FIG. 3

FIG. 20

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(54) Title: ANATOMICALLY SHAPED AUGMENTS

(57) Abstract: Augments (104, 206) for implantation of an orthopedic implant device (100, 200) in a bone. A distal end (146) of an outer portion (132) of the augment can have a shape that is configured to generally conform to the shape of a metaphyseal-diaphyseal junction of an intramedullary canal (118) of the bone (116). Further, a proximal end (148) of the outer portion has a shape that is configured to generally conform to a shape of the metaphyseal region of the intramedullary canal. Additionally, the shape of the outer portion at the distal end can be separated from the shape of the outer portion at the proximal end by a distance that is approximately equal to the distance between the metaphyseal-diaphyseal junction and the metaphyseal region of the intramedullary canal.
ANATOMICALLY SHAPED AUGMENTS

BACKGROUND

[0001] Embodiments of the present application generally relate to orthopedic augments. More particularly, but not exclusively, embodiments of the present application relate to anatomically shaped orthopedic augments that are configured to prevent or minimize unequal loading conditions and provide enhanced flexibility in placement within the associated bone canal.

[0002] Metaphyseal and/or diaphyseal augments typically assist in preventing loosening and/or subsidence of an articular implant/component, such as, for example, an implanted tibia baseplate. Such augments can help distribute loads exerted on or by the articular implant through the bone, with the articular component maintaining fixation, which can result in a longer implant life.

[0003] One of the primary forces attributed to early failures of orthopedic implants, particularly in the tibia, is torsional stress. Moreover, torsional stresses can shear the articular implant-bone interface (cemented or un-cemented) apart, which can facilitate premature or early failure of the implant. Other forces, such as shear forces, can also contribute to similar premature or early failure of the articular implant-bone interface. Additionally, compressive loads, particularly unequal loads to a median plane (i.e. medial loading) of the articular implant-bone interface, can also cause subsidence and early failures of the articular implant.

[0004] Additionally, too much cortical contact with the augment can, as a consequence of carrying too much of the load, stress shield the host bone of the bone interface. Such situations can result in bone resorption, which can contribute to early failure of the implant. Additionally, unequal cortical contact due to lack of conformity or fit can load a particular region of the bone, and thereby relieve the articular implant-bone interface in a similar region. In at least certain situations, areas subjected to such unequal loads or contact can exhibit characteristics similar to a fulcrum, which can facilitate bone-interface failures for both the augment and the articular implant.
BRIEF SUMMARY

[0005] An aspect of the present application is an augment for implantation of an orthopedic implant device in a bone, the augment having an augment wall that includes an outer portion and an inner portion. The inner portion of the augment wall defines an inner region of the augment that is sized to receive placement of one or more components of the orthopedic implant device. A distal end of the outer portion has a first shape that is configured to generally conform to the shape of a metaphyseal-diaphyseal junction of a canal of the bone. Additionally, a proximal end of the outer portion has a second shape that is configured to generally conform to a shape of the metaphyseal region of the canal of the bone. Further, the first shape has a different shape and size than the second shape.

[0006] Another aspect of the present application is an augment for implantation of an orthopedic implant device in a bone, the augment having an augment wall that includes a posterior curvature portion and an anterior-medial portion. The posterior curvature portion at a first end of the augment is shaped to generally conform to a posterior curvature wall of a canal of the bone at a metaphyseal-diaphyseal junction of the canal, while the posterior curvature portion at a second end of the augment is shaped to generally conform to a posterior curvature wall of the canal at a metaphyseal region of the canal. Further, the anterior-medial portion at the first end of the augment is shaped to generally conform to an anterior-medial wall of the canal at the metaphyseal-diaphyseal junction, while the anterior-medial portion at the second end of the augment is shaped to generally conform to the anterior-medial wall at the metaphyseal region of the canal. Additionally, the shape of the posterior curvature portion at the metaphyseal region is different than the shape of the anterior-medial portion at the metaphyseal region.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The description herein makes reference to the accompanying figures wherein like reference numerals refer to like parts throughout the several views.

[0008] Figure 1 illustrates an anterior-posterior view of a tibial implant device having a tibial augment according to an embodiment of the present application.

[0009] Figure 2 illustrates a medial-lateral view of the tibial implant device shown in Figure 1.
Figure 3 illustrates an isometric view of the tibial implant device shown in Figure 1.

Figure 4 illustrates an isometric view of a tibial implant device having an offset/angled coupler.

Figures 5A and 5C-5J illustrate, respectively, an anterior view of a proximal tibia bone and transverse slice views of the proximal tibia bone, as taken from identified line 5C-5C through identified line 5J-5J.

Figure 5B illustrates a medial-lateral view of the proximal tibia bone illustrated in Figure 5A.

Figure 6 illustrates a perspective view of a symmetrical tibial augment according to an embodiment of the present application.

Figure 7 illustrates a front side view of the symmetrical tibial augment illustrated in Figure 6.

Figure 8 illustrates a right side view of the symmetrical tibial augment illustrated in Figure 6.

Figure 9 illustrates a top view of the symmetrical tibial augment illustrated in Figure 6.

Figure 10 illustrates a bottom view of the symmetrical tibial augment illustrated in Figure 6.

Figures 11A-11I illustrate, respectively, the anterior view of the proximal tibia bone and slice views from Figures 5A-5J, but with an exemplary symmetrical tibial augment of the present application implanted in the intramedullary canal.

Figure 12A illustrates an anterior view of a proximal tibia bone with an exemplary symmetrical tibial augment of the present application implanted in the intramedullary canal.

Figure 12B illustrates a medial-lateral view of the proximal tibia bone that is illustrated in Figure 12A.

Figure 12C illustrates a slice view of the proximal tibia bone and exemplary symmetrical tibial augment along line 12C-12C from Figure 12A.

Figure 12D illustrates a slice view of the proximal tibia bone and exemplary symmetrical tibial augment along line 12D-12D from Figure 12A.
Figure 13 illustrates a top view of an asymmetrical tibial augment according to an illustrated embodiment of the present application.

Figure 14 illustrates a bottom view of the asymmetrical tibial illustrated in Figure 13.

Figure 15 illustrates a front view of the asymmetrical tibial illustrated in Figure 13.

Figure 16 illustrates a right side view of the asymmetrical tibial illustrated in Figure 13.

Figures 17A and 17C-17J illustrate, respectively, an anterior view and associated slice views of a proximal tibia bone with an exemplary asymmetrical tibial augment of the present application implanted in the intramedullary canal.

Figure 17B illustrates a medial-lateral view of the proximal tibia bone that is illustrated in Figure 17A.

Figure 18 illustrates a posterior-anterior view of a femoral implant device having a femoral articular component, an intramedullary stem, and a femoral augment according to an illustrated embodiment of the present application.

Figure 19 illustrates a medial-lateral view of the femoral implant device shown in Figure 18, which is depicted as further including distal and posterior augments.

Figure 20 illustrates an isometric view of the femoral implant device shown in Figure 18.

Figure 21 illustrates an isometric view of the femoral implant having an offset/angled coupler.

Figure 22 illustrates a distal end view of a fully contained femoral augment according to an illustrated embodiment of the present application.

Figure 23 illustrates a proximal end view of the fully contained femoral augment according to an illustrated embodiment of the present application.

Figure 24 illustrates a posterior side view of the fully contained femoral augment illustrated in Figures 22 and 23.

Figure 25 illustrates a medial side view of the fully contained femoral augment illustrated in Figures 22 and 23.
Figure 26 illustrates an anterior side view of the fully contained femoral augment illustrated in Figures 22 and 23.

Figure 27 illustrates a distal end view of a femoral augment structured to accommodate partial containment according to an illustrated embodiment of the present application.

Figure 28 illustrates a proximal end view of a femoral augment structured to accommodate partial containment according to an illustrated embodiment of the present application.

Figure 29 illustrates a posterior side view of the femoral augment illustrated in Figures 27 and 28.

Figure 30 illustrates a medial side view of the femoral augment illustrated in Figures 27 and 28.

Figure 31 illustrates an anterior side view of the femoral augment illustrated in Figures 27 and 28.

The foregoing summary, as well as the following detailed description of certain embodiments of the present application, will be better understood when read in conjunction with the appended drawings in which like reference numbers indicate like features, components and method steps. For the purpose of illustrating the invention, there is shown in the drawings, certain embodiments. It should be understood, however, that the present invention is not limited to the arrangements and instrumentalities shown in the attached drawings.

DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

Certain terminology is used in the foregoing description for convenience and is not intended to be limiting. Words such as "upper," "lower," "top," "bottom," "first," and "second" designate directions in the drawings to which reference is made. This terminology includes the words specifically noted above, derivatives thereof, and words of similar import. Additionally, the words "a" and "one" are defined as including one or more of the referenced item unless specifically noted. The phrase "at least one of followed by a list of two or more items, such as "A, B or C," means any individual one of A, B or C, as well as any combination thereof.
Figures 1-4 illustrate anterior-posterior, medial-lateral, and isometric views, respectively, of an exemplary tibial implant device 100. In the depicted embodiment, the tibial implant device 100 is a tibial articular assembly that includes a tibial (articular) baseplate 102, a tibial augment 104, and a stem 106. The stem 106, which can extend along a central stem axis 108, can be directly or indirectly coupled to the tibial baseplate 102, such as, for example, coupled to a tray stem 110. As illustrated in Figure 4, according to certain embodiments, the tibial implant device 100 can include an offset/angled coupler 112, which can offset at least the central stem axis 108 relative to a central tray stem axis 114 of the tray stem 110. The tibial implant device 100 can also include other components, such as, for example, other intramedullary stems and other augments that can be assembled to the tibial implant device 100.

The depicted tibial implant device 100 is structured to be cemented into and through the tibial augment 104 and onto a prepared proximal tibia of a patient. Further, while Figures 1-4 illustrate the tibial augment 104 positioned on or about a tibial implant device 100 in a non-implanted state or condition, the tibial augment 104 can be implanted in a bone of the patient prior to implantation of the remainder of the tibial implant device 100. Thus, an inner region 144 of the tibial augment 104 can be sized to receive passage and/or placement of at least a portion of the stem 106 and/or other components of the tibial implant device 100, including, for example, the offset/angled coupler 112 and/or the tray stem 110, during implantation of the tibial implant device 100 in a patient.

Figures 5A and 5B illustrate anterior and medial-lateral views, respectively, of a proximal tibia bone 116. Figure 5A also includes transverse slice views of the proximal tibia bone 116, as taken from identified lines 5C-5C through identified line 5J-5J (Figures 5C-5J). The proximal tibia bone 116 is oriented in Figure 5A such that the bone 116 generally tapers inwardly for each sequential transverse slice view, thereby also reducing the size of the intramedullary canal 118. Further, as depicted in each of slices 5E-5E through 5J-5J (Figures 5E-5J) of Figure 5A, the cortical shape of the intramedullary canal 118 can be generally defined by an inner wall 120 of the proximal tibia bone 116 that comprises, at least in part, an anterior-medial wall 122, a posterior curvature wall 124, and an anterior-lateral wall 126, the anterior-lateral wall 126 and the posterior curvature wall 124 being separated from each other, at least in part, by the anterior-medial wall 122.
Figures 6-10 illustrate an example of a symmetrical tibial augment 104 according to an illustrated embodiment of the present application. A variety of different augments can be used for the tibial augment 104, including, for example, a cone or sleeve augment, among other augments. Further, the tibial augment 104, and more specifically an augment wall 128, can have a variety of shapes and sizes, and can have a symmetrical or asymmetrical configuration. For example, as illustrated by at least Figures 9 and 10, according to certain embodiments, the augment wall 128 of the tibial augment 104 can be generally symmetrical about a midline 134 that is generally perpendicular to a central longitudinal axis 136 of the tibial augment 104. Thus, as shown in Figure 9, according to the illustrate embodiment, the midline 134 can generally divide the tibial augment 104 into generally symmetrical first and second sides 138a, 138b. The augment wall 128 can further include at least one opening 140a, 140b that is configured to accommodate placement of a component of the tibial implant device 100. For example, according to the embodiment illustrated in Figures 6-10, the tibial augment 104 can include two opening 140a, 140b that are sized to accommodate at least the passage and/or placement of at least a portion of the keel(s) 142a, 142b of the tibial baseplate 102 about or through the opening(s) 140a, 140b. Further, while in the illustrated embodiment the augment wall 128 at the first and second sides 138a, 138b of the tibial augment 104 are depicted as having an opening 140a, 140b, other embodiments can be generally symmetrical with the exception that the augment wall 128 at one of the first and second sides 138a, 138b can contain an opening 140a, 140b, while such an opening 140a, 140b is not present at the other of the first and second sides 138a, 138b.

The augment wall 128 includes an inner portion 130 and an outer portion 132. The inner portion 130 of the augment wall 128 can generally define an inner region 144 of the tibial augment 104. At least a portion of the inner region 144 can extend between a distal end 146 and a proximal end 148 of the tibial augment 104. Additionally, as discussed above, the inner region 144 can be sized to receive placement of at least one or more components of the tibial augment 104, such as, for example, the stem 106, offset/angled coupler 112, and/or tray stem 110 of the tibial baseplate 102, among other components. Additionally, while the surface of the outer portion 132 of the augment wall 128 in the illustrated embodiment has a step appearance or configuration, a variety of other surfaces or surface shapes can also be employed.
The outer portion 132 of the augment wall 128 is shaped to generally fit the cortical shape of a proximal tibia, and more specifically, a portion of the intramedullary canal of the tibia. According to certain embodiments, the outer portion 132 of the augment wall 128 of the tibial augment 104 can be configured such that at least the distal end 146, or diaphyseal end, of the tibial augment 104 conforms to the general shape of the metaphyseal-diaphyseal junction of the tibia bone 116, and at least the proximal end 148 of the tibial augment 104 conforms to the general shape or profile of the metaphyseal region of the tibial bone 116. According to other embodiments, the distal end 146 and/or proximal end 148 can be shaped to provide other cross-sectional shapes that facilitate the ability of the tibial augment 104 to conform to the size and/or shape of at least a portion of the intramedullary canal 118 of the tibia bone 116. Such conforming may not be limited to the physical shape(s) of each section of the outer portion 132 of the augment 104 mating or matching the shape of the adjacent portion of the inner wall 120 of the intramedullary canal 118, but instead can include being shaped to operably contact an adjacent portion of the inner wall 120 of the intramedullary canal 118 while a central longitudinal axis 136 of the tibial augment 104 is aligned with, or at a selected position away from, a reference axis, including, for example, a longitudinal axis of the intramedullary canal 118, the central stem axis 108, and/or the central tray stem axis 114, among other reference axes. Additionally, according to certain embodiments, the portion of the tibial augment 104 that is shaped to generally conform, or fit, to the shape or profile of the metaphyseal region can be located at distance away, in the metaphyseal direction, from the portion of the tibial augment 104 that conforms to the general shape or profile of the metaphyseal-diaphyseal junction that is about the same as the distance between the metaphyseal region and metaphyseal-diaphyseal junction of the tibia bone 116.

Shaping the tibial augment 104 to generally conform to, or accommodate, changes and/or variances in the shape of the intramedullary canal 118 of the tibia bone 116, can prevent or minimize the extent to which the tibial augment 104 is subjected to unequal loading conditions. Further, by shaping different portions or areas of the tibial augment 104, as well as other augments herein, to generally conform to or otherwise accommodate the shape of at least an adjacent inner wall of the associated bone canal or cavity, the generally anatomically shaped augments discussed herein, including the tibial augment 104, 104′, and the below-discussed femoral augment 206, 206′, can reduce the impact forces on the corresponding articular implant-
bone interface by distributing such forces or loads over a relatively larger surface area. More specifically, for example, such conforming configurations of the augments 104, 104', 206, 206' can improve resistance to torsional stress by equally distributing such forces circumferentially.

Further, such variations among and/or along at least the augment wall 128 of the tibial augment 104 can improve flexibility in the placement of the tibial augment 104, and thus reduce or minimize the tibial augment 104 from hindering the ability to position an associated articular component relative to a joint line, while also not hindering joint balance (flexion-extension balance) and rotation of each component relative to the patella-femoral joint.

To generally accommodate the cortical shape(s) of the intramedullary canal 118 of the tibia bone 116, including, for example, the shape at both the metaphyseal-diaphyseal junction and at metaphyseal region of the tibial bone 116, as well as the shapes therebetween, different areas or sides of the outer portion 132 of the augment wall 128 can have different shapes. Additionally, the shapes along such different areas or sides of the outer portion 132 of the augment wall 128 can also vary between the distal and proximal ends 146, 148 of the tibial augment 104. Such variances or inconsistencies among and/or along the sides or areas of the tibial augment 104 can preclude the augment wall 128 of the tibial augment 104 from having a generally uniform cylindrical or conical shape.

Referencing Figures 9-10, according to certain embodiments, the augment wall 128 of the tibial augment 104 can include a first, or posterior curvature, portion 150 and a second, or anterior-medial, portion 152 that are separated from each other by at least a transversal axis 154 that is at least perpendicular to the midline 134. Additionally, in the illustrated embodiment, at least a portion of posterior curvature portion 150 has a shape that is different than a corresponding portion of the anterior-medial portion 152. For example, as shown by the top view of the proximal end 148 of the tibial augment 104 in Figure 9, the posterior curvature portion 150 can include a generally flat section 156a that transitions into rounded end sections 156b, 156c, while the anterior-medial portion 152 can include a rounded section 158a that transitions into generally flat sections 158b, 158c. Such differences in shapes, and the resulting dissimilar profiles, are depicted by at least Figure 8 and 10 at least in the region around the proximal end 148 of the tibial augment 104. As demonstrated by at least slices 11D-11D and 1IE-1 IE from Figure 11A, such differences in the shapes of the posterior curvature and anterior-medial portions 150, 152 of the tibial augment 104 can facilitate the ability of the tibial...
augment 104 to generally conform to the shape of at least the adjacent posterior curvature wall 126 and the anterior-medial wall 122, respectively, of the inner wall 120 of the intramedullary canal 118. Additionally, as indicated by slice 11D-1 1D (Figure 11D) from Figure 11A, a portion of the anterior-medial portion 152 and/or the posterior curvature portion 150 can contact other portions of the inner wall 120 of the intramedullary canal 118, including, for example, the lateral wall 166.

[00056] The different shapes of the posterior curvature and anterior-medial portions 150, 152 can alter or vary between the distal and proximal ends 146, 148 along the augment wall 128 so that the outer position 132 of the augment 104 generally conforms to changes in shape along the inner wall 120 of the intramedullary canal 118 of the tibia bone 116, as depicted each of slice views 5C-5C through 5J-5J from Figure 5A and 11B-11B through 11F-11I (Figures 11B-11I) from Figure 11A. According to the illustrated embodiment shown in at least Figures 6-11, such changes in shape in the inner wall 120 of the intramedullary canal 118, and corresponding changes in shape along at least the posterior curvature and anterior-medial portions 150, 152 of the augment wall 128, can result in the posterior curvature and anterior-medial portions 150, 152 generally having similar shapes at the distal end 146 of the tibial augment 104, as shown, for example, by Figure 10 and slice E-E in Figure 11. Such similarities in the shape of the posterior curvature and anterior-medial portions 150, 152 can, for example, provide the augment wall 128 with a generally circular, semi-circular, or slightly oval shape at the distal end 146 of the tibial augment 104. However, again, the particular shape(s) of the augment wall 128 at the distal end 146 of the tibial augment 104 can be configured or selected to generally conform to the metaphyseal-diaphyseal junction of the tibia bone 116.

[00057] Figures 12A-12D further illustrate the symmetrical tibial augment 104 that is shaped to conform to the shape of the cortical shape of the bone 116, and more specifically, in the illustrated embodiment, to the adjacent shape of the intramedullary canal 118. For example, as shown in Figure 12C, the proximal end 148 of the tibial augment 104 is shaped to generally conform to the general shape or profile of adjacent portions of the metaphyseal region of the tibial bone 116. Further, as shown in Figures 12C and 12D, the region around the anterior-lateral wall 126, and moreover, in the region of the tibial tubercle 160, can often be covered, at least in part, by the anterior aspect of a transversely resected portion of the proximal tibia bone 116. Such coverage can prevent the tibial augment 104 from having direct access inferior-superior to
the cancellous area 162 that can be present behind the tibial tubercle 160. Yet, without direct access or special instrumentation, preparation, as well as placement of the tibial augments that lack the anatomical shapes disclosed herein, at such a location can be difficult.

[00058] Referencing Figures 13-16, in at least certain instances, patients can have an abnormality in the shape and/or size of the intramedullary canal 118 and/or can require enhanced support from a tibial augment 104’. In such situations, the tibial augment 104’ can have an asymmetrical configuration about the midline 134, as shown in at least Figures 13 and 14. Such an asymmetrical configuration can increase a thickness of the augment wall 128 between at least certain sections of the inner and outer portions 130, 132 of the augment wall 128. For example, compared to slices 11D-11D, 11E-11E, and 11F-11F (Figures 11D-11F) from Figure 11A, the asymmetrical tibial augment 104’ shown in slice views from 17E-17E, 17F-17F, and 17G-17G (Figures 17E-17G) from Figure 17A has and increased thickness in the augment wall 128 at least in the vicinity of the lateral wall 166 portion of the inner wall 120 of the intramedullary canal 118. However, according to certain embodiments, such increases in the thickness of the augment wall 128 and/or increases of the augment wall 128 in certain locations can be limited due to the previously discussed limitations associated with the cancellous area 162 behind the tibial tubercle 160.

[00059] Figures 18-20 illustrate posterior-anterior, medial-lateral, and isometric views, respectively, of a femoral implant device 200. According to an illustrated embodiment of the present application, the femoral implant device 200 includes a femoral articular component 202, an intramedullary stem 204, and a femoral augment 206. Additionally, as shown in Figure 19, according to certain embodiments, the femoral implant device 200 can also include a distal augment 208 and/or a posterior augment 210. The stem 204, which can extend along a central stem axis 212, can be directly or indirectly coupled to the femoral articular component 202, such as, for example, coupled to a component stem 220 of the femoral articular component 202, as shown in Figure 21. As illustrated in Figure 21, according to certain embodiments, the femoral implant device 200 can include an offset/angled coupler 216, which can offset at least the central stem axis 212 relative to a component stem axis 218 of the component stem 220.

[00060] The depicted femoral implant device 200 is structured to be cemented into and through the femoral augment 206 and onto a prepared distal femur of a patient. Further, while Figures 18-21 illustrate the femoral augment 206 positioned on or about a femoral implant
device 200 in a non-implanted state or condition, the femoral augment 206 can be implanted in a bone of the patient prior to implantation of the remainder of the femoral implant device 200. Thus, an inner region of the femoral augment 206 can be sized to receive passage and/or placement of at least a portion of the stem 204 and/or other components of the femoral implant device 200, including, for example, the offset/angled coupler 216 and/or the component stem 220, during implantation of the femoral implant device 200 in a patient.

[00061] Figures 23-26 illustrate an example of a fully contained femoral augment 206 according to an illustrated embodiment of the present application. A variety of different augments can be used for the femoral augment 206, including, for example, a cone or sleeve augment, among other augments. Further, the femoral augment 206 can have a variety of shapes and sizes. The femoral augment 206 can include an augment wall 222 that extends about a central axis 224 of the femoral augment 206. The augment wall 222 has an inner portion 226 and an outer portion 228. The inner portion 226 of the augment wall 222 can generally define an inner region 230 of the femoral augment 206. At least a portion of the inner region 230 can extend between a distal end 232 and a proximal end 234 of the femoral augment 206. The inner region 230 can be sized to receive placement of at least one or more components of the femoral augment 206, such as, for example, the stem 204, offset/angled coupler 216, and/or component stem 220 of the femoral articular component 202, among other components. For example, according to certain embodiments, the inner region 230 is sized to receive placement of at least the junction between the stem 204 and the component stem 220.

[00062] The outer portion 228 of the augment wall 222 can be shaped to generally fit the cortical shape of a distal femur, and more specifically, of a portion of the intramedullary canal of the femur. Thus, according to certain embodiments, a diaphyseal, or distal end 232, of the femoral augment 206 can be shaped to generally conform to the general shape of the metaphyseal-diaphyseal junction. The opposing proximal end 234 of the femoral augment 206 can be configured to conform to the general shape or profile of the metaphyseal region of the femoral bone. According to other embodiments, the distal end 232 and/or proximal end 234 can be shaped to provide other cross-sectional shapes that facilitate the ability of the femoral augment 206 to conform to the size and/or shape of at least a portion of the intramedullary canal of the femur. Such conforming may not be limited to the physical shape(s) of each section of the outer portion 228 of the augment mating or matching the shape of the adjacent portion of the
inner wall of the intramedullary canal of the femoral bone, but instead can include being shaped to operably contact an adjacent portion of the inner wall of the intramedullary canal while a central axis 224 of the femoral augment 206 is aligned with, or at a selected position away from, a reference axis, including, for example, a longitudinal axis of the intramedullary canal of the femur, the central stem axis 212, and/or the component stem axis 218, among other reference axes. Additionally, the portion of the femoral augment 206 that is shaped to generally conform to the shape or profile of the metaphyseal region can be located at distance away, generally in the distal direction, from the portion of the femoral augment 206 that conforms to the general shape or profile of the metaphyseal-diaphyseal junction that is about the same as the distance between the metaphyseal region and metaphyseal-diaphyseal junction of the tibia.

[00063] Similar to the tibial augment 104, 104’, shaping the femoral augment 206 to generally conform to, or accommodate, changes and/or variances in the shape of the intramedullary canal of the femur can prevent or minimize the extent to which the femoral augment 206 is subjected to unequal loading conditions. Further, again, by shaping different portions or areas of the femoral augment 206, as well as other augment(s) herein, to generally conform to or otherwise accommodate the shape of at least an adjacent inner wall of the associated bone canal or cavity, the generally anatomically shaped augment(s) 104, 104’, 206, 206’, discussed herein can reduce the impact forces on the corresponding articular implant-bone interface by distributing such forces or loads over a relatively larger surface area. More specifically, for example, such conforming configurations of the augment(s) 104, 104’, 206, 206’ can improve resistance to torsional stress by equally distributing such forces circumferentially.

[00064] To generally accommodate the cortical shape(s) of the medullary canal of the femur, including, for example, the shape at both the metaphyseal-diaphyseal junction and at metaphyseal region of the femur, as well as the shape therebetween, different areas or sides of the outer portion 228 of the augment wall 222 can have different shapes. Additionally, the shapes along such different areas or sides of the outer portion 228 of the augment wall 222 can also vary between the distal and proximal ends 232, 234 of the femoral augment 206. Such variances or inconsistencies among and/or along the sides or areas of the femoral augment 206 can preclude the augment wall 222 of the femoral augment 206 from having a generally uniform cylindrical or conical shape.
Referencing Figures 22-26, according to certain embodiments, the outer portion 228 of the augment wall 222 can include a recess or relief 236. As shown by at least Figure 26, according to the illustrated embodiment, the relief 236 can extend along a portion of the augment wall 222, such as, for example, extending from the proximal end 234 to a region generally adjacent to the distal end 232 of the femoral augment 206. However, according to other embodiments, the relief 236 can extend between, and through, the proximal end 234 and/or the distal end 232 of the femoral augment 206. In the illustrated embodiment, the relief 236 can have one or more sidewalls 238 and a base wall 240. For example, as shown in Figure 23, the one or more sidewalls 238 can include a first sidewall 238a and a second sidewall 238b. The first and second sidewalls 238a, 238b can be angled such that the first and second sidewalls 238a, 238b converge toward each other from generally opposite directions and/or angles. For example, in the illustrated embodiment, the first and second sidewalls 238a, 238b can each extend from opposing first ends 242a, 242b, and converge toward each other so as to intersect or be generally in proximity to each other at second ends 244a, 244b of the first and second sidewalls 238a, 238b. Further, in the illustrated embodiment, the second ends 244a, 244b can be adjacent to, or generally form, an augment flange 246 that projects away from the first and second sidewalls 238a, 238b.

As indicated by Figure 25, according to certain embodiments, the first and second sidewalls 238a, 238b can also be angled or tapered, and thus non-parallel to a longitudinal central axis 224 of the femoral augment 206. For example, as shown in the embodiment depicted in Figure 26, the portion of the first and second sidewalls 238a, 238b at the proximal end 234 of the augment wall 222 can be separated from the central axis 224 of the femoral augment 206 by a distance that is smaller than the distance between the central axis 224 and the vicinity of the intersection of the first and second sidewalls 238a, 238b and the base wall 240. However, according to other embodiments, the first and second sidewalls 238a, 238b can be generally parallel to the central axis 224 of the femoral augment 206.

As shown by at least Figures 19 and 20, according to the illustrated embodiment, the relief 236 can be shaped such that, when the femoral augment 206 is operably positioned on the femoral implant device 200, the relief 236 is generally parallel to the bone facing side of the anterior flange 248 of the femoral implant device 200. Such a shape can at least assist in adjustable rotational displacement of the femoral augment 206 relative to the femoral implant.
device 200, and more particularly, of the anterior flange 248 (Figure 19) relative to the femoral augment 206. Such rotational adjustment can also be facilitated by the angular orientation of the first and/or second sidewalls 238a, 238b of the augment wall 222. For example, as indicated by the exemplary femoral augments 206, 206' shown in Figures 23 and Figure 28, the first sidewall 238a can be oriented to facilitate that ability to adjust the angular position of the femoral augment 206 relative to other components of the femoral implant device 200, such as, for example, relative to the anterior flange 248, by about 20 degrees, among other degrees of rotational freedom. Thus, for example, such rotational displacement can, when the femoral implant device 200 is implanted in a patient, allow for selective adjustment in the distance between the first end 242a of the first sidewall 238a and the anterior flange 248.

[00068] The rotational freedom provided by incorporation of the relief 236 and the associated adjustment in the position of the femoral augment 206 relative to the anterior flange 248 can assist in the femoral augment being adapted to accommodate rotational variation in the geometry of the intramedullary canal of the femur. Moreover, the relief 236 can assist in enhancing the flexibility as to the orientation at which the femoral augment 206 can be implanted in the intramedullary canal so as to further enhance the ability of the femoral augment 206 to conform or otherwise accommodate the particular shape of the intramedullary canal while also minimizing or preventing the position of the femoral augment 206 from impeding the positioning or operation of other components of the femoral implant device 200. For example, the rotational freedom of the femoral augment 206 that is provided by, at least in part, the inclusion of the relief 236 can enhance the ability to position the femoral augment 206 to accommodate for rotational variation in the shape of the intramedullary canal while also not preventing the femoral implant device 200, such a femoral articular component, from being positioned at a particular transverse rotational location.

[00069] Figures 27-31 illustrate a femoral augment 206' that is adapted to accommodate larger components, or collections of components, in the inner region 230' of the augment 206'. For example, the femoral augment 206' depicted in Figures 27-31 can be adapted to receive in the inner region one or more of the stem 204, component stem 220, and/or the offset/angled coupler 216, among other components. According to such an embodiment, the relief 236 or augment flange 246, if any, can include one or more tear lines or relief areas 250 that are adapted to open, break through, or tear the augment wall 222, or otherwise relieve at least a portion of the
augment 206'. Thus, in certain situations, the formation of an opening along one or more of the tear lines or relief areas 250 can provide access to additional space so as to prevent the inner region 230' from restricting or impeding positioning of components of the femoral implant device 200 relative to the femoral augment 206. Thus, unlike the fully contained inner region 230 of the femoral augment 206 shown in Figures 23-24, the tear lines or relief areas 250 can allow for the femoral augment 206' to transition from being fully contained to partially contained, which can occur, for example, upon the formation of openings or breakage along the tear line or relief areas 250.

[00070] Additionally, in the illustrated embodiments of the femoral augments 206, 206' shown in at least Figures 23-31, at least some sides of the of the femoral augments 206, 206' can have different shapes and/or configurations. Further, similar to the tibial augments 104, 104' discussed above, the shape or configurations of those sides can alter, and can alter differently, between the proximal and distal ends 232, 234 of the femoral augments 206, 206'. For example, referencing the top views of Figures 23 and 28, at the distal ends 232 of the femoral augments 206, 206', the femoral augments 206, 206' can have be generally egg-shape, which can assist in providing different shaped and sized profiles along the augment wall 222 of the femoral augments 206, 206', and shown by a comparison of Figures 24 and 26 with Figure 25, and a similar comparison of Figures 29 and 31 with Figure 30. Further, while the distal end 234 in the illustrated embodiments is shown as being generally egg-shaped, as shown in the Figures 22 and 27, the proximal ends 232 of the femoral augments 206, 206' can be generally circular. Thus, the transitions between, and the associated shapes, of the proximal and distal ends 232, 234 can preclude the femoral augments 206, 206' from having a generally uniform cylindrical or conical shape. Instead, as previously mentioned, such variations in shapes along different portions of the femoral augment 206, 206' can be adapted to enhance the ability of the femoral augment 206, 206' to generally conform to the shape of adjacent portions of the intramedullary canal of the femur.

[00071] While the invention has been described in connection with what is presently considered to be the most practical and preferred embodiment, it is to be understood that the invention is not to be limited to the disclosed embodiment s), but on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims, which scope is to be accorded the broadest interpretation so as to
encompass all such modifications and equivalent structures as permitted under the law. Furthermore it should be understood that while the use of the word preferable, preferably, or preferred in the description above indicates that feature so described may be more desirable, it nonetheless may not be necessary and any embodiment lacking the same may be contemplated as within the scope of the invention, that scope being defined by the claims that follow. In reading the claims it is intended that when words such as "a," "an," "at least one" and "at least a portion" are used, there is no intention to limit the claim to only one item unless specifically stated to the contrary in the claim. Further, when the language "at least a portion" and/or "a portion" is used the item may include a portion and/or the entire item unless specifically stated to the contrary.
CLAIMS

1. An augment for implantation of an orthopedic implant device in a bone, the augment comprising:
   an augment wall having an outer portion and an inner portion, the inner portion defining an inner region of the augment, the inner region sized to receive placement of one or more components of the orthopedic implant device, a distal end of the outer portion having a first shape configured to generally conform to the shape of a metaphyseal-diaphyseal junction of a canal of the bone, a proximal end of the outer portion having a second shape configured to generally conform to a shape of the metaphyseal region of the canal of the bone, the first shape having a different shape and size than the second shape.

2. The augment of claim 1, wherein the first shape of the distal end of the outer wall is separated from the second shape of the proximal end by a distance that is approximately the distance between the metaphyseal-diaphyseal junction and the metaphyseal region of the canal of the bone.

3. The augment of claim 1 or 2, wherein the proximal end of the outer wall includes a posterior curvature portion and an anterior-medial portion, at least a portion of the posterior curvature portion shaped to generally conform to a posterior curvature wall of the canal at the metaphyseal region, at least a portion of the anterior-medial portion shaped to generally conform to an anterior-medial wall of the canal at the metaphyseal region, and wherein shape of the posterior curvature portion at the proximal end is different than the shape of the anterior-medial portion at the proximal end.

4. The augment of any preceding claim, wherein the distal end of the outer portion has a generally circular or oval shape.

5. The augment of any preceding claim, wherein the proximal end of the outer portion has a generally circular or oval shape.

6. The augment of any preceding claim, wherein the augment wall includes one or more openings that extend from the proximal end and through the outer and inner portions of the
augment wall, the one or more openings sized to receive placement of a portion of a component of the orthopedic implant device.

7. The augment of claim 6, wherein the one or more openings comprises a first opening and a second opening, the first and second openings each sized to receive insertion of a keel of the orthopedic implant device.

8. The augment of any preceding claim, wherein a portion of the outer portion includes a relief that is configured to accommodate rotational displacement of the augment relative to a component of the orthopedic implant device.

9. The augment of claim 8, wherein the relief is positioned along the outer portion at a location that permits, when implanted in a patient, the relief to be adjacent to an anterior flange of the orthopedic implant device.

10. The augment of claim 8 or 9, wherein the relief comprises at least one sidewall that tapers outwardly as the at least one sidewall extends from the proximal end and toward the distal end.

11. The augment of claim 8 or 9, wherein the relief comprises a pair of converging sidewalls, each sidewall of the pair of converging sidewalls extending in opposite directions, and wherein an end of each sidewall of the pair of converging sidewalls is adjoined to an opposing portion of the outer portion.

12. The augment of any preceding claim, wherein the augment wall includes one or more tear areas that are configured to tear at least a portion of the augment wall to accommodate placement of the augment about one or more components of the orthopedic implant device.

13. An augment for implantation of an orthopedic implant device in a bone, the augment comprising:

   an augment wall having a posterior curvature portion and an anterior-medial portion, the posterior curvature portion at a first end of the augment being shaped to generally conform to a posterior curvature wall of a canal of the bone at a metaphyseal-diaphyseal junction of the canal, the posterior curvature portion at a second end of the augment shaped to generally conform to a posterior curvature wall of the canal at a metaphyseal region of the canal, the anterior-medial
portion at the first end of the augment being shaped to generally conform to an anterior-medial wall of the canal at the metaphyseal-diaphyseal junction, the anterior-medial portion at the second end of the augment being shaped to generally conform to the anterior-medial wall at the metaphyseal region of the canal, and wherein the shape of the posterior curvature portion at the metaphyseal region is different than the shape of the anterior-medial portion at the metaphyseal region.

14. The augment of claim 13, wherein the shape of the posterior curvature portion and the shape of the anterior-medial portion at the first end of the outer wall is separated from the shape of the posterior curvature portion and the shape of the anterior-medial portion at the second end by a distance that is approximately the distance between the metaphyseal-diaphyseal junction and the metaphyseal region of the canal of the bone.

15. The augment of claim 13 or 14, wherein the posterior curvature portion and the anterior-medial portion have a generally circular or oval shape at the first end of the augment.

16. The augment of any one of claims 13-15, wherein the augment wall includes one or more openings that extend from the second end and through the augment wall, the one or more openings sized to receive placement of a portion of a component of the orthopedic implant device, and wherein the augment wall generally defines an inner region that is sized to receive insertion of one or more components of the orthopedic implant device.

17. The augment of claim 16, wherein the one or more openings comprises a first opening and a second opening, the first and second openings each sized to receive insertion of a keel of the orthopedic implant device.

18. The augment of any one of claims 13-17, wherein an outer portion of the augment wall includes a relief that is configured to accommodate rotational displacement of the augment relative to a component of the orthopedic implant device.

19. The augment of claim 18, wherein the relief is positioned along the outer portion at a location that permits, when implanted in a patient, the relief to be adjacent to an anterior flange of the orthopedic implant device.
20. The augment of claim 18 or 19, wherein the relief comprises at least one sidewall that tapers outwardly as the at least one sidewall extends from the second end and toward the first end.

21. The augment of any one of claims 13-20, wherein the augment wall includes one or more relief areas that are configured to relieve at least a portion of the augment to accommodate placement of the augment about one or more components of the orthopedic implant device.
A. CLASSIFICATION OF SUBJECT MATTER
INV. 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

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Date of the actual completion of the international search
29 July 2016

Date of mailing of the international search report
09/08/2016

Name and mailing address of the ISA:
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