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**Giordano et al.**

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(54) **METHODS AND APPARATUS FOR TREATING SPONDYLOLYSIS**

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(57) **ABSTRACT**

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For treating a fracture in a pars interarticularis, methods and apparatus provide for: (i) coupling a spinous process plate to a lateral side of a spinous process of a spine of a patient, the spinous process plate extending substantially parallel to a sagittal plane through the spine, the spinous process plate including a first fixation element configured to attach the spinous process plate to the lateral side; (ii) coupling a laminar plate to a laminar on the lateral side, the laminar plate extending transversely from the spinous process plate and transversely to both the sagittal plane and a coronal plane through the spine, the laminar plate including a second fixation element configured to attach the laminar plate to the laminar on the lateral side; (iii) engaging a sub-laminar hook to the laminar on the lateral side, the sub-laminar hook extending transversely from the laminar plate and substantially parallel to a transverse plane through the spine, the sub-laminar hook configured to extend and hook beneath the laminar on the lateral side; (iv) extending a rod toward a

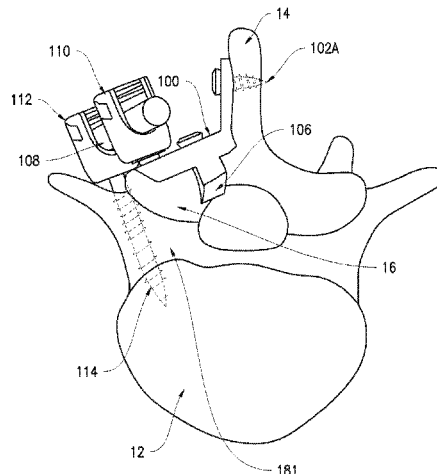
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**A61B 17/56** (2006.01)

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CPC ..... **A61B 17/7071** (2013.01); **A61B 17/7043** (2013.01); **A61B 17/7044** (2013.01); **A61B 2017/564** (2013.01)

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CPC ..... A61B 17/7043; A61B 17/7044; A61B 17/7047; A61B 17/7053;  
(Continued)

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pedicle on the lateral side, the rod having proximal and distal ends and extending substantially perpendicular to a length of the fracture, from the laminar plate toward the pedicle; and (v) anchoring the rod in a configuration that prohibits movement of first and second parts of the fractured pars interarticularis relative to one another, by coupling the proximal end to the laminar plate, and the distal end to the pedicle on the lateral side.

### 20 Claims, 9 Drawing Sheets

#### (58) Field of Classification Search

CPC ..... A61B 17/705–7058; A61B 17/7067–706; A61B 17/7071

See application file for complete search history.

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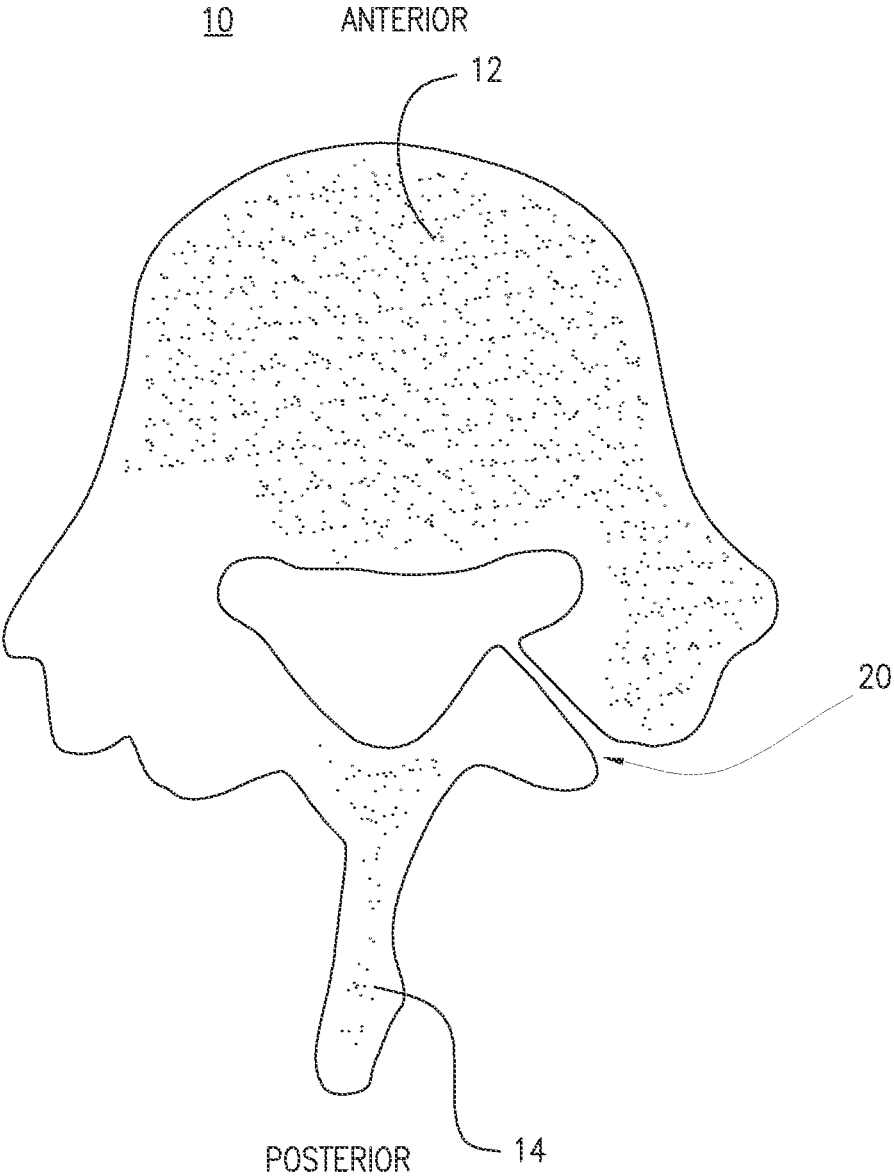
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*FIG. 1*

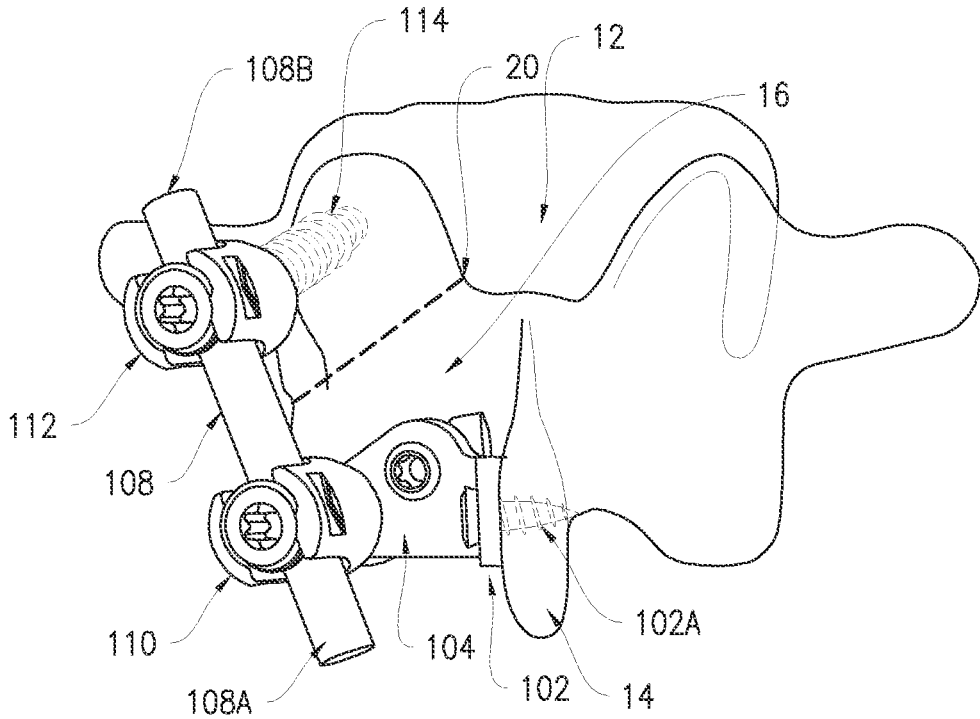


FIG. 2

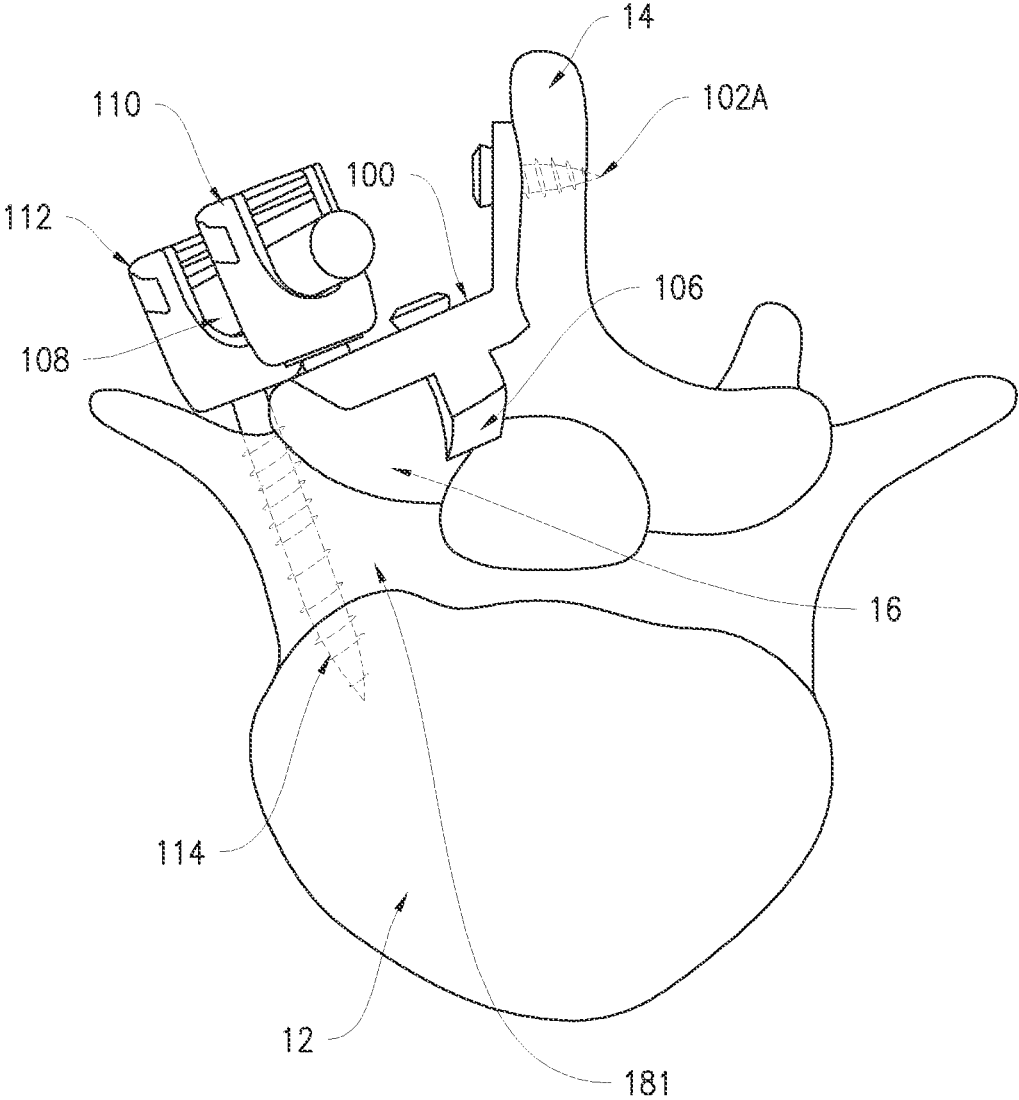


FIG. 3

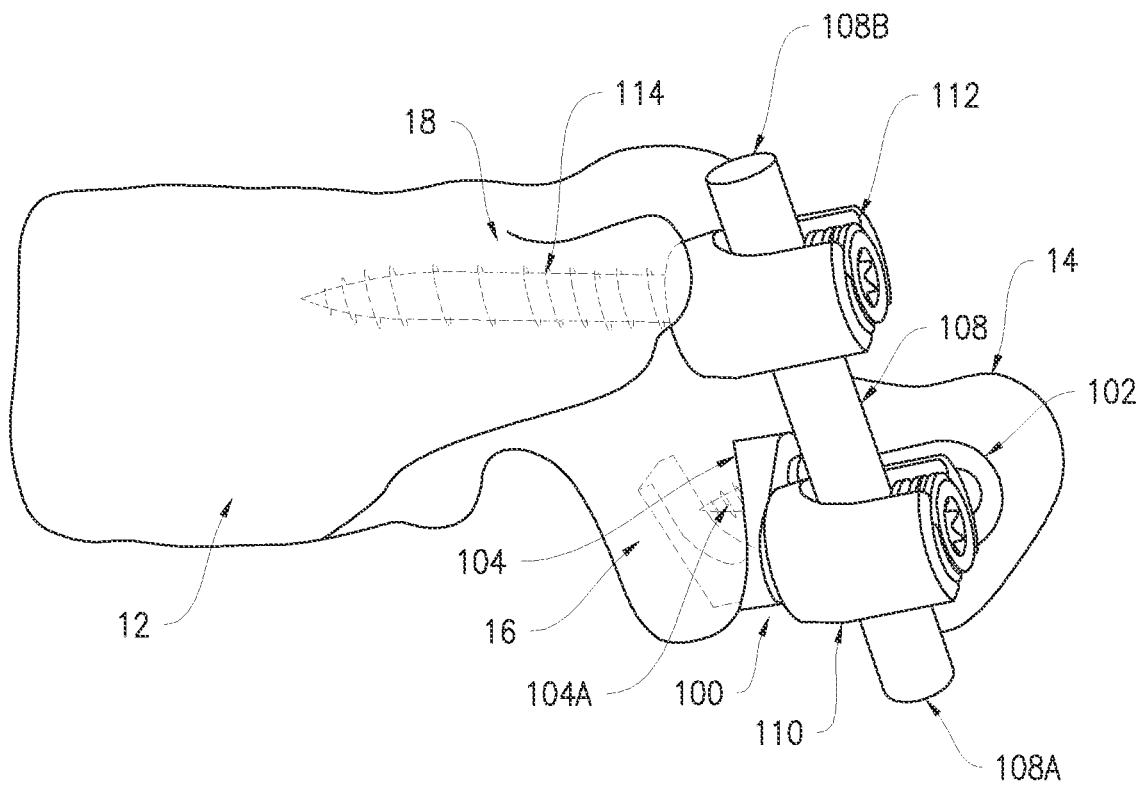
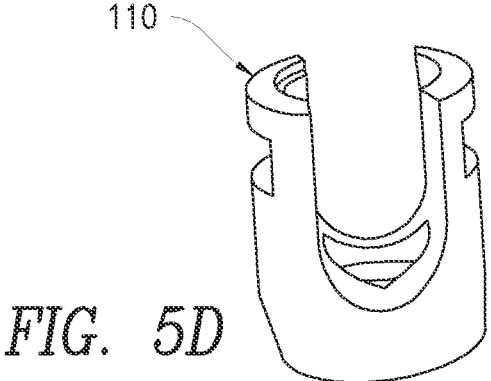
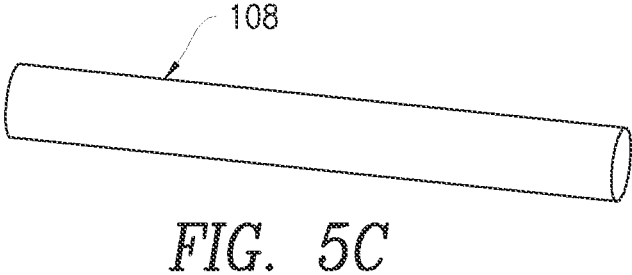
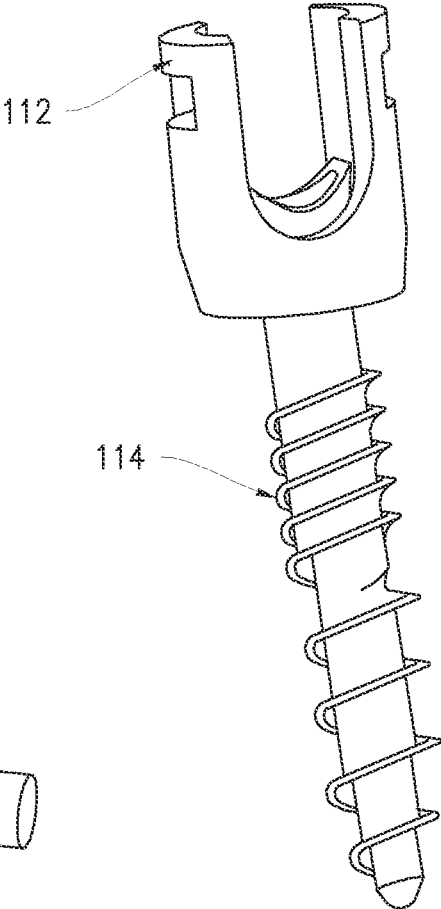
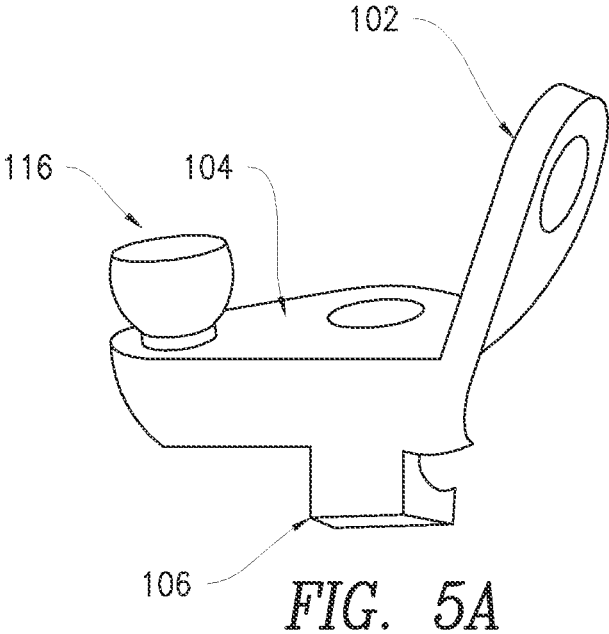


FIG. 4



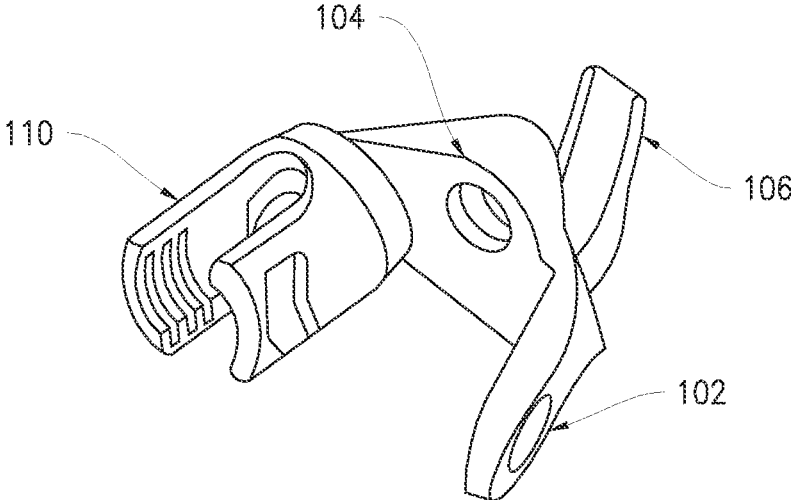


FIG. 6

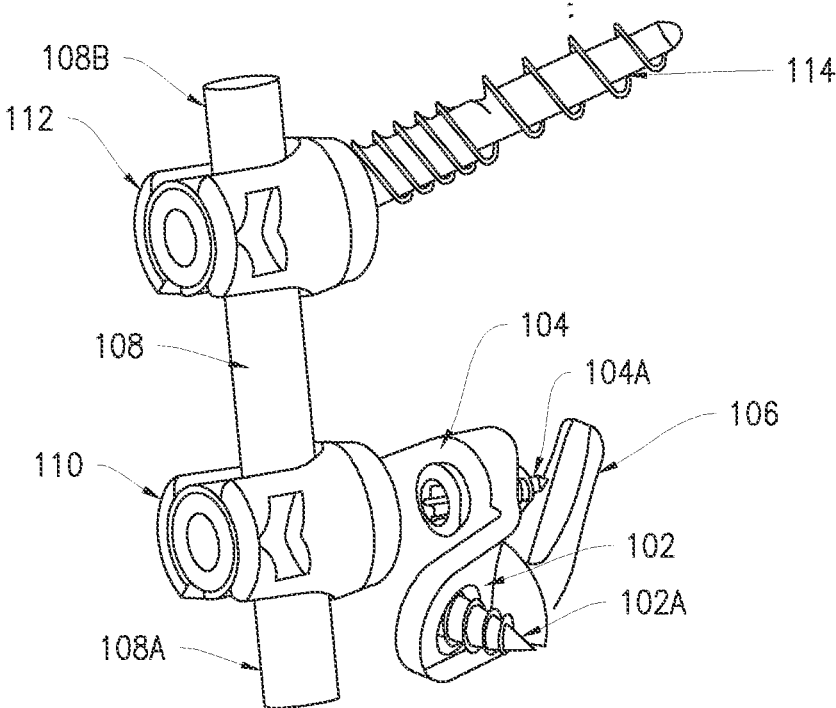


FIG. 7



FIG. 8

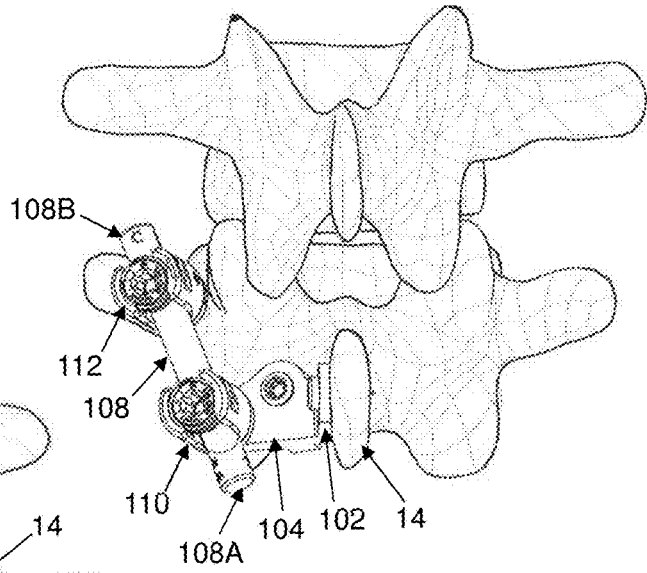


FIG. 9

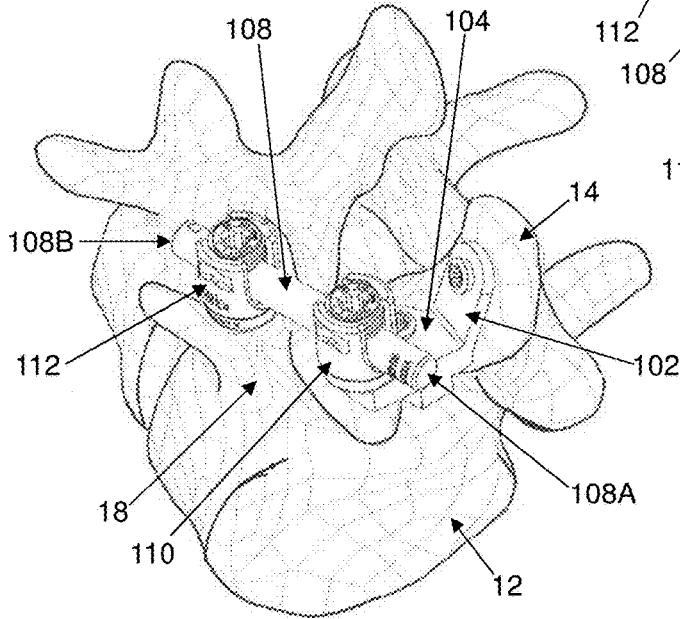


FIG. 10

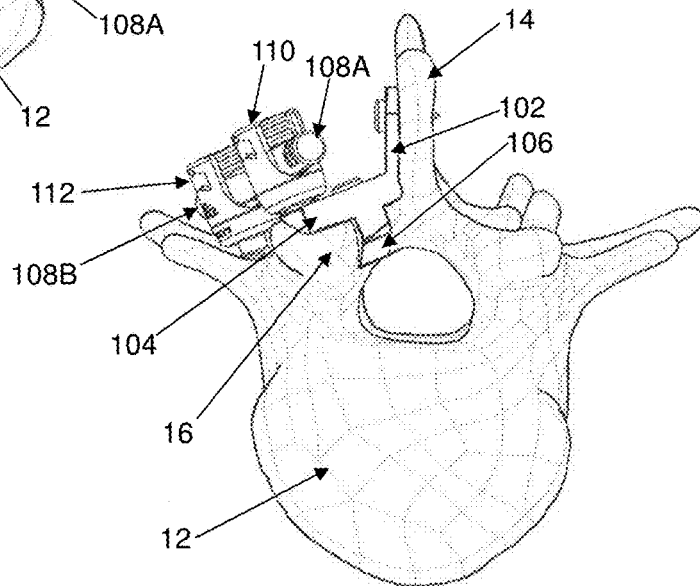


FIG. 11

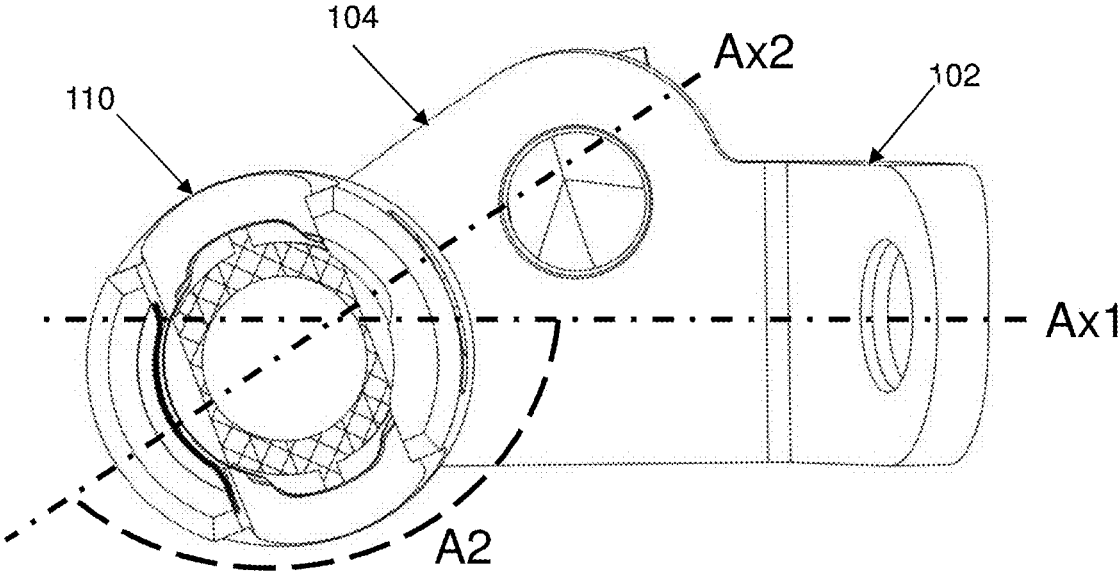
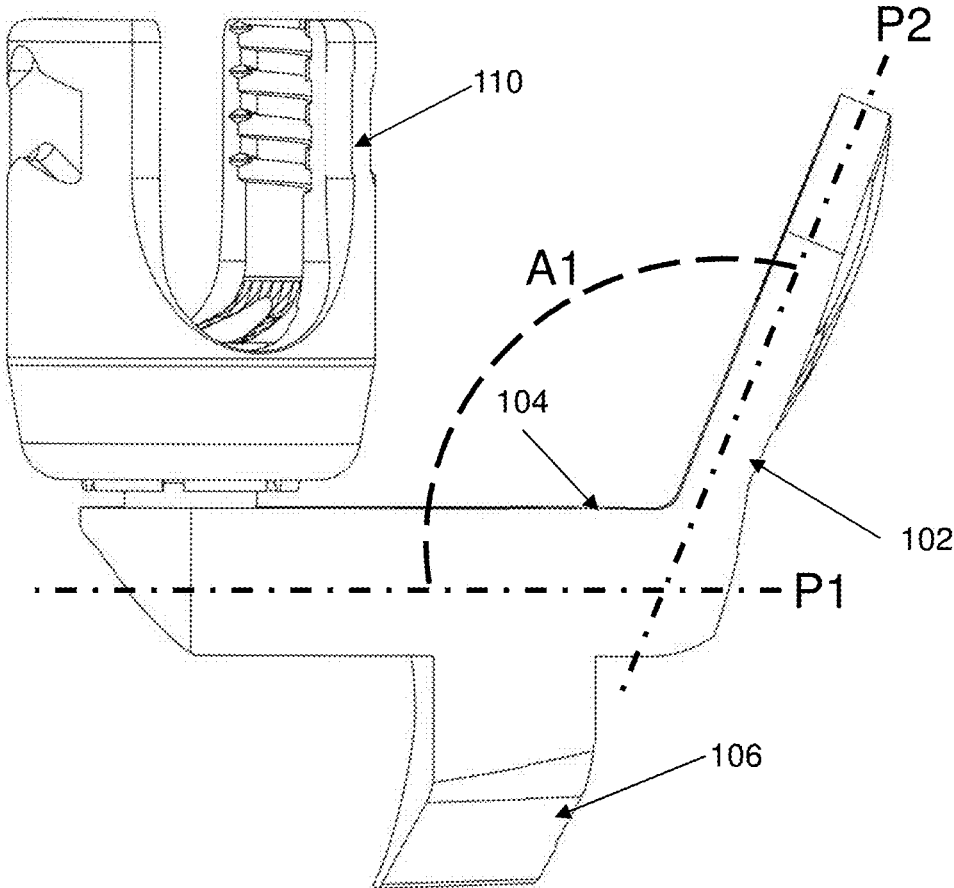


FIG. 12



ANATOMICAL PLANES

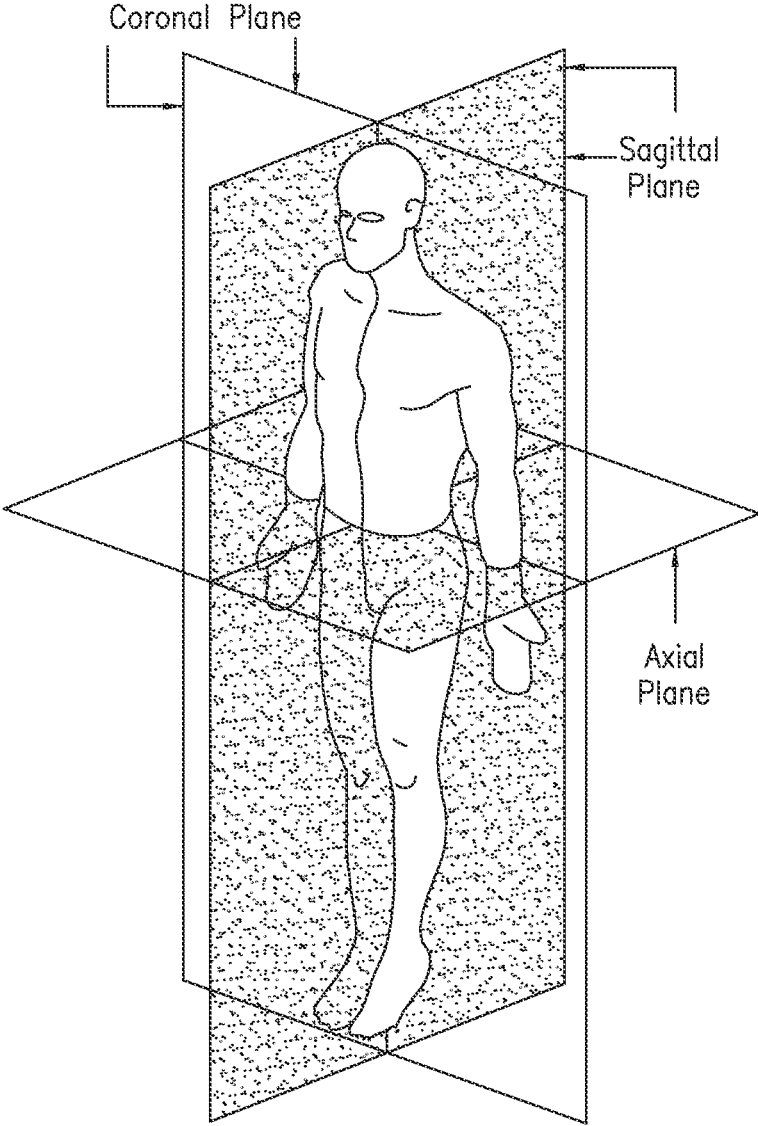


FIG. 13

## METHODS AND APPARATUS FOR TREATING SPONDYLOLYSIS

### BACKGROUND OF THE INVENTION

The present invention relates to methods and apparatus for treating spondylolysis.

Spondylolysis is a defect or stress fracture in the pars interarticularis of the vertebral arch. Although the vast majority of cases occur in the lower lumbar vertebrae of the spine (e.g., L5), spondylolysis may also occur in the cervical vertebrae.

Pars stress fractures involve a small connecting bone in the spine, called the pars interarticularis. The pars bone is a small bone that connects the facet joints, the chain of joints found on each side of the spine. The facet joints spread apart and have no pressure on them when the patient is sitting or bending forward; however, they press against each other and are under pressure during activities such as running, jumping, kicking, rotating or arching backward.

Spondylolysis is a common diagnosis that exists in anywhere from about 4-6% of the adolescent (young adult) population. It is believed that both repetitive trauma and an inherent genetic weakness can make an individual more susceptible to spondylolysis. Research supports that there are hereditary and acquired risk factors that can make one more susceptible to spondylolysis. Spondylolysis is generally more prevalent in males compared to females and tends to occur earlier in males due to their involvement in more strenuous activities at a younger age. In a young athlete, the spine is still growing, which means that there are many ossification centers, leaving points of weakness in the spine. This leaves young athletes at increased risk of spondylolysis, particularly when involved in repetitive hyperextension and rotation across the lumbar spine. Spondylolysis is a common cause of low back pain in preadolescents and adolescent athletes, as it accounts for about 50% of all low back pain.

The rise in athletic participation, as well as the intensity of participation has led to a growing incidence of these stress fractures. Most of these are treated without surgery but 20% of these require surgical intervention. A lot of these are treated by benign neglect primarily because no great techniques exist to repair this stress fracture. The L4 spondylolysis untreated increases the stress on the L4-5 disc space to 120% and the untreated L5 spondylolysis untreated increases the stress on the L5-S1 disc space to 168%. Repair of the lysis returns the stress on the disc caused by the spondylolysis to near normal, thereby preventing disc degeneration and back pain.

Significant numbers, perhaps even all of the adult isthmic spondylolisthesis that are fused with pedicle screws and interbody fusions are essentially adult manifestations of an untreated adolescent spondylolysis. Unfortunately, many of these become symptomatic in adulthood when people have already determined their livelihood. Many times after the lumbar fusion for spondylolisthesis, patients do recover and are markedly improved but may be left with restrictions that prevent them from returning to their profession. Frequently this leads to permanent restrictions and ultimately burdens society and the disability system.

Current techniques to repair a pars interarticularis stress fracture include wires and cables, repair with pedicle screw and a curved rod under the spinous process, pedicle screws, or a rod hook construct under the lamina.

Although the conventional techniques may yield some degree of improvement, they are crude and have limitations.

None of the conventional techniques that presently exist provide sufficient segmental rigid multi-planar fixation. The conventional techniques also have secondary side effects, as they encroach and disrupt neighboring facet joints. Alteration of the anatomy resulting from the conventional techniques may lead to foraminal stenosis and postoperative radiculopathy. The conventional techniques also require sizable implants that may become painful hardware in a thin patient.

The problems associated with the conventional techniques for repair of a pars interarticularis stress fracture have led surgeons to shy away from treating spondylolysis surgically. The lack of a superior surgical technique has also led to practitioners recommending that patients live with residual symptoms and refrain from sports or other risky activities. The current recommendation for patients with this diagnosis include: 1) Elimination of all activities and wear a lumbo-sacral orthosis for three months (if the fracture heals, then the patients may resume all activities). 2) If the fracture does not heal, avoid certain sports and activities, and consider occupations that avoid manual labor. For patients that have mild residual symptoms, accept the residuals, and find coping mechanisms. 3) Patients that fail to heal and remain symptomatic are typically treated surgically.

Accordingly, there are needs in the art for improved methods and apparatus for treating spondylolysis.

### SUMMARY OF THE INVENTION

In accordance with one or more embodiments of the invention, methods and apparatus provide for treating a fracture in a pars interarticularis of a vertebral arch on a lateral side of a spinous process of a spine of a patient, the fracture having a length and defining a first part of the fractured pars interarticularis and a second part of the fractured pars interarticularis.

The methods and apparatus may provide for coupling a spinous process plate to a lateral side of a spinous process of a spine of a patient, the spinous process plate extending substantially parallel to a sagittal plane (anterior-posterior plane) through the spine of the patient when implanted, the spinous process plate including a first fixation element configured to attach the spinous process plate to the lateral side of the spinous process.

The methods and apparatus may further provide for coupling a laminar plate to a lamina on the lateral side of the spinous process of the spine, the laminar plate extending transversely from the spinous process plate and transversely to both the sagittal plane and a coronal plane (lateral plane) through the spine of the patient when implanted, the laminar plate including a second fixation element configured to attach the laminar plate to the lamina on the lateral side of the spinous process.

The methods and apparatus may still further provide for engaging a sub-laminar hook to the lamina on the lateral side of the spinous process, the sub-laminar hook extending transversely from the laminar plate and substantially parallel to a transverse plane through the spine of the patient when implanted, the sub-laminar hook configured to extend and hook beneath the lamina on the lateral side of the spinous process of the spine.

The methods and apparatus may still further provide for extending a rod toward a pedicle on the lateral side of the spinous process of the spine of the patient, the rod having

proximal and distal ends and extending substantially perpendicular to the length of the fracture, from the laminar plate toward the pedicle.

The methods and apparatus may still further provide for anchoring the rod in a configuration that prohibits movement of the first and second parts of the fractured pars interarticularis relative to one another when implanted.

Preferably, the rod prohibits movement of bone associated with a fracture in a pars interarticularis of a vertebral arch on the one lateral side of the spinous process of the spine.

Preferably, the anchoring includes coupling the proximal end of the rod to the laminar plate by a coupling element, and coupling the distal end of the rod to the pedicle on the lateral side by a third fixation element.

The methods and apparatus may still further provide that the first fixation element includes a first aperture through the spinous process plate and a first anchoring element extending through the first aperture and into the lateral side of the spinous process, thereby facilitating the attachment of the spinous process plate to the spinous process of the spine.

The methods and apparatus may still further provide that the second fixation element includes a second aperture through the laminar plate and a second anchoring element extending through the second aperture and into the laminar on the lateral side of the spinous process, thereby facilitating the attachment of the laminar plate to the laminar of the spine.

The methods and apparatus may still further provide that the coupling element includes a tulip coupled to the laminar plate via a coupling feature on the laminar plate, and a locking element fixing the proximal end of the rod to the tulip

The methods and apparatus may still further provide that the third fixation element includes a tulip coupled to the pedicle via a pedicle screw, and a locking element fixing the distal end of the rod to the tulip.

The methods and apparatus may still further provide that the spinous process plate extends in a first plane, the laminar plate extends in a second plane, and the first and second planes are at an obtuse angle with respect to one another.

The methods and apparatus may still further provide that the obtuse angle is one of: (i) between 90 degrees and about 140 degrees; (ii) between 90 degrees and about 130 degrees; (iii) between 90 degrees and about 120 degrees; (iv) between about 100 degrees and about 120 degrees; and (v) about 110 degrees.

The methods and apparatus may still further provide that the laminar plate includes an axis extending substantially parallel to the transverse plane of the patient, and the rod includes a longitudinal axis extending from the laminar plate at an obtuse angle with respect to the axis.

The methods and apparatus may still further provide that the obtuse angle is one of: (i) between about 120 degrees and about 160 degrees; (ii) between about 130 degrees and about 150 degrees; and (iii) about 140 degrees.

The methods and apparatus may still further provide that the spinous process plate, the laminar plate, and the rod are sized and shaped to connect to a lumbar vertebra of the spine of the patient.

Other aspects, features, and advantages of the present invention will be apparent to one skilled in the art from the description herein taken in conjunction with the accompanying drawings.

#### DESCRIPTION OF THE DRAWINGS

For the purposes of illustration, there are forms shown in the drawings that are presently preferred, it being under-

stood, however, that the invention is not limited to the precise arrangements and instrumentalities shown.

FIG. 1 is a view of a patient's vertebra in the transverse plane, where the patient suffers from a pars fracture;

FIG. 2 is a posterior view of an illustration of a lumbar vertebra on which a pars plate apparatus has been attached, in order to simulate surgical treatment of a pars fracture;

FIG. 3 is a bottom view of the arrangement of FIG. 2;

FIG. 4 is a side view of the arrangement of FIG. 2;

FIGS. 5A-D are perspective views of components of a pars plate apparatus in accordance with one or more embodiments of the invention;

FIG. 6 is a perspective view of the pars plate apparatus, as partially assembled using certain components of FIG. 5;

FIG. 7 is a perspective view of the pars plate apparatus, as assembled with all of the components of FIG. 5;

FIG. 8 is a posterior view of a portion of a lumbar spine on which a pars plate apparatus is disposed in order to treat a pars fracture;

FIG. 9 is an alternative posterior-transverse perspective view of the arrangement of FIG. 8;

FIG. 10 is a transverse view of the arrangement of FIG. 8; and

FIG. 11 is a posterior view of the pars plate apparatus in accordance with one or more embodiments of the invention.

FIG. 12 is a transverse view of the pars plate apparatus in accordance with one or more embodiments of the invention.

FIG. 13 is an anatomical schematic diagram showing the respective coronal plane, sagittal plane, and axial (or transverse) plane of the human anatomy as used herein.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to the drawings wherein like numerals indicate like elements there is shown in FIG. 1 with reference to FIG. 13 a view of a patient's vertebra 12 in the transverse (axial) plane, where the patient suffers from a pars fracture 20. As is the general case, the fracture 20 is located in the pars interarticularis, which connects the facet joints at respective lateral sides of the spinous process 14. The fracture has a length and defines a first part of the fractured pars interarticularis and a second part of the fractured pars interarticularis.

FIG. 2 is a posterior view of an illustration of a lumbar vertebra (shown as partially transparent for convenience of understanding the illustrated embodiments) on which a pars plate apparatus 100 has been attached. The pars plate apparatus 100 traverses a fracture 20. FIG. 3 is a bottom view of the arrangement of FIG. 2. FIG. 4 is a side view of the arrangement of FIG. 2.

Some details regarding the design and function of the pars plate apparatus 100 will now be presented with additional reference to FIGS. 5A-D and 6-12.

FIGS. 5A-D are perspective views of components of a pars plate apparatus 100 in accordance with one or more embodiments of the invention. FIG. 6 is a perspective view of the pars plate apparatus 100, as partially assembled using certain components of FIG. 5. FIG. 7 is a perspective view of the pars plate apparatus 100, as assembled with all of the components of FIG. 5.

The pars plate apparatus 100 includes a spinous process plate 102, a laminar plate 104, a sub-laminar hook 106, a first tulip 110, a second tulip 112, a pedicle screw 114, and a rod 108. The spinous process plate 102, laminar plate 104, and sub-laminar hook 106 are sized, shaped, and interoper-

able to fit adjacent a vertebra of the patient, such as a vertebra of the lumbar spine of the patient.

The spinous process plate **102** extends substantially parallel to the sagittal plane (anterior-posterior plane) through a spine of the patient when implanted. The spinous process plate **102** includes at least one first fixation element **102A** (see also FIGS. **2** and **3**) that is configured to attach, and thereby facilitate a connection of, the spinous process plate **102** to a lateral side of the spinous process **14** of the spine. For example, the first fixation element **102A** may include a first aperture through the spinous process plate **102** and a first anchoring element (such as a nail, screw, or the like) extending through the first aperture and into the lateral side of the spinous process **14**, thereby facilitating the connection or attachment of the spinous process plate **102** to the spinous process **14** of the spine.

The laminar plate **104** extends transversely from the spinous process plate **102** and transversely to both the sagittal plane and the coronal plane (lateral plane) through the spine of the patient when implanted. The laminar plate **104** includes at least one second fixation element **104A** (see also FIG. **4**) that is configured to attach, and thereby facilitate a connection of, the laminar plate **104** to a laminar on the lateral side of the spinous process **14** of the spine. For example, the second fixation element **104A** may include a second aperture through the laminar plate **104** and a second anchoring element (such as a nail, screw, or the like), extending through the second aperture and into the laminar **16** on the lateral side of the spinous process **14**, thereby facilitating the connection or attachment of the laminar plate **104** to the laminar **16** of the spine.

The laminar plate **104** further includes a coupling feature **116** (e.g., head **116**) configured for cooperation with the first tulip **110** for coupling the rod **108** to the laminar plate **104** as discussed in greater detail below.

The sub-laminar hook **106** extends transversely from the laminar plate **104** and substantially parallel to the transverse (axial) plane through the spine of the patient when implanted. The sub-laminar hook **106** is sized and shaped or otherwise configured to extend and hook beneath the laminar **16** on the lateral side of the spinous process **14** of the spine.

The rod **108** includes a proximal end **108A** and a distal end **108B** and extends (e.g., substantially perpendicular to the length of the fracture) from the laminar plate **104** toward a pedicle **18** on the lateral side of the spinous process **14** of the spine when implanted. The rod **108** is sized, shaped, or otherwise configured, and anchored to prohibit movement of bone associated with the fracture **20** in the pars interarticularis of the vertebral arch when implanted; for example, to prohibit movement of the first and second parts of the fractured pars interarticularis relative to one another when implanted.

Reference is now made also to FIGS. **8**, **9** and **10**, where FIG. **8** is a posterior view of a portion of a lumbar spine on which the pars plate apparatus **100** is disposed, FIG. **9** is an alternative posterior-transverse perspective view of the arrangement of FIG. **8**, and FIG. **10** is a transverse view of the arrangement of FIGS. **8** and **9**.

With regard to the anchoring of the rod **108**, the pars plate apparatus **100** includes at least one coupling element coupling the proximal end **108A** of the rod **108** to the laminar plate **104**. For example, the coupling element may include the first tulip **110** coupled to the laminar plate **104** via the head **116**, and a locking element (e.g., a tulip internal screw) fixing the proximal end **108A** of the rod **108** to the first tulip **110**. In preferred embodiments, the first tulip **110** couples to

the head **116** by way of an interference fit, or snap fit, between the first tulip **110** and the head **116**. For example, an aperture at the bottom of the first tulip **110** has an internal diameter smaller than a largest diameter of the head **116**, but which under sufficient force as the aperture is pressed against the curvature of the head **116** toward the laminar plate **104** can expand to allow the head **116** to pass through the aperture and thereafter return to its original dimension once the force is removed. In this manner, the first tulip **110** is retained on the head **116** and therefore coupled to the laminar plate **104**.

Further with regard to the anchoring of the rod **108**, the pars plate apparatus **100** includes at least one third fixation element coupling the distal end **108B** of the rod **108** to the pedicle **18** on the lateral side of the spinous process **14** of the spine when implanted. For example, the third fixation element may include the second tulip **112** coupled to the pedicle **18** via the pedicle screw **114**, and a locking element (e.g., a tulip internal screw) fixing the distal end **108B** of the rod **108** to the second tulip **112**.

Referring now also to FIGS. **11** and **12**, the spinous process plate **102** extends in a first plane **P1**, the laminar plate **104** extends in a second plane **P2**, and the first and second planes **P1**, **P2** are at an obtuse angle **A1** with respect to one another. For example, the obtuse angle **A** may be one of: (i) between 90 degrees and about 140 degrees; (ii) between 90 degrees and about 130 degrees; (iii) between 90 degrees and about 120 degrees; (iv) between about 100 degrees and about 120 degrees; and (v) about 110 degrees.

Further with reference to FIGS. **11** and **12**, the laminar plate **104** includes an axis **Ax1** extending substantially parallel to the transverse plane of the patient, and the rod **108** (not shown but fits into the first tulip **110**) includes a longitudinal axis **Ax2** extending from the laminar plate **104** at an obtuse angle **A2** with respect to the axis **Ax1**. For example, the obtuse angle **A2** may be one of: (i) between about 120 degrees and about 160 degrees; (ii) between about 130 degrees and about 150 degrees; and (iii) about 140 degrees.

Although the invention herein has been described with reference to particular embodiments, it is to be understood that these embodiments are merely illustrative of the principles and applications of the present invention. It is therefore to be understood that numerous modifications may be made to the illustrative embodiments and that other arrangements may be devised without departing from the spirit and scope of the present invention as defined by the appended claims.

The invention claimed is:

**1.** An apparatus for treating a fracture in a pars interarticularis of a vertebral arch on a lateral side of a spinous process of a spine of a patient, the fracture having a length and defining a first part of the fractured pars interarticularis and a second part of the fractured pars interarticularis, the apparatus comprising:

a spinous process plate extending substantially parallel to a sagittal plane (anterior-posterior plane) through the spine when implanted, the spinous process plate including a first fixation element configured to attach the spinous process plate to the lateral side;

a laminar plate extending transversely from the spinous process plate and transversely to both the sagittal plane and a coronal plane (lateral plane) through the spine when implanted, the laminar plate including a second fixation element configured to attach the laminar plate to a laminar on the lateral side;

a sub-laminar hook extending transversely from the laminar plate and substantially parallel to a transverse plane through the spine when implanted, the sub-laminar hook configured to extend and hook beneath the laminar on the lateral side;

a rod having proximal and distal ends, the rod extending substantially perpendicular to the length of the fracture, from the laminar plate toward a pedicle on the lateral side when implanted, the rod anchored in a configuration that prohibits movement of the first and second parts of the fractured pars interarticularis relative to one another when implanted;

a coupling element coupling the proximal end of the rod to the laminar plate where the coupling element includes features that require the rod to extend along an axis that does not intersect or pass over either of the first fixation element or the second fixation element; and

a third fixation element coupling the distal end of the rod to the pedicle on the lateral side when implanted.

2. The apparatus of claim 1, wherein the first fixation element includes a first aperture through the spinous process plate and a first anchoring element extending through the first aperture and into the lateral side, thereby facilitating the attachment of the spinous process plate to the spinous process.

3. The apparatus of claim 1, wherein the second fixation element includes a second aperture through the laminar plate and a second anchoring element extending through the second aperture and into the laminar on the lateral side, thereby facilitating the attachment of the laminar plate to the laminar.

4. The apparatus of claim 1, wherein the coupling element includes a tulip coupled to the laminar plate via an interference fit between the tulip and a coupling feature on the laminar plate, and a locking element fixing the proximal end of the rod to the tulip.

5. The apparatus of claim 1, wherein the third fixation element includes a tulip coupled to the pedicle via a pedicle screw, and a locking element fixing the distal end of the rod to the tulip.

6. The apparatus of claim 1, wherein the spinous process plate extends in a first plane, the laminar plate extends in a second plane, and the first and second planes are at an obtuse angle with respect to one another.

7. The apparatus of claim 6, wherein the obtuse angle is one of: (i) between 90 degrees and about 140 degrees; (ii) between 90 degrees and about 130 degrees; (iii) between 90 degrees and about 120 degrees; (iv) between about 100 degrees and about 120 degrees; and (v) about 110 degrees.

8. The apparatus of claim 1, wherein the laminar plate includes an axis extending substantially parallel to the transverse plane of the patient, and the rod includes a longitudinal axis extending from the laminar plate at an obtuse angle with respect to the axis.

9. The apparatus of claim 8, wherein the obtuse angle is one of: (i) between about 120 degrees and about 160 degrees; (ii) between about 130 degrees and about 150 degrees; and (iii) about 140 degrees.

10. The apparatus of claim 1, wherein the spinous process plate, the laminar plate, and the rod are sized and shaped to connect to a lumbar vertebra of the spine.

11. A method for treating a fracture in a pars interarticularis of a vertebral arch on a lateral side of a spinous process of a spine of a patient, the fracture having a length and

defining a first part of the fractured pars interarticularis and a second part of the fractured pars interarticularis, the method comprising:

coupling a spinous process plate to the lateral side, the spinous process plate extending substantially parallel to a sagittal plane (anterior-posterior plane) through the spine when implanted, the spinous process plate including a first fixation element configured to attach the spinous process plate to the lateral side;

coupling a laminar plate to a laminar on the lateral side, the laminar plate extending transversely from the spinous process plate and transversely to both the sagittal plane and a coronal plane (lateral plane) through the spine when implanted, the laminar plate including a second fixation element configured to attach the laminar plate to the laminar on the lateral side;

engaging a sub-laminar hook to the laminar on the lateral side, the sub-laminar hook extending transversely from the laminar plate and substantially parallel to a transverse plane through the spine when implanted, the sub-laminar hook configured to extend and hook beneath the laminar on the lateral side; and

extending a rod toward a pedicle on the lateral side, the rod having proximal and distal ends and extending substantially perpendicular to the length of the fracture, from the laminar plate toward the pedicle,

anchoring the rod in a configuration that prohibits movement of the first and second parts of the fractured pars interarticularis relative to one another when implanted; wherein the anchoring includes coupling the proximal end of the rod to the laminar plate by a coupling element, where the coupling element includes features that require the rod to extend along an axis that does not intersect or pass over either of the first fixation element or the second fixation element; and

coupling the distal end of the rod to the pedicle on the lateral side by a third fixation element.

12. The method of claim 11, wherein the first fixation element includes a first aperture through the spinous process plate and a first anchoring element extending through the first aperture and into the lateral side, thereby facilitating the attachment of the spinous process plate to the spinous process.

13. The method of claim 11, wherein the second fixation element includes a second aperture through the laminar plate and a second anchoring element extending through the second aperture and into the laminar on the lateral side, thereby facilitating the attachment of the laminar plate to the laminar.

14. The method of claim 11, wherein the coupling element includes a tulip coupled to the laminar plate via a coupling feature on the laminar plate, and a locking element fixing the proximal end of the rod to the tulip.

15. The method of claim 11, wherein the third fixation element includes a tulip coupled to the pedicle via a pedicle screw, and a locking element fixing the distal end of the rod to the tulip.

16. The method of claim 11, wherein the spinous process plate extends in a first plane, the laminar plate extends in a second plane, and the first and second planes are at an obtuse angle with respect to one another.

17. The method of claim 16, wherein the obtuse angle is one of: (i) between 90 degrees and about 140 degrees; (ii) between 90 degrees and about 130 degrees; (iii) between 90 degrees and about 120 degrees; (iv) between about 100 degrees and about 120 degrees; and (v) about 110 degrees.

18. The method of claim 11, wherein the laminar plate includes an axis extending substantially parallel to the transverse plane of the patient, and the rod includes a longitudinal axis extending from the laminar plate at an obtuse angle with respect to the axis. 5

19. The method of claim 18, wherein the obtuse angle is one of: (i) between about 120 degrees and about 160 degrees; (ii) between about 130 degrees and about 150 degrees; and (iii) about 140 degrees.

20. The method of claim 11, wherein the spinous process 10 plate, the laminar plate, and the rod are sized and shaped to connect to a lumbar vertebra of the spine.

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