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Luk et al.

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(54) **ANTERIOR TRANSPEDICULAR FIXATION SYSTEM AND METHOD FOR MAINTAINING A VERTEBRAL COLUMN**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 50 days.

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(51) **Int. Cl.**⁷ **A61B 17/56**

(52) **U.S. Cl.** **606/61; 606/73; 623/17.11**

(58) **Field of Search** 606/60, 61, 66, 606/69–73; 623/16.11, 17.11, 17.15, 17.16

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ABSTRACT

(57) The present invention relates to an internal anterior transpedicular fixation system and a method for rigidly fixing the spine anteriorly at the level above and below a thoracolumbar burst fracture or tumor. The internal anterior transpedicular fixation system has a support member defining a plurality of engaging portions thereon. At least two of the engaging portions are spaced longitudinally from each other and adapted to span at least one vertebra. At least two of the engaging portions are spaced laterally from each other and adapted to span a lateral distance of the vertebra. A plurality of fixation elements are provided to mount the engaging portions onto the vertebra. Thereby, the support member is restrained from rotational or translational movement relative to the vertebra.

18 Claims, 5 Drawing Sheets

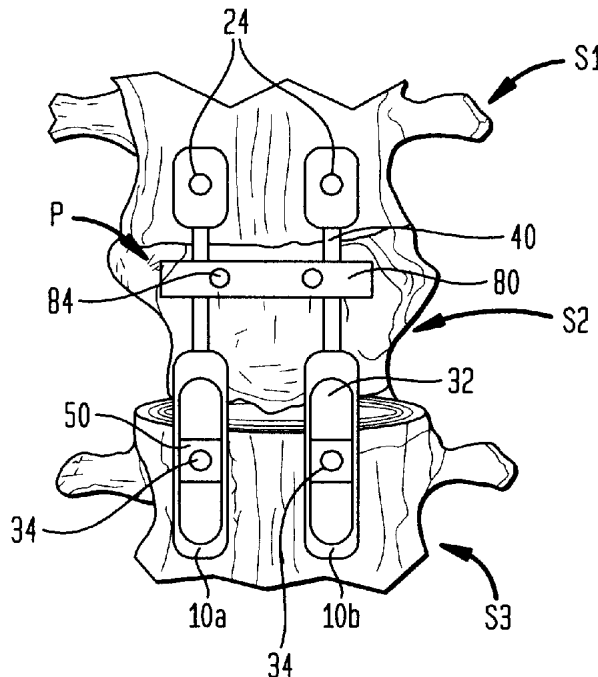


FIG. 1

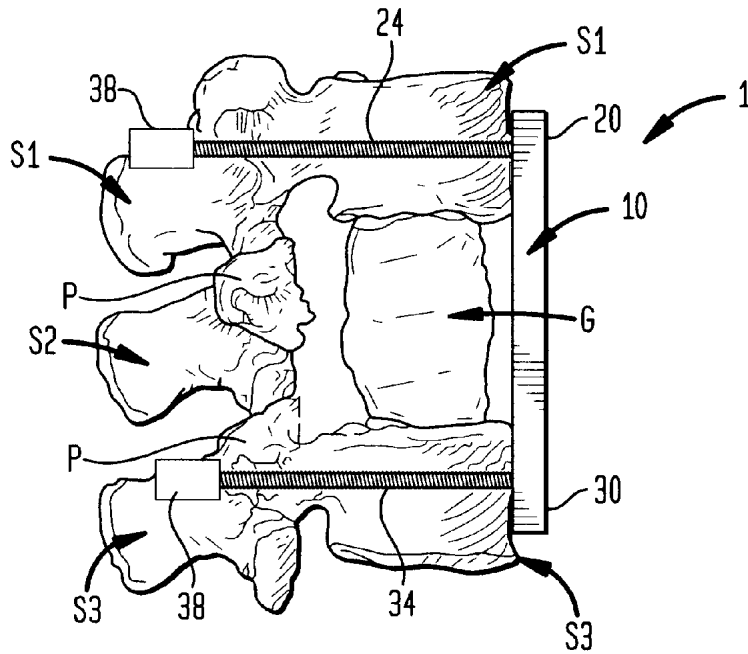


FIG. 2

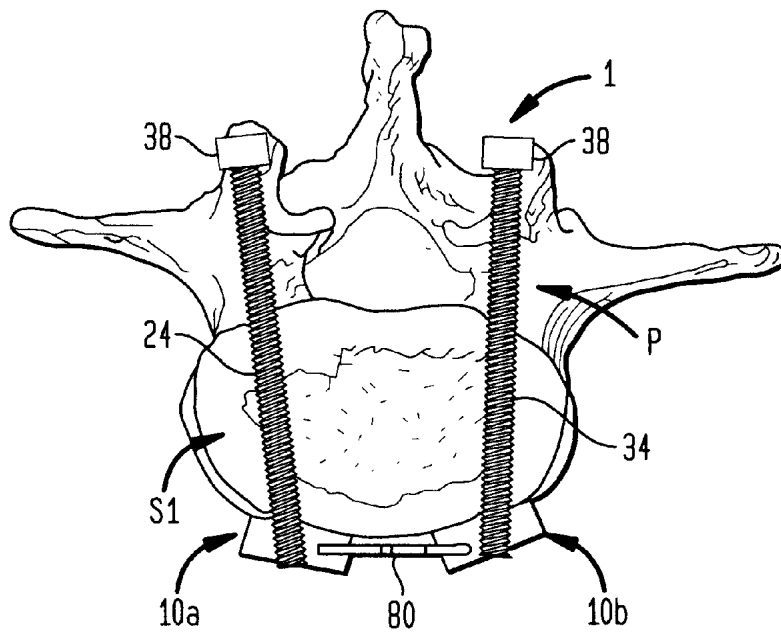


FIG. 3

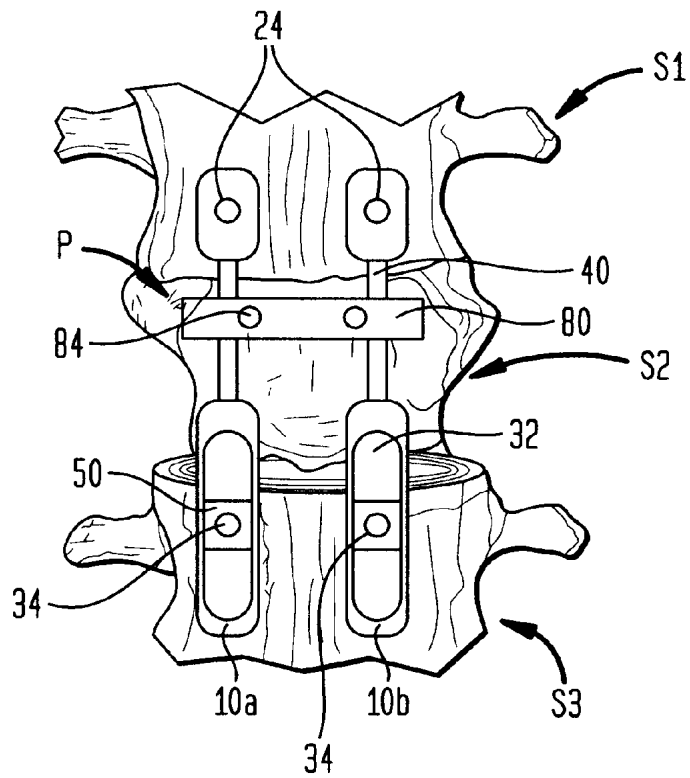


FIG. 4

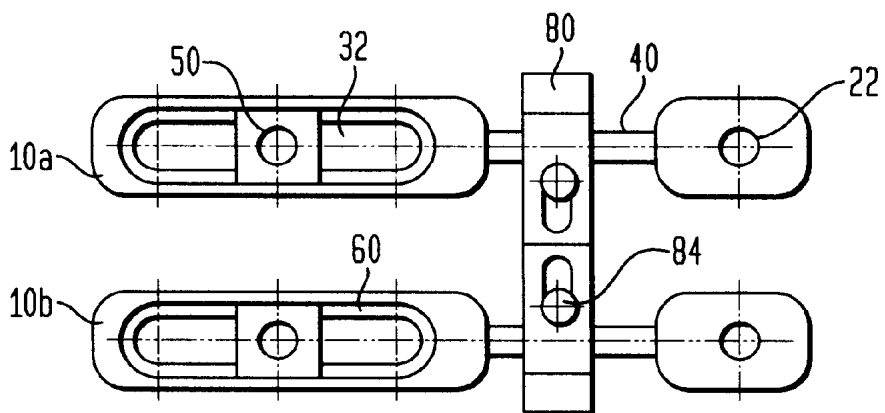


FIG. 5

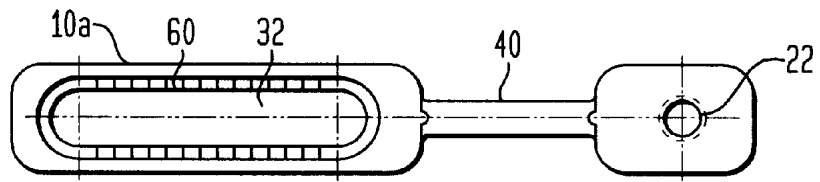


FIG. 6

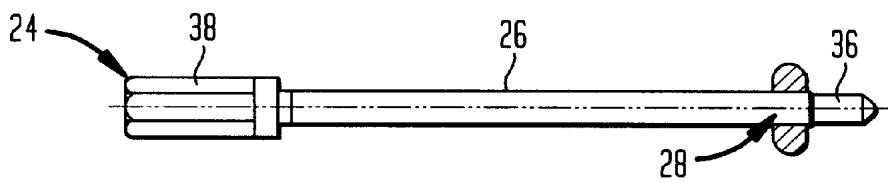


FIG. 7A

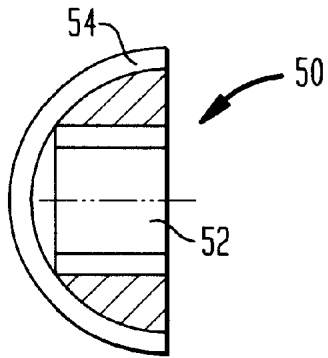


FIG. 7B

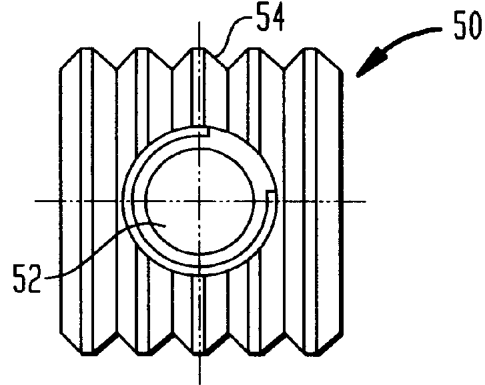


FIG. 8A

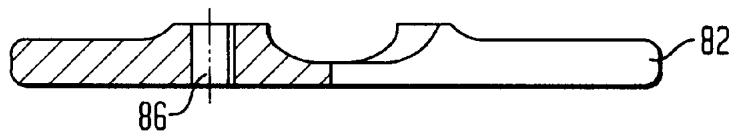


FIG. 8B

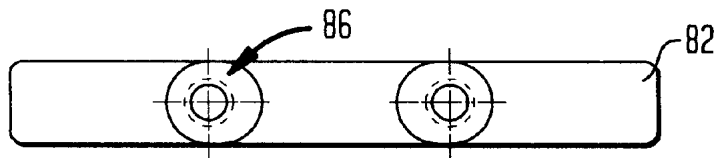
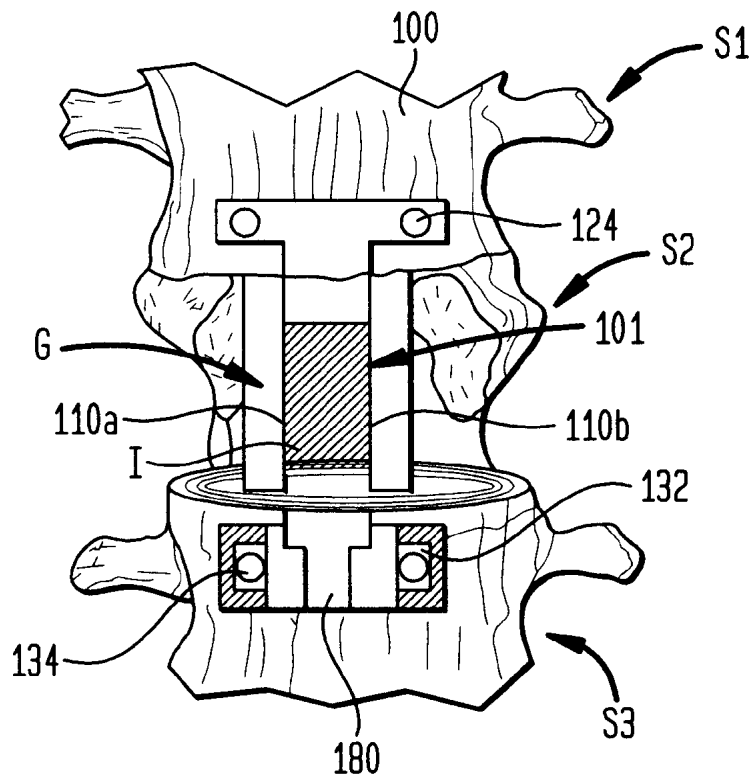


FIG. 9



ANTERIOR TRANSPEDICULAR FIXATION SYSTEM AND METHOD FOR MAINTAINING A VERTEBRAL COLUMN

This application claims the benefit of provisional application Ser. No. 60/165,971 filed Nov. 17, 1999.

FIELD OF THE INVENTION

The present invention generally relates to a system for correcting spinal deformities anteriorly. More specifically, the present invention relates to an improved anterior transpedicular fixation system and a method for maintaining vertebrae in a desired symmetrical spatial relationship.

BACKGROUND OF THE INVENTION

Various forms of instrumentation and procedures are known for surgical treatments of spinal disorders, burst fractures, or tumors. For example, Harrington posterior Spinal Instrumentation, Edwards Hooks and Rod Sleeves, Luque Segmental Spinal Instrumentation and Luque Rectangles, and Kostuik-Harrington Instrumentation are commonly used. U.S. Pat. Nos. 4,433,676; 4,653,481; 4,269,178; 4,409,968; and 4,648,388 disclose details of such instrumentations. Some of the above systems utilize hook-type members which are merely hooked over the laminae or on selected transverse processes of the spine. Other systems, such as the Luque Segmental Spinal Rectangles which is used to stabilize spinal fractures and low back fusions, use Luque wires to secure the rectangle to the spine.

In some of the prior posterior spinal fixation systems, screws are used to hold a single rod in place. In other systems, screws are used to hold a slotted plate in place. The screws and slots are located so that the plate can be adjusted in order to align the plate apertures or slots with the end of the screw. Typically, a nut is used to hold the plate to the screw. The latter arrangement is also referred to as a Steffee plate, which is a posterior fixation system with the cantilever arrangement. Such an arrangement has the large moments applied to the plate and screw junction, but has little purchase between the plate and the screw and nut since only a small portion of the plate is engaged adjacent to the slots. In addition, the rigid plates is not flexible in locating the fasteners in the vertebrae. The above posterior approaches, even to this level of advancement, do not solve the problem of treating thoracolumbar tumors or burst fractures.

In the early 1980's various anterior fixation devices were developed to allow visualization of bone fragments that were present with burst fractures, so that attention could then be directed toward complete decompression of the canal to provide the best environment for neurological recovery. However, the anterior approach has caused increased operative morbidity due to the very difficult nature of the procedure. Moreover, many of the anterior fixation approaches have problems of potential risk to the vascular network and in complete clearance of the spinal canal. The conventional anterior approaches are not true anterior fixation but antero-lateral fixations. Most of the anterior systems rely on support from the vertebral body only and therefore cannot be used in the extremely osteoporotic spine because the vertebral body strength is not sufficient.

One such system is the Kanada device marketed by Acromed, Inc. of Cleveland, Ohio. The Kanada device utilizes vertebral body staples through which fixation screws are placed into the vertebral body. Rods are then engaged between the screws in the superior and inferior vertebral bodies. Normally two screws are placed in each body.

Therefore two rods are needed between the vertebrae. The rods are threaded at their ends to allow compression and distraction. However, the loads are born solely by the vertebral bodies. The posterior column of the spine or pedicle do not share any loads.

U.S. Pat. No. 4,289,123 discloses another anterior spinal fixation system, marketed by Zimmer, for treating tumors or thoracolumbar burst fractures. This system is similar to the Kanada device in that it uses rods between the superior and inferior vertebrae. In addition, a pair of large plates are contoured in accordance with the vertebrae and engage with the same through, such as screws.

Several plating systems have been developed for anterior internal fixation of the spine. Among these plating systems, the Syracuse I-plate provides a number of differently sized I-shaped plates which are engaged across the burst fracture. However, the Syracuse I-plate does not allow for compression or distraction of a bone graft between the superior and inferior vertebrae. The Stafix plating system, provided by Duma International of Taipai, Taiwan, includes a plate that has a number of screw holes and a single screw slot. The Stafix plate permits quadrilateral placement of bone screws, but not compression or distraction. Moreover, the Stafix plate, as with the above-mentioned anterior plates, can not provide rigid or semi-rigid fixation using bone screws or bone bolts. Moreover, U.S. Pat. No. 5,324,290 discloses an internal anterior fixation systems for treating vertebral burst fractures. The internal anterior fixation system uses an elongated plate which includes integral superior, inferior and bridge portions. The superior and inferior portions are provided for fixation to corresponding vertebrae while the bridge portion spanning between the portions over the affected vertebra.

Therefore, it is an object of the present invention to provide a fixation system that is capable of efficient management of thoracolumbar burst fractures and tumors and of easy implantation, to thereby reduce operative morbidity. Another object is to provide a system which permits anterior load sharing by the fixation system, posterior load sharing by posterior vertebral structure. Yet another object is to provide a fixation system that has compression and/or distraction function.

SUMMARY OF THE INVENTION

The present invention relates to an anterior transpedicular fixation system having longitudinal and transverse support members. The support members are connected to each other and mounted onto one or more vertebrae to support the spine and to prevent rotational or translational movement of the support members. The anterior transpedicular spinal fixation system allows a surgeon the full access to the disc area, captures two cortical surfaces via transpedicular screws or rods insertion, and pulls the two vertebral bodies closer to each other insuring a tight fusion. Therefore, the anterior transpedicular spinal fixation system is capable of distributing compressive loads to the support members, the vertebral body, and the posterior column of the spine, restraining the support members from rotational and translational movement, and preventing displacement of the graft material.

In one embodiment, the anterior transpedicular fixation system comprises a pair of supporting plates each having a first engaging portion, a second engaging portion, and a bridge portion integrally spanning between the first and second engaging portions. The first and second engaging portions each define a receiving portion, such as an opening.

Moreover, a plurality of fixation elements are provided each adapted to extend through one of the openings and be mounted onto a vertebra. Further, the anterior transpedicular spinal fixation system comprises a joining member adapted to connect the bridge portions of the supporting plates. It is preferred that the components of the anterior transpedicular spinal fixation system are made of rigid materials. As a result, the supporting plates are restrained from rotational or translational movement. In an alternative embodiment, the bridge portions of the supporting plates and the clamping member are merged into one unitary member to provide both longitudinal and transverse support to the spine.

The present invention also relates to a method for maintaining vertebrae in a desired relationship. The surgical process according to the present invention includes removing the patient's intervertebral disc or vertebral body, inserting the bone graft material to replace the extracted anterior column, pre-drilling pilot screw holes on both cordices of the pedicle and the vertebral body, and mounting a support member to the vertebral body to increase its mechanical stability and to distribute rotational and translational loads to the support members, the vertebral body, and the posterior column of the spine.

These and other features and advantages of the present invention will be readily apparent from the following detailed description of the invention, the scope of the invention being set out in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The detailed description of the present invention will be better understood in conjunction with the accompanying drawings, wherein like reference characters represent like elements, as follows:

FIG. 1 is a lateral diagrammatic view of one embodiment of the spinal anterior fixation system of the present invention, mounted on a portion of a spinal column.

FIG. 2 is a top view of the spinal fixation system of the present invention of FIG. 1, which conforms to the transpedicular of the spine;

FIG. 3 is an anterior diagrammatic view of the spinal fixation system as illustrated in FIGS. 1 and 2, which is held in a desired position;

FIG. 4 is an elevational view of the supporting plates of the spinal fixation system of FIGS. 1 to 3, which supporting plates are joined by a clamping member;

FIG. 5 is an elevational view showing one embodiment of a supporting plate of FIG. 4;

FIG. 6 is an elevational view of one embodiment of a transpedicular screw of FIGS. 1 to 3;

FIGS. 7a and 7b are transverse cross-sectional and elevational views of a fastener member of FIGS. 3 and 4;

FIGS. 8a and 8b are longitudinal partial cross-sectional and elevational views of a clamping member of the fixation system of FIG. 4; and

FIG. 9 is an anterior diagrammatic view of an alternative embodiment of the anterior spinal fixation system of the present invention, in which the supporting plates and the clamping member are integrated into a unitary member.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Exemplary anterior transpedicular fixation systems embodying the principles of the present invention are shown throughout the drawings. The anterior transpedicular fixa-

tion system of the present invention is adapted to be mounted onto one or more vertebrae to support the spine and to prevent the same from rotational or translational movement. In the following description of various embodiments of anterior transpedicular fixation systems, similar elements or components thereof are designated with reference numbers that have the same last two digits and redundant description is omitted.

FIGS. 1 to 8 illustrate a first embodiment of the anterior transpedicular fixation system 1 formed according to the present invention. The anterior transpedicular fixation system 1 has a support member 10 adapted to span at least one vertebra and to be mounted thereonto. In an exemplary embodiment as shown in FIG. 1, the fixation system 1 includes a pair of supporting plates 10a and 10b adapted to span one or more vertebrae. For example, the supporting plates 10a and 10b can span a vertebra S2 that can have a burst fracture or tumors and can have been subjected to a vertebral body corpectomy. Additionally or alternatively, the fixation system 1 can apply to situations where a vertebral bone graft is inserted between first and second vertebrae, such as superior and inferior vertebrae S1 and S3 (see FIG. 1). The supporting plates 10a and 10b can be joined to each other through a joining member 80 and be mounted onto first and second vertebrae, respectively, through fixation elements 24 and 34. Preferably, the various components of the present invention are made of rigid material. As a result, the anterior transpedicular fixation system 1 of the present invention is capable of providing support for the spine. As the supporting plates 10a and 10b can be formed similarly, only one of which will be described in great detail as follows.

The supporting plate 10a can comprise first and second engaging portions 20 and 30 provided at opposite ends of the supporting plate 10a and a bridge portion 40 joining the first and second engaging portions 20 and 30. The first engaging portion 20, such as a superior engaging portion, can include a first receiving portion 22 for receiving a first fixation element 24. The first receiving portion 22 can be formed in various ways as will be described below. The first fixation element 24 can be adapted to engage with a first vertebra S1 to thus mount the first engaging portion 20 of the supporting plate 10a onto the first vertebra S1 as will be described below. Similarly, the second engaging portion 30, such as an inferior engaging portion, can include a second receiving portion 32 for receiving a second fixation element 34. The second receiving portion 32 can be formed in various ways as will be described below. The second fixation element 34 can be adapted to engage with the second vertebra S3 to thus mount the second engaging portion 30 of the supporting plate 10a onto the second vertebra S3 as will be described below.

The first and second receiving portions 22 and 32 can be formed in various ways to facilitate their engagement with the fixation elements 24 and 34, respectively. For instance, the receiving portions 22 and 32 can be threaded openings adapted to engage with plate thread portions 28 on the fixation elements 24 and 34. It will be appreciated that other embodiments for engaging the receiving portions 22 and 32 with the fixation elements 24 and 34 are also within the scope of the present invention.

The supporting plate 10a can be formed so that it can be applied to various spinal anatomy situations and/or span different numbers of vertebrae. In an embodiment as shown in FIGS. 4 and 5, the second receiving portion 32 of the supporting plate 10a can be formed as an elongated slot. The second fixation element 34 can extend through and move

along the second receiving portion **32** to a desired position depending on the spinal anatomy situations and/or the number of vertebrae that the supporting plate **10a** spans. The second fixation element **34** can then be fixed to the second receiving portion **32** at the desired position through the mechanism discussed below. As a result, the elongated slot **32** is capable of allowing the supporting plate **10a** to span a desired number of vertebrae and thus to fit for various spinal anatomy situations.

The elongated slot **32** of the supporting plate **10a** can be formed in various ways. In one embodiment as shown in FIGS. **3** to **5**, the longitudinal axis of the elongated slot **32** extends parallelly to that of the supporting plate **10a**.

In one embodiment, the elongated slot **32** can further include a scalloped structure **60** provided thereon. Preferably, the scalloped structure **60** is provided at the interface of the elongated slot **32** and the fastener member **50**, which can include a complementary scalloped structure **54** as will be described below. In a preferred embodiment, the scalloped structure **60** may be curved to engage a curved scalloped surface **56** on the fastener member **50** as will be described below. The elongated slot **32** and/or the scalloped structures **54** and **60** are capable of assisting the application of compression and/or distraction to the vertebrae after the fixation system **1** is partially mounted onto the vertebrae. In an exemplary embodiment, the scalloped slots **32** can allow the fixation elements **34** to be adjusted, oriented, and/or repositioned therein as desired to maintain an appropriate degree of compression or distraction at the fracture or graft site. It will be appreciated that minimizing the distance between the fixed vertebrae is essential to create compression on a bone graft **G** inserted between the vertebrae as shown in FIG. **1**.

The supporting plate **10a** of the anterior transpedicular fixation system **1** can have any suitable length. Among other factors, the length of the supporting plate **10a** can be determined according to the spinal anatomy situations and/or the number of vertebrae that the supporting plate **10a** spans. For example, the length of the supporting plate **10a** can be between 6 cm and 12 cm. In one embodiment, a plurality of supporting plates **10a** are formed which are in 1 cm increments.

The first and second engaging portions **20** and **30** can be joined to each other through a bridge portion **40**. The bridge portion **40** can be configured to span a burst fracture vertebra **S2**. In a preferred embodiment, the bridge portion **40** can be so formed that its length can be adjusted as desired depending upon the particular vertebral anatomy. As shown in FIGS. **3** and **4**, the distance between the first and second engaging portions **20** and **30** can be adjusted by changing the length of the bridge portion **40**. It will be appreciated that various embodiments of bridge portion **40** are within the scope of the present invention.

In a preferred embodiment, the transverse width of the bridge portion **40** is smaller than the width of the first and second engaging portions **20** and **30** of the supporting plate **10a**. Unlike conventional anterior plates, the supporting plate **10a** of the present invention is capable of limiting its wider portions to the areas that directly interface the vertebrae. The reduced profile of the bridge portion **40** can facilitate the insertion of the supporting plate **10a** and thus minimize possible trauma to surrounding tissue without affecting the stability of the supporting plate **10a** in maintaining the fixation of the region.

The anterior transpedicular fixation system **1** of the present invention further comprises first and second fixation

elements **24** and **34** adapted to mount the supporting plates **10a** and **10b** onto the vertebrae, respectively. As the fixation elements **24** and **34** can be formed similarly, only one of which will be described in great detail as follows.

The fixation element **24** can be formed in various ways. In one embodiment, the fixation element **24** can be a transpedicular screw element. The transpedicular screw element **24** can be adapted to extend through the first and second thread openings **22** and **32** on the supporting plates **10a** and **10b** and further engage with the vertebrae. In an exemplary embodiment as shown in FIGS. **1**, **2**, and **6**, the transpedicular screw element **24** can have the dual-threading design and include a bone screw thread **26** and a plate screw thread **28**. The bone screw thread **26** can be used to purchase of bone and therefore can have a wider pitch and a deeper thread than those of the plate screw thread **28**. The plate screw thread **28** can be adapted to engage with a thread opening **22** (see FIGS. **4** and **5**) in the supporting plate **10a**. In an alternative embodiment, the plate screw thread **28** can be adapted to engage with a threaded opening **32** in the fastener member **50**. It will be appreciated that other embodiments of fixation elements **24** and **34** are within the scope of the present invention.

In the above embodiment, the transpedicular screw element **24** can have a drill bit end **36** as shown in FIG. **6**. The drill bit end **36** can guide the transpedicular screw element **24** through the vertebra and can be removed after the transpedicular screw element **24** is threaded into the supporting plate **10a**. At the other end of the transpedicular screw element **24**, a locking member **38**, such as a locking nut (see FIG. **6**), or similar locking devices is provided. The locking member **38** can engage with the posterior surface of the vertebrae column after the transpedicular screw element **24** is inserted into vertebra and mounted to one of the first and second engaging portions **20** and **30** as shown in FIGS. **1** and **2**. Because the pedicle is the strongest vertebral structure, the anterior transpedicular fixation system **1** of the present invention allows loads to be distributed between and shared by the pedicles **P** and the supporting plates **10a** and **10b**.

In another embodiment, the fixation element **24** can further comprise a fastener member **50**. The fastener member **50** can be adapted to mount the fixation element **24** onto the second receiving portion **32**. In an exemplary embodiment, the fastener member **50** can have a threaded opening **52** for engaging with plate thread portions **28** on the fixation elements **24** and **34**.

Additionally or alternatively, the fastener member **50** can have a scalloped structure **54** (see FIGS. **7a** and **7b**) for engaging with a complementary scalloped structure **60** on the second receiving portion **32** of the supporting plate **10a**. In an exemplary embodiment, the scalloped structure **54** can be curved, such as that shown in FIGS. **7a** and **7b**. In a preferred embodiment, the curved scalloped structure **54** is a semi-circular surface. The scalloped structures **54** and **60** allow the fastener member **50** to be adjusted and oriented in the second receiving portion **32** as desired when applying compression and/or distraction to the vertebrae. It will be appreciated that other embodiments of the fastener member **50** are also within the scope of the present invention.

The anterior transpedicular fixation system **1** of the present invention further comprises a joining member **80** adapted to join the supporting plates **10a** and **10b**. The length of the clamping member **80** can be varied to accommodate different width of the vertebrae of patients. The joining member **80** can be formed in various ways. In an exemplary embodiment, the joining member **80** can be a two-piece

clamping member include two half members **82**, as illustrated in FIGS. **3**, **4**, **8a**, and **8b**. The two-piece joining member **80** can be adapted to join each other by various conventional clamping mechanism, such as clamping screws **84**.

As shown in FIG. **4**, the two half members **82** are adapted to sandwich the bridge portions **40** of the supporting plates **10a** and **10b**. Each half member **82** can have at least one screw opening **86** thereon for receiving the clamping screws **84**. By tightening the clamping screws **84**, the supporting plates **10a** and **10b** can be clamped and fixed in relation to each other and thus restrained from rotational and translational movement. Accordingly, the joining member **80** can form a stable, firm, and symmetrical structure, which allows optimum anterior load distribution between the joined vertebrae and the supporting plates **10a** and **10b**. It will be appreciated that other embodiments of the joining member **80** are also within the scope of the present invention.

The anterior transpedicular system **1** of the present invention can be made of any suitable material. Preferably, the material forming the anterior transpedicular system **1** is a material that is bio-compatible. Additionally or alternatively, the material can have the required stiffness for anterior fixation of the spine. Exemplary materials can be FDA approved human implant metals (e.g., 316L stainless steel), titanium, and titanium alloy (e.g., titanium-vanadium-aluminum). It will be appreciated that other applicable materials are also within the scope of the present invention.

In a typical surgical procedure, the fixation elements **24** and **34** are inserted into and through a patient's vertebrae. Then the fixation elements **24** and **34** are made to extend through and partially engage with the receiving portions **22** and **32** of the supporting plates **10a** and **10b**. After applying compression and/or distraction to the supporting plates **10a** and **10b**, the fixation elements **24** and **34** can be completely joined with the receiving portions **22** and **32** to fix the supporting plates **10a** and **10b** to the patient's vertebrae, thereby forming a solid fixation. In the embodiment where transpedicular screws are used as the fixation elements **24** and **34**, such transpedicular screws are inserted into a patient's vertebrae and the threaded holes **22** and **32** in the supporting plates **10a** and **10b**. Before the transpedicular screws **24** and **34** are to be firmly tightened, compression and/or distraction is applied to the supporting plates **10a** and **10b**.

FIG. **9** shows an alternative embodiment of the anterior transpedicular system of the present invention. In the following description, elements or components similar to those in the embodiment of FIGS. **1** to **8**, are designated with the same reference numbers increased by **100** and redundant description is omitted.

According to the anterior transpedicular fixation system **101**, the supporting plates **110a** and **110b** are integrated with the joining member **180** to form a unitary member. As a result, the anterior transpedicular fixation system **101** comprises longitudinal and transverse support members **110** and **180** that are integrally formed. The longitudinal support member **110** is adapted to span at least one vertebra. The transverse support member **180** is adapted to accommodate different width of the vertebrae of patients. The anterior transpedicular fixation system **101** also comprises a plurality of fixation elements **124** and **134** adapted to mount the anterior transpedicular fixation system **101** onto a patient's vertebrae. It is preferred that the various components of the anterior transpedicular fixation system **101** are made of rigid materials. Accordingly, the anterior transpedicular fixation

system **101** of the present invention is capable of supporting the spine and preventing vertebrae from rotational or translational movement.

It will be appreciated that the various features described herein can be used singly or in any combination thereof. Therefore, the present invention is not limited to only the embodiments specifically described herein. While the foregoing description and drawings represent a preferred embodiment of the present invention, it will be understood that various additions, modifications and substitutions can be made therein without departing from the spirit and scope of the present invention as defined in the accompanying claims. The presently disclosed embodiment is therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims, and not limited to the foregoing description.

We claim:

1. An internal anterior transpedicular fixation system for treating spinal pathologies including vertebral burst fractures or tumors which have been subjected to a vertebral corpectomy, comprising:

a pair of supporting plates, each plate for spanning at least one vertebra and having a first engaging portion, a second engaging portion, and a bridge portion joining said first and second engaging portions, said first engaging portion defining a first receiving portion, said second engaging portion defining a second receiving portion;

a clamping member for connecting said bridge portions of said supporting plates; and

a plurality of fixation elements for mounting one of said first and second receiving portions onto a vertebra, wherein said fixation element is a transpedicular screw having a pointed tip, a bone screw thread portion in a middle portion of the screw and a plate screw thread portion adjacent to the pointed tip of the screw, said plate screw thread portion for engaging with said threaded opening in one of said first and second receiving portions;

whereby said supporting plates and the vertebra are restrained from relative rotational or translational movement.

2. The internal anterior fixation system of claim **1**, wherein said first and second engaging portions each have a width, and said bridge portion has a width substantially less than the width of said first and second engaging portions.

3. The anterior fixation system of claim **1**, wherein at least one of said first and second receiving portions is a threaded opening.

4. The anterior fixation system of claim **1**, wherein said supporting plate includes a scalloped structure defined in at least one of said first and second receiving portions.

5. The anterior fixation system of claim **1**, wherein said second receiving portions are elongated slots.

6. The anterior fixation system of claim **1**, wherein said bone screw thread portion has a wider pitch and a deeper thread to purchase of bone.

7. The anterior fixation system of claim **1**, wherein said transpedicular screw has a locking member provided at the opposite end of said plate screw thread portion for engaging said transpedicular screw onto the posterior surface of the vertebra.

8. The anterior fixation system of claim **1**, wherein said fixation element further comprises a fastener member for engaging said plate screw thread portion on the transpedicular screw.

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9. The anterior fixation system of claim 1, wherein said clamping member has an adjustable length.

10. An internal anterior transpedicular fixation system comprising:

a support member defining a plurality of engaging portions thereon, at least two of said engaging portions being spaced longitudinally from each other and for spanning at least one vertebra, at least two of said engaging portions being spaced laterally from each other and for spanning a lateral distance of said vertebra; and

a plurality of fixation elements for mounting said engaging portions onto said vertebra, wherein said fixation element is a transpedicular screw having a pointed tip, a bone screw thread portion in a middle portion of the screw and a plate screw thread portion adjacent to the pointed tip of the screw;

whereby said support members and said vertebra are restrained from relative rotational or translational movement.

11. The internal anterior fixation system of claim 10, wherein said support member comprises first and second engaging portions for spanning at least two vertebrae and third and fourth engaging portions laterally spaced from said first and second engaging portions, respectively.

12. The internal anterior fixation system of claim 10, wherein at least one of said engaging portions is a threaded opening for engaging with said plate screw portion on one of said fixation elements.

13. The internal anterior fixation system of claim 10, wherein at least one of said fixation members further comprises a fastener member adapted to join said fixation element with one of said engaging portions, and wherein said fastener member includes a threaded opening for engaging with said plate screw portion on said fixation element.

14. The internal anterior fixation system of claim 10, wherein each said fixation element has a locking member at the opposite end of said plate screw portion.

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15. A method for supporting vertebrae, comprising:

providing a fixation system comprising a support member and a plurality of fixation elements, said support member having first and second engaging portions for engaging with said fixation elements and for mounting onto at least one vertebra and said fixation element is a transpedicular screw having a pointed tip, a bone screw thread portion in a middle portion of the screw and a plate screw thread portion adjacent to the pointed tip of the screw;

forming a plurality of openings in the posterior surface bicortically of a displaced vertebra for receiving said fixation elements;

inserting said fixation elements from posterior vertebra bicortically into said openings respectively; and

fixing said first and second engaging portions to their corresponding fixation elements to thereby support the vertebra.

16. The method of claim 15 further comprising:

fixing one of said first and second engaging portions; and applying compression or distraction to the vertebra before fixing the other of said first and second engaging portions.

17. The method of claim 15, wherein said support member comprises a pair of supporting plates, each having a first engaging portion and second engaging portion, the method further comprising joining said supporting plates by a clamping member to thereby hold said supporting plates against axial and rotational movement.

18. The method of claim 17 further comprising:

fixing one of said first and second engaging portions; applying compression or distraction to the vertebra before fixing the other of said first and second engaging portions; and

joining said supporting plates by clamping member after applying compression or distraction to the vertebra.

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