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LOW PROFILE PLATE

Abstract

The present application generally relates to orthopedic systems, and in particular, to systems including independent plates and spacers. A plating system can include a spacer and a plate that is independent from the spacer. A number of locking mechanisms can be provided to secure the plate to the spacer. In some cases, the spacer includes a pair of notches that extend on an outer surface of the spacer. The plate can include a pair of lateral extensions that can engage the notches to secure the plate to the spacer. In other cases, the spacer includes an opening including a pair of inlets. The plate can include an enclosed posterior extension that can be received in the pair of inlets to secure the plate to the spacer.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATIONS [0001] The present application is a continuation of U.S. patent application Ser. No. 18/342,826 filed on Jun. 28, 2023, which is a continuation of U.S. application Ser. No. 17/140,358 which is a continuation of U.S. application Ser. No. 16/033,277 filed Jul. 12, 2018, which is a continuation-in-part of U.S. Ser. No. 15/278,481 filed Sep. 28, 2016, which is (i) a continuation-in-part application of U.S. Ser. No. 14/476,439, filed Sep. 3, 2014 and (ii) a continuation-in-part application of U.S. Ser. No. 14/727,035, filed Jun. 1, 2015, which is a continuation-in-part application of U.S. application Ser. No. 14/341,035, filed

Jul. 25, 2014, which is a continuation-in-part application of U.S. Ser. No. 14/320,200, filed Jun. 30, 2014, which is a continuation-in-part application of U.S. Ser. No. 14/190,948, filed Feb. 26, 2014, now issued as U.S. Pat. No. 9,237,957, which is a continuation-in-part application of (i) U.S. Ser. No. 13/785,434, filed Mar. 5, 2013, now issued as U.S. Pat. No. 9,149,365, and of (ii) U.S. Ser. No. 14/085,318, filed Nov. 20, 2013, now issued as U.S. Pat. No. 9,398,960, which is a continuation-in-part application of U.S. patent application Ser. No. 13/785,856, filed Mar. 5, 2013, now issued as U.S. Pat. No. 9,204,975, which is a continuation-in-part of U.S. patent application Ser. No. 13/559,917, filed Jul. 27, 2012, now issued as U.S. Pat. No. 8,961,606, which is a continuation-in-part of Ser. No. 13/267,119, filed Oct. 6, 2011, which claims priority to U.S. Provisional Application 61/535,726, filed on Sep. 16, 2011, the entire of contents of each of the references are incorporated by reference herein in their entirety.

FIELD OF THE INVENTION

[0002] The present application is generally directed to orthopedic systems, and in particular, to systems including plates and spacers.

BACKGROUND

[0003] Spinal discs and/or vertebral bodies of a spine can be displaced or damaged due to trauma, disease, degenerative defects, or wear over an extended period of time. One result of this displacement or damage may be chronic back pain. In some cases, to alleviate back pain, the disc can be removed and replaced with an implant, such as a spacer, that promotes fusion. In addition to providing one or more spacers, a plating system can be used to further stabilize the spine during the fusion process. Such a plating system can include one or more plates and screws for aligning and holding vertebrae in a fixed position with respect to one another.

[0004] Accordingly, there is a need for improved systems involving plating systems and spacers for spinal fusion and stabilization.

SUMMARY OF THE INVENTION

[0005] Various systems, devices and methods related to plating systems are provided. In some embodiments, a spinal system comprises a spacer for inserting into an intervertebral space and a plate configured to abut the spacer. The spacer can include an upper surface, a lower surface and an opening that extends between the upper surface to the lower surface, wherein the spacer further includes a tapered leading end. The plate for abutting the spacer can include a plate body, a first opening formed in the plate body for receiving a first bone screw, a second opening formed in the plate body for receiving a second bone screw, a set screw, and a pair of extensions that extend from the plate body that are configured to engage the spacer. The first opening can angled in an upward direction, while the second opening can be angled in a downward direction. The set screw can be configured to prevent back-out of both the first and the second bone screws, wherein the set screw has a first position whereby the first and second bone screws can be inserted past the set screw and into the first and second openings and a second position following rotation of the set screw whereby the first and second bone screws are prevented from backing out by the set screw. A first bone screw is provided for inserting into the first opening in the plate body, wherein the first bone screw is configured to be inserted into a first vertebral body. A second bone screw is provided for inserting into the second opening in the plate body, wherein the second bone screw is configured to be inserted into a second vertebral body different from the vertebral body.

[0006] In other embodiments, a spinal system comprises a spacer for inserting into an intervertebral space and a plate configured to abut the spacer. The spacer can include an upper surface, a lower surface and an opening that extends between the upper surface to the lower surface, wherein the spacer further includes a concave leading end. The plate for abutting the spacer can include a plate body, a first opening formed in the plate body for receiving a first bone screw, a second opening formed in the plate body for receiving a second bone screw, a set screw, and a pair of extensions that extend from the plate body that are configured to engage the spacer. The first opening can angled in an upward direction, while the second opening can be angled in a downward direction. The set screw can be configured to prevent back-out of at least one of the first and the second bone screws, wherein the set screw has a first position whereby at least one of the first and second bone screws can be inserted past the set screw and into at least one of the first and second openings and a second position following rotation of the set screw whereby at least one of the first and second bone screws are prevented from backing out by the set screw. Each of the pair of extensions can include a window that extends along a length of the extension. A first bone screw is provided for inserting into the first opening in the plate body, wherein the first bone screw is configured to be inserted into a first vertebral body. A second bone screw is provided for inserting into the second opening in the plate body, wherein the second bone screw is configured to be inserted into a second vertebral body different from the vertebral body.

[0007] In some embodiments, a spinal system comprises a spacer for inserting into an intervertebral space and a plate configured to abut the spacer. The spacer can include an upper surface, a lower surface and an opening that extends between the upper surface to the lower surface. The plate for abutting the spacer can include a plate body, a first opening formed in the plate body for receiving a first bone screw, a second opening formed in the plate body for receiving a second bone screw, a set screw, and a pair of extensions that extend from the plate body that are configured to engage the spacer. The first opening can angled in an upward direction, while the second opening can be angled in a downward direction. The set screw can be configured to prevent back-out of at least one of the first and the second bone screws, wherein the set screw has a first position whereby at least one of the first and second bone screws can be inserted past the set screw and into at least one of the first and second openings and a second position following rotation of the set screw whereby at least one of the first and second bone screws are prevented from backing out by the set screw. Each of the pair of extensions can include a window that extends along a length of the extension. A first bone screw is provided for inserting into the first opening in the plate body, wherein the first bone screw is configured to be inserted into a first vertebral body. A second bone screw is provided for inserting into the second opening in the plate body, wherein the second bone screw is configured to be inserted into a second vertebral body different from the vertebral body. The spacer and the plate are independent from one another such that the spacer can be inserted into a desired spinal location prior to abutting the spacer with the plate.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIGS. **1**A-**1**D illustrate different views of a low profile plate attached to a spacer according to some embodiments.

[0009] FIGS. **2**A-**2**D illustrate different views of the low profile plate shown in FIGS. **1**A-**1**D.

[0010] FIGS. **3**A-**3**D illustrate different views of a PEEK spacer to be used with the low profile plate shown in FIGS. **2**A-**2**D.

[0011] FIGS. **4**A-**4**D illustrate different views of an allograft spacer to be used with the low profile plate shown in FIGS. **2**A-**2**D.

[0012] FIGS. **5**A-**5**D illustrate different views of a second alternative embodiment of a low profile plate attached to a spacer according to some embodiments.

[0013] FIGS. **6**A-**6**D illustrate different views of the low profile plate shown in FIGS. **5**A-**5**D.

[0014] FIGS. **7**A-**7**D illustrate different views of a PEEK spacer to be used with the low profile plate in FIGS. **6**A-**6**D.

[0015] FIGS. **8**A-**8**D illustrate different views of an allograft spacer to be used with the low profile plate in FIGS. **6**A-**6**D.

[0016] FIGS. **9**A-**9**D illustrate different views of a third alternative embodiment of a low profile plate attached to a spacer according to some embodiments.

[0017] FIGS. **10**A-**10**D illustrate different views of the low profile plate shown in FIGS. **9**A-**9**D.

[0018] FIGS. **11**A-**11**D illustrate different views of a fourth alternative embodiment of a low profile plate attached to a spacer according to some embodiments.

[0019] FIGS. **12**A-**12**D illustrate different views of the low profile plate shown in FIGS. **11**A-**11**D.

[0020] FIGS. **13**A-**13**D illustrate different views of a multi-piece allograft spacer to be used with the low profile plates discussed above according to some embodiments.

[0021] FIGS. **14**A-**14**D illustrate different views of an alternative multi-piece allograft spacer to be used with the lower profile plates discussed above according to some embodiments.

[0022] FIGS. **15**A-**15**D illustrate different views of an alternative low profile plate attached to a spacer according to some embodiments.

[0023] FIGS. **16**A-**16**D illustrate different views of a low profile plate shown in FIGS. **15**A-**15**D.

[0024] FIGS. **17**A-**17**C illustrate different views of a spacer shown in FIGS. **15**A-**15**D.

[0025] FIGS. **18**A-**18**D illustrate different views of another alternative low profile plate attached to a spacer according to some embodiments.

[0026] FIG. **19** illustrates a lordotic version of the low profile plate and spacer shown in FIGS. **18**A-**18**D.

[0027] FIGS. **20**A-**20**D illustrate different views of another alternative low profile plate attached to multiple spacers according to some embodiments.

[0028] FIGS. **21**A and **21**B illustrate different views of another alternative low profile plate attached to multiple spacers according to some embodiments.

[0029] FIG. **22** illustrates another alternative low profile plate attached to multiple spacers according to some embodiments.

[0030] FIG. **23** illustrates another alternative low profile plate attached to multiple spacers according to some embodiments.

[0031] FIGS. **24**A-**24**C illustrate another alternative low profile plate attached to a multi-piece spacer having three pieces according to some embodiments.

[0032] FIGS. **25**A and **25**B illustrate another alternative low profile plate attached to a multi-piece spacer having a metal insert according to some embodiments.

[0033] FIGS. **26**A-**26**D illustrate another alternative plate having raised and lowered screw openings in attachment with a spacer according to some embodiments.

[0034] FIGS. **27**A-**27**D illustrate another alternative plate having raised and lowered screw openings in attachment with a spacer according to some embodiments.

[0035] FIG. **28** illustrates the plate and spacer in FIGS. **26**A-**26**D in use within a vertebral space.

[0036] FIGS. **29**A-**29**C illustrate the plate in FIGS. **26**A-**26**D.

[0037] FIGS. **30**A-**30**E illustrate different views of an allograft spacer that can be used with the plate in FIGS. **26**A-**26**D.

[0038] FIGS. **31**A-**31**E illustrate different views of a PEEK spacer that can be used with the plate in FIGS. **26**A-**26**D.

[0039] FIGS. **32**A and **32**B illustrate different views of a spacer having a notch having a curved channel in accordance with some embodiments.

[0040] FIGS. **33-40** illustrate various views of a vertebral spacer in accordance with a first exemplary embodiment of the present disclosure.

[0041] FIG. **41** is a perspective view of another exemplary intervertebral spacer in accordance with an example of the present disclosure.

[0042] FIG. **42** is an insertion device in accordance with an example of the present disclosure.

[0043] FIGS. **43-46** depict various end or cross-sectional views of the insertion device of FIG. **42**.

[0044] FIGS. **47-49** depict the insertion device of FIG. **42** coupled with an intervertebral anchor in accordance with an example of the present disclosure.

[0045] FIGS. **50-55** depict an exemplary tool and method of installing a vertebral anchor in accordance with an example of the present disclosure.

[0046] FIG. **56** is a perspective view of another exemplary insertion device in accordance with an example of the present disclosure.

[0047] FIG. **57** is a perspective view of an insertion device and an intervertebral spacer having a plurality of fasteners in accordance with an example of the present disclosure.

[0048] FIGS. **58-60** depict another exemplary method of installing a vertebral anchor in accordance with an example of the present disclosure.

[0049] FIG. **61** is a side view of a vertebral anchor in accordance with an example of the present disclosure.

[0050] FIG. **62** is an enlarged view of detail A in FIG. **61**, illustrating a distal portion of the vertebral anchor of FIG. **29**.

[0051] FIG. **63** is a top view of the vertebral anchor of FIG. **61**.

[0052] FIG. **64** is an enlarged view of detail B in FIG. **63**, illustrating a distal portion of the vertebral anchor of FIG. **31**.

[0053] FIG. **65** is a perspective view of the vertebral anchor of FIG. **61**.

[0054] FIG. **66** is an enlarged view of detail C in FIG. **65**, illustrating a distal portion of the vertebral anchor of FIG. **65**.

[0055] FIG. **67** is another perspective view of the vertebral anchor of FIG. **61**.

[0056] FIG. **68** is an end view of the vertebral anchor of FIG. **61**.

[0057] FIGS. **69-72** illustrate various views of another exemplary vertebral anchor in accordance with an example of the present disclosure.

[0058] FIG. **73** is a top perspective view of a plate and spacer system with curved bone anchors in accordance with some embodiments.

[0059] FIG. **74** is a top perspective view of a plate and spacer system with straight bone anchors in accordance with some embodiments.

[0060] FIG. **75** is a top perspective view of a plate in accordance with some embodiments.

[0061] FIG. **76** is a front view of the plate of FIG. **75**.

[0062] FIG. **77** is a top view of the plate of FIG. **75**.

[0063] FIG. **78** is a top perspective view of a PEEK spacer in accordance with some embodiments.

[0064] FIG. **79** is a top perspective view of an allograft spacer in accordance with some embodiments.

[0065] FIG. **80** is a top perspective view of an alternative allograft spacer in accordance with some embodiments.

[0066] FIGS. **81**A and **81**B provide top perspective views of a spacer and a plate and spacer system, respectively, in accordance with one embodiment.

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

[0067] The present application is generally directed to orthopedic systems, and in particular, to systems including plates and spacers.

[0068] The present application discloses orthopedic plating systems that can be used in spinal surgeries, such as spinal fusions. The plating systems disclosed herein include a plate and a spacer that are independent from one another. In some cases, the plate and the spacer can be pre-attached to one another before positioning them in a desired location of the spine. In other cases, the spacer can first be inserted into a desired location of the spine, and then the plate can be inserted thereafter. Advantageously, the plating systems disclosed herein are of low-profile. For example, they can provide a very small, anterior footprint cervical plate solution for fusion procedures. One skilled in the art will appreciate that while the plating systems can be used with cervical procedures, the plating systems are not limited to such areas, and can be used with other regions of the spine.

[0069] FIGS. **1**A-**1**D illustrate different views of a plating system comprising a low profile plate attached to a spacer according to some embodiments. The plating system **5** includes a spacer **10** attached to a low-profile plate **50**. Advantageously, the plating system **5** can be inserted through an anterior approach into a spine, and can desirably provide a small anterior footprint.

[0070] The spacer **10** is configured to have an upper surface **12**, a lower surface **14**, and a leading end **22**. In some embodiments, the upper surface **12** and/or lower surface **14** includes texturing **16**, such as teeth, ribs, ripples, etc. to assist in providing frictional contact with adjacent vertebral bodies. In some embodiments, the leading end **22** of the spacer **10** can be slightly tapered, as shown in FIG. **1**A. With the taper, the leading end **22** can serve as a distraction surface that helps the spacer to be inserted into an intervertebral space. As shown in FIG. **1**B, the leading end **22** can be concave, though in other embodiments, the leading end **22** can be straight or convex.

[0071] The spacer **10** can be substantially C-shaped (as shown in FIG. **3**B), whereby it includes two side arms **13** that surround an inner opening **20**. Adjacent the side arms **13** is a convex wall **19**. In some embodiments, the convex wall **19** is substantially parallel to the concave surface of the leading end **22**. The opening **20**, which is configured to receive natural or synthetic graft material therein to assist in a fusion procedure, has an open side that is opposite convex wall **19**, thereby giving the spacer **10** its C-shape.

[0072] The spacer **10** has a number of unique features that accommodate the attachment of a plate **50** thereto. Each of the side arms **13** of the spacer **10** includes a notch **17** (shown in FIG. **3**B) for receiving a corresponding protrusion **71** of a lateral arm or extension **70** of the plate **50**, thereby advantageously forming a first locking mechanism between the spacer **10** and the plate **50**. In addition, in some embodiments, each of the side arms **13** of the spacer **10** can also include a hump region **26** (shown in FIG. **3**B) that can extend in part into a window **72** of an attached plate **50** (shown in FIG. **2**A), thereby advantageously providing a second locking mechanism between the spacer **10** and the plate **50**. Advantageously, by providing secure first and second locking mechanisms between the spacer **10** and the plate **50**, the plate and spacer will be kept securely together during any type of impaction of the plating system within the body. Furthermore, each of the side arms **13** of the spacer **10** can include a cut-away portion or chamfer **18**, **19** (shown in FIG. **3**C) to advantageously accommodate screws which pass through the plate. In embodiments that involve a pair of screws through the plate **50**—one of which passes in an upward direction, and the other of which passes in a downward direction—one side arm **13** of the spacer **10** will include an upper chamfer **18** formed on an upper surface to accommodate the upwardly directed screw, while the second side arm **13** of the spacer will include a lower chamfer **19** formed on a lower surface to accommodate the downwardly directed screw.

[0073] The spacer **10** can be formed of any material. In some embodiments, the spacer **10** is formed of a polymer, such as PEEK, as shown in FIG. **3**A. In some embodiments, the spacer **10** is formed of allograft bone, as shown in FIG. **4**A. In some instances, to form an allograft implant, allograft bone may be cut or shaved from a desired bone member. The cut allograft bone will then be assembled together, using an adhesive or mechanical fastener (e.g., bone pins). Accordingly, in some embodiments, an allograft spacer **10** is formed of two, three, four or more layers that are assembled together, such as by one or more bone pins. One particular advantage of the invention is that the plate **50** can work with a variety of different spacers **10**, as the plate **50** is independently removable from and attachable to the spacer **10**. Regardless of whether a surgeon chooses to implant an allograft spacer or PEEK spacer **10** into an intervertebral space, the surgeon can simply attach the low-profile plate **50** to the spacer **10** following implantation into the intervertebral space.

[0074] The plate **50** is configured to have a plate body and a pair of lateral extensions **70** that extend from the plate body, each of which has a protrusion **71**, for inserting into a corresponding notch **17** of the spacer **10**. These lateral extensions **70** help form the first locking mechanism between the plate **50** and the spacer **10**, as discussed above. In addition, the lateral extensions **70** of the plate **50** each include a window **72** (shown in FIG. **2**A) for receiving a hump region **26** on the arms **13** of the spacer **10**, thereby helping to form the second locking mechanism between the plate **50** and the spacer **10**, as discussed above.

[0075] In addition to attaching to the spacer **10**, the plate **50** is also configured to attach into one or more vertebral bodies via one or more bone screws. As shown in FIG. **1**A, the plate **50** includes a first screw hole **52** and a second screw hole **54** for receiving bone screws therein. In some embodiments, screw hole **52** is angled upwardly such that an inserted bone screw passes upward into an upper vertebral body, while screw hole **54** is angled downwardly such that an inserted bone screw passes downward into a lower vertebral body. While the illustrated embodiment illustrates a pair of screw holes for receiving a pair of bone screws, it is possible to have one, three, four, five or more screw holes for receiving a different number of bone screws.
[0076] Over time, it is possible for bone screws to back-out. The plate **50** thus has a blocking or set screw **56** (shown in FIG. **1**C) that assists in preventing back-out of inserted bone screws. As shown in FIG. **1**C, the set screw **56** can be in an initial position that allows first and second bone screws to pass through holes **52**, **54**. Once the bone screws have been inserted through the holes **52**, **54**, the set screw **56** can be rotated (e.g., 90 degrees), to thereby block the bone screws and prevent back out of the bone screws. In some embodiments, the set screw **56** abuts a side of the head of the bone screws to prevent back-out of the bone screws, while in other embodiments, the set screw **56** rests over a top of the head of the bone screws to prevent back-out of the bone screws. In some embodiments, the set screw **56** comes pre-fixed with the plate **50**. As shown in FIG. **1**C, a single set screw **56** can be used to conveniently block a pair of bone screws. In other embodiments, each bone screw can be assigned its own set screw, which can operate independently of one another, to prevent back-out of the bone screw.
[0077] The plate **50** can also include one or more knife-like edges **63** that provide additional torsional stabilization when the plate **50** rests against a bone member. As shown in FIG. **1**C, the knife-like edges **63** can be formed on both the upper and lower surfaces of the plate **50** body. While the illustrated embodiment shows a pair of knife-like edges **63** on an upper surface of the plate body and a pair of knife-like edges **63** on a lower surface of the plate body, one skilled in the art will appreciate that a different number of knife-like edges **63** can be provided.
[0078] FIGS. **2**A-**2**D illustrate different views of the low profile plate shown in FIGS. **1**A-**1**D. From these views, one can see the pair of lateral extensions **70** that extend from the body of the plate **50**. At the distal end of each of the lateral extensions **70** is an inwardly-facing protrusion **71** that is configured to fit into a corresponding notch in the spacer **10**. In addition, from these views, one can see the windows **72** that are formed in each of the lateral extensions **70**. The windows **72** advantageously receive hump regions **26** of the spacer to provide a locking mechanism, and also help to improve desirable radiolucency. Advantageously, the windows **72** can have rounded edges to accommodate the spacer **10** therein. While the illustrated windows **72** are shown as rectangular with rounded edges, in other embodiments, the windows **72** can have a different shape, such as circular or oval. In some embodiments, the plate **50** is assembled axially to the spacer **10**.
[0079] In some embodiments, the low profile plate **50** can also include indented gripping sections **73** (shown in FIGS. **2**A and **2**B). These indented gripping sections **73** advantageously provide a gripping surface for an insertion instrument, thereby facilitating easy delivery of the plate to a spacer body during surgery.
[0080] FIGS. **3**A-**3**D illustrate different views of a PEEK spacer to be used with the low profile plate shown in FIGS. **2**A-**2**D. From these views, one can see how the spacer **10***a* includes an upper surface **12***a* and a lower surface **14***a* with texturing **16***a*; a generally C-shaped body including a pair of arms **13***a* each having a notch **17***a* formed therein and an upper chamfer **18***a* or lower chamfer **19***a*; and a tapered leading edge **22***a*. In addition, one skilled in the art can appreciate the substantially symmetric shape of the inner opening **20***a*, which serves as a graft hole for receiving graft material therein.
[0081] FIGS. **4**A-**4**D illustrate different views of an allograft spacer to be used with the lower profile plate shown in FIGS. **2**A-**2**D. While the allograft spacer **10***b* shares similar features to the PEEK spacer **10***a* shown in previous figures, such as the notches **17***b*, hump surfaces **26***b*, and

chamfers **18***b*, **19***b*, the allograft spacer **10***b* need not be the same. For example, the shape of the graft opening **20***b* can be more of an arch, as shown in FIG. **4**B.

[0082] FIGS. **5**A-**5**D illustrate different views of a second alternative embodiment of a low profile plate attached to a spacer according to some embodiments. Rather than having a plate **50** with lateral extensions **70** that extend around the outer surface of a spacer **10**, the present embodiment of the plating system **105** includes a plate **150** with an enclosed posterior extension **155** that fits within the body of the spacer **110**. The enclosed posterior extension **155** includes extending surfaces **166**, **167** that are fitted into corresponding inlets **121**, **123** formed in the body of the spacer **110**, thereby forming a first locking mechanism between the plate **150** and the spacer **110**. In addition, the enclosed posterior extension **155** of the plate **50** includes one or more deformable locking tabs **160** (shown in FIG. **6**B) that securely lock into tab holes **181***a* in the spacer body **110**, thereby forming a second locking mechanism between the plate **150** and the spacer **110**. While in some embodiments, the plate **150** can be attached to the spacer **110** after inserting the spacer **110** into a desired location in the body, in other embodiments, the plate **150** can be pre-assembled with the spacer **110** prior to inserting the plating system **105** into the desired location.

[0083] Like the spacer **10** in FIG. **1**A, the spacer **110** is configured to have an upper surface **112**, a lower surface **114**, and a leading end **122**. In some embodiments, the upper surface **112** and/or lower surface **114** includes texturing **116**, such as teeth, ribs, ripples, etc. to assist in providing frictional contact with adjacent vertebral bodies. In some embodiments, the leading end **122** of the spacer **110** can be slightly tapered, as shown in FIG. **7**D. With the taper, the leading end **122** can serve as a distraction surface that helps the spacer **110** to be inserted into an intervertebral space. As shown in FIG. **1**B, the leading end **122** can be concave, though in other embodiments, the leading end **122** can be straight or convex.

[0084] The spacer **110** can be substantially C-shaped (as shown in FIG. **7**B), whereby it includes two side arms **113** that surround an inner opening **120**. Adjacent the side arms **113** is a straight wall **119** that forms the border of the graft opening **120**. The straight wall **119** can include one or more tab holes **181** (shown in FIG. **7**A) for receiving deformable tab locks **160** therein. The graft opening **20**, which is configured to receive natural or synthetic graft material therein to assist in a fusion procedure, has an open side that is opposite the straight wall **119**, thereby giving the spacer **110** its C-shape.

[0085] In some embodiments, the graft opening **120** (shown in FIG. **7**B) has a different shape from the opening **20** of the spacer **10** of the prior embodiment, as the graft opening **120** is configured to not only receive graft material, but also the enclosed posterior extension **155** of the plate **150**. For example, the graft opening **120** includes two inlets—a first inlet **121** formed at the junction between the first arm **113** and wall **119** and a second inlet **123** formed at the junction between the second arm **113** and wall **119** (shown in FIG. **7**B)—for receiving outwardly extending surfaces **166**, **167** of the plate **150** (shown in FIG. **6**B). In addition, the graft opening **120** includes two outwardly tapering walls **111** that provide enough space to accommodate any bone screws inserted in the plate **150**. As such, additional chamfers **18**, **19** (as shown in FIG. **3**B) are optional.

[0086] Like spacer **10**, the spacer **110** can be formed of a variety of materials. In some embodiments, the spacer **110** comprises PEEK, as shown in FIG. **7**A, while in other embodiments, the spacer **110** comprises allograft bone, as shown in FIG. **8**A.

[0087] The plate **150** is configured to have a plate body, and an enclosed posterior extension **155** that extends from the plate body, which is received within and retains the spacer **110**. The enclosed posterior extension **155** includes first and second outwardly extending surfaces **166**, **167** that fit into inlets **121**, **123** formed within the spacer **110** body to form a first locking mechanism. In addition, one or more deformable tab locks **160** extend from an exterior surface of the enclosed posterior extension **155** and are received in corresponding tab holes **181** in the spacer **110** to form a second locking mechanism. In some embodiments, the side walls of the enclosed posterior extension **155** can include one or more windows **172** (shown in FIG. **6**A) for improving radiolucency of the plating system. In some embodiments, the plate **150** is assembled axially to the spacer **110**.

[0088] In addition to attaching to the spacer **110**, the plate **150** is also configured to attach into one or more vertebral bodies via one or more bone screws **88**, **89**. As shown in FIG. **5**A, the plate **150** includes a first screw hole **152** and a second screw hole **154** for receiving bone screws **88**, **89** therein. In some embodiments, screw hole **152** is angled upwardly such that an inserted bone screw **88** passes upward into an upper vertebral body, while screw hole **154** is angled downwardly such that an inserted bone screw **89** passes downward into a lower vertebral body. While the illustrated embodiment illustrates a pair of screw holes for receiving a pair of bone screws, it is possible to have one, three, four, five or more screw holes for receiving a different number of bone screws.

[0089] Over time, it is possible for bone screws to back-out. The plate **150** thus has a blocking or set screw **156** (shown in FIG. **5**C) that assists in preventing back-out of inserted bone screws. As shown in FIG. **5**C, the set screw **156** can be in an initial position that allows first and second bone screws to pass through holes **152**, **154**. Once the bone screws have been inserted through the holes **152**, **154**, the set screw **156** can be rotated (e.g., 90 degrees), to thereby block the bone screws and prevent back out of the bone screws. In some embodiments, the set screw **156** abuts a side of the head of the bone screws to prevent back-out of the bone screws, while in other embodiments, the set screw **156** rests over a top of the head of the bone screws to prevent back-out of the bone screws. In some embodiments, the set screw **156** comes pre-fixed with the plate **150**. As shown in FIG. **5**C, a single set screw **156** can be used to conveniently block a pair of bone screws. In other embodiments, each bone screw can be assigned its own set screw, which can operate independently of one another, to prevent back-out of the bone screw.

[0090] The plate **150** can also include one or more torsional stabilizers **163**. In some embodiments, the torsional stabilizers **163** can comprise knife-like edges **163** that provide additional torsional stabilization when the plate **150** rests against a bone member. As shown in FIG. **5**C, the knife-like edges **163** can be formed on both the upper and lower surfaces of the plate **150** body. While the illustrated embodiment shows a pair of knife-like edges **163** on an upper surface of the plate body and a pair of knife-like edges **163** on a lower surface of the plate body, one skilled in the art will appreciate that a different number of knife-like edges **163** can be provided. In some embodiments, the torsional stabilizers **163** are flush with the body of the plate **150**.

[0091] FIGS. **6**A-**6**D illustrate different views of the low profile plate shown in FIGS. **5**A-**5**D. From these views, one can see the enclosed posterior extension **155** that extends from the body of the plate **150**. At the distal end of the enclosed posterior extension **155** are a pair of outwardly extending surfaces **166**, **167** that are configured to fit within inlets **121**, **123** formed in the spacer. From these views, one can also see the deformable tab lock **160** (FIG. **6**B) that can help secure the plate **150** to the spacer **110**. In addition, from these views, one can see the windows **172** that are formed in each of the arms of the enclosed posterior extension **155**. The windows **172** advantageously help to improve desirable radiolucency, and are of large size to provide a large viewing surface area. While the illustrated windows **172** are shown as triangular with rounded edges, in other embodiments, the windows **172** can have a different shape, such as circular or oval. In some embodiments, the plate **150** is assembled axially to the spacer **110**.

[0092] In some embodiments, the low profile plate **150** can also include indented gripping sections **173** (shown in FIGS. **6**A and **6**B). These indented gripping sections **173** advantageously provide a gripping surface for an insertion instrument, thereby facilitating easy delivery of the plate to a spacer body during surgery.

[0093] FIGS. **7**A-**7**D illustrate different views of a PEEK spacer to be used with the low profile plate shown in FIGS. **5**A-**5**D. From these views, one can see how the spacer **110***a* includes an upper surface **112***a* and a lower surface **114***a* with texturing **116***a*; a generally C-shaped body including a pair of arms **113***a* each having an inner inlet **121**, **123***a* formed therein; and a tapered leading edge **122***a*. In addition, one skilled in the art can appreciate the substantially symmetric

shape of the inner opening **120***a*, which serves as a graft hole for receiving graft material therein.
[0094] FIGS. **8**A-**8**D illustrate different views of an allograft spacer to be used with the lower profile plate shown in FIGS. **5**A-**5**D. While the allograft spacer **110***b* shares similar features to the PEEK spacer **110***a* shown in previous figures, such as the C-shaped body including a pair of arms **113***b* each having an inlet **121***b*, **123***b* formed therein, the allograft spacer **110***b* need not be the same.
[0095] FIGS. **9**A-**9**D illustrate different views of a third alternative embodiment of a low profile plate attached to a spacer according to some embodiments. In the present embodiment, the plating system **205** includes a plate **250** having lateral arms or extensions **270** that extend around an exterior surface of a spacer **210**. The lateral extensions **270** extend wider than the lateral extensions **70** in the first embodiment, and do not necessarily have to interlock with the spacer **210**. While in some embodiments, the plate **250** can be attached to the spacer **210** after inserting the spacer **210** into a desired location in the body, in other embodiments, the plate **250** can be pre-assembled with the spacer **210** prior to inserting the plating system **205** into the desired location.
[0096] Like the spacer **10** in FIG. **1**A, the spacer **210** is configured to have an upper surface **212**, a lower surface **214**, and a leading end **222**. In some embodiments, the upper surface **212** and/or lower surface **214** includes texturing **216**, such as teeth, ribs, ripples, etc. to assist in providing frictional contact with adjacent vertebral bodies. In some embodiments, the leading end **222** of the spacer **210** can be slightly tapered, as shown in FIG. **9**D. With the taper, the leading end **222** can serve as a distraction surface that helps the spacer **210** to be inserted into an intervertebral space. As shown in FIG. **9**B, the leading end **222** can be slightly concave, though in other embodiments, the leading end **122** can be straight or convex. Unlike previously illustrated spacers, the spacer **210** can have a graft hole **220** that is completely enclosed. As shown in FIG. **9**B, the graft hole **220** can surrounded by four walls. In addition, the spacer **210** can include four outer walls: two straight walls, a convex wall and a concave wall.
[0097] In some embodiments, the graft opening **220** (shown in FIG. **9**B) has a different shape from the openings of prior embodiments, as the graft opening **220** is enclosed. While the graft opening **220** is rectangular with rounded edges, in other embodiments, the graft opening **220** can have a different shape. For example, in some embodiments, the graft opening **220** can have curved walls, instead of straight walls, or can have tapered walls, instead of straight walls.
[0098] Like spacer **10**, the spacer **210** can be formed of a variety of materials. In some embodiments, the spacer **210** comprises allograft bone, while in other embodiments, the spacer **210** comprises PEEK.
[0099] The plate **250** is configured to have a pair of lateral extensions **270** that receive the spacer **210**. As shown in FIG. **9**A, in some embodiments, the lateral extensions **270** include one or more windows **272** for improving radiolucency of the plating system. In some embodiments, the plate **250** is assembled axially to the spacer **210**.
[0100] In addition to capturing the spacer **210**, the plate **250** is also configured to attach into one or more vertebral bodies via one or more bone screws **88**, **89**. As shown in FIG. **9**A, the plate **250** includes a first screw hole **252** and a second screw hole **254** for receiving bone screws **88**, **89** therein. In some embodiments, screw hole **252** is angled upwardly such that an inserted bone screw **88** passes upward into an upper vertebral body, while screw hole **254** is angled downwardly such that an inserted bone screw **89** passes downward into a lower vertebral body. While the illustrated embodiment illustrates a pair of screw holes for receiving a pair of bone screws, it is possible to have one, three, four, five or more screw holes for receiving a different number of bone screws.
[0101] Over time, it is possible for bone screws to back-out. The plate **250** thus has a blocking or set screw **256** (shown in FIG. **9**C) that assists in preventing back-out of inserted bone screws. As shown in FIG. **9**C, the set screw **256** can be in an initial position that allows first and second bone screws to pass through holes **252**, **254**. Once the bone screws have been inserted through the holes **252**, **254**, the set screw **256** can be rotated (e.g., 90 degrees), to thereby block the bone screws and

prevent back out of the bone screws. In some embodiments, the set screw **256** abuts a side of the head of the bone screws to prevent back-out of the bone screws, while in other embodiments, the set screw **256** rests over a top of the head of the bone screws to prevent back-out of the bone screws. In some embodiments, the set screw **256** comes pre-fixed with the plate **250**. As shown in FIG. **9**C, a single set screw **256** can be used to conveniently block a pair of bone screws. In other embodiments, each bone screw can be assigned its own set screw, which can operate independently of one another, to prevent back-out of the bone screw.

[0102] FIGS. **10**A-**10**D illustrate different views of the low profile plate shown in FIGS. **9**A-**9**D. From these views, one can see the lateral extensions **270** that extend from the body of the plate **250**. From these views, one can also see the windows **272** (FIG. **10**A) that extend along a substantial length of the lateral extensions **270**. In some embodiments, each window **272** has a length greater than half the length of each lateral extension **270**, thereby advantageously increasing the radiolucency of the plating system. In some embodiments, the plate **250** is assembled axially to the spacer **210**.

[0103] In some embodiments, the low profile plate **250** can also include indented gripping sections **273** (shown in FIGS. **10**A and **10**B). These indented gripping sections **273** advantageously provide a gripping surface for an insertion instrument, thereby facilitating easy delivery of the plate to a spacer body during surgery.

[0104] FIGS. **11**A-**11**D illustrate different views of a fourth alternative embodiment of a low profile plate attached to a spacer according to some embodiments. Like the previous embodiment, the plating system **305** includes a plate **350** having lateral arms or extensions **370** that extend around an exterior surface of a spacer **310**. The lateral extensions **370** extend wider than the lateral extensions **70** in the first embodiment, and do not necessarily have to interlock with the spacer **310**. While in some embodiments, the plate **350** can be attached to the spacer **310** after inserting the spacer **310** into a desired location in the body, in other embodiments, the plate **350** can be pre-assembled with the spacer **310** prior to inserting the plating system **305** into the desired location.

[0105] Like the spacer **10** in FIG. **1**A, the spacer **310** is configured to have an upper surface **312**, a lower surface **314**, and a leading end **322**. In some embodiments, the upper surface **312** and/or lower surface **314** includes texturing **316**, such as teeth, ribs, ripples, etc. to assist in providing frictional contact with adjacent vertebral bodies. In some embodiments, the leading end **322** of the spacer **310** can be slightly tapered, as shown in FIG. **11**D. With the taper, the leading end **322** can serve as a distraction surface that helps the spacer **310** to be inserted into an intervertebral space. As shown in FIG. **11**B, the leading end **322** can be slightly concave, though in other embodiments, the leading end **322** can be straight or convex. In some embodiments, the spacer **310** can have a graft hole **320** that is completely enclosed. As shown in FIG. **11**B, the graft hole **320** can surrounded by four walls. In addition, the spacer **310** can be comprised of four outer walls: two straight, one concave and one convex.

[0106] In some embodiments, the graft opening **320** (shown in FIG. **11**B) of the spacer **310** is enclosed. While the graft opening **320** is rectangular with rounded edges, in other embodiments, the graft opening **320** can have a different shape. For example, in some embodiments, the graft opening **320** can have curved walls, instead of straight walls, or can have tapered walls, instead of straight walls.

[0107] Like spacer **10**, the spacer **310** can be formed of a variety of materials. In some embodiments, the spacer **210** comprises allograft bone, while in other embodiments, the spacer **310** comprises PEEK.

[0108] The plate **350** is configured to have a pair of lateral extensions **370** that receive the spacer **310**. As shown in FIG. **11**A, in some embodiments, the lateral extensions **370** include one or more windows **372** for improving radiolucency of the plating system. In some embodiments, the plate **350** is assembled axially to the spacer **310**.

[0109] In addition to capturing the spacer **310**, the plate **350** is also configured to attach into one or more vertebral bodies via one or more bone screws **88**, **89**. As shown in FIG. **9**A, the plate **350** includes a first screw hole **351**, a second screw hole **352** and a third screw hole **354** for receiving bone screws **87**, **88**, **89** therein. In some embodiments, screw holes **352** and **354** are angled upwardly such that inserted bone screws **87**, **88** pass upward into an upper vertebral body, while screw hole **351** is angled downwardly such that inserted bone screw **89** passes downward into a lower vertebral body. While the illustrated embodiment illustrates three screw holes for receiving three bone screws, it is possible to have one, two, four, five or more screw holes for receiving a different number of bone screws.

[0110] Over time, it is possible for bone screws to back-out. The plate **350** thus has blocking or set screws **356**, **357**, **358** (shown in FIG. **12**C), each of which corresponds to one of screw holes **351**, **352**, **354**. As shown in FIG. **12**C, the set screws **356**, **357**, **358** can be in an initial position that allows first, second and third bone screws to pass through holes **351**, **352**, **354**. Once the bone screws have been inserted through the holes **351**, **352**, **354**, the set screws **356**, **357**, **358** can be rotated (e.g., 90 degrees), to thereby block the bone screws and prevent back out of the bone screws. In some embodiments, the set screws **356**, **357**, **358** abut a side of the head of the bone screws to prevent back-out of the bone screws, while in other embodiments, the set screws **356**, **357**, **358** rest over a top of the head of the bone screws to prevent back-out of the bone screws. In some embodiments, the set screws **356**, **357**, **358** come pre-fixed with the plate **350**. As shown in FIG. **12**C, a single set screw **356**, **357**, **358** can be used to conveniently block a single bone screws. In other embodiments, each set screw can be designed to block more than one set screw to prevent back-out of the bone screw.

[0111] FIGS. **12**A-**12**D illustrate different views of the low profile plate shown in FIGS. **11**A-**11**D. From these views, one can see the lateral extensions **370** that extend from the body of the plate **350**. From these views, one can also see the windows **372** (FIG. **12**A) that extend along a substantial length of the lateral extensions **370**. In some embodiments, each window **372** has a length greater than half the length of each lateral extension **370**, thereby advantageously increasing the radiolucency of the plating system. In some embodiments, the plate **350** is assembled axially to the spacer **310**.

[0112] The plating systems describe include a plate that is independent from a spacer. The plate is low-profile and can be used with any type of spacer, such as allograft or PEEK.

[0113] FIGS. **13**A-**13**D illustrate different views of a multi-piece allograft spacer to be used with the low profile plates discussed above according to some embodiments. The multi-piece allograft spacer **410** can be formed of an upper member **436** and a lower member **438** that are connected together via one or more pins **475**. The upper member **436** and the lower member **438** each include cut-out portions that help form a graft opening **420** in the spacer **410**.

[0114] The upper member **436** can include an upper surface having bone engagement surfaces (e.g., ridges, teeth, ribs) and a lower interfacing surface **446**. The lower member **438** can include a lower surface having bone engagement surfaces (e.g., ridges, teeth, ribs) and an upper interfacing surface **448**. In some embodiments, the upper member **436** can include one or more holes **462**, while the lower member **438** can include one or more holes **464** which align with the one or more holes **462** of the upper member. The aligned holes are configured to receive one or more pins **475** to keep the upper and lower members of the allograft spacer together. In some embodiments, the pins **475** are also formed of bone material, such as allograft.

[0115] As shown best in FIG. **13**C, the lower interfacing surface **446** of the upper member **436** is directly engaged with the upper interfacing surface **448** of the lower member **438**. While the lower interfacing surface **446** and the upper interfacing surface **448** can be flat-on-flat, as both surfaces are planar, in some embodiments (as shown in FIG. **13**C), the interface between the two surfaces is at an angle relative to the holes for receiving the pins **475**. In other words, the pins **475** are received at an angle to the interface between the upper member **436** and the lower member **438**. In addition, as shown in FIG. **13**C, holes **462** and **464** need not go through the entirety of their respective members. For example, as shown in FIG. **13**C, while hole **462** goes entirely through the upper and lower surface of the upper member **436**, hole **464** goes only through the upper surface of the lower member **438**, and does not go through to the lower surface. Accordingly, in some embodiments, aligned holes **462** and **464** create a "blind" pin-hole, whereby the hole does not go through the uppermost and lowermost surfaces of the spacer **410**. Advantageously, in some embodiments, the use of such blind holes for receiving pins helps to maintain the pins within the spacer body.

[0116] FIGS. **14**A-**14**D illustrate different views of an alternative multi-piece allograft spacer to be used with the lower profile plates discussed above according to some embodiments. The multi-piece allograft spacer **510** can be formed of a left member **536** and a right member **538** that are connected together in series or side-by-side (e.g., laterally) via one or more pins **575**. The left member **536** and the right member **538** each include cut-out portions that help form a graft opening **520** in the spacer **510**.

[0117] The left member **536** can include upper and lower surfaces having bone engagement surfaces (e.g., ridges, teeth, ribs). In addition, the left member **536** further includes a right interfacing surface **546**. The right member **538** can also include upper and lower surfaces having bone engagement surfaces (e.g., ridges, teeth, ribs). In addition, the right member **538** further includes a left interfacing surface **548**. In some embodiments, the left member **536** can include one or more holes **562**, while the right member **538** can include one or more holes **564** which align with the one or more holes **562** of the left member. The aligned holes are configured to receive one or more pins **575** to keep the left and right members of the allograft spacer together.

[0118] As shown best in FIG. **14**A, the right interfacing surface **546** of the left member **536** is directly engaged with the left interfacing surface **548** of the right member **538**. While the right interfacing surface **546** and the left interfacing surface **548** can be flat-on-flat, as both surfaces are planar, in some embodiments (as shown in FIG. **14**A), the interface between the two surfaces is at an angle relative to the holes for receiving the pins **575**. In other words, the pins **575** are received at an angle to the interface between the left member **536** and the right member **538**. In addition, as shown in FIG. **14**B, holes **562** and **564** need not go through the entirety of their respective members. In other words, one or more of the holes (e.g., holes **562**, **564** or combined) can be blind holes, whereby the holes do not go through the left and right surfaces of the lateral implants.

[0119] By having multi-piece allograft spacers that are either stacked or aligned side-by-side, it is possible to have spacers of increased height and width. While the embodiments herein show two piece spacers, one skilled in the art will appreciate that three or more members can be combined to form multi-piece allograft spacers for use with any of the plate members described above.

[0120] FIGS. **15**A-**15**D illustrate different views of an alternative low profile plate attached to a spacer according to some embodiments. The plating system **605** comprises a plate **650** attached or mounted to a spacer **610**.

[0121] The system **605** includes a number of similar features to prior embodiments. The spacer **610** includes a body having an upper surface **612** and a lower surface **614** with texturing (e.g., ribs, grooves, teeth, protrusions) and sidewalls including one or more notches **617** for receiving plate extensions. The body of the spacer **610** can be U-shaped or C-shaped, such that a central portion includes a graft opening **620** for receiving graft material therein. The plate **650** includes a body having a first screw hole **652** for receiving a first screw member therethrough, a second screw hole **654** for receiving a second screw member therethrough, and a recess for receiving a blocking fastener or set screw **656**. In addition, a pair of extension arms or members **670** extend from the plate body and are received in each of the notches **617** formed in the spacer **10**. Each of the extension members **617** includes a window **672** for receiving a hump portion or region of the spacer to further secure the spacer **610** with the plate **650**. In addition, the plate member **650** can include one or more stabilizers or knife-like edges **663** that can help secure the plate member **650** to a vertebral body. While the stabilizers **663** are shown as sharp and pointed, in other embodiments, the stabilizers **663** are more blunt and in some cases, even slightly rounded.

[0122] The plating system **605** in FIGS. **15**A and **15**D is unique in that the first upper screw hole **652** has been raised such that a central axis of the first upper screw hole **652** is positioned higher than the upper surface **612** of the spacer **610**. In addition, the second lower screw hole **654** has been lowered such that a central axis of the second lower screw hole **654** is positioned below the lower surface **614** of the spacer **610**. As shown in FIG. **15**B, each of the holes **652**, **654** has an adjacent brow member that extends from the plate body. First screw hole **652** is adjacent upper brow member **662**, while second screw hole **654** is adjacent lower brow member **664**. Upper brow member **662** has been raised to accommodate the raised upper screw hole **652**, while lower brow member **664** has been lowered to accommodate the lowered lower screw hole **654**. Advantageously, by raising the upper screw hole **652** and lowering the lower screw hole **654**, this reduces the likelihood of any viewing obstruction that may occur from the spacer **610**. Moreover, even though the upper brow member **662** is raised and the lower brow member **664** is lowered, advantageously, the plating system **605** still maintains a low profile such that most if not all of the plate system remains in a disc space. In other embodiments, it may be desired for a part of the upper brow member **662**, a part of the lower brow member **664** or both to contact a vertebral face (e.g., an anterior face), thereby providing stability to the plating system **605**.

[0123] FIGS. **16**A-**16**D illustrate different views of a plate member **650** used in the plating system **605**. From these views, one can clearly see how the upper brow member **662** and first upper hole member **652** have been raised, while the lower brow member **664** and second lower hole member **664** have been lowered, relative to other designs. In some embodiments, the entire central axis of first upper hole member **652** (e.g., from a front of the plate member **650** to a back of the plate member **650**) is continuously above the upper surface of the spacer, thereby advantageously providing a less unobstructed view of the first upper hole member **652**. Likewise, in some embodiments, the entire central axis of the second lower hole member **654** (e.g., from a front of the plate member **650** to a back of the plate member **650**) is continuously below the lower surface of the spacer, thereby advantageously providing a less unobstructed view of the second lower hole member **654**.

[0124] FIGS. **17**A-**17**C illustrate different views of a spacer **610** used in the plating system **605**. From these views, one can clearly see features of the spacer **610** includes its upper surface **612**, lower surface **614**, sidewalls with notches **617** and graft opening **620**. In addition, with the plate member removed from the views, one can also see an upper chamfer **618***a* and a lower chamfer **618***b* that are cut into the spacer **610**. These chamfers **618***a*, **618***b* advantageously provide clearance for bone screws that are inserted through the plating system **605**. One skilled in the art will appreciate that the spacer can be made of many different materials. In some embodiments, the spacer will be made out of bone (e.g., allograft), while in other embodiments, the spacer will be made of PEEK. Advantageously, the plating system **605** is removably attached to the spacer **610** such that a surgeon can choose to include a spacer of a certain material as so desired during a surgical procedure.

[0125] FIGS. **18**A-**18**D illustrate different views of yet another plate system involving a plate member and a spacer having a unique multi-piece composition in accordance with some embodiments. The plate system **705** includes similar elements as found in prior embodiments, including a plate member **750** having a first upwardly oriented screw hole **752** for receiving a first screw, a second downwardly oriented screw hole **754** for receiving a second screw, and a blocking member or screw **756**, as well as a spacer **710** (e.g., allograft or PEEK) having an upper surface **712**, a lower surface **714**, a graft opening **720**, and notches **717** for receiving arms or extensions **770** of the plate member **750**. The plate member **750** also includes one or more windows **772** in its extensions **770** for receiving a raised or bump out portion of the spacer **705**, thereby helping to retain the spacer **705** within the plate member **750**. In addition, the plate member **750** includes stabilizers **763** in the form of knife-like edges that help to grip into a vertebral body.

[0126] In addition to these features, the spacer **710** has a unique multi-piece composition. As shown in FIGS. **18**A and **18**D, in some embodiments, the spacer **710** has a body formed of two adjacent members—a first member **711** and a second member **713**. The first member **711** and the second member **713** can be held together via one or more pin members, although in other embodiments, the first member **711** and second member **713** can be held via adhesive, mateable connections, etc. As shown in FIG. **18**D, second member **713** can include an upper overhang region **717** that hangs over a part of the first member **711**. Similarly, first member **711** can include a lower overhang region **711** that hangs below a part of the second member **713**. Advantageously, these overhang regions **711** serve as guides to identify the location of the interface **715** between the first member **711** and the second member **713**. During manufacturing, the overhang regions **711** make it easy to inspect the interface to **715** to ensure that the two members **711**, **713** are properly secured together. While the illustrated embodiment shows a spacer **710** having two separate overhanging regions, in other embodiments, the spacer **710** can have one single overhanging region. As before, the spacer **710** can be made of many different types of materials, including bone (e.g., allograft) and PEEK), and a surgeon can advantageously decide what type of spacer should accompany the plate before or during surgery.

[0127] FIG. **19** shows a plating system **805** having a plate member **850** having extensions **870** and a spacer **810** similar to that found in FIGS. **18**A-**18**D; however, the spacer **810** is designed to accommodate lordosis. In other words, while the upper surface **712** and lower surface **714** of the spacer **710** can be substantially parallel (as shown in FIG. **18**C), the upper surface **812** and lower surface **814** of the spacer **810** can have some degree of angulation or lordosis. In some embodiments, relative to a mid-line of the spacer **810**, the upper surface **812** and/or lower surface **814** can have a degree of angulation of 2, 3, 5, 7, 12 degrees or more. Advantageously, the lordotic spacer **810** (which is accompanied with the plate member **850**) helps to accommodate different anatomies.

[0128] FIGS. **20**A-**20**D show yet another alternative plating system having a plate member attached to multiple spacers in accordance with embodiments of the present application. The unique plating system **905** comprises a plate member **950** having a pair of inner arms or extensions **975** and a pair of outer arms or extensions **970** for receiving one or more spacers **910** therein. In some embodiments, both the inner and outer extensions **975**, **970** include protruding portions designed to be received in notches in the one or more spacers.

[0129] As shown in FIG. **20**A, the plating system **905** includes a first spacer **910***a* that is retained between a shorter outer extension **970** and a longer inner extension **975** of the plate member **950**. The shorter outer extension **970** of the plate is configured to be received in notch **917** of the spacer **910***a*, while the longer inner extension **975** of the plate is configured to be received in notch of the spacer **910***a*. In addition, advantageously, the shorter outer extension **970** includes a window **972** and the longer inner extension **975** includes a window **974**. Each of the windows **972**, **974** is configured to receive a bump out portion of the spacer **910**, thereby helping to retain the spacer **910** to the plate member **905**. In addition, the windows **972**, **974** help to provide a means to visualize fusion (e.g., in a lateral image) that is occurring once the spacer is implanted within a disc space. Similarly, the plating system **905** includes a second spacer **910***b* that is retained between a shorter outer extension **970** and a longer inner extension **975** on an opposite side of the plate member **950**. While in the present embodiment, each of the longer inner extensions **975** is separated from the other without any connecting member, in other embodiments, a connection bar or bridge (such as shown in FIGS. **21**A and **21**B) can extend between the two inner extensions **975**. Advantageously, when the plating system **905** is placed in a disc space, graft material can be packed between the two inner extensions **975** to promote fusion within the disc space.

[0130] Advantageously, in accordance with some embodiments, the plating system **905** is designed to hold at least two spacers **910***a*, **910***b*. In some embodiments, the spacers **910***a*, **910***b* are substantially rectangular pieces. In some embodiments, the spacers **910***a*, **910***b* can have substantially rounded edges. In some embodiments, the spacers **910***a*, **910***b* can include one or more chamfers **918** for providing clearance for one or more screws that are inserted through the plate member **905**. For example, spacer **910***a* can include a chamfer that provides clearance for a screw that passes through plate opening **954**, while spacer **910***b* can include a chamfer that provides clearance for a screw that passes through plate opening **952**. Advantageously, the use of two spacers **910***a*, **910***b*—one on each side of the plate system **905**—helps to stabilize the plate system within the disc space. Moreover, having multiple individual spacers **910***a*, **910***b* that are smaller in size can case manufacturing issues, as the spacers can be formed of relatively small pieces of bone, which can be easier to find than larger pieces of bone. In other words, bone that is removed from a body can improve the yield of production, as it will be easier to create the spacer members. While the spacers **910***a*, **910***b* are illustrated as being single-bodied members in the present embodiments, in other embodiments, the spacers can be formed of multiple pieces (e.g., pinned together).

[0131] FIGS. **21**A and **21**B illustrate different views of another alternative low profile plate attached to multiple spacers according to some embodiments. The plate system **1005** comprises a plate member **1050** attached to a pair of spacers **1010***a* and **1010***b*. Like the embodiment in FIG. **20**A, the plate member **1050** of the present embodiment includes a pair of outer arms or extensions **1070***a*, **1070***b* and a pair of inner arms or extensions **1075***a*, **1075***b*. Plate extensions **1070***a* and **1075***a* are configured to retain spacer **1010***a*, while plate extensions **1070***b* and **1075***b* are configured to retain spacer **1010***b*. As shown in FIGS. **21**A and **21**B, the inner extensions **1075***a* and **1075***b* includes a connection or bridge member **1088** that extends between them. Advantageously, the bridge member **1088** helps provide added stability to the plate system **1005**, and also helps provide a barrier to retain graft material within the plate system **1005**. As shown in FIG. **21**A, in some embodiments, the inner extensions **1075***a* and **1075***b* are parallel to one another.

[0132] As shown in FIG. **21**B, outer plate extensions **1070***a* and **1070***b* include at least one window **1072** formed therein. Similarly, inner plate extensions **1075***a* and **1075***b* include at least one window formed therein. As shown in FIG. **21**B, inner plate extensions each include two windows —**1074** and **1075**—that are formed adjacent to one another. Inner plate extension **1075***a* includes windows **1074***a* and **1075***a*, while inner plate extension **1075***b* includes windows **1074***b* and **1075***b*. In some embodiments, the windows **1072**, **1074**, **1075** can advantageously be designed to hold a bump out portion of the spacers and/or provide increased visualization to a surgeon during or after a fusion procedure. While in some embodiments, each of the windows **1072**, **1074**, and **1075** perform the same duties and functions, in other embodiments, the windows can perform different functions. For example, while inner window **1074** can be used to both retain the spacer and aid in fusion visualization, inner window **1075** can be used simply for fusion visualization.

[0133] FIG. **22** illustrates another alternative low profile plate attached to multiple spacers according to some embodiments. The plate system **1105** comprises a plate member **1150** attached to a pair of spacers **1110***a* and **1110***b*. Like the embodiment in FIG. **21**A, the plate member **1150** of the present embodiment includes a pair of outer arms or extensions **1170***a*, **1170***b* and a pair of inner arms or extensions **1175***a*, **1175***b*. Plate extensions **1170***a* and **1175***a* are configured to retain spacer **1110***a*, while plate extensions **1170***b* and **1175***b* are configured to retain spacer **1110***b*. As shown in FIGS. **21**A and **21**B, the inner extensions **1175***a* and **1175***b* includes a connection or bridge member **1188** that extends between them. Advantageously, the bridge member **1188** helps provide added stability to the plate system **1105**, and also helps provide a barrier to retain graft material within the plate system **1105**. In contrast to the inner extensions **1075***a*, **1075***b* in FIG. **21**A, the inner extensions **1175***a*, **1175***b* are non-parallel and angulated relative to one another. Furthermore, due to the shape of the plate member **1150**, the shapes of the individual spacers **1110***a* and **1110***b* differ in that they have a prominent angled surface adjacent to the inner extensions **1175***a*, **1175***b*.

[0134] FIG. **23** illustrates another alternative low profile plate attached to multiple spacers according to some embodiments. The plate system **1205** comprises a plate member **1250** attached to a pair of spacers **1210***a* and **1210***b*. Like the embodiment in FIG. **22**, the plate member **1250** of the present embodiment includes a pair of outer arms or extensions **1270***a*, **1270***b* and a pair of inner arms or extensions **1275***a*, **1275***b*. Plate extensions **1270***a* and **1275***a* are configured to retain spacer **1210***a*, while plate extensions **1270***b* and **1275***b* are configured to retain spacer **1210***b*. As shown in FIGS. **23**, the inner extensions **1275***a* and **1275***b* includes a connection or bridge member **1288** that extends between them. Advantageously, the bridge member **1288** helps provide added stability to the plate system **1205**, and also helps provide a barrier to retain graft material within the plate system **1205**. In contrast to the bridge member **1188** in FIG. **22**, the bridge member **1288** is elongated and extends to a distal end of the spacers **1210***a*, **1210***b*, thereby creating an even larger space for receiving graft material in the middle of the plate system **1205**.

[0135] FIGS. **24**A-**24**C illustrate another alternative low profile plate attached to multiple spacers according to some embodiments. The plate system **1305** comprises a plate member **1350** attached to a multi-piece spacer **1310** formed of three members **1310***a*, **1310***b*, **1310***c*. Like the embodiment in FIG. **23**, the plate member **1350** of the present embodiment includes a pair of outer arms or extensions **1370***a*, **1370***b* and a pair of inner arms or extensions **1375***a*, **1375***b* connected by a bridge member **1388**. The inner extensions **1375***a*, **1375***b* and bridge member **1388** are configured to be enclosed by the body of the spacer **1310**. Advantageously, the bridge member **1388** helps provide added stability to the plate system **1305**, and also helps provide a barrier to retain graft material within the plate system **1305**.

[0136] In some embodiments, the spacer **1310** is formed of three different members **1310***a*, **1310***b*, **1310***c*. The members **1310***a* and **1310***b* can be outer members which bound the inner member **1310***c*. As shown in FIG. **24**C, the members **1310***a* and **1310***b* can be substantially similar, and can include upper and lower surfaces with surface protrusions to enable better gripping of bone. Inner member **1310***c* can be different from the other members and can include a relatively smooth surface without surface protrusions. In addition, the inner member **1310***c* can be of a different height than the other members. In some embodiments, the three members **1310***a*, **1310***b*, **1310***c* are pinned together, while in other embodiments, they can be joined together via an adhesive or mateable connection. Advantageously, the addition of the inner member **1310***c* provides further support to the overall structure of the plate system **1305**.

[0137] FIGS. **25**A and **25**B illustrate another alternative low profile plate attached to a multi-piece spacer having a metal insert according to some embodiments. The plate system **1405** comprises a plate member **1450** attached to a multi-piece spacer **1410** formed of two similar components **1410***a*, **1410***b* and a metal insert **1439**. The plate member **1450** can include a first screw opening, a second screw opening and a rotatable locking mechanism **1456** to prevent back out of screws that are inserted through the openings. In some embodiments, the plate member **1450** of the present embodiment is mounted to the front of the spacer. In other embodiments, the plate member **1450** includes a pair of outer arms or extensions and/or a pair of inner arms or extensions (not shown) to help retain the spacer **1410** within the plate member **1450**.

[0138] In some embodiments, the spacer **1410** is formed of two members **1410***a* and **1410***b* separated by a metal insert **1439**. These members partially enclose a graft opening **1420**. The two members **1410***a* and **1410***b* can be formed of a material different from the metal insert **1439**, such as PEEK. Advantageously, the metal insert **1439** is designed to provide additional strength to the spacer **1410**. In some embodiments, the metal insert **1439** is formed of titanium. As shown in the exploded view in FIG. **25**B, the spacer **1410** be attached to the plate member **1450** via vertical fastening members **1429***a*, **1429***b*. One skilled in the art will appreciate that the spacer **1410** can be used with any of the other plate members discussed above.

[0139] FIGS. **26**A-**26**D illustrate another alternative plate having raised and lowered screw openings in attachment with a spacer according to some embodiments. The plate **1550** and spacer **1510** have many similar features as in prior embodiments; however, the upper screw hole **1552** in the plate **1550** has been raised, while the lower screw hole **1554** in the plate **1550** has been lowered. The upper screw hole **1552** has been raised such that a center axis of the upper screw hole **1552** is positioned entirely above an upper surface **1512** of the spacer **1510**. The lower screw hole **1554** has been lowered such that a center axis of the lower screw hole **1554** is positioned entirely below a lower surface **1514** of the spacer **1510**. Advantageously, by raising the upper screw hole **1552** such that a center axis extends completely above the upper surface **1512** of the spacer **1510**, this provides a plate member **1550** having increased visibility on its upper end and also provides an upper plate portion that can be uniquely positioned relative to a disc space, as shown in FIG. **28**. Likewise, by lowering the lower screw hole **1554** such that a center axis extends completely below the lower surface **1514** of the spacer **1510**, this provides a plate member **1550** having increased visibility on its lower end and also provides a lower plate portion that can be uniquely positioned relative to a disc space, as also shown in FIG. **28**.

[0140] In some embodiments, the plate **1550** and the spacer **1510** have many similar features as in prior embodiments. For example, the spacer **1510** is configured to have a body having an upper surface **1512** in contact with an upper vertebral body and a lower surface **1514** in contact with a lower vertebral body. The spacer body includes notches for receiving portions of the plate **1550** therein. In some embodiments, the spacer **1510** is formed of a natural material, such as allograft bone.

[0141] The plate **1550** includes the upper screw hole **1552** and the lower screw hole **1554**, and a pair of arms or extensions that are designed to be received within the spacer **1510**. As noted above, the upper screw hole **1552** has been raised such that a center axis that extends through the upper screw hole **1552** is positioned higher than an upper surface of the spacer **1510**. In some embodiments, only a portion of the center axis through the upper screw hole **1552** is positioned higher than an upper surface of the spacer **1510**, while in other embodiments, the entire center axis through the upper screw hole **1552** is positioned higher than an upper surface of the spacer **1510**. Likewise, the lower screw hole **1554** has been lowered such that a center axis that extends through the lower screw hole **1554** is positioned lower than a lower surface of the spacer **1510**. In some embodiments, only a portion of the center axis that passes through the lower screw hole **1554** is positioned lower than a lower surface of the spacer **1510**, while in other embodiments, the entire center axis through the lower screw hole **1552** is positioned lower than a lower surface of the spacer **1510**.

[0142] In some embodiments, the plate **1550** includes an upper extension, eyelid or rim **1571** through which the upper screw hole **1552** can pass through. In some embodiments, the upper rim **1571** has an anterior or front face **1553** and a posterior or back face **1555** (identified in FIG. **26**C). In some embodiments, both the front face **1553** and the rear face **1555** of the upper rim **1571** are straight and vertical and not angled relative to height of vertical axis of the spacer. In other embodiments, either the front face **1553** or the rear face **1555** can be straight, while the other face can be angled (e.g., in an anterior direction). In yet other embodiments, both the front face **1553** and the rear face **1555** of the upper rim **1571** can be angled. Advantageously, in some embodiments, the upper screw hole **1552** extends through the upper rim **1571** at an angle such that a screw that is inserted through the upper screw hole **1552** will be inserted at or near a corner edge of an upper vertebral body (as shown in FIG. **28**). By being positioned at or near a corner edge of the upper vertebral body, it is not necessary for the screw to be positioned through an anterior face or aspect of the upper vertebral body, thereby maintaining a low profile implant. In some embodiments, the majority or entirety of the upper rim **1571** including the upper screw hole **1552** can be configured such that the upper portion of the plate rests at or near a corner edge of the upper vertebral body, thereby maintaining a low profile implant.

[0143] In some embodiments, the plate **1550** includes a lower extension, eyelid or rim **1573** through which the lower screw hole **1554** can pass through. In some embodiments, the lower rim **1573** has an anterior or front face **1553** and a posterior or back face **1555** (identified in FIG. **29**A). In some embodiments, both the front face **1553** and the rear face **1555** of the lower rim **1573** are straight and vertical and not angled relative to height of vertical axis of the spacer. In other embodiments, either the front face **1553** or the rear face **1555** can be straight, while the other face can be angled (e.g., in an anterior direction). In yet other embodiments, both the front face **1553** and the rear face **1555** of the lower rim **1573** can be angled. Advantageously, in some embodiments, the lower screw hole **1554** extends through the lower rim **1573** at an angle such that a screw that is inserted through the lower screw hole **1554** will be inserted at or near a corner edge of a lower vertebral body (as shown in FIG. **28**). By being positioned at or near a corner edge of the lower vertebral body, it is not necessary for the screw to be positioned through an anterior face or aspect of the upper vertebral body, thereby maintaining a low profile implant. In some embodiments, the majority or entirety of the lower rim **1573** including the lower screw hole **1554** can be configured such that the lower portion of the plate rests at or near a corner edge of the lower vertebral body, thereby maintaining a low profile implant. Advantageously, in some embodiments, at least a portion of the upper rim **1571** and/or a portion of the lower rim **1573** is maintained within the disc space between the upper vertebral body and the lower vertebral body, thereby maintaining an implant with a low profile.

[0144] FIGS. **27**A-**27**D illustrate another alternative plate having raised and lowered screw openings in attachment with a spacer according to some embodiments. The plate **1550** and the spacer **1610** are similar to the assembly in FIGS. **26**A-**26**D, except the spacer **1610** is formed of a different material, such as PEEK. Advantageously, the plate **1550** is capable of being assembled with either the bone spacer **1510** shown in FIGS. **26**A-**26**D or the PEEK spacer **1610** shown in FIGS. **27**A-**27**D prior to insertion into a disc space, thereby providing versatility to a surgeon.

[0145] FIG. **28** illustrates the plate and spacer in FIGS. **26**A-**26**D in use within a vertebral space. From this view, one can see how the plate **1550** is designed to have an upper rim **1571** that accommodates an upper screw hole **1552** and a lower rim **1573** that accommodates a lower screw hole **1554**. The upper screw hole **1552** receives an upwardly angled screw that is configured to be inserted at or near a corner of the upper vertebral body, thereby avoiding insertion through an anterior face or aspect of the upper vertebral body. The lower screw hole **1554** receives a downwardly angled screw that is configured to be inserted at or near a corner of the lower vertebral body, thereby avoiding insertion though an anterior face or aspect of the lower vertebral body.

[0146] FIGS. **29**A-**29**C illustrate the plate in FIGS. **26**A-**26**D without a spacer. As shown in these figures, the plate **1550** includes an upper rim **1571** that accommodates an upwardly angled screw hole **1552** and a lower rim **1573** that accommodates a downwardly angled screw hole **1554**. The upper rim **1571** includes a front or anterior face **1553***a* and a rear or posterior face **1555***a*, while the lower rim **1573** includes a front or anterior face **1553***b* and a rear or posterior face **1555***b*. As shown in FIG. **29**B, in some embodiments, the entire anterior face of the plate (e.g., including the upper anterior face of the upper rim **1571** and the lower anterior face of the lower rim **1573**) can be straight and non-angled. In other embodiments, portions of the anterior face can be slightly angled, such as in an anterior direction. In addition, as shown in FIG. **29**B, in some embodiments, portions of the posterior faces of the plate (e.g., posterior faces **1555***a* and **1555***b*) can also be straight and non-angled. In other embodiments, portions of the posterior faces can be angled (e.g., in an anterior direction), such as 5 degrees, 10 degrees, 15 degrees, or more. In some embodiments, the anterior and/or posterior faces of the rims can be angled between 5 and 15 degrees.

[0147] FIGS. **30**A-**30**E illustrate different views of an allograft spacer **1510** that can be used with the plate in FIGS. **26**A-**26**D. The allograft spacer **1510** includes a notch **1517** for receiving extension members of the plate therein. FIGS. **31**A-**31**E illustrate different views of a PEEK spacer **1610** that can be used with the same plate. The PEEK spacer **1610** includes a notch **1617** for receiving extension members of the plate therein. As noted above, the surgeon can desirably choose which spacer to insert into a surgical site.

[0148] FIGS. **32**A and B illustrate different views of a spacer **1710** (either allograft or PEEK) for receiving extension members of the plate. The spacer **1710** includes a pair of channels or notches **1717** for receiving an extension member from a plate. Each of the notches **1717** extends a vertical distance from an upper surface of the spacer **1710** to a lower surface of the spacer **1710**.

[0149] In FIG. **32**B, a single notch **1717** out of a pair of notches is visible from the sideview. Each of the notches **1710** is comprised of two sidewalls **1721**, **1723** that form a channel that extend from an upper surface to a lower surface of the spacer **1710**. In some embodiments, one or more of the sidewalls **1721**, **1723** can be straight with no angle or curvature. However, in other embodiments, as shown in FIG. **31**, one or more sidewalls **1721**, **1723** can have a curved portion. In the figure, first sidewall **1721** comprises a first curved portion **1722**, while second sidewall **1723** comprises a second curved portion **1724**. Due to the curved portions **1723**, **1724**, each of the notches **1710** can form a bent, curved or tortured channel for receiving an extension member of a plate therein. The advantage of having a tortured channel for receiving an extension member (such as any of the extension members **70** in FIG. **2**D, **170** in FIG. **6**D, **670** in FIG. **16**B, **870** in FIG. **19**, **970** in FIG. **20**B, etc), is that this provides a tighter fit between the respective plate member and the spacer. Should a plate-spacer system encounter any forces that might cause slippage of the plate from the spacer, the tortured channel **1717** reduces the likelihood that this will occur.

[0150] As shown in FIG. **32**B, the first sidewall **1721** and the second sidewall **1723** of the notch **1717** can include a straight upper portion, a curved or bent middle portion, and a straight lower portion. While the sidewalls **1721**, **1723** are shown as substantially or completely parallel to each other in the figure, in other embodiments, the sidewalls **1721**, **1723** need not be aligned with one another, so long as the sidewalls form a bent or tortured path through the spacer.

[0151] FIGS. **33-40** illustrate the different views of an intervertebral spacer **2010** according to the present disclosure. The intervertebral spacer **2010** as shown in FIGS. **33-40** may be, e.g., a stand-alone anterior lumbar interbody spacer used to provide structural stability in skeletally mature individuals following discectomies. These intervertebral spacers may be available in various heights and geometric configurations to fit the anatomically needs of a wide variety of patients. Specifically, FIGS. **33-40** illustrate one embodiment of an intervertebral spacer **2010**. Intervertebral spacer **2010** may be generally positioned in the intervertebral space between two adjacent vertebral bodies. As shown in the figures, intervertebral spacer **2010** may include a spacer portion **2012** and a plate portion **2014**. In one example, the spacer portion **2012** may include a graft window **2011** for the placement of, e.g., bone graft or bone-growth inducing material, to enhance fusion between two adjacent vertebral bodies.

[0152] The spacer portion **2012** can be comprised of any material that is conducive to the enhancement of fusion between the two adjacent vertebral bodies. In one particular embodiment, the spacer portion **2012** is made of PEEK material, which may be physiologically compatible. It should be noted that any other materials that are physiologically compatible also may be used. The spacer portion **2012** may include tantalum pins that enable radiographic visualization, or other suitable radiographic markers. The spacer portion **2012** further may include superior and inferior surfaces that are provided with a plurality of geometric configurations, such as, e.g., protrusions **2013** (e.g., ribs, bumps, other textures, or the like). The superior and inferior surfaces of the spacer portion **2012** may be bi-convex for greater contact with the vertebral endplates of the adjacent vertebral bodies. The protrusions **2013** can be configured to be any size or shape for further anchoring the spacer portion **2012** to each of the adjacent vertebral bodies. Protrusions **2013** on the superior and inferior surfaces of each implant may grip the endplates of the adjacent vertebral bodies to aid in expulsion resistance.

[0153] The plate portion **2014** can also be comprised of any physiologically compatible material. In one example, the plate portion **2014** of the intervertebral spacer **2010** may be formed from titanium. The plate portion **2014** may include at least one bore **2026**. In some embodiments, plate portion **2014** may include a plurality of bores **2026**, in such embodiments, one or more bores **2026** may or may not include threads for receiving corresponding threads on a fastener. That is to say, in some examples, one or more of bores **2026** may interact with features (e.g., threads) configured to receive features (e.g., corresponding threads) of a fastening member (e.g., a linear bone screw) to be disposed therethrough. Bores **2026** may be substantially linear. Such a configuration allows bores **2026** to receive both linear fastening members and curvilinear fastening members. That is, a given bore **2026** may be configured to receive either a linear fastening member (e.g., a screw) or a curvilinear fastening member (as discussed below in greater detail) at the discretion of an operator, surgeon, physician, or the like. In one embodiment, e.g., bores **2026** may include one or more features, e.g., threads, that are configured to engage with threads of a fastening member (e.g., a linear fastening member or bone screw). Further, in some examples, a curvilinear fastening member disposed through a given bore **2026** may be configured so as not to engage the threads of the given bore **2026**. Still further, each bore **2026** may include locking features configured to engage with complimentary features on a curvilinear fastening member to prevent the curvilinear fastening member from rotating when disposed through the bore **2026**. In one example, each bore **2026** may be defined by a circumferential wall having a recess (not shown) disposed therein. The recess may be configured to receive a protrusion extending from the curvilinear fastening member to prevent the curvilinear fastening member from rotating. In one example, three bores **2026** may be provided. In yet another example, two outer bores **2026** may surround a central bore **2026**. The two outer bores **2026** may be angled to guide a fastening member (e.g., a vertebral anchor **2300** described with reference to FIGS. **61-68**, or a bone screw) along a first trajectory **2040** shown in FIG. **46** (e.g., toward one of a superior or inferior surface of intervertebral spacer **2010**), while the central bore **2026** may be angled to guide a fastening member along a second trajectory **2042** (e.g., toward the other of the superior and inferior surface of intervertebral spacer **2010**), and vice versa. In some examples, all bores **2026** may guide respective fasteners along the same trajectory. The bores **2026** can accommodate a straight longitudinal fastening member (e.g., a screw, pin, or the like) and/or a fastening member exhibiting a curvature (e.g., vertebral anchor **2300** shown in FIG. **61**). In some examples, a combination of vertebral anchors **2300** and conventional screws may be used to install the same intervertebral spacer **2010**.

[0154] Also, in the plate portion **2014** of the intervertebral spacer **2010**, a fastener back out prevention mechanism may be provided. The fastener back out prevention mechanism may include one or more screws **2016**, each having a head portion **2024** and a shank **2022** having threads **2022***a*. Shank **2022** may be received by a bore **2048** (shown in FIG. **40**) that extends from a first side **2044** of plate portion **2014** toward a second side **2046** of plate portion **2014**. Shank **2022** also may be received by a nut **2018** having a threaded bore **2018***a* (shown in FIG. **33**). Nut **2018** may have a substantially rectangular cross-section, or may have another suitable shape. Nut **2018** may be secured within a recess **2020** on second side **2046** of plate portion **2014**. However, it is contemplated that screws **2016** may be secured to plate portion **2014** by any other suitable mechanism. Head portion **2024** may have a generally rectangular cross-section such that it may prevent a fastening member from backing out of bores **2026** when disposed in certain configurations (e.g., a blocking configuration). For example, referring to FIG. **40**, the head portion **2024** of screw **2016** may extend over, cover, and/or block at least a portion of the opening of one more of bores **2026**, preventing a fastening member (e.g., a vertebral anchor **2300** or a bone screw) extended through a bore **2026** from backing out of plate portion **2014** and a vertebral body. It is also contemplated that in some examples, a single head portion **24** may extend at least partially over two adjacent bores **2026** (e.g., both an outer bore **2026** and a central bore **2026**), thereby blocking the openings of more than one bore **2026** at the same time while disposed in a blocking configuration. Head portion **2024** can be moved from the blocking configuration to a non-blocking configuration by rotating head portion by, e.g., 90 degrees or another suitable measure. While depicted as rectangular, it is contemplated that head portion **2024** may be formed in other suitable elongate shapes, such as, e.g., cylindrical or the like. In the example of FIG. **8**, plate portion **2014** may be configured to receive two screws **2016** in bores **2048** (shown in FIG. **40**). Each of the screws **2016** may be configured to block fastening members disposed in an outer bore **2026** and a central bore **2026**, such that each outer bore **2026** is blocked by a single screw **2016**, and the central bore **2026** is blocked by both screws **2016**.

[0155] A coupling mechanism may connect the spacer portion **2012** and the plate portion **2014** rigidly to each other, if desired. With reference to FIG. **34**, the coupling mechanism may include one or more fastening members **2034** that extend through corresponding recesses **2036** disposed through spacer portion **2012** and recesses **2038** disposed through at least a portion of plate portion **2014**. In one example, a fastening member **2034** may extend through the superior and inferior surfaces of spacer portion **2012** (via a recess **2036**) and may be received by recess **38** of plate portion **2014**, thereby coupling spacer portion **2012** and plate portion **2014**. It is contemplated that recess **2038** and fastening member **2034** may include complimentary mating features (e.g., threads) to facilitate coupling of plate portion **2014** to spacer portion **2012**. In the example shown in FIG. **34**, plate portion **2014** may be formed by three bore sections **2028**, **2030**, and **2032**. Bore sections **2028**, **2030**, and **2032** may either be integrally formed or detachable with spacer portion **2012**. In one example, bore section **2028** may be integral with spacer portion **2012** while bore sections **2030** and **2032** may be detachable with spacer portion **2012** via fastening members **2034** and recesses **2036** and **2038**. In one example, the detachable bore sections **2030** and **2032** may include the outer bores **2026** that are configured to direct a vertebral anchor **2300** or bone screw along the first exit trajectory **2040**, and the bore section **2028** may include the central bore **2026** configured to direct a vertebral anchor **2300** or bone screw along the second exit trajectory **2042**. Further, one or more of the bore sections **2028**, **2030**, and **2032** may include a portion configured to extend through a slot of or other opening in spacer portion **2012**. In such examples, the recesses **2036**, **2038**, or the like associated with the bore sections may align with recesses formed through spacer portion **2012** to receive fastening members **2034**.

[0156] Plate portion **2014** also may include coupling features for coupling plate portion **2014** to an anchor insertion device **2100** which will be described further with reference to FIGS. **42-55**. As shown in FIG. **40**, plate portion **2014** may include a channel (e.g., a snap-fit channel) **2050** having an opening disposed in an outer surface of plate portion **2014**. The channel **2050** may be configured to receive an extension (e.g., a cantilever and/or snap-fitting extension) of anchor insertion device **2100** to couple plate portion **2014** to the insertion device **2100**. In some examples, channel **2050** may be disposed in bore section **2030** of plate portion **2014**. With continuing reference to FIG. **40**, channel **2050** may have a generally ovular opening, although other suitable opening configurations such as, e.g., circular, square, rectangular, star-shaped, or the like are also contemplated. Plate portion **2014** also may include a bore **2052** (e.g., a threaded bore) having an opening that is also disposed through an outer surface of plate portion **2014**. In one example, bore **2052** may be disposed through bore section **2032** of plate portion **2014**.

[0157] In an exemplary method, a physician, surgeon, or other suitable operator may remove, among other things, the native intervertebral disc between two vertebral bodies. The operator then may select a given intervertebral spacer, e.g., intervertebral spacer **2010**, to replace the removed native intervertebral disc. Based on the geometry of the surrounding vertebral bodies and/or anatomy, the operator may determine that linear fastening members (e.g., linear bone screws), curvilinear fastening members (e.g., vertebral anchors **2300** or **2400**), or a combination of linear fastening members and curvilinear fastening members, will provide optimal fit and securement of intervertebral spacer **2010** between the vertebral bodies. For example, the curvature of the spine at one or more of the vertebral bodies may substantially inhibit the use of the tools and driving members used to install linear fastening members. In such examples, curvilinear fastening members may be selected to secure intervertebral spacer **2010**. The curvilinear fastening members may be installed through the same linear bore **2026** that may be configured to receive linear fastening members. Further, the curvilinear fastening members may be installed through the linear bore with a positioning member (described with reference to FIG. **42**) utilizing a guide member that can be extended only along a linear track.

[0158] In one example, one or more curvilinear fasteners may be used to secure intervertebral spacer **2010** to one vertebral body defining an intervertebral space, while one or more linear fasteners may be used to secure intervertebral spacer **2010** to the other vertebral body defining the intervertebral space. For example, curvilinear fasteners may be extended through outer bores **2026** while a linear fastener is extended through central bore **2026**. Alternatively, linear fastening members may be extended through outer bores **2026** while a curvilinear fastening member is extended through central bore **2026**. In yet another example, both linear and curvilinear fastening members may be used to secure the same intervertebral spacer into a given vertebral body. That is, a curvilinear fastening member may be extended through one outer bore **2026**, while a linear fastening member is extended through the other outer bore **2026**.

[0159] FIG. **41** depicts an intervertebral spacer **2090** in accordance with an example of the present disclosure. In some examples, intervertebral spacer **2090** may be substantially similar to intervertebral spacer **2010**, or may be another suitable intervertebral spacer. In the example shown in FIG. **41**, spacer **2090** may be a generally rectangular spacer defining a cavity **2091**. Cavity **2091** may be packed with bone graft or bone-growth inducing materials. Spacer **2090** may include one or more of inferior surfaces, superior surfaces, biconvex surfaces, among others. In some examples, the surfaces of spacer **2090** or any other bone contacting surface described in the present disclosure may include one or more of teeth, ridges, friction increasing elements, keels, or gripping or purchasing projections.

[0160] Spacer **2090** may include a plate portion **2092** that may include one or more features described with reference to plate portion **2014** of intervertebral spacer **2010**. In one example, one or more bores **2093** may disposed through plate portion **2092**. Though FIG. **41** depicts two bores **2093**, those of ordinary skill in the art will recognize that any suitable number of bores may be provided. Bores **2093** may include one or more features described with reference to bores **2026** of intervertebral spacer **2010**. The two bores **2093** may be angled to guide a fastening member (e.g., a vertebral anchor **2300** or a bone screw) along differing trajectories. For example, one bore **2093** may be angled to urge a fastening member along a first trajectory (e.g., toward one of a superior or inferior surface of intervertebral spacer **2090**), while the other bore **2093** may be angled to urge a fastening member along a second trajectory (e.g., toward the other of the superior and inferior surface of intervertebral spacer **2090**). The bores **2093** can accommodate a straight longitudinal fastening member (e.g., a screw, pin, or the like) and/or a fastening member exhibiting a curvature (e.g., vertebral anchor **2300** or **2400**). In some examples, a combination of vertebral anchors **2300** or **2400** and conventional screws may be used to install the same intervertebral spacer **2090** as shown in FIG. **57**. A circumferential wall defining bores **2093** may further include one or more recesses **2094** disposed therein. The one or more recesses **2094** may be configured to receive one or more protrusions **2460** disposed on a head portion **2406** of a vertebral anchor **2400** (described with reference to FIGS. **69-72**). Thus, in some examples, recesses **2094** may be partially-spherical to receive protrusions **2460**. However, it is contemplated that recesses **2094** may be formed in any suitable shape configured to receive protrusions **2460**. Plate portion **2092** also may include a bore **2095** having an opening that is disposed through an outer surface of plate portion **2092**. The bore **2095** may include one or more features, e.g., threads or other features to engage with an insertion device **2200** described with further detail below. Intervertebral spacer **2090** also may include one or more features configured to prevent fastening members from backing out of bores **2093**, such as, e.g., screws **2016** described with reference to FIGS. **33-40**.

[0161] Intervertebral spacer **2090** may be inserted into an intervertebral space between two vertebral bodies in a substantially similar manner as intervertebral spacers **2010**. In one example, one or more curvilinear fasteners may be used to secure intervertebral spacer **2090** to one vertebral body defining an intervertebral space, while one or more linear fasteners may be used to secure intervertebral spacer **2090** to the other vertebral body defining the intervertebral space. For example, a curvilinear fastener may be extended through one bore **2093** while a linear fastener is extended through the other bore **2093**.

[0162] An insertion device **2100** is shown in FIG. **42**, which may be used to position vertebral anchors **2300** through a plate portion of an intervertebral spacer (e.g., plate portion **2014** of intervertebral spacer **2010**) and through a vertebral body. Insertion device **2100** may extend from a trailing end **2102** toward a leading end **2104**. A trailing housing **2106** may be disposed at trailing end **2102** and may define one or more elongate channels **2108**. In the embodiment shown, three elongate channels **2108** are shown, although any other suitable number of elongate channels **2108** may be disposed through trailing housing **2106**. Each of elongate channels **2108** may receive a guide member **2110** therethrough. Guide member **2110** may include a head portion **2112** and an elongate portion **2114** that extends away from the head portion **2112**. In some examples, head portion **2112** may include one or more flattened and reinforced surfaces configured to receive the force of a striking member (e.g., a hammer or the like). Elongate portion **2114** may be extended through one or more elongate channels **2108** toward leading end **2104**. The distal or leading end of elongate portion **2114** may include a stepped portion **2132** (shown in FIG. **50**). Stepped portion **2132** may be separated from the remainder of elongate portion **2114** by a vertical wall **2130**. In some examples, stepped portion **2132** may include a smaller cross-sectional dimension (e.g., thickness or width) as compared to a remainder of elongate portion **2114**.

[0163] A connecting housing **2115** may extend from trailing housing **2106** toward an anchor housing **2116** disposed at leading end **104**. In some examples, connecting housing **2115** may be an alignment shaft configured to align elongate channels **2108** with a corresponding number of anchor channels **2118** (see FIG. **43**) disposed in anchor housing **2116**. In the embodiment shown in FIG. **42**, connecting housing **2115** may extend from only one of elongate channels **2108** to couple trailing housing **2106** to anchor housing **2116**. However, those of ordinary skill in the art will appreciate that a shaft **2116** may extend from more than one elongate channel **2108** toward anchor housing **2116**. Guide member **2110** may extend through an elongate channel **2108**, through connecting housing **2115**, and into an anchor channel **2118**, where it may come into contact with a vertebral anchor **2300** just before inserting the vertebral anchor **2300** through a vertebral body, as described further with reference to FIGS. **50-55**. In some examples, connecting housing **2115** may merely align certain elongate channels **2108** in trailing housing **2106** with anchor channels **2118** disposed in anchor housing **2116**. In such examples, elongate portion **2114** of guide member **2110** may exit a leading end of elongate channel **2108** and extend through an open and unconfined space before entering a trailing end of an anchor channel **2118**.

[0164] As best seen in FIG. **43**, anchor housing **2116** may include one or more anchor channels **2118**. Each anchor channel **2118** may have a variable cross-section along the length of anchor housing **2116**. In some examples, a given cross-section of anchor channel **2118** may be t-shaped or any another suitable cross-section. A curvature at the leading end of anchor channel **2118** may be complimentary to certain portions of a curvilinear anchor (e.g., anchor **2300** shown in FIG. **61**). Those portions may include an elongate shank **2308** and elongate fin **2310**, shown in FIGS. **61** and **63**. That is, anchor channel **2118** may be defined by a concave surface **2119** that is complimentary to elongate shank **2308** of vertebral anchor **2300**. For example, a laterally extending portion **2148** of each channel **2118** may be configured to complement and receive a curved elongate shank **2308**, and a vertically extending portion **2126** of each channel **2118** may receive a curved elongate fin **2310**. Thus, a vertebral anchor **2300** may be disposed within each anchor channel **2118** and may exit anchor channel **2118** along a given exit trajectory. Some anchor channels **2118** may urge a vertebral anchor **2300** along a first exit trajectory **2120** while other exit channels **2118** may urge a vertebral anchor **2300** along a second exit trajectory **2122**. First exit trajectory **2120** may extend in a first vertical direction out of the leading end of anchor housing **2116** while the second, different exit trajectory **2122** may extend in a second vertical direction out of the trailing end of anchor housing **2116**. A given anchor housing **2116** may include a plurality of anchor channels **2118** that may direct all vertebral anchors **2300** along the first exit trajectory **2120**, all vertebral anchors **2300** along the second exit trajectory **2122**, or some vertebral anchors **2300** along the first exit trajectory

2120 and some vertebral anchors **2300** along the second exit trajectory **2122**. Each of first and second trajectories **2120** and **2122** may intersect a longitudinal axis of insertion device **2100** and/or guide member **2110**. In one example, laterally adjacent anchor channels **2118** may be configured to direct vertebral anchors **2300** along different exit trajectories. In the exemplary embodiment shown in FIGS. **43-46**, anchor housing **2116** may include three anchor channels **2118**. Two outer anchor channels **2118** may be laterally offset from an inner anchor channel **2118**. The outer anchor channels **2118** may urge respective vertebral anchors **2300** along first exit trajectory **2120** while the inner anchor channel **2118** may urge a vertebral anchor **2300** along second exit trajectory **2122**. Anchor channel **2118** may further include a stop wall **2146** (shown in FIGS. **50-55**) that may extend radially inward from a wall of anchor channel **2118**. Stop wall **2146** may be configured to abut a vertical wall of elongate portion **2114** (of guide member **2110**) to prevent elongate portion **2114** from being inserted too far distally into a patient by an operator. Thus, stop wall **2146** also may prevent an inadvertent excessive force from being applied to intervertebral spacer **2010** or to a vertebral body by elongate portion **2114**.

[0165] Anchor housing **2116** may include one or more features to engage with corresponding features disposed on plate portion **2014** of intervertebral spacer **2010**. In one example, an extension **2117** (e.g., a hook fit, slip fit or cantilevered snap-fit extension **2117**) may extend longitudinally outward from the leading end (e.g., a distal face) of anchor housing **2116**. Extension **2117** may include one or more surfaces configured to engage channel **2050** of plate portion **2014** in a snap fit or other suitable engagement. Anchor housing **2116** also may include a threaded shank **2113** that extends longitudinally outward from the leading endface of anchor housing **2116**. In some examples, threaded shank **2113** may be received by bore **2052** of plate portion **2014**. While snap-fit and threaded connections are disclosed in the examples shown by the figures, it should be noted that any other additional or alternative type of engagement may be utilized to couple anchor housing **2116** to plate portion **2014**.

[0166] Anchor housing **2116** also may include one or more positioning members **2138**, as shown in FIG. **50**. Each positioning member **2138** may secure a vertebral anchor **2300** within a respective anchor channel **2118**. Thus, each anchor channel **2138** may be associated with its own respective positioning member **2138**. In one example, positioning member **2138** may be an elongate cantilever that is coupled to a leading end portion of anchor housing **2116** via a linkage or hinge **2140**. In some examples, linkage or hinge **2140** may be a spring-biased linkage or may be another suitable hinge or linkage. Positioning member **2138** may extend from linkage **2140** toward trailing end **2102**. At its proximal or trailing end, positioning member **2138** may include a ramp **2142** and an extension **2144** spaced from ramp **2142** by a recess. Ramp **2142** may be an inclined surface configured to engage elongate portion **2114** of guide member **2110**. Positioning member **2138** may be configured to pivot about the linkage **2140** and away from an interior of anchor channel **2118** when ramp **2142** is engaged by elongate portion **2114** of guide member **2110**. In some examples, positioning member **2138** may pivot in a direction that is opposite to the exit trajectory of its associated anchor channel **2118**. That is, if a given anchor channel **2118** is configured to guide a vertebral anchor into a vertebral body along first trajectory **2120**, the associated positioning member **2138** of that elongate channel may pivot about linkage **2140** in the vertical direction that is opposite to the vertical vector of first trajectory **2120**. On the other hand, if a given anchor channel **2118** is configured to guide a vertebral anchor **2300** along the second trajectory **2122**, the associated positioning member **2138** of that anchor channel **2118** may be configured to pivot in a vertical direction that is opposite to the vertical vector of second trajectory **2122**. Extension **2144** may include any suitable configuration (e.g., a ball or the like), and may be configured to be releasably coupled to a vertebral anchor **2300** via groove **22318**.

[0167] Vertebral anchors **2300** may be loaded into anchor channels **2118** prior to the coupling of anchor housing **2116** to plate portion **14** of intervertebral spacer **2010**. Vertebral anchors **2300** may be loaded from either the trailing end or the leading end of anchor housing **2116**, if desired. In some examples, vertebral anchors **2300** may be loaded by a spring-loaded block device. In one example, a vertebral anchor **2300** may be loaded into the leading end of anchor housing **2116** with trailing end **2302** of the vertebral anchor being inserted first. That is, trailing end **2302** of vertebral anchor **2300** may be loaded into anchor channels **2118** before leading end **2304**. Thus, vertebral anchors **2300** may be loaded in a reverse manner such that the vertebral anchors **2300** are loaded in the opposite direction to which they are inserted into the body. As vertebral anchors **2300** are moved proximally through anchor channels **2116**, groove **2318** may be coupled to extension **2144** of positioning member **2138**. The docking, mating, or connection of extension **2144** with groove **2318** may fix vertebral anchor **2300** within anchor channel **2118** until vertebral anchor **2300** is inserted through a vertebral body. In one example, extension **2144** may be a ball and a groove **2318** of vertebral anchor **2300** may be a socket such that extension **2144** and groove **2318** form a ball and socket joint. However, those of ordinary skill in the art will appreciate that any other suitable form of releasable connection may be utilized.

[0168] Anchor housing **2116** may be coupled to intervertebral spacer **2010** to install vertebral anchors **2300** into the body. Anchor housing **2116** and plate portion **2014** may be aligned via extension **2117** and channel **2050**, and/or via shank **2113** and bore **2052** in such a manner as to align channels **2118** of anchor housing **2116** with bores **2026** of plate portion **2014**. The alignment of channels **2118** and bores **2026** may permit one or more vertebral anchors **2300** to be guided from a channel **2118** through a corresponding bore **2026** of plate portion **2014**, and into a vertebral body. Further, the anchor housing **2116** and plate portion **2014** may be aligned such that the exit trajectory of a given channel **2118** may be aligned (e.g., collinear or coplanar) with the exit trajectory of an aligned bore **2026**. In some examples, the number of channels **2118** disposed in anchor housing **2116** may correspond exactly with the number of bores **2026**. However, it is contemplated that an exact correspondence may not exist between channels **2118** and bores **2026**. For example, an anchor housing **2116** may include fewer channels **2118** than bores **2026** in a plate portion. In such examples, anchor housing **2116** may be coupled to plate portion **2014** in a number of different configurations. In such examples, after a vertebral anchor **2300** is inserted through a vertebral body, anchor housing **2116** may be uncoupled from plate portion **2014**, reloaded with a new vertebral anchor **2300**, and recoupled to plate portion **2014** at a different location.

[0169] With continuing reference to FIGS. **50-55**, there is depicted an exemplary method of positioning a vertebral anchor **2300** via insertion device **2100**. Referring to FIG. **50**, vertebral anchor **2300** is shown loaded into an anchor channel **2118**. The vertebral anchor **2300** may be secured within the anchor channel **2118** via the coupling of extension **2144** with groove **2318** of the vertebral anchor **2300** as set forth above. Elongate portion **2114** of guide member **2110** then may be advanced distally (e.g., in the direction of leading end **2304**) such that the distal end of elongate portion **2114** may contact ramp **2142** (FIGS. **51** and **52**). In some examples, stepped portion **2132** of elongate portion **2114** may contact the ramp **2142**. Elongate portion **2114** may be advanced further distally, causing ramp **2142** to slide vertically upward, thereby disengaging extension **2144** from groove **2318** of vertebral anchor **2300** (FIG. **52**). As elongate portion **2114** is advanced further distally, the distal end of elongate portion **2114** may abut the trailing end **2302** of vertebral anchor (FIG. **53**). In some examples, the stepped portion **2132** of elongate portion **2114** may abut head portion **2306** of vertebral anchor **2300**. Uncoupled from extension **2144**, vertebral anchor **2300** then may be advanced out of the leading end of anchor housing **2116** and anchor channel **2118** (FIG. **54**) and ultimately inserted into a vertebral body (not shown) along a given exit trajectory (e.g., trajectory **2120** or **2122**.), as shown in FIG. **55**. After impacting one vertebral anchor **2300** through a vertebral body, the same guide member **2110** (and elongate portion **2114**) may be withdrawn and reinserted through a different elongate channel **2108** and anchor channel **2118** (having another preloaded vertebral anchor **2300**), to impact a different vertebral anchor **2300**, if desired. Alternatively, each set of elongate channels may include a dedicated guide member **2110**.

[0170] One embodiment of an insertion device **2200** is shown in FIGS. **56-60**. Insertion device

2200 may extend from a first, trailing end **2202** toward a second, leading end **2204**. A base portion **2206** may include a proximal annular rim **2208** and base shaft **2209** extending therefrom. An alignment shaft **2210** may extend from base shaft **2209**. In the example shown in FIG. **56** the leading end **2204** of alignment shaft **2210** may have a smaller diameter than the trailing end of alignment shaft **2210**, although other suitable configurations, including a substantially constant diameter shaft **2210**, are also contemplated. In some examples, alignment shaft **2210** may include one or more longitudinally extending windows **2218**. In some examples, alignment shaft **2210** may be a hollow elongate shaft accommodating a drive mechanism **2216** therein. Drive mechanism **2216** may be configured to actuate a coupling **2222** disposed at the leading end of alignment shaft **2210**. Drive mechanism **2216** may be a spring loaded drive shaft configured to reciprocally move coupling **2222** between a retracted configuration and an extended configuration. While in the extended configuration, coupling **2222** may engage with, e.g., bore **2095** of intervertebral spacer **2090** to couple insertion device **2200** to intervertebral spacer **2090**. While coupling **2222** is engaged to bore **2095**, drive mechanism **2216** may move coupling **2222** to the retracted configuration to disengage insertion device **2200** from intervertebral spacer **2090**.

[0171] Coupling **2222** may be disposed in an anchor housing **2220** that is disposed at the leading end **2204** of alignment shaft **2210**. Anchor housing **2220** may include at least one anchor channel **2224**. Anchor channel **2224** may include one or more features described with reference to anchor channel **2118** of insertion device **2100**. For example, anchor channel **2224** may have a variable cross-section along its length and may have a concave surface **2230** (shown in FIGS. **58-60**) that is complimentary to, e.g., elongate shank **2408** of anchor **2400** shown in FIG. **69**. For example, a laterally extending portion of anchor channel **2224** may receive a curved elongate shank **2408**. A guide member **2228** that may be substantially similar to guide member **2110** may be inserted through anchor channel **2224** to assist with deploying an anchor disposed therein.

[0172] It is contemplated that insertion device **2200** may include additional or alternative features for attaching to intervertebral spacer **2090** such as, e.g., positive attachments, cam attachments, threaded attachments or other suitable attachments. In some examples, pins or other members also may prevent the rotation of insertion device **2200** relative to intervertebral spacer **2090** when the insertion device **2200** and intervertebral spacer **2090** are engaged. In some examples, the leading end of insertion device **2200** may couple to the anterior face, lateral sides, or other regions of intervertebral spacer **2090**. In one embodiment, the insertion device **2200** may include a stop that extends in either the cephalad or caudal direction of a centerline of insertion device **2200** to prevent the intervertebral spacer **2090** from being inadvertently impacted undesirably. That is, a stop may extend from the superior or inferior surface of insertion device **2200** and may contact, e.g., a surface of the intervertebral spacer or vertebral body.

[0173] Anchor housing **2220** may be coupled to an intervertebral spacer, e.g., intervertebral spacer **2090**, to install vertebral anchors **2400** into the body. Anchor housing **2220** and plate portion **2092** may be aligned via coupling **2222** and bore **2095**, in such a manner as to align channel **2224** of anchor housing **2220** with a bore **2093** of plate portion **2014**. In some examples, anchor channels **2224** may be laterally offset from the length of alignment shaft **2210**. The alignment of channel **2224** and bore **2093** may permit one or more vertebral anchors **2400** to be guided from a channel **2224** through a corresponding bore **2093** of plate portion **2092**, and into a vertebral body. Further, the anchor housing **2220** and plate portion **2092** may be aligned such that the exit trajectory of a given channel **2224** may be inline (e.g., collinear or coplanar) with the exit trajectory of an aligned bore **2093**. While only one anchor channel **2224** is shown in the example of FIGS. **56-60**, it is contemplated that additional anchor channels **2224** may be utilized (e.g., a double or multi-barreled configuration) such that the number of channels **2224** disposed in anchor housing **2220** may correspond exactly with the number of bores **2093** in vertebral spacer **2090**. In some examples, a guide member may extend through one or more anchor channels **2224** to simultaneously insert one or more fastening members (e.g., vertebral anchors or screws) through one or more vertebral bodies. Other mechanisms of anchor insertion are also contemplated such as, e.g., a blocking set screw or leaf spring cutout of the spacer or plate that is flexible in the insertion direction and stiff in the expulsion direction. An associated intervertebral spacer also may include rotational stabilizers to add stability to the construct in vivo, and may contain radiographic markers to aid in interoperative visibility.

[0174] FIGS. **58-60** depict an exemplary method of positioning a vertebral anchor **2400** via insertion device **2200**. Referring to FIG. **58**, vertebral anchor **2400** is shown loaded into an anchor channel **2224**. The vertebral anchor **2400** may be secured within the anchor channel **2224** by any suitable mechanism. Guide member **2228** then may be advanced distally such that the distal end of guide member **2228** may contact head portion **2406** of vertebral anchor **2400** (FIG. **58**). Guide member **2228** may extend from trailing end **2202**, through a trailing opening **2226** (shown in FIG. **57**) of anchor channel **2224** to abut a vertebral anchor **2400**. Vertebral anchor **2400** then may be advanced out of the leading end of anchor housing **2220** and anchor channel **2224** (FIG. **59**) and ultimately inserted into a vertebral body (not shown) along a given exit trajectory, as shown in FIG. **60**. After impacting one vertebral anchor **2400** through a vertebral body, anchor housing **2220** may be disengaged from plate portion **2092**, and another vertebral anchor **2400** may be loaded into anchor channel **2224**. When anchor channel **2224** is reloaded, anchor housing **2220** may be re-engaged with plate portion **2092** in a substantially similar manner as before, except that anchor channel **2224** may be aligned with a different bore **2093** of vertebral spacer **2090**.

[0175] A vertebral anchor **2300** shown in FIG. **2029** may extend from a first, trailing end **2302** toward a second, leading end **2304**, and may include a head portion **2306**, an elongate shank **2308**, and an elongate fin **2310**. Vertebral anchor **2300** may be formed from a rigid, bio-compatible material such as, e.g., titanium or polyetheretherketone (PEEK), among others. The head portion **2306**, elongate shank **2308**, and elongate fin **2310** may be formed of the same or of different materials. Portions of vertebral anchor **2300** may be treated with a titanium and/or hydroxyapatite plasma spray coating to encourage bony on-growth, improving the strength and stability of the connection between the respective component and the underlying bone (e.g., a vertebral body). Any other suitable coating also may be provided on one or more surfaces of vertebral anchor **2300**. Such coatings may include therapeutic agents (e.g., antibiotic coatings), if desired. Vertebral anchor **2300** also may include radiopaque markings to facilitate in vivo visualization and insertion. Vertebral anchor **2300** may be configured to be impacted into vertebral bodies to secure implants within the intervertebral space of a patient. Vertebral anchor **2300** may be inserted into the patient and impacted through the bone of a vertebral body.

[0176] The head portion **2306** may be disposed at trailing end **2302** of vertebral anchor **2300** and may be generally spherical or ball shaped. In some examples, the head portion **2306** may be shaped in a substantially similar manner as the head portion of other vertebral fastening members (e.g., bone screws). In some examples, the head portion **2306** may include a bore **2312** to facilitate removal of vertebral anchor **2300** from a vertebral body. In some examples, bore **2312** may be a threaded bore or may include other suitable features to facilitate the extraction of vertebral anchor **2300** from a vertebral body by, e.g., a pulling tool or the like. In some examples, a tool with a threaded tip may be rotated to threadingly engage bore **2312**, and the tool may be linearly withdrawn to extract vertebral anchor **2300** from within a vertebral body. The pooling tool also may include one or more of a cam attachment, an expandable driver, or another feature for removing vertebral anchor **2300**. A plurality of slots or notches **2314** may be formed in the outer periphery of head portion **2306**. In some examples, a plurality of flanges **2316** may define the plurality of slots **2314** about the outer periphery of the head portion **2306**. The flanges **2316** may be disposed around head portion **2306** to form a generally t-shaped cross-section. A groove **2318** (e.g., a semi-cylindrical groove) may be formed in the outer periphery of head portion **2306**. In some examples, the groove **2318** may be disposed within one of the flanges **2316**, or in another suitable location on head portion **2306**. In some examples, one or more grooves **2318** may be disposed along the periphery of head portion **2306**. Groove **2318** may cooperate with an extension (e.g., extension **2144** shown in FIG. **50**) of an installation device as discussed above. In some examples, the flanges **2316** and slots **2314** of the head portion **2306** may cooperate with or be received by complimentary shaped features in a spacer, implant, plate system or the like. The interaction between the flanges **2316**, slots **2314**, and the complimentary-shaped features may prevent the relative rotation of vertebral anchor **2300** before, during and/or after installation of vertebral anchor **2300** into a vertebral body.

[0177] Elongate shank **2308** may extend away from the head portion **2306** toward the leading end **2304**. In some examples, elongate shank **2308** may be planar and may exhibit a curvature as it extends away from the head portion **2306**. That is to say, in some examples, elongate shank **2308** may include a curvilinear configuration. Specifically, elongate shank **2308** may be curved (e.g., symmetrically curved) about a longitudinal axis. More specifically, elongate shank **2308** exhibit a curvature about a median longitudinal axis. Further, the elongate shank **2308** may be curved such that a concave surface **2320** and a convex surface **2322** extend from trailing end **2302** toward leading end **2304**. The leading end of the elongate shank **2308** may be formed by a pair of inclined surfaces **2323** and **2324** that extend from the lateral ends of elongate shank **2308** toward an apex **2326**. Apex **2326** may be disposed on a longitudinal axis of vertebral anchor **2300**. Thus, at leading end **2304**, elongate shank **2308** may be formed as a projectile point, arrowhead, bladed edge, cutting edge, or the like to facilitate impaction and insertion through bone and/or tissue. To reduce impaction force, the apex **2326** may feature a hollow style which may be similar to a knife edge. That is, the edge or apex **2326** of the anchor may approach a shallow angle, e.g., approximately 15 degrees at the sharpest point, which may increase closer to a central axis. In some examples, apex **2326** may be rounded to prevent injury, but may still be sharp around its edges. To further reduce insertion force and manufacturing time, the hollow surfaces may be surface machined using, e.g., a 1 mm full radius mill and, e.g., a 0.25 mm step-over, which may result in the wavy surface (including a plurality of rolling peaks and valleys) along the face of the hollow surface. As further shown in FIGS. **61-68**, inclined surfaces **2123** and **2124** may include one or more geometric features, such as, e.g., serrations (shown in FIG. **62**), teeth, tapers, bevels or the like to further facilitate spearing, cutting, slicing, or impacting of elongate shank **2308** through bone and/or tissue. Inclined surfaces **2323** and **2324** also may be formed with an edge (e.g., a v-edge, beveled edge, chisel edge, convex edge or the like) to facilitate impaction.

[0178] Elongate fin **2310** also may extend away from head portion **2306** toward the leading end **2304** of vertebral anchor **2300**. Elongate fin **2310** also may extend away from the concave surface **2320** of the elongate shank **2308**. The vertical periphery of elongate fin **2310** may be defined by a concave surface **2328**. In some examples, the elongate shank **2308** and elongate fin **2310** may be generally orthogonal to one another and may form a generally t-shaped cross-section. The t-shaped cross-section formed by elongate shank **2308** and elongate fin **2310** may reduce impaction forces of vertebral anchor **2300**, and may increase the torsional stability of vertebral anchor **2300** as compared to anchors having planar cross-sections. At leading end **2304**, elongate fin **2310** may include a ramped surface **2130** that extends toward apex **2326**. Ramped surface **2330** may include one or more of the geometrical features described with reference to inclined surfaces **2323** and **2324**. In some examples, a vertical periphery of ramp **2130** may be beveled and/or have a v-shaped cross-section.

[0179] Turning now to FIGS. **69-72**, a further embodiment of a vertebral anchor **2400** is depicted. Vertebral anchor **2400** may extend from a first, trailing end **2402** toward a second, leading end **2404**, and may include a head portion **2406**, an elongate shank **2408**, and an elongate fin **2428**. Vertebral anchor **2400** may be formed from one or more of the materials used to form vertebral anchor **2300** and may be treated with one or more similar coatings, if desired. Vertebral anchor **2400** may be inserted into a patient and impacted through bone of a vertebral body.

[0180] The head portion **2406** may be disposed at trailing end **2402** of vertebral anchor **2400** and may have a partially spherical outer periphery. In some examples, the head portion **2406** may be formed by a plurality of spherical segments formed by removing one or more spherical caps from the spherical outer periphery of head portion **2406**. In the embodiments shown in FIGS. **69-72**, at least three planar surfaces **2411**, **2413**, and **2450** may define at least a portion of the outer periphery of the partially-spherical head portion **2406**. In one example, planar surfaces **2411** and **2413** may be substantially parallel to one another, and may be substantially orthogonal to planar surface **2450**. In some examples, planar surface **2450** may define the proximal-most portion of head portion **2406** and of vertebral anchor **2400**. That is, planar surface **2450** may define the surface that is furthest toward trailing end **2402** of vertebral anchor **2400**. A recess (e.g., a concave recess) **2452** may be disposed within planar surface **2450** such that planar surface **2450** may be defined by interrupted hemispherical arc portions, as seen in FIG. **64**. A bore **2412** may have an opening disposed within recess **2452**. Bore **2412** may extend through head portion **2406** and may include one or more features described with reference to bore **2312** of vertebral anchor **2300**. While not shown in FIGS. **69-72**, it is contemplated that head portion **2406** may include other features described with reference to head portion **2306** of vertebral anchor **2300**, such as, e.g., grooves and/or mating features configured to secure and position vertebral anchor **2400** within an anchor channel of an insertion device.

[0181] Head portion **2406** also may include one or more protrusions **2460** that may extend away from the outer periphery of head portion **2406**. In the examples shown, protrusions **2460** may be formed as spherical caps (e.g., partial domes), although protrusions **2460** may be formed in any other suitable configuration. In some examples, the base of protrusions **2460** may include an annular rim **2462** that may, e.g., extend radially away from protrusions **2460**. In some examples, head portion **2406** may include two protrusions **2460** that extend in opposite directions. It is contemplated that another suitable number of protrusions **2460** may be employed in alternative configurations.

[0182] Elongate shank **2408** may extend away from the head portion **2406** toward the leading end **2404**. In some examples, elongate shank **2408** may be planar and may exhibit a curvature as it extends away from the head portion **2406**. In some examples, elongate shank **2408** may be curved (e.g., symmetrically curved) about a longitudinal axis. More specifically, elongate shank **2408** may exhibit a curvature about a median longitudinal axis. Further, the elongate shank **2408** may be curved such that a concave surface **2420** and a convex surface **2422** extend from trailing end **2402** toward leading end **2404**. The leading end of the elongate shank **2408** may be formed by a pair of inclined surfaces **2423** and **2424** that extend from the lateral ends of elongate shank **2408** toward an apex **2426**. Apex **2426** may be disposed on a longitudinal axis of vertebral anchor **2400**. In some embodiments, apex **2426** may include a curvilinear periphery. Thus, at leading end **2404**, elongate shank **2408** may be formed to include any of the suitable geometries and features disposed on vertebral anchor **2300** to facilitate impaction.

[0183] In one example, the lateral sides of elongate shank **2408** may include one or more cutouts **2421**. For example, each lateral side of elongate shank **2408** may include two cutouts **2421** to form one or more keels **2425**. The keels **2425** may generally extend and point in a reverse manner with respect to a remainder of vertebral anchor **2400**. That is, the end points of the keels **2425** may be oriented toward the trailing end **2402** and not leading end **2404**. Thus, keels **2425** may assist in inhibiting vertebral anchor **2400** from exiting a vertebral body once inserted therein. In the embodiment shown in FIGS. **63-66**, each lateral side of elongate shank **2408** may include two cutouts **2421** and three keels **2425**, although any other suitable combination of cutouts and keels may be utilized.

[0184] One or more apertures **2427** may disposed through the surface of elongate shank **2408**. Though depicted as through-holes, apertures **2427** also may include blind recesses disposed in one or more surfaces of elongate shank **2308**. Once inserted through the bone of a vertebral body, apertures **2427** may encourage bony in-growth or on-growth therein, further securing vertebral anchor **2400** within a respective vertebral body. In some examples, apertures **2427** may be packed with bone graft or other bone-growth inducing substances.

[0185] Elongate fin **2428** also may extend away from head portion **2406** toward the leading end **2404** of vertebral anchor **2400**. Elongate fin **2428** also may extend away from the concave surface of the elongate shank **2408**. The vertical periphery of elongate fin **2428** may be defined by one or more cutouts **2431** and keels **2435** in a substantially similar manner as the lateral sides of elongate shank **2408**. In some examples, the elongate shank **2408** and elongate fin **2428** may be generally orthogonal to one another and may form a generally t-shaped cross-section. The t-shaped cross-section formed by elongate shank **2408** and elongate fin **2428** may reduce impaction forces of vertebral anchor **2400**, and may increase the torsional stability of vertebral anchor **2400** as compared to anchors having planar cross-sections. At leading end **2404**, elongate fin **2428** may include a ramped surface **2430** that extends toward apex **2426**. Ramped surface **2430** may include one or more of the geometrical features described with reference to inclined surfaces **2423** and **2424**. In some examples, apertures (not shown but similar to apertures **2427**) may be disposed on or through elongate fin **2428** to encourage bony in-growth or on-growth therein.

[0186] In some examples, vertebral anchors **2300** and **2400** may facilitate easy insertion of various vertebral spacers (e.g., stand-alone ACDF and/or ALIF spacers) through the use of inline impaction of anchors **2300** and **2400** through the spacer. In some examples, the inline operation may be facilitated through appropriate implant design, instrument design, and design of the implant-instrument interface. In some examples, the various examples of the present disclosure may permit the use of stand-alone spacers at the most caudal or most cephalad cervical disc spaces (e.g., C5-C6/C6-C7 and C2-C3), and at the caudal lumbar levels (e.g., L5-S1) where angled instruments may pose insertion problems due to interference with tissue or other anatomy.

[0187] In addition to the embodiments above, additional plate and spacer systems can be provided that are of low profile. These plate and spacer systems are advantageously capable of providing multiple options to a surgeon. In particular, they allow a surgeon to choose the type of spacer (e.g., PEEK or allograft) to accompany the plate. In addition, they allow a surgeon to choose whether to use a straight bone anchor, a curved bone anchor, or a combination of both in order to be inserted into a patient.

[0188] FIG. **73** is a top perspective view of a plate and spacer system with curved bone anchors in accordance with some embodiments. The plate and spacer system **2500** is advantageously low profile. In addition, the plate and spacer system **2500** provides numerous options, such as the ability to use a PEEK or allograft spacer, as well as the ability to use straight or curved bone anchors.

[0189] The plate and spacer system **2500** comprises a novel, low profile plate **2514** including a pair of bore holes **2526** for receiving a bone fastener therein. In the present embodiment, the plate **2514** receives a pair of non-threaded, curved bone fasteners, shims or anchors **2300** (similar to the curved bone fasteners in FIGS. **61** and **67**). Advantageously, these curved bone fasteners **2300** can be easily impacted into bone, without having to thread them therein. In other embodiments, the plate **2514** can received straight, threaded bone fasteners. In addition, in other embodiments, the plate **2514** can receive at least one non-threaded, curved bone fastener and at least one straight, threaded bone fastener. The plate **2514** is configured to receive at least one blocking member **2516**. The blocking member **2516** can be in the form of a fastener with cutouts. In a first configuration, the cutouts of the blocking member **2516** each align with a perimeter of the adjacent bore hole **2526**, thereby allowing a bone fastener to pass therethrough. In a second configuration, the blocking member **2516** is rotated such that the cutouts do not align with the perimeter of an adjacent bore hole **2526**, thereby preventing a fastener from inadvertent backout.

[0190] In addition, the plate **2514** comprises torsional stabilizers **2563**, which provides the system **2500** with stability as it is engaged with bone. In the present embodiment, the plate and spacer system **2500** includes a pair of upper torsional stabilizers **2563** for gripping a superior vertebrae and a pair of lower torsional stabilizers **2563** for gripping lower vertebrae. In some embodiments, the torsional stabilizers **2563** include pointed, knife-like edges, while in other embodiments, the torsional stabilizers **2563** include blunted edges. In some embodiments, the plate and spacer system **2500** includes less than two or more than two upper torsional stabilizers **2563**, and similarly, less than two or more than two lower torsional stabilizers **2563**.

[0191] The plate **2514** further comprises a pair of extensions or arms **2570** that extend from a front plate portion. Each of the arms **2570** includes a window **2572** that is designed to receive a bump out portion of the spacer **2512**, thereby connecting the spacer **2512** to the plate **2514**. In some embodiments, the window **2572** comprises a fully-enclosed perimeter that extends around a bump out portion of the spacer **2512**. In some embodiments, the distal end of each of the arms **2570** comprises a lateral, inwardly facing protrusion **2568** that is received in a respective notch or groove of the spacer **2512**. Accordingly, the plate and spacer system **2500** advantageously include multiple ways to secure the plate **2514** to the spacer **2512** thereby forming a secure system.

[0192] As shown in FIG. **73**, the plate **2514** includes a pair of channels **2550**, **2552** for receiving an insertion instrument therein. In some embodiments, the channels **2550**, **2552** can differ from one another. For example, channel **2550** can comprise a full enclosed, threaded opening or hole that is designed to receive a threaded portion of an instrument. Channel **2552** can be a partially enclosed, non-threaded opening that includes a hook engagement cut out for receiving a non-threaded portion of an instrument. In some embodiments, a single instrument (such as that in FIG. **42**) can be provided that includes both a threaded portion and a non-threaded hook portion. The instrument can be used to deposit one or more curved or straight fasteners.

[0193] The plate and spacer system **2500** further includes at least one spacer **2512** that is attachable to the plate **2514**. Advantageously, a surgeon can choose the type of spacer **2512** to be attached to the plate **2514**, such as an allograft spacer or PEEK spacer. The spacer **2512** includes a central opening for receiving graft material **2520** therein. In addition, the spacer **2512** can include superior and inferior surfaces having surface texturing thereon to better engage adjacent vertebrae. In the present embodiment, the spacer **2512** comprises a plurality of ridges on the superior and inferior surfaces.

[0194] FIG. **74** is a top perspective view of a plate and spacer system with straight bone anchors in accordance with some embodiments. While the plate and spacer system **2500** is similar to that of FIG. **73** such that the plate **2514** and the spacer **2512** include similar features, the present embodiment is shown as receiving straight, threaded bone fasteners **88** received through the plate **2514**. The present embodiment thus demonstrates the ability of the plate to receive either straight, threaded bone fasteners **88** or curved, non-threaded bone fasteners or anchors **2300** depending on the desires of the surgeon.

[0195] FIG. **75** is a top perspective view of a plate in accordance with some embodiments. From this view, one can see the plate **2514** detached from the spacer **2512** without any fastener received therein. As shown in FIG. **75**, the bore holes **2526** of the plate **2514** can be non-threaded, and are capable of accommodating any of the fasteners or anchors described above. In other embodiments, the bore holes **2526** can be completely or partially threaded.

[0196] FIG. **76** is a front view of the plate of FIG. **75**. From this view, one can see the channels **2550**, **2552** for receiving different portions of an instrument therein. One can see how the channel **2550** comprises a threaded hole completed enclosed by a perimeter, whereas channel **2552** comprises a non-threaded hole partially enclosed by a perimeter.

[0197] FIG. **77** is a top view of the plate of FIG. **75**. From this view, one can see a pair of lateral tracks **2580** that extend through sidewalls of the plate. These lateral tracks **2580** advantageously accommodate a press assembly (not shown) that can be used to press a desired spacer **2512** onto the plate **2514**.

[0198] FIG. **78** is a top perspective view of a PEEK spacer in accordance with some embodiments. The spacer **2512** comprises a C-shape spacer having a superior surface and an inferior surface with a plurality of protrusions formed thereon. In addition, the spacer **2512** comprises a flatly cut upper chamfer **2518***a* and a flatly cut lower chamfer **2518***b* for providing clearance to a screw or anchor that is inserted through the plate.

[0199] FIG. **79** is a top perspective view of an allograft spacer in accordance with some embodiments. The spacer **2512** comprises a C-shaped spacer having a superior surface and an inferior surface with a plurality of ridges formed thereon. In addition, the spacer **2512** comprises a flatly cut upper chamfer **2518***a* and a flatly cut lower chamfer **2518***b* for providing clearance to a screw or anchor that is inserted through the plate.

[0200] FIG. **80** is a top perspective view of an alternative allograft spacer in accordance with some embodiments. The spacer **2512** comprises a C-shaped spacer having a superior surface and an inferior surface with a plurality of ridges formed thereon. In addition, the spacer **2512** comprises a curved cut upper chamfer **2518***a* and a curved cut lower chamfer **2518***b* for providing clearance to a screw or anchor that is inserted through the plate. In some embodiments, the curved chamfers better conform to a screw or anchor that is received through the plate. In addition, the curved chamfers **2518***a*, **2518***b* allow for more material to be left on the spacer **2512** during manufacturing, which makes the spacer **2512** stronger.

[0201] Turning now to FIGS. **81**A-**81**B, an alternative plating system **3005** comprising a low profile plate **3050** attached to a spacer **3010** is shown. Plating system **3005** is similar to the other spacer and plate systems described herein with the addition of an interference **3028** adjacent the hump regions or protrusions **3026** configured to fit in window **3072** in arms or extensions **70** of the plate **3050**. It is desirable for the spacer **3010** to fit snugly to the plate **3050**. The interference **3028** may enhance the fit of the spacer **3010** to the plate **3050** by allowing the small amount of material of the interference **3028** to deform during the assembly process. By deforming the interference **3028**, the system **3005** may better accommodate tolerance of machining and/or the varying shrink rates encountered in the lyophilization process for allograft spacers **3010**.

[0202] In particular, the interference **3028** may be located in the notches or slots **3017** in the spacer **3010** configured to receive the inwardly facing protrusions **3071** on the ends of the arms **3070**. The interference **3028** may include a minor protrusion including two sloped surfaces meeting at a central apex. The interference **3028** may be elongated along the length of the slots **3017**. For example, the slots **3017** in the spacer **3010** may be provided with uneven and/or offset surfaces to provide small amounts of interference when the spacer **3010** is assembled to the plate **3050**. Small interference surfaces within the slots **3017** are easy to manufacture and can account for machining tolerances stackup between the two mating components. The interference **3028** may also help to accommodate the varying shrink rates encountered in the lyophilization process for allograft spacers post-machining.

[0203] One skilled in the art will appreciate that any of the plate systems described above can be used with other spinal implants. Among the other implants that can accompany the plate systems include stabilization systems and rod systems, including rod members, hook members, and bone fasteners such as pedicle screws. One skilled in the art will appreciate that any of the plate systems described above can also be used with one another, or can be used multiple times along different segments of the spine. In addition, any of the plate systems described above can be used with a variety of navigation and guidance tools, including those related to neuromonitoring and robotics. Furthermore, one of skill in the art will appreciate that the plate systems described above can be produced in a number of different ways, including in part via 3-D printing methods.

[0204] It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the scope or spirit of the invention. Moreover, the improved plate systems and bone screw assemblies and related methods of use need not feature all of the objects, advantages, features and aspects discussed above. Thus, for example, those skilled in the art will recognize that the invention can be embodied or carried out in a manner that achieves or optimizes one advantage or a group of advantages as taught herein without necessarily achieving other objects or advantages as may be taught or suggested herein. In addition, while a number of variations of the invention have been shown and described in detail, other modifications and methods of use, which are within the scope of this invention, will be readily apparent to those of skill in the art based upon this disclosure. It is contemplated that various combinations or subcombinations of these specific features and aspects of embodiments may be made and still fall within the scope of the invention. Accordingly, it should be understood that various features and aspects of the disclosed embodiments can be combined with or substituted for one another in order to form varying modes of the discussed bone screw assemblies. Thus, it is intended that the present invention cover the modifications and variations of this invention provided that they come within the scope of the appended claims or their equivalents.

Claims

1. A method for stabilizing vertebral bodies comprising the steps of: providing a plate member including an upper rim and a lower rim, the plate member further including a first arm and a second arm, the first arm and the second arm each including at least one window; providing a spacer having first and second lateral sides, the first and second lateral sides defining the width of the spacer, wherein the spacer attaches to the plate member by engaging the first lateral side of the spacer with the at least one window in the first arm and engaging the second lateral side of the spacer with the at least one window in the second arm; providing a first screw upwardly insertable through an upper screw hole of the upper rim; and providing a second screw downwardly insertable through a lower screw hole of the lower rim, wherein protrusions on the spacer are configured to fit in the at least one window of the first arm and the second arm.
2. The method of claim 1, wherein the upper rim of the plate member includes an anterior face and a posterior face, wherein each of the anterior face and the posterior face are straight and non-angled with respect to a vertical axis defined by the spacer.
3. The method of claim 1, wherein the upper rim of the plate member includes an anterior face and a posterior face, wherein at least one of the anterior face and the posterior face are angled with respect to a vertical axis defined by the spacer.
4. The method of claim 3, wherein the posterior face of the upper rim is angled between 5 and 15 degrees in an anterior direction relative to a longitudinal axis that extends vertically from an upper surface of the spacer to a lower surface of the spacer.
5. The method of claim 1, wherein the plate member includes a rotatable locking mechanism designed to prevent backout of the first screw and the second screw from the plate member.
6. The method of claim 1, wherein the plate member includes a stabilizer for inserting partially into a disc space.
7. The method of claim 1, wherein a height of each window is greater than a length of each window.
8. The method of claim 1, further comprising a graft opening, the graft opening being defined by the plate member and the spacer.
9. A method configured to fixate two adjacent vertebral bodies, comprising the steps of: providing a plate having a body; an upper rim extending from the body and a lower rim extending from the body, wherein the upper rim includes an upper screw hole extending through the upper rim and having an upper screw hole center axis and the lower rim includes a lower screw hole extending through the lower rim and having a lower screw hole center axis; a first screw insertable through the upper screw hole, wherein the first screw is oriented in an upward direction; and a second screw insertable through the lower screw hole, wherein the second screw is oriented in a downward direction; wherein the body comprises a first window and a second window configured to attach the body to a spacer, and wherein the upper screw hole center axis is positioned entirely above an upper surface of the spacer and the lower screw hole center axis is positioned entirely below a

lower surface of the spacer, wherein protrusions on the spacer are configured to fit in the first window and the second window of the body of the plate.

10. The method of claim 9, further comprising a graft opening, the graft opening being defined by the plate and the spacer.

11. The method of claim 9, wherein the spacer comprises a tapered upper surface and a tapered lowered surface.

12. The method of claim 9, wherein the spacer is formed of allograft or PEEK.

13. The method of claim 9, wherein the spacer comprises a first bump out portion and a second bump out portion, wherein the first bump out portion is securable to a first arm of the plate and the second bump out portion is securable to a second arm of the plate member.

14. The method of claim 13, wherein the first arm comprises the first window configured to receive the first bump out portion of the spacer and the second arm comprises the second window configured to receive the second bump out portion of the spacer.

15. The method of claim 9, wherein the plate includes a first stabilizer that extends upwardly and a second stabilizer that extends downwardly.

16. The method of claim 9, wherein the upper rim has a front surface and a back surface, wherein at least one of the front surface and the back surface is angled in an anterior direction.

17. The method of claim 16, wherein both the front surface and the back surface of the upper rim are angled in an anterior direction.

18. The method of claim 9, wherein the upper rim has a front surface and a back surface, wherein both the front surface and the back surface are non-angled with respect to a vertical axis defined by the spacer.

19. The method of claim 9, wherein the first window has a height greater than a length of the first window.
