greater area of contact the stability during the articulation of the femoral component 102 over the tibial component 106 is substantially higher, and the wear of the insert 110 due to the articulation is substantially less.

[0049] Figure 6(a) and Figure 6(b) illustrate different views of the tibial coupling component 108, according to an implementation of the present subject matter. In an implementation, the tibial coupling component 108 has a base 602 that complements, in shape, the supportive flange 502 of the tibial component 106. The base 602 provides a support to the tibial component 106 when the tibial component 106 is coupled to the tibial coupling component 108. The tibial component 106 transfers the load at the knee joint, directly onto the tibial coupling component 108. The base 602 has a rough upper-surface 604 which facilitates in providing a substantially stable and strong fixation between the base 602 and the supportive flange 502. The rough upper surface 604 may have indents and spots.

[0050] The tibial coupling component 108 has an elongate member 606 coupled to an under-surface 608 of the base 602. The elongate member 606 has a length in a range from about 80 mm to about 160 mm. The elongate member 606 has an anatomical shape similar to that of the intramedullary canal of the tibial bone. To provide such anatomical shape, the elongate member 606 is made broader at its proximal end 610 and is made narrower at its distal end 612. The elongate member 606 tapers down from the proximal end 610 to the distal end 612, as shown in Figure 6(a). In an implementation, the elongate member 606 has a perimeter, i.e., the peripheral dimension in a range from about 10 mm to about 14 mm at the proximal end 610, and has a perimeter in a range from about 8 mm to about 10 mm at the distal end 612. The length and the perimeters of the elongate member 606 depend upon the anatomy and requirement of the patient.

[0051] Further, the elongate member 606 is coupled with the base 602 through an intermediate portion 614. The intermediate portion 614 has a contoured outer profile. In an implementation, the intermediate portion 614 is configured as butterfly wings. The contoured outer profile is such that a width of the intermediate portion 614, about a longitudinal axis L of the elongate member 606, decreases gradually in a direction from the base 602 to the elongate member 606. The outer surface 616 of the intermediate portion 614 interfaces smoothly with the under-surface 608 of the base 602 at one end and with the elongate member 606 at the other end.

[0052] The anatomically-shaped elongate member 606 and the contoured intermediate member 614 coupling the elongate member 606 with the base 602 facilitate in providing a uniform weight distribution at the knee joint and a uniform load transfer from the femur bone to the tibial bone across the knee joint. Such configuration of the tibial coupling component 108 also allows the tibial bone to repair itself and naturally integrate with the tibial coupling component 108.

[0053] Further, the elongate member 606 of the tibial coupling component 108 has a cavity at the proximal end 610. The base 602 and the intermediate portion 614 have openings, together marked as 618, which extend to the cavity in the elongate member 606. The fixation stem 508 and the supportive element 510 of the tibial component 106 are inserted into the cavity through the opening 618 to couple the tibial component 106 to the tibial coupling component 108. The base 602 is coupled with the supportive flange 502 by using a cement, such as PMMA, between the upper-surface 604 of the base 602 and the under-surface 504 of the supportive flange 502.

[0054] Figure 7(a) illustrates an insert 110-1 having an elevated ridge 702, according to an implementation of the present subject matter. Figure 7(b) and Figure 7(c) show different perspective views of the insert 110-1. The insert 110-1 is used in the knee joint prosthesis 100 with the femoral component 102-2 without an intercondylar bridge. The elevated ridge 702 is in the centre of the insert 110-1 and has a height ranging from about 2.5 mm to about 5 mm. The elevated ridge 702 has a wider anterior portion and narrower posterior portion which minimizes the pressure on collateral ligaments. The elevated ridge 702 helps in stabilizing knee both in cruciate retaining and cruciate sacrificing procedures.

[0055] The insert 110-1 has two parallel scooped out engagement slots 704-1 and 704-2 (collectively referred to as the engagement slots 704) on either outer side of the elevated ridge 702. The condyles 202 of the femoral component 102 articulate on the engagement slots 704. The insert 110-1 has various anterior-posterior, medio-lateral and superior-inferior thicknesses for different size of bones. An angulated elevated anterior thickness on both articular surfaces increases anterior stability and an elevated posterior articular surface provides for better conformity of articulation between the insert 110-1 and the femoral component 102. Further, the insert 110-1 has almost flat articular surface 706 which increases the modularity between the femoral component 102 and the tibial component 106 and facilitating rotational movements.

[0056] Figure 8(a) illustrates an insert 110-2 with a circular peg 802, according to an implementation of the present subject matter. Figure 8(b) and Figure 8(c) show different perspective views of the insert 110-2. The insert 110-2 is used in the knee joint prosthesis 100 with the femoral component 102-1 having the intercondylar bridge 224. The circular peg 802 is substantially in the centre, which stabilizes the knee in case of posterior cruciate loss and instability caused by collateral ligaments of the knee joint.

[0057] As shown in Figure 8(a), the insert 110-2 has a groove 804 to accommodate the intercondylar bridge 224 of the femoral component 102-2. The groove 804 has an arc-shaped profile to accommodate the arc-shaped intercondylar bridge 224. The intercondylar bridge 224 is accommodated in the groove 804 at one position of the femoral component 102 during its articulation over the insert 110-2. The intercondylar bridge 224 and the groove 804 in the insert 110-2 facilitates in increasing the degree of flexion of the knee joint, in providing an improved stability at the knee joint, and in minimizing the pressure on the patellar component. Other features of the insert 110-2 are similar to the previously discussed insert 110-1.

[0058] Further, in an implementation, the knee joint prosthesis 100 may include a patella component. Figures 9(a) and 9(b) illustrate different perspective views of a patella component 900, according to an implementation of the present subject matter. The patella component 900 has a circular stem 902. The circular stem 902 is substantially in the centre of the posterior of the patella 900 and is used for articulating with the femoral component 102. The circular stem 902 has thickness ranging from 10 mm to 16 mm and length ranging from about 3 mm to about 7 mm. The circular stem 902 fits in the opening 218 in the femoral component 102. The anterior of the patella 900 is a convex shaped surface and the posterior surface has circular grooves 904.

[0059] In an implementation, the femoral component 102, the femoral coupling component 104, the tibial component 106, and the tibial coupling component 108 can be metallic or non-metallic. Materials used should be biocompatible which the human body can accept without creating a rejection response. The materials used can be one of stainless steel, cobalt-chromium alloy, titanium and titanium alloy and tantalum. These materials also facilitate in providing substantial stability and strength of the knee joint prosthesis 100, and in providing substantially faster post-operation recovery. In an implementation, the insert 110 is made of polyethylene.

[0060] Further, the components 102 to 110 used in the knee joint prosthesis 100 can be manufactured with nano-structured biological bearings, made of titanium and nickel. The nano-structured raw material may produce a porous structure with dendrites coated on the surface, which can mimic the signals of the bones in the human body. This allows natural bone to grow into the knee joint prosthesis 100 and thereby causing natural integration. Improved raw material can enhance the life of the component by reducing friction. The fixation or augmentation of different components can be carried out with the help of PMMA.

[0061] Various components in the knee joint prosthesis 100 can be used in different combination for an injured or diseased knee joint. In one implementation, a femoral component 102, an insert 110, a tibial component 106, and a tibial coupling component 108 may be used for primary total knee replacement. In one implementation, a femoral component 102, a femoral coupling component 104, an insert 110, and a tibial component 106 may be used for primary total knee replacement.

[0062] In another implementation, a femoral component 102-1, a femoral coupling component 104, an insert 110-2, a tibial component 106, and a tibial coupling component 108 may be used for primary total knee replacement both for cruciate retaining and substituting surgeries, when there is a peri-prosthetic fracture. In another implementation, a femoral

component 102-2, a femoral coupling component 104, an insert 110-1, a tibial component 106, and a tibial coupling component 108 may be used in patients with severe deformity around the knee joint, with poor quality collateral ligaments and peri-prosthetic fracture, in revision knee replacement or in bone tumour cases around the knee joint.

[0063] The knee joint prosthesis 100 also takes care of the narrow intra-medullar spaces in certain ethnic groups, which makes it difficult to use conventional readily available similar devices. By improving the design standard, the knee joint prosthesis 100 has minimized the impact on the walls of the bone thereby reducing the complications while inserting the femoral coupling component 104 of the knee joint prosthesis 100 inside the femur bone and the tibial coupling component 108 inside the tibial bone.

[0064] The knee joint prosthesis 100 looks after the poor quality of soft tissue and ligaments. This will enable the person to recover at the fastest pace after surgery. Patient will be ready to perform most of the functions which his daily routine demands. The knee joint prosthesis 100 allows people to perform complete and normal range of knee movements which was either too restricted by conventional implants which also dictated the quality of life. A patient of any age with the knee joint prosthesis 100 will have excellent stability and excellent range of motion at the knee joint.

[0065] Although the disclosed subject matter has been described with reference to particular embodiments, the disclosed subject matter is not intended to be limited to the particulars disclosed; rather, the subject matter extends to all functionally equivalent structures, and uses within the scope of the appended claims.

I/We claim:

1. A knee joint prosthesis (100) comprising:

a femoral component (102);

a tibial component (106) interfacing with the femoral component (102) through an insert (110); and

a tibial coupling component (108) coupled with the tibial component (106), at a distal end (120) of the tibial component (106), for coupling with a tibial bone, wherein the tibial coupling component (108) comprises:

a base (602) to support the tibial component (106); and

an elongate member (606) coupled to an under-surface (608) of the base (602), wherein the elongate member (606) is coupled to the base (602) through an intermediate portion (614) having a variable width, about a longitudinal axis of the elongate member (606), for weight distribution and load transfer.

2. The knee joint prosthesis (100) as claimed in claim 1, wherein the intermediate portion (614) has a contoured outer profile with the variable width decreasing in a direction from the base (602) to the elongate member (606).

3. The knee joint prosthesis (100) as claimed in claim 1, wherein the elongate member (606) has an anatomical shape of that of an intramedullary canal of the tibial bone, and wherein the elongate member (606) has a perimeter, at a proximal end (610), in a range from about 10 mm to about 14 mm and has a perimeter, at a distal end (612), in a range from about 8 mm to about 10 mm.

4. The knee joint prosthesis (100) as claimed in claim 3, wherein the elongate member (606 has a length in a range from about 80 mm to about 160 mm.

5. The knee joint prosthesis (100) as claimed in claim 1, wherein the tibial component (106) comprises a supportive flange (502) having a rough under-surface (504), and wherein the base (602) has a rough upper-surface (604) for fixedly coupling the base (602) with the supportive flange (502).

6. The knee joint prosthesis (100) as claimed in claim 5, wherein the tibial component (106) comprises:

a supportive element (510) and a fixation stem (508) juxtaposed to each other and extending distally from the supportive flange (502),

wherein the elongate member (606), at one end, has a cavity, and wherein the base (602) and the intermediate portion (614) have openings (618) extending to the cavity, and wherein the supportive element (510) and the fixation stem (508) are received in the cavity through the openings (618) for coupling the tibial component (106) with the tibial coupling component (108).

7. The knee joint prosthesis (100) as claimed in claim 1, wherein the femoral component (102) comprises two condyles (202) separated by a constant intercondylar distance, and wherein the femoral component (102), at one end, comprises an intercondylar bridge (224) inter-connecting the two condyles (202), wherein the intercondylar bridge (202) is arc shaped.

8. The knee joint prosthesis (100) as claimed in claim 7, wherein the insert (110) comprises a groove (804) to accommodate the intercondylar bridge (224) while the femoral component (102) is articulating over the insert (110).

9. The knee joint prosthesis (100) as claimed in claim 1 further comprising a femoral coupling component (104) coupled with the femoral component (102), at a distal end (114) of the femoral coupling component (104), wherein the femoral coupling component (104) comprises:

a stem (402) for coupling with a femoral bone; and

a coupling element (404) having a dome-shaped central portion (406) integrally coupled with the stem (402) and having a first leg (408-1) and a second leg (408-2) extending from the dome-shaped central portion (406), wherein the first leg (408-1) and the second leg (408-2) couple with the femoral component (102).

10. A knee joint prosthesis (100) comprising:

a tibial component (106);

a femoral component (102) interfacing with the tibial component (106) through an insert (110); and

a femoral coupling component (104) coupled with the femoral component (102), at a distal end (114) of the femoral coupling component (104), wherein the femoral coupling component (104) comprises:

a stem (402) for coupling with a femoral bone; and

a coupling element (404) having a dome-shaped central portion (406) integrally coupled with the stem (402) and having a first leg (408-1) and a second leg (408-2)

extending from the dome-shaped central portion (406), wherein the first leg (408-1) and the second leg (408-2) couple with the femoral component (102).

11. The knee joint prosthesis (100) as claimed in claim 10, wherein the femoral component (102) comprises two condyles (202) and two pegs (210), one each on a posterior surface (206-1, 206-2) of each of the two condyles (202), and wherein each of the first leg (408-1) and the second leg (408-2) has a hole (410-1, 410-2), and wherein the two pegs (210) are passed through the respective hole (410-1, 410-2) of the first leg (408-1) and the second leg (408-2) for coupling the femoral component (102) with the femoral coupling component (104).

12. The knee joint prosthesis (100) as claimed in claim 10, wherein the stem (402) is inclined posteriorly at an angle in a range from about 4 degrees to about 8 degrees.

13. The knee joint prosthesis (100) as claimed in claim 10, wherein the stem (402) is inclined outwardly, towards one of a right-side and a left-side of the knee joint prosthesis (100), at an angle in a range from about 4 degrees to about 6 degrees.

14. The knee joint prosthesis (100) as claimed in claim 10, wherein the stem (402) has a thickness in a range from about 10 mm to about 14 mm, and has a length in a range from about 80 mm to about 160 mm.

15. The knee joint prosthesis (100) as claimed in claim 10, wherein the femoral coupling component (104) has a slopy posterior surface (412) with a valgus slope in a range from about 130 degrees to about 140 degrees.

16. The knee joint prosthesis (100) as claimed in claim 11, wherein the femoral component (102) comprises notches on inner side of the condyles (202) for extraction of the femoral component from the femoral bone.

17. The knee joint prosthesis (100) as claimed in claim 10 further comprising a tibial coupling component (108) coupled with the tibial component (106), at a distal end (120) of the tibial component (106), for coupling with a tibial bone, wherein the tibial coupling component (108) comprises:

a base (602) to support the tibial component (106); and

an elongate member (606) coupled to an under-surface (608) of the base (602), wherein the elongate member (606) is coupled to the base (602) through an intermediate portion (614) having a contoured outer profile with a variable width, about a longitudinal

axis of the elongate member (606), decreasing in a direction from the base (602) to the elongate member (606).

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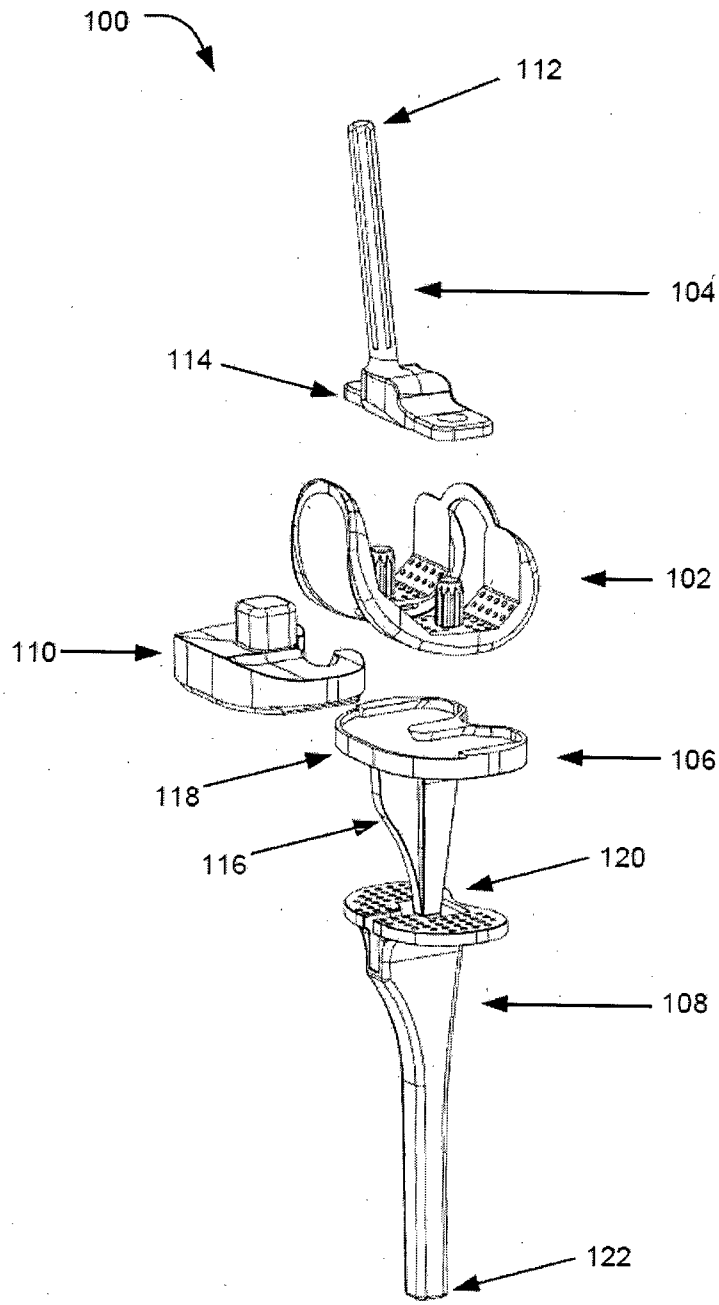


Figure 1

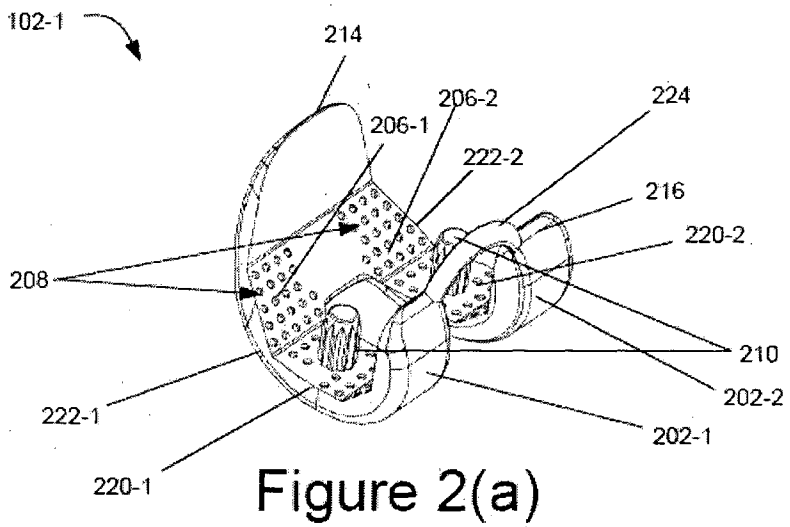
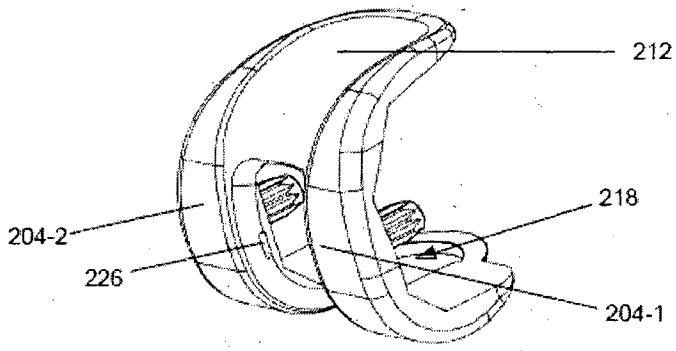


Figure 2(a)



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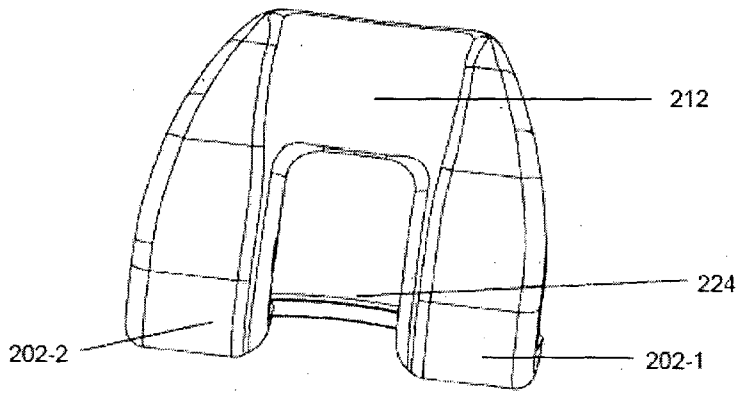

Figure 2(c)

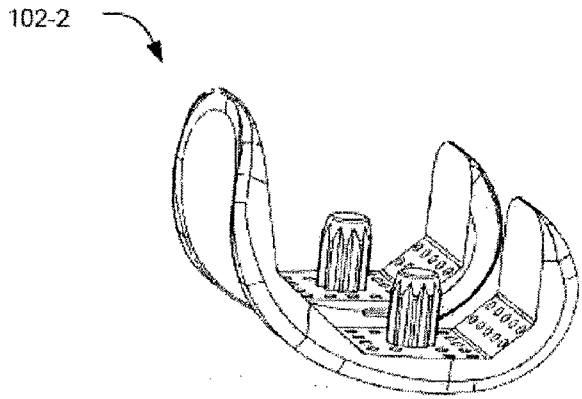

Figure 3(a)

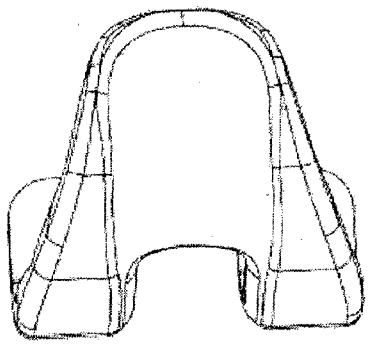

Figure 3(b)

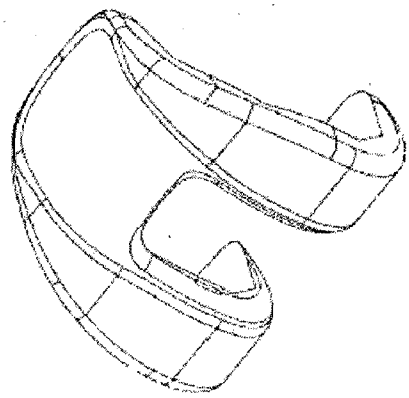

Figure 3(c)

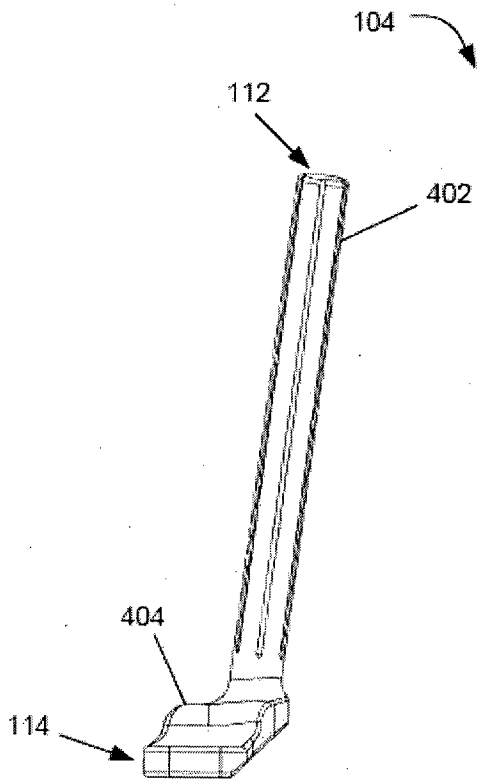

Figure 4(a)

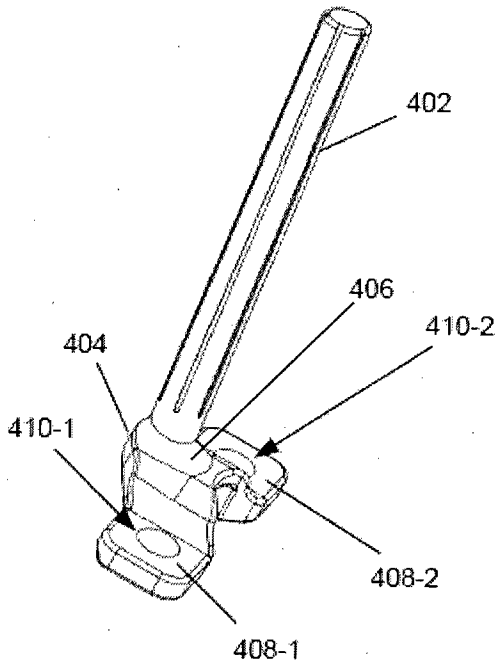

Figure 4(b)

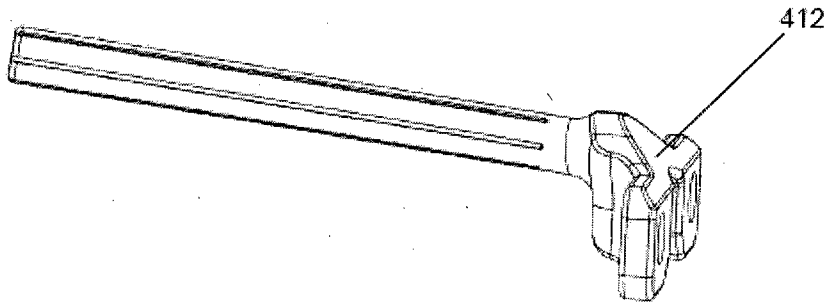

Figure 4(c)

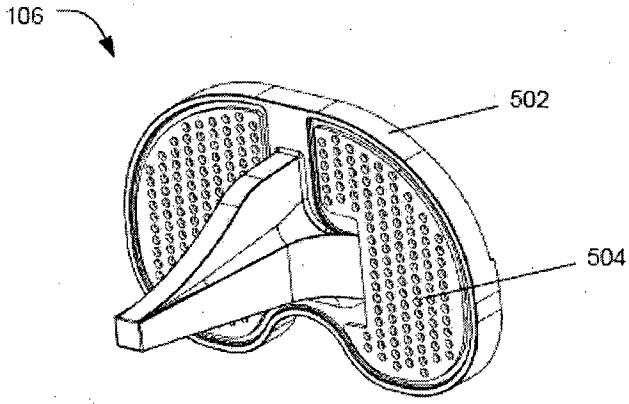

Figure 5(a)

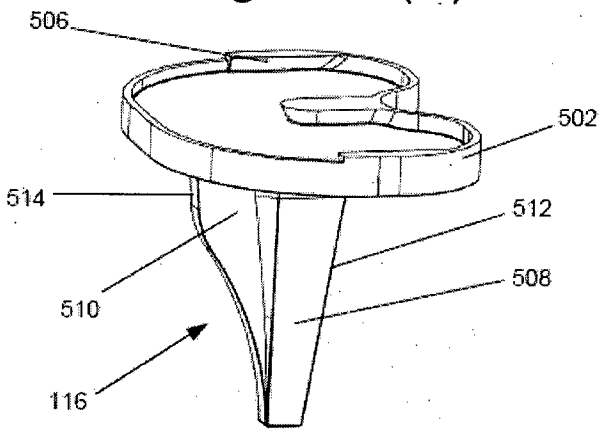

Figure 5(b)

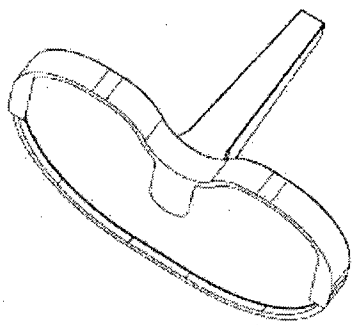

Figure 5(c)

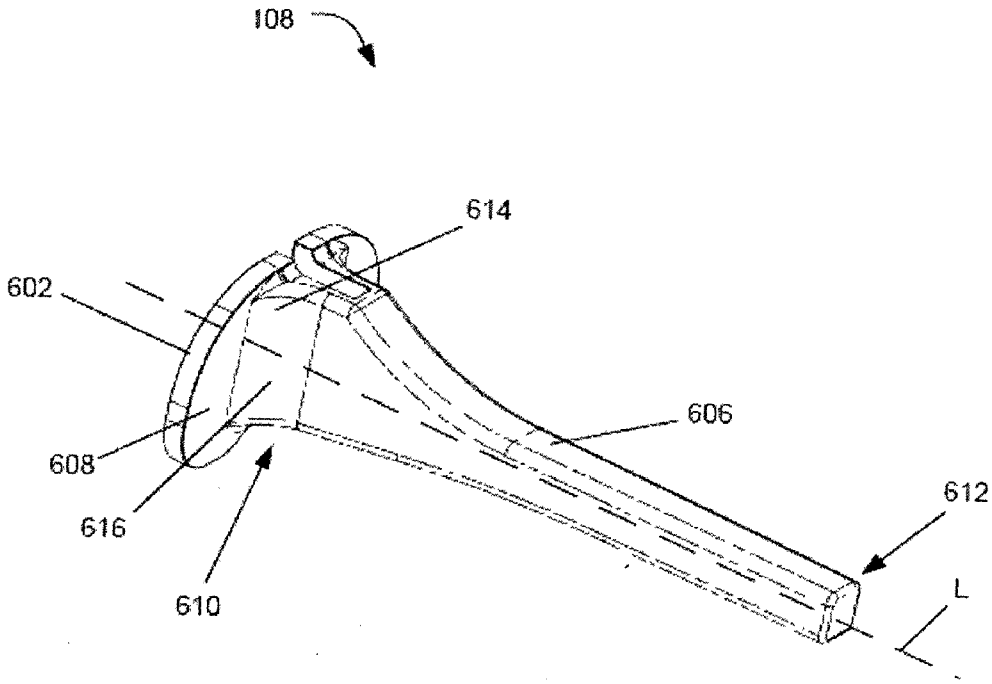

Figure 6(a)

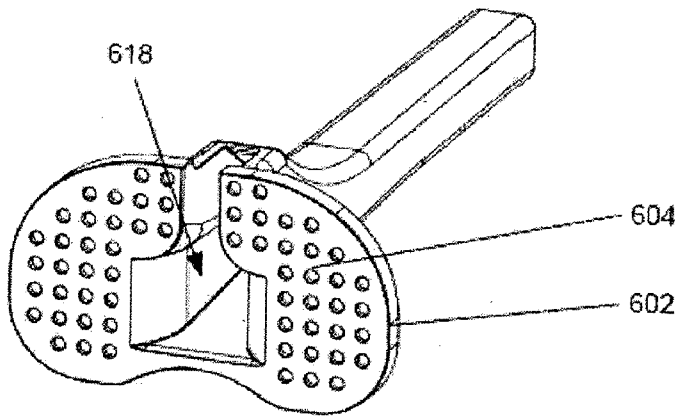

Figure 6(b)

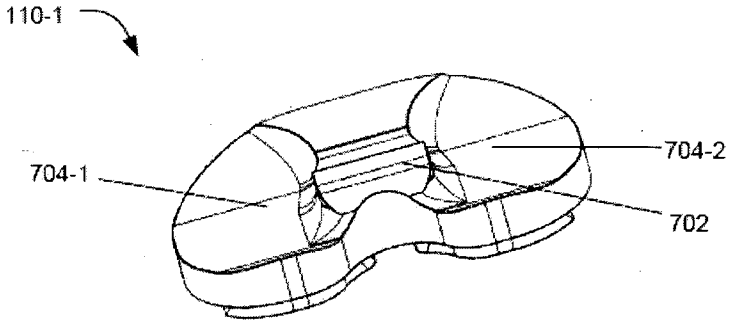

Figure 7(a)

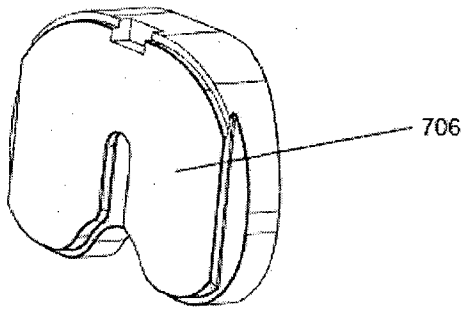

Figure 7(b)

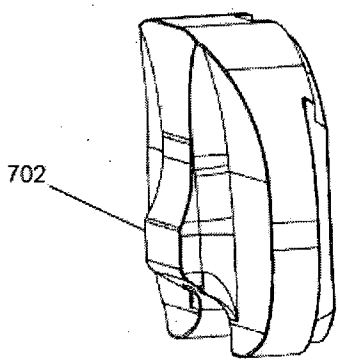

Figure 7(c)

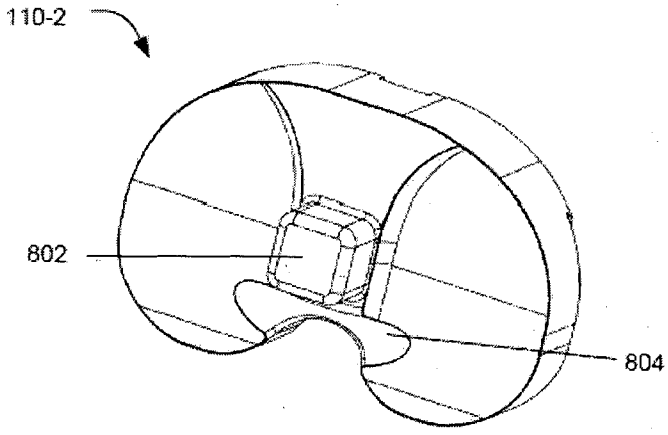

Figure 8(a)

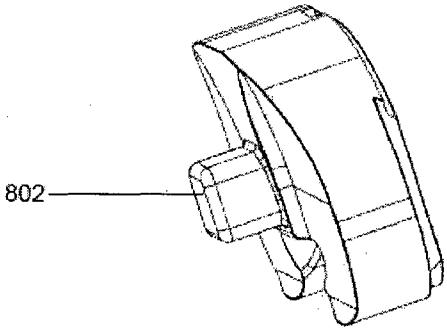

Figure 8(b)

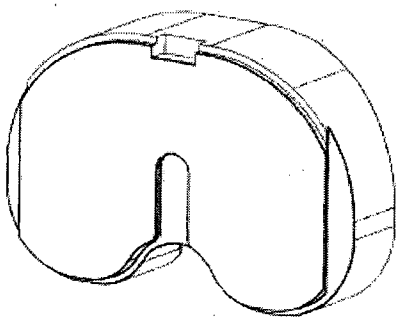

Figure 8(c)

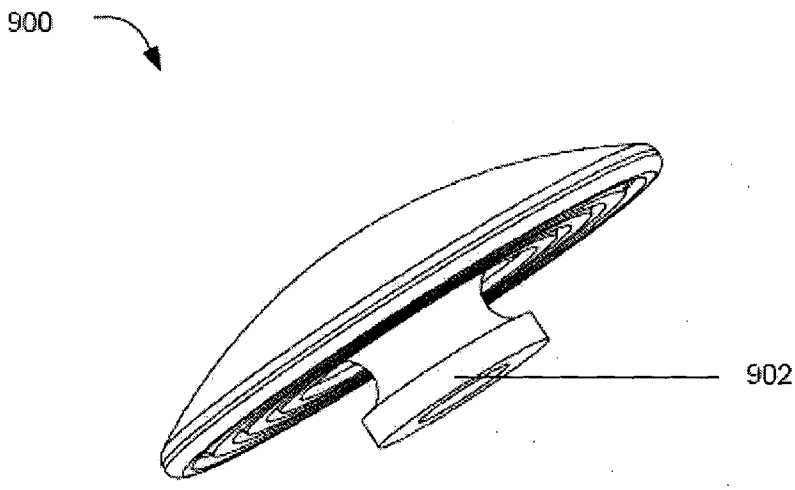

Figure 9(a)

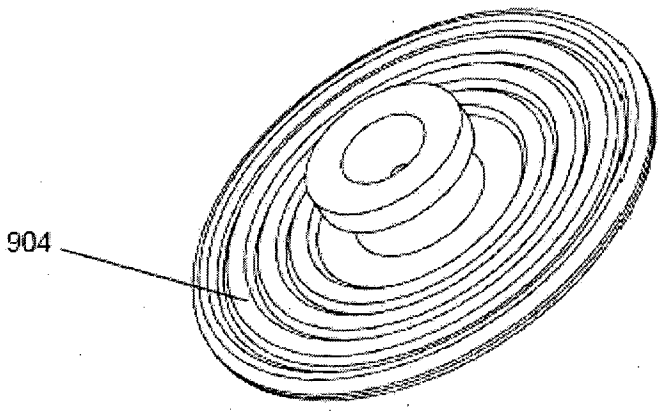

Figure 9(b)

INTERNATIONAL SEARCH REPORT

International application No
PCT/IN2013/000383

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61F2/38 A61F2/30
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)
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	US 2004/049286 A1 (GERMAN BEBORAH S [US] ET AL GERMAN DEBORAH S [US] ET AL) 11 March 2004 (2004-03-11)	1,2,6
Y	paragraph [0035] - paragraph [0051] figures 6-15,21,22	7,9,17

X	US 2012/016482 A1 (MOORADIAN MARK [US] ET AL) 19 January 2012 (2012-01-19) paragraph [0059] - paragraph [0066] figures 2-4	1,2,6

Y	FR 2 955 482 A1 (SCHWARTZ CLAUDE [FR]; VASTEL LAURENT [FR]; CASSARD XAVIER [FR]; DELANN) 29 July 2011 (2011-07-29) page 5, line 27 - page 8, line 35 figures 1-4	7

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[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
13 September 2013	25/09/2013

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

3

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

INTERNATIONAL SEARCH REPORT

International application No
PCT/IN2013/000383

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	EP 2 130 518 A1 (DEPUY PRODUCTS INC [US]) 9 December 2009 (2009-12-09) paragraph [0021] - paragraph [0028] paragraph [0034] - paragraph [0036] figures 1,8 -----	10 9,17

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IN2013/000383

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