Title: STRUCTURE FOR JOINING AND RETAINING MULTIPART ORTHOPEDIC IMPLANTS

Abstract: An orthopedic implant structure is provided for joining and retaining components of a multi-part orthopedic device. The orthopedic implant joining and retaining structure may be embodied in two or more components of the multi-part orthopedic device. In one form, the multi-part orthopedic implant structure is a resilient snap structure (36) such as a resilient flange (50) in one part (12a) and a channel structure (34) formed in another part (12b) of an orthopedic implant (10). A channel (40) of the channel structure (34) may have a cavity (42) formed at a rear of the channel (40) that accepts a configured lip (52) formed on an end of the resilient flange (50). According to another embodiment, the retaining structure includes resilient snap flanges (202) formed on an interconnection component (166) of the multi part orthopedic implant (160). A corresponding bore (198) in another part (164) of the multi-part orthopedic implant (160) receives the interconnection component (166).
For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.
STRUCTURE FOR JOINING AND RETAINING MULTI-PART ORTHOPEDIC IMPLANTS

RELATED APPLICATIONS

This patent application claims the benefit of and/or priority to U.S. Provisional Patent Application No. 60/775,103 filed February 21, 2006, entitled "Retaining Structure For Multi-Part Orthopedic Devices" the entire contents of which is specifically incorporated herein by reference.

Field of the Invention

The present invention relates to orthopedic devices and components and, more particularly, to a structure for joining and retaining parts of multi-part orthopedic devices.

Background of the Invention

Orthopedic treatment for the correction of skeletal problems due to trauma, injury, disease, deformity or the like can include orthopedic surgery for implanting one or more orthopedic devices. Orthopedic surgery is now commonly used to implant artificial joints, mend bones and correct spinal problems. The manufacture of orthopedic implants such as joint replacement devices and spinal devices comprises a large sector of the orthopedic industry.

Because of the configuration of some orthopedic implants, various types of orthopedic implants need to be assembled before use. Sometimes assembly is accomplished before implantation and sometimes assembly is accomplished during implantation. In either case, the parts or components of the orthopedic implant need to be joined in a reliable, accurate and dependable manner that allows the assembly and retention of the components. Thus, a structure is necessary to allow the components of the orthopedic implant to be joined and retained in a reliable, accurate and dependable manner.
In view of the above, it is desirable to provide a structure to join and retain components or parts of an orthopedic implant in a reliable, accurate and dependable manner. It is thus an object of the present invention to provide a structure and/or manner to join one part of an orthopedic implant with another part of the orthopedic implant in order to hold the parts together during use.
SUMMARY OF THE INVENTION

An orthopedic implant structure is provided for joining and retaining components of a multi-part orthopedic device. The orthopedic implant joining and retaining structure may be embodied in two or more components of the multi-part orthopedic device.

In one form, the multi-part orthopedic implant joining and retaining structure is a resilient snap structure. The present structure provides a positive, reliable, accurate and dependable joining and retention mechanism that is fabricated from a bio-compatible material.

According to one embodiment, the retaining structure includes a channel formed in one portion of one part of an orthopedic implant and a resilient flange formed in one portion of another part of the orthopedic implant. The channel has a cavity formed at a rear of the channel. A configured lip is formed on an end of the resilient flange. The resilient flange bends during insertion into the channel due to the configured lip and dimensions of the partially open channel. Once the lip of the flange reaches the cavity of the channel, the resiliency of the flange causes the flange to bend or snap into the cavity. Reverse motion of parts is inhibited by co-action of the lip and a front edge of the cavity.

Depending on the length of the cavity, the retaining structure may allow limited movement of one part relative to another part. In this manner, the orthopedic device may be limitedly dynamic.

According to another embodiment, the retaining structure includes resilient snap flanges formed on an interconnection component of the multi-part orthopedic implant. Corresponding recesses in another part of the multi-part orthopedic implant receives the interconnection component. Dimensioned channels terminating in an open area formed in two (or more) pieces of an orthopedic implant causes the deformation of the snap flanges of the interconnection component during connection that thereafter resiliently return to their original state upon reaching the open area.

Other snap configurations and orthopedic implants and/or devices are also contemplated in accordance with the present principles. In one form,
the resilient snap structure includes a resilient head structure of a bone screw that deforms upon insertion into a configured head structure of a spine fixation construct. In yet another form, the resilient snap structure includes configured, pivoting cams of a head structure of a spine fixation construct that snap into a configured connection plate. The connection plate is configured with a rim and trough that provide snap connection by the pivoting cams.
BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other features of the present invention will become more apparent to one skilled in the art upon also reading the following description of embodiments with reference to the accompanying drawings wherein:

FIG. 1 is a perspective view of a one level (1-L), two piece spine plate utilizing an embodiment of a retaining structure in accordance with the present principles;

FIG. 2 is a top perspective view of the one segment of the one level, two piece spine plate of FIG. 1;

FIG. 3 is a bottom perspective view of the spine plate segment of FIG. 2;

FIG. 4A is an enlarged sectional view of the retaining structure illustrating the manner in which the retaining structure joins;

FIG. 4B is an enlarged sectional view of the retaining structure after joining;

FIG. 5 is a perspective view of a two level (2-L), three piece spine plate utilizing an embodiment of a retaining structure in accordance with the present principles;

FIG. 6 is a top perspective view of a middle segment of the two level, three piece spine plate of FIG. 5;

FIG. 7 is a bottom perspective view of the middle segment of FIG. 6;

FIG. 8 is bottom plan view of the two level, three piece spine plate of FIG. 5;

FIG. 9 is an exploded perspective view of a two-piece vertebral interbody device utilizing an embodiment of a retaining structure in accordance with the present principles;

FIG. 10 is an enlarged, perspective view of a portion of the two-piece vertebral interbody device illustrating anti-rotation features thereof;
FIG. 11 is an enlarged perspective view of a two-sided retention post utilized to join the two pieces of the vertebral interbody device of FIG. 9;

FIG. 12 is a top view of the two-piece vertebral interbody device of FIG. 9, assembled;

FIG. 13 is a sectional view of the two-piece vertebral interbody device taken along line 13-13 of FIG. 12; and

FIG. 14 is an enlarged sectional view of a portion of the two-piece vertebral interbody device taken along circle 14-14 of FIG. 13.

Corresponding reference characters indicate corresponding parts throughout the several views. Although the drawings represent embodiments of the invention, the drawings are not necessarily to scale and certain features may be exaggerated in order to better illustrate and explain the principles of the present invention. The exemplifications set out herein illustrate several embodiments of the invention, but the exemplifications are not to be construed as limiting the scope of the invention in any manner.
DETAILED DESCRIPTION OF THE INVENTION

FIGS. 1-8 depict various views of an orthopedic implant or device utilizing an embodiment of the present invention and particularly utilizing a joining and retaining structure. Referring to FIG. 1 there is depicted an orthopedic implant generally designated 10 that is particularly a one level (1-L), two piece spine plate. The spine plate 10 is representative of the various types of spine plates that may use the present invention.

The spine plate 10 is preferably, but not necessarily, made from a suitable, biocompatible material such as titanium. The spine plate 10 is formed of identical first and second segments, parts, components or halves 12a and 12b one of which is rotated 180° relative to the other part, then joined with the other half. As such, the plate segment 12b is identical to plate segment 12a and thus the same parts of plate segment 12b are labeled with the same number but provided with the letter designation "b." It should be appreciated that the present invention is not dependent upon such symmetry and thus can be used on non-symmetrical segments of spine plates.

Plate segment 12a has two screw bores 16a and 18a with a cover plate bore 20a disposed between the screw bores 16a and 18a. A first leg 22a extends from adjacent the screw bore 16a while a second leg 24a extends from adjacent the screw bore 18a. When joined, the plate segments 12a and 12b form an oblong opening or window 30. Referring additionally to FIGS. 2 and 3 (showing a top perspective view and a bottom perspective view respectively) a plate segment labeled 12 is shown representing the plate segments 12a and 12b since they are identical.

The leg 22 includes a reception area 34 defined by a partially open, configured slot or channel 40 that terminates in an end wall 58. The slot 40 includes a cutout 42 having a front, sloping ledge 44. The leg 22 also defines a front surface 54.

The leg 24 includes a retention structure 36 on a front portion of a projection 46 extending beyond a stop surface 56. The retention structure 36 includes first and second relief slots 48 and 49 that define a flange 50.
The flange 50 has a front lip 52 that extends upward from the surface of the flange 50 and thus the projection 46. The flange 50 is somewhat resilient in that pressure or force exerted onto the flange 50 through the lip 52 causes the flange 50 to deform or bend slightly in a direction of the applied pressure. Because the flange 50 is resilient, the flange 50 returns to its original position or normal state after the pressure or force upon the lip 52 ceases.

The flange 50 is adapted to be received in the cutout 42. With additional reference to FIGS. 4A and 4B, as the projection 46 is inserted into the slot 40, the sides of the slot 40 retain the projection 46 in the slot 40 while the flange 50 bends toward the open area of the slot 40 due to contact with surface 53 of the slot 40. Further travel of the flange 50 towards the end surface 58 of the slot 40 allows the lip 52 to encounter sloped ledge 44. Once the lip 52 encounters ledge 44, the resiliency of the flange 50 causes the flange to bend back (snap) into its original position and thus into the cutout, cavity or concavity 42.

Travel of two components relative to one another ceases when surface 59 contacts surface 58 and surface 56 contacts surface 54. As seen in FIG. 4B, the plate 10 may be limitedly dynamic to the extent that there is distance between the lip 52 and the ledge 44 as represented by the double-headed arrow. The plate 10 may be static if there is no distance between the lip 52 and the ledge 44.

Referring to FIG. 5, there is depicted an embodiment of another orthopedic device generally designated 60 in which the present invention may be used. Particularly, FIG. 5 depicts a two level (2-L) spine plate. The two level spine plate is formed by providing a middle part or component 70 between the components 12a and 12b. The middle component 70 is configured to receive the end components 12a and 12b. The middle component 70 is formed of a body 72 having a first screw bore 74 and a second screw bore 76. A plate cover bore 78 is disposed between the screw bores 74 and 76. A first leg 80 extends from one side of the body 72 adjacent the bore 74. A second leg 82 extends from one side of the body 72 adjacent the bore 74 opposite to that of the first leg 80. A third leg 84 extends from one side of the body 72 adjacent the bore 76, while a fourth leg
86 extends from one side of the body 72 adjacent the bore 76 opposite to that of the third leg 84. The first and third legs 80, 84 extend in the same direction while the second and fourth legs 82, 86 extend in the same direction. The two level plate 60 thus defines first and second oblong windows 88 and 90. The window 88 is defined between the middle component 70 and the end component 12a while the window 90 is defined between the middle component 70 and the end component 12b.

Referring to FIGS. 6 and 7, there is depicted a top perspective view and a bottom plan view, respectively, of the middle component 72. The leg 80 includes a retention structure 92 on a front portion of a projection 94 extending beyond a stop surface 96. The retention structure 92 includes first and second relief slots 98 and 99 that define a flange 100. The flange 100 has a front lip 102 that extends upward from the surface of the flange 100 and thus the projection 96. The flange 100 is somewhat resilient in that pressure or force exerted onto the flange 100 through the lip 102 causes the flange 100 to deform or bend slightly in a direction of the applied pressure. Because the flange 100 is resilient, the flange 100 returns to its original position or normal state after the pressure or force upon the lip 102 ceases.

The leg 82 includes a reception area 126 defined by a partially open, configured slot or channel 128 that terminates in an end wall 136. The slot 128 includes a cutout 132 having a front, sloping ledge 134. The leg 82 also defines a front surface 138. The reception area 126 is configured to receive the retention structure 36b of the end component 12b in like manner to the reception of the retention structure 36b into the reception area 34a.

The leg 84 includes a reception area 130 defined by a partially open, configured slot or channel 140 that terminates in an end wall 146. The slot 140 includes a cutout 142 having a front, sloping ledge 144. The leg 84 also defines a front surface 148. The reception area 130 is configured to receive the retention structure 36a of the end component 12a in like manner to the reception of the retention structure 36a into the reception area 34b.

The leg 86 includes a retention structure 110 on a front portion of a projection 112 extending beyond a stop surface 114. The retention structure 110 includes first and second relief slots 116 and 117 that define a flange
118. The flange 118 has a front lip 120 that extends upward from the surface of the flange 118 and thus the projection 112. The flange 118 is somewhat resilient in that pressure or force exerted onto the flange 118 through the lip 120 causes the flange 118 to deform or bend slightly in a direction of the applied pressure. Because the flange 118 is resilient, the flange 118 returns to its original position or normal state after the pressure or force upon the lip 120 ceases.

It can be seen that the middle structure 70 is symmetric about a 180° rotation of itself. FIG. 8 depicts an underside view of the two level spine plate 60.

FIGS. 9-14 depict various views of another orthopedic implant or device utilizing an embodiment of the present invention and particularly a joining and retaining structure. Referring to FIG. 9, there is depicted an orthopedic implant generally designated 160 that is particularly a two-piece, vertebral interbody or intrabody device. The two-piece, vertebral interbody device 160 is representative of the various types of N-piece vertebral interbody devices that may use the present invention. Particularly, pieces of the interbody device are connected to one another via a connection device having resilient snaps or snap structures. The resilient snaps deform when received by an interbody piece, but then return to their original position once received.

The interbody device 160 includes a first piece, portion or section 162 and a second piece, portion or section 164 that are joined by a connection device 166. The first and second pieces 162, 164 and the connection device 166 are formed of a bio-compatible material. Also, the nomenclature first and second is arbitrary.

The first piece 162 is defined by a generally arced oblong body 168. The body 168 has a toothed or serrated upper surface 170 and a toothed or serrated lower surface 172. The nomenclature upper and lower is arbitrary. The body 168 defines an inner cavity 174 and a plurality of side windows. While one end of the body 168 is curved, the other end has an essentially flat face 176. Anti-rotation features are provided on/in the flat face 176. Particularly, first and second posts or pegs 178a, 178b are provided on
opposite corners of the face 176. Additionally, first and second bores 180a, 180b are provided on opposite corners, opposite to the posts 178a, 178b. A central connection device bore 182 is also provided in the face 176.

The second piece 164 is defined by a generally arced oblong body 184. The body 184 has a toothed or serrated upper surface 186 and a toothed or serrated lower surface 188. The nomenclature upper and lower is arbitrary. The body 184 defines an inner cavity 190 and a plurality of side windows. While one end of the body 184 is curved, the other end has an essentially flat face 192 (see, e.g. FIG. 10). Anti-rotation features are provided on/in the face 192. Particularly, first and second posts or pegs 194a, 194b are provided on opposite corners of the face 192. Additionally, first and second bores 196a, 196b are provided on opposite corners, opposite to the posts 194a, 194b. A central connection device bore 198 is also provided in the face 192.

The posts 178a, 178b of the body 168 of the first piece 160 are sized and configured to be received in the bores 196b, 196a, respectively, in the face 192 of the body 184 of the second piece 162 when joined. Likewise, the posts 194a, 194b of the body 184 of the second piece 162 are sized and configured to be received in the bores 180b, 180a, respectively, in the face 176 of the body 168 of the first piece 160 when joined. The reception of posts and bores upon joining of the first and second pieces 160, 162 prohibits rotation of one piece relative to another piece (anti-rotation).

FIG. 11 particularly depicts the connection device 166 that allows the joining of the first and second pieces 162, 164. The connection device 166 is defined by a generally cylindrical body 200 having a first head or end 202 and a second head or end 204. The nomenclature first and second is arbitrary. The first and second heads 202, 204 are formed as resilient snap structures. The first head 202 has four snaps 206a, 206b, 206c, 206d that define an "X" pattern of slots in the first head 202 and respective ledges 207a, 207b, 207c, 207d. The second head 204 has four snaps 208a, 208b, 208c, 208d that define an "X" pattern of slots in the first head 204 and respective ledges 209a, 209b, 209c, 209d. A portion of each of the snaps 206a, 206b, 206c, 206d, 208a, 208b, 208c, 208d extend radially beyond the
radial dimension of the cylindrical body 200 such that the ledges 207a, 207b, 207c, 207d, 209a, 209b, 209c, 209d of the respective snaps 206a, 206b, 206c, 206d, 208a, 208b, 208c, 208d extend radially beyond the radial dimension of the cylindrical body 200 (i.e. the middle portion thereof between the heads 202, 204).

With particular reference to FIGS. 13 and 14, the central bore 182 of the first piece 160 and the central bore 198 of the second piece 162 is sized radially to receive the connection device 200. Particularly, the radial size (diameter) of each central bore 182, 198 is sized to cause the snaps 206a, 206b, 206c, 206d, 208a, 208b, 208c, 208d to deform radially inward during insertion and travel through the bores 182, 198 but snugly surround the middle cylindrical portion of the body 200 of the connection device 166. The length of each of the central bores 182 and 198 is such that the snaps 206a, 206b, 206c, 206d, 208a, 208b, 208c, 208d will spring or return back to their original position and allow the ledges 207a, 207b, 207c, 207d, 209a, 209b, 209c, 209d of respective snaps 206a, 206b, 206c, 206d, 208a, 208b, 208c, 208d to rest against the inner walls of the respective pieces 160, 162. In this manner, the two pieces 160, 162 of the interbody device are joined, coupled, or connected.

Other orthopedic implants may utilize embodiments of the present invention. For example, spine fixation constructs may utilize the present joining and retaining structure. In one form, a bone screw structure is connected to a rod holder of a rod holder construct via a resilient snap structure. The resilient snap structure of the rod holder expands when a configured head of the bone screw structure is inserted therein and then contracts back to its normal state around the configured head to retain the configured head and thus the bone screw structure. In this embodiment, the spine fixation construct thus includes a bone screw structure and a rod holder construct. A spine rod is retained in and by the rod holder construct and may or may not be considered as part of the spine fixation construct.

Another form of a spine fixation construct that utilizes the present joining and retaining structure provides for two bone screw structures, a snap connection plate and two head constructs form. In this embodiment,
the two head constructs are coupled to the snap connection plate via cam lock snaps. A construct comprising two head constructs and the snap connection plate is then situated onto the two bone screw structures.

While the invention has been illustrated and described in detail in the drawings and foregoing description, the same is to be considered as illustrative and not restrictive in character, it being understood that only preferred embodiments has been shown and described and that all changes and modifications that come within the spirit of the invention are desired to be protected.
CLAIMS

What is claimed is:

1. An orthopedic implant (10) comprising:
   a first component (12a); and
   a second component (12b) for assembly with the first component (12a);
   the first component (12a) having a first snap structure (36) integrally formed therewith; and
   the second component (12b) having a second snap structure (34) integrally formed therewith and configured for engagement with the first snap structure (36) whereby the first and second components (12a, 12b) are joined and retained together.

2. The orthopedic implant (10) of claim 1, wherein the first snap structure (36) comprises a resilient flange (50).

3. The orthopedic implant (10) of claim 2, wherein the second snap structure (34) comprises a channel (40) configured to receive the resilient flange (50), and a cavity (42) formed at a rear of the channel (40).

4. The orthopedic implant (10) of claim 3, wherein the channel (40) comprises a partially open channel.

5. The orthopedic implant (10) of claim 3, further comprising a configured lip (52) formed on an end of the resilient flange (50) and wherein the resilient flange (50) is compressed during insertion into the channel (40) due to the configured lip (52) and dimensions of the partially open channel (40) and then decompresses once the configured lip (52) of the resilient flange (50) reaches the cavity (42) of the channel (40) and the resiliency of the resilient flange (50) causes the resilient flange (50) to snap into the cavity (42).
6. The orthopedic implant (10) of claim 5, wherein the cavity (42) includes a ridge and front edge (44) that inhibits reverse motion of the first and second components (12a, 12b).

7. The orthopedic implant (10) of claim 1, wherein the first component (12a) comprises one portion of a spine plate and the second component comprises another portion of the spine plate.

8. A joining and retaining structure for a multi-part orthopedic implant (160) comprising:
   a resilient snap structure (202) integrally formed in a first part (166) of the multi-part orthopedic implant (160); and
   a recess (182) integrally formed in a second part (162) of the multi-part orthopedic implant (160) that is adapted to be assembled with the first part (166) of the multi-part orthopedic implant, the recess (182) adapted to receive the resilient snap structure (202) upon assembly of the first and second parts (166, 162).

9. The joining and retaining structure (160) of claim 8, wherein the recess (182) comprises a bore configured to receive the resilient snap structure, and a cavity (174) formed at a rear of the bore.

10. The joining and retaining structure (160) of claim 8, wherein the recess (182) includes an interior wall that inhibits reverse motion of the first and second parts (166, 162).

11. The joining and retaining structure (160) of claim 10, wherein the resilient snap structure (202) comprises a slotted head.
12. An orthopedic implant comprising:
   a first component having a resilient flange structure integrally formed therewith; and
   a second component for assembly with the first component, the second component having an edge structure integrally formed therewith and configured to receive and retain the resilient flange structure during assembly of the first and second components whereby the first and second components are joined and retained together.

13. The orthopedic implant of claim 12, wherein the edge structure is formed by a cavity.

14. The orthopedic implant of claim 12, wherein the edge structure is formed by a bore.

15. The orthopedic implant of claim 13, wherein the edge structure is formed by a channel.
Fig. 4A

Fig. 4B
Fig. 14