SPINAL DISC ANNULUS REPAIR DEVICE

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ABSTRACT

A stent, or device for repair and reconstruction of the spinal disc wall, or annulus fibrosus, after surgical incision or pathologic rupture, which is inserted through an aperture into the subannular space. The stent has radial extensions which are caused or allowed to expand into an expanded configuration to bridge the aperture. The stent thereby occludes the defective region from the inside of the vertebral disc and prevents the migration of nucleus pulposus therethrough, while also providing a scaffold for tissue growth.
SPINAL DISC ANNULUS REPAIR DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of U.S. Ser. No. 10/085,040, filed Mar. 1, 2002, which is a continuation of Ser. No. 09/647,078, filed Sep. 5, 2001, now U.S. Pat. No. 6,592,625, which is a continuation of Ser. No. 09/484,706, filed Jan. 18, 2000, now abandoned, and which claims the benefit of U.S. Provisional Application No. 60/160,710, filed Oct. 20, 1999.

FIELD OF THE INVENTION

[0002] The invention generally relates to a surgical method of intervertebral disc wall reconstruction. The invention also relates to an annular repair device, or stent, for annular disc repair. The effects of said reconstruction are restoration of disc wall integrity and reduction of the failure rate (3-21%) of a common surgical procedure (disc fragment removal or discectomy). This surgical procedure is performed about 390,000 times annually in the United States.

BACKGROUND OF THE INVENTION

[0003] The spinal column is formed from a number of vertebrae, which in their normal state are separated from each other by cartilaginous intervertebral discs. The intervertebral disc acts in the spine as a crucial stabilizer, and as a mechanism for force distribution between the vertebral bodies. Without the disc, collapse of the intervertebral space occurs in conjunction with abnormal joint mechanics and premature development of arthritic changes.

[0004] The normal intervertebral disc has an outer ligamentous ring called the annulus surrounding the nucleus pulposus. The annulus binds the adjacent vertebrae together and is constituted of collagen fibers that are attached to the vertebrae and cross each other so that half of the individual fibers will tighten as the vertebrae are rotated in either direction, thus resisting twisting or torsional motion. The nucleus pulposus is constituted of loose tissue, having about 85% water content, which moves about during bending from front to back and from side to side.

[0005] The aging process contributes to gradual changes in the intervertebral discs. The annulus loses much of its flexibility and resilience, becoming more dense and solid in composition. The aging annulus is also marked by the appearance on propagation of cracks or fissures in the annular wall. Similarly, the nucleus desiccates, increasing viscosity and thus losing its fluidity. In combination, these features of the aged intervertebral discs result in less dynamic stress distribution because of the more viscous nucleus pulposus, and less ability to withstand localized stresses by the annulus fibrosus due to its desiccation, loss of flexibility and the presence of fissures. Occasionally fissures may form rents through the annular wall. In these instances, the nucleus pulposus is urged outwardly from the subannular space through a rent, often into the spinal column. Extruded nucleus pulposus can, and often does, mechanically press on the spinal cord or spinal nerve rootlet. This painful condition is clinically referred to as a ruptured or herniated disc.

[0006] In the event of annulus rupture, the subannular nucleus pulposus migrates along the path of least resistance forcing the fissure to open further, allowing migration of the nucleus pulposus through the wall of the disc, with resultant nerve compression and leakage of chemicals of inflammation into the space around the adjacent nerve roots supplying the extremities, bladder, bowel and genitalia. The usual effect of nerve compression and inflammation is intolerable back or neck pain, radiating into the extremities, with accompanying numbness, weakness, and in late stages, paralysis and muscle atrophy, and/or bladder and bowel incontinence. Additionally, injury, disease or other degenerative disorders may cause one or more of the intervertebral discs to shrink, collapse, deteriorate or become displaced, herniated, or otherwise damaged and compromised.

[0007] The surgical standard of care for treatment of herniated, displaced or ruptured intervertebral discs is fragment removal and nerve decompression without a requirement to reconstruct the annular wall. While results are currently acceptable, they are not optimal. Various authors report 3.1-21% recurrent disc herniation, representing a failure of the primary procedure and requiring re-operation for the same condition. An estimated 10% recurrence rate results in 39,000 re-operations in the United States each year.

[0008] An additional method of relieving the symptoms is thermal annuloplasty, involving the heating of sub-annular zones in the non-herniated painful disc, seeking pain relief, but making no claim of reconstruction of the ruptured, discontinuous annulus wall.

[0009] There is currently no known method of annulus reconstruction, either primarily or augmented with an annulus stent.

BRIEF SUMMARY OF THE INVENTION

[0010] The present invention provides methods and related materials for reconstruction of the disc wall in cases of displaced, herniated, ruptured, or otherwise damaged intervertebral discs. In accordance with the invention, an annulus stent is disclosed for repair of an intervertebral disc annulus, comprising a centralized hub section, said hub section comprising lateral extensions from the hub section.

[0011] In an exemplary embodiment, one or more mild biodegradable surgical sutures are placed at about equal distances along the sides of a pathologic aperture in the ruptured disc wall (annulus) or along the sides of a surgical incision in the annular wall, which may be weakened or thinned.

[0012] Sutures are then tied in such fashion as to draw together the sides of the aperture, effecting reapproximation or closure of the opening, to enhance natural healing and subsequent reconstruction by natural tissue (fibroblasts) crossing the now surgically narrowed gap in the disc annulus.

[0013] A 25-30% reduction in the rate of recurrence of disc nucleus herniation through this aperture, has been achieved using this method.

[0014] In another embodiment, the method can be augmented by placement of a patch of human muscle fascia (the membrane covering the muscle) or any other autograft or allograft acting as a bridge in and across the aperture, providing a platform for traverse of fibroblasts or other
normal cells of repair existing in and around the various layers of the disc annulus, prior to closure of the aperture.

[0015] A 30-50% reduction in the rate of recurrence of disc herniation has been achieved using the aforementioned fascial augmentation with this embodiment.

[0016] Having demonstrated that human muscle fascia is adaptable for annular reconstruction, other biocompatible membranes can be employed as a bridge, stent, patch or barrier to subsequent migration of the disc nucleus through the aperture. Such biocompatible materials may be, for example, medical grade biocompatible fabrics, biodegradable polymeric sheets, or form fitting or non-form fitting fillers for the cavity created by removal of a portion of the disc nucleus pulposus in the course of the disc fragment removal or discectomy. The prosthetic material can be placed in and around the intervertebral space, created by removal of the degenerated disc fragments.

[0017] Additional objects and advantages of the invention will be set forth in part in the description which follows, and in part will be obvious from the description, or may be learned by practice of the invention. The objects and advantages of the invention will be realized and attained by means of the elements and combinations particularly pointed out in the appended claims.

[0018] It is to be understood that both the foregoing general description and the following detailed description are exemplary and explanatory only and are not restrictive of the invention, as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate illustrative embodiments of the invention and, together with the description, serve to explain the principles of the invention.

[0020] FIG. 1 shows a perspective view of an illustrative embodiment of an annulus stent.

[0021] FIG. 2 shows a front view of the annulus stent of FIG. 1.

[0022] FIG. 3 shows a side view of the annulus stent of FIG. 1.

[0023] FIGS. 4A-4C show a front view of alternative illustrative embodiments of an annulus stent.

[0024] FIGS. 5A-5B show the alternative embodiment of a further illustrative embodiment of an annulus stent.

[0025] FIGS. 6A-6B show the alternative embodiment of a further illustrative embodiment of an annulus stent.

[0026] FIG. 7 shows a primary closure of an opening in the disc annulus.

[0027] FIGS. 8A-8B show a primary closure with a stent.

[0028] FIG. 9 shows a method of suturing an annulus stent into the disc annulus, utilizing sub-annular fixation points.

[0029] FIGS. 10A-10B show a further illustrative embodiment of an annulus stent with flexible bladder being expanded into the disc annulus.

[0030] FIGS. 11A-11D show an annulus stent being inserted into the disc annulus.

[0031] FIGS. 12A-12B show an annulus stent with a flexible bladder being expanded.

DETAILED DESCRIPTION OF THE INVENTION

[0032] Reference will now be made in detail to an illustrative embodiment of the invention, which appears in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

[0033] In one embodiment of the present invention, as shown in FIG. 7, a damaged annulus 42 is repaired by use of surgical sutures 40. One or more surgical sutures 40 are placed at about equal distances along the sides of a pathologic aperture 44 in the annulus 42. Reapproximation or closure of the aperture 44 is accomplished by tying the sutures 40 so that the sides of the aperture 44 are drawn together. The reapproximation or closure of the aperture 44 enhances the natural healing and subsequent reconstruction by the natural tissue (e.g., fibroblasts) crossing the now surgically narrowed gap in the annulus 42. Preferably, the surgical sutures 40 are biodegradable, but permanent non-biodegradable may be utilized.

[0034] Additionally, to repair a weakened or thinned wall of a disc annulus 42, a surgical incision is made along the weakened or thinned region of the annulus 42 and one or more surgical sutures 40 can be placed at about equal distances laterally from the incision. Reapproximation or closure of the incision is accomplished by tying the sutures 40 so that the sides of the incision are drawn together. The reapproximation or closure of the incision enhances the natural healing and subsequent reconstruction by the natural tissue crossing the now surgically narrowed gap in the annulus 42. Preferably, the surgical sutures 40 are biodegradable, but permanent non-biodegradable materials may be utilized.

[0035] In an alternative embodiment, the method can be augmented by the placement of a patch of human muscle fascia or any other autograft, allograft or xenograft in and across the aperture 44. The patch acts as a bridge in and across the aperture 44, providing a platform for traverse of fibroblasts or other normal cells of repair existing in and around the various layers of the disc annulus 42, prior to closure of the aperture 44.

[0036] In a further embodiment, as shown in FIGS. 8A-B a biocompatible membrane can be employed as an annulus stent 10, being placed in and across the aperture 44. The annulus stent 10 acts as a bridge in and across the aperture 44, providing a platform for a traverse of fibroblasts or other normal cells of repair existing in and around the various layers of the disc annulus 42, prior to closure of the aperture 44.

[0037] In an illustrative embodiment, as shown in FIGS. 1-3, the annulus stent 10 comprises a centralized vertical extension 12, with an upper section 14 and a lower section 16. The centralized vertical extension 12 can be trapezoid in shape through the width and may be from about 8 mm-12 mm in length.
Additionally, the upper section 14 of the central vertical extension 12 may be any number of different shapes, as shown in FIGS. 4A and 4B, with the sides of the upper section 14 being curved or with the upper section 14 being circular in shape. Furthermore, the annulus stent 10 may contain a recess between the upper section 14 and the lower section 16, enabling the annulus stent 10 to form a compatible fit with the edges of the aperture 44.

The upper section 14 of the central vertical extension 12 can comprise a slot 18, where the slot 18 forms an orifice through the upper section 14. The slot 18 is positioned within the upper section 14 such that it traverses the upper section’s 14 longitudinal axis. The slot 18 is of such a size and shape that sutures, tension bands, staples or any other type of fixation device known in the art may be passed through, to affix the annulus stent 10 to the disc annulus 42.

In an alternative embodiment, the upper section 14 of the central vertical extension 12 may be perforated. The perforated upper section 14 contains a plurality of holes that traverse the longitudinal axis of upper section 14. The perforations are of such a size and shape that sutures, tension bands, staples or any other type of fixation device known in the art may be passed through, to affix the annulus stent 10 to the disc annulus 42.

The lower section 16 of the central vertical extension 12 can comprise a pair of lateral extensions, a left lateral extension 20 and a right lateral extension 22. The lateral extensions 20 and 22 comprise an inside edge 24, an outside edge 26, an upper surface 28, and a lower surface 30. The lateral extensions 20 and 22 have an essentially constant thickness throughout. The inside edge 24 is attached to and is about the same length as the lower section 16. The outside edge 26 can be about 8 mm-10 mm in length. The inside edge 24 and the lower section 16 meet to form a horizontal plane, essentially perpendicular to the central vertical extension 12. The upper surface 28 of the lateral extensions 20 and 22 can form an angle from about 0°-60° below the horizontal plane. The width of the annulus stent 10 may be from about 3 mm-5 mm.

Additionally, the upper surface 28 of the lateral extensions 20 and 22 may be barbed for fixation to the inside surface of the disc annulus 42 and to resist expulsion through the aperture 44.

In an alternative embodiment, as shown in FIG. 4B, the lateral extensions 20 and 22 have a greater thickness at the inside edge 24 than at the outside edge 26.

In an illustrative embodiment, the annulus stent 10 is a solid unit, formed from one or more of the flexible resilient biocompatible or bioresorbable materials well known in the art.

For example, the annulus stent 10 may be made from:

- A porous matrix or mesh of biocompatible and bioresorbable fibers acting as a scaffold to regenerate disc tissue and replace annulus fibrosus as disclosed in, for example, U.S. Pat. No. 5,108,438 (Stone) and U.S. Pat. No. 5,258,045 (Stone), a strong network of inert fibers intermingled with a bioresorbable (or bioabsorbable) material which attracts tissue ingrowth as disclosed in, for example, U.S. Pat. No. 4,904,260 (Ray et al.);
- A biodegradable substrate as disclosed in, for example, U.S. Pat. No. 5,964,807 (Gan et al.); or
- An expandable polytetrafluoroethylene (ePTFE), as used for conventional vascular grafts, such as those sold by W.L. Gore and Associates, Inc. under the trademarks GORE-TEX and PRECULE, or by Impra, Inc. under the trademark IMPRA.

Furthermore, the annulus stent 10, may contain hygroscopic material for a controlled limited expansion of the annulus stent 10 to fill the evacuated disc space cavity.

Additionally, the annulus stent 10 may comprise materials to facilitate regeneration of disc tissue, such as bioactive silica-based materials that assist in regeneration of disc tissue as disclosed in U.S. Pat. No. 5,849,331 (Ducheyne et al.), or other tissue growth factors well known in the art.

In further embodiments, as shown in FIGS. 5A-5B and 6A-6B, the left and right lateral extensions 20 and 22 join to form a solid pyramid or cone. Additionally, the left and right lateral extensions 20 and 22 may form a solid trapezoidal, wedge, or bullet shape. The solid formation may be a solid biocompatible or bioresorbable flexible material, allowing the lateral extensions 20 and 22 to be compressed for insertion into aperture 44, then to expand conforming to the shape of the annulus’ 42 inner wall.

Alternatively, a compressible core may be attached to the lower surface 30 of the lateral extensions 20 and 22, forming a pyramid, cone, trapezoid, wedge, or bullet shape. The compressible core may be made from one of the biocompatible or bioresorbable resilient foams well known in the art. The core can also comprise a fluid-expandable membrane, e.g., a balloon. The compressible core allows the lateral extensions 20 and 22 to be compressed for insertion into aperture 44, then to expand conforming to the shape of the annulus 42 inner wall and to the cavity created by pathologic extrusion or surgical removal of the disc fragment.

In an illustrative method of use, as shown in FIGS. 11A-D, the lateral extensions 20 and 22 are compressed together for insertion into the aperture 44 of the disc annulus 42. The annulus stent 10 is then inserted into the aperture 44, where the lateral extensions 20, 22 expand. In an expanded configuration, the upper surface 28 can substantially conform to the contour of the inside surface of the disc annulus 42. The upper section 14 is positioned within the aperture 44 so that the annulus stent 10 may be secured to the disc annulus 42, using means well known in the art.

In an alternative method, where the length of the aperture 44 is less than the length of the outside edge 26 of the annulus stent 10, the annulus stent 10 can be inserted laterally into the aperture 44. The lateral extensions 20 and 22 are compressed, and the annulus stent 10 can then be laterally inserted into the aperture 44. The annulus stent 10 can then be rotated inside the disc annulus 42, such that the upper section 14 can be held back through the aperture 44. The lateral extensions 20 and 22 are then allowed to expand, with the upper surface 28 contouring to the inside surface of...
the disc annulus 42. The upper section 14 can be positioned within, or proximate to, the aperture 44 in the subannular space such that the annulus stent 10 may be secured to the disc annulus, using means well known in the art.

[0055] In an alternative method of securing the annulus stent 10 in the aperture 44, as shown in FIG. 9, a first surgical screw 50 and second surgical screw 52, with eye-holes 53 located at the top of the screws 50 and 52, are opposingly inserted into the adjacent vertebrae 54 and 56 below the annulus stent 10. After insertion of the annulus stent 10 into the aperture 44, a suture 40 is passed down though the disc annulus 42, adjacent to the aperture 44, through the eye hole 53 on the first screw 50 then back up through the disc annulus 42 and through the orifice 18 on the annulus stent 10. This is repeated for the second screw 52, after which the suture 40 is secured. One or more surgical sutures 40 are placed at about equal distances along the sides of the aperture 44 in the disc annulus 42. Reapproximation or closure of the aperture 44 is accomplished by tying the sutures 40 in such a fashion that the sides of the aperture 44 are drawn together. The reapproximation or closure of the aperture 44 enhances the natural healing and subsequent reconstruction by the natural tissue crossing the now surgically narrowed gap in the annulus 42. Preferably, the surgical sutures 40 are biodegradable but permanent non-biodegradable forms may be utilized. This method should decrease the strain on the disc annulus 42 adjacent to the aperture 44, precluding the tearing of the sutures through the disc annulus 42.

[0056] It is anticipated that fibroblasts will engage the fibers of the polymer or fabric of the intervertebral disc stent 10, forming a strong wall duplicating the currently existing condition of healing seen in the normal reparative process.

[0057] In an additional embodiment, as shown in FIGS. 10A-B, a flexible bladder 60 is attached to the lower surface 30 of the annulus stent 10. The flexible bladder 60 comprises an internal cavity 62 surrounded by a membrane 64, where the membrane 64 is made from a thin flexible biocompatible material. The flexible bladder 60 is attached to the lower surface 30 of the annulus stent 10 in an unexpanded condition. The flexible bladder 60 is expanded by injecting a biocompatible fluid or expansive foam, as known in the art, into the internal cavity 62. The exact size of the flexible bladder 60 can be varied for different individuals. The typical size of an adult nucleus is about 2 cm in the semi-minor axis, 4 cm in the semi-major axis, and 1.2 cm in thickness.

[0058] In an alternative embodiment, the membrane 64 is made of a semi-permeable biocompatible material.

[0059] In an illustrative embodiment, a hydrogel is injected into the internal cavity 62 of the flexible bladder 60. A hydrogel is a substance formed when an organic polymer (natural or synthetic) is cross-linked via, covalent, ionic, or hydrogen bonds to create a three-dimensional open-lattice structure, which entrap water molecules to form a gel. The hydrogel may be used in either the hydrated or dehydrated form.

[0060] In a method of use, where the annulus stent 10 has been inserted into the aperture 44, as has been previously described and shown in FIGS. 12A-B, an injection instrument, as known in the art, such as a syringe, is used to inject the biocompatible fluid or expansive foam into the internal cavity 62 of the flexible bladder 60. The biocompatible fluid or expansive foam is injected through the annulus stent 10 into the internal cavity 62 of the flexible bladder 60. Sufficient material is injected into the internal cavity 62 to expand the flexible bladder 60 to fill the void in the intervertebral disc cavity. The use of the flexible bladder 60 is particularly useful when it is required to remove all or part of the intervertebral disc nucleus.

[0061] The surgical repair of an intervertebral disc may require the removal of the entire disc nucleus, being replaced with an implant, or the removal of a portion of the disc nucleus thereby leaving a void in the intervertebral disc cavity. The flexible bladder 60 allows for the removal of only the damaged section of the disc nucleus, with the expanded flexible bladder 60 filling the resultant void in the intervertebral disc cavity. A major advantage of the annulus stent 10 with the flexible bladder 60 is that the incision area in the annulus 42 can be reduced in size, as there is no need for the insertion of an implant into the intervertebral disc cavity.

[0062] In an alternative method of use, a dehydrated hydrogel is injected into the internal cavity 62 of the flexible bladder 60. Fluid, from the disc nucleus, passes through the semipermeable membrane 64 hydrating the dehydrated hydrogel. As the hydrogel absorbs the fluid the flexible bladder 60 expands, filling the void in the intervertebral disc cavity.

[0063] All patents referred to or cited herein are incorporated by reference in their entirety to the extent they are not inconsistent with the explicit teachings of this specification, including: U.S. Pat. No. 5,108,438 (Stone), U.S. Pat. No. 5,258,043 (Stone), U.S. Pat. No. 4,904,260 (Ray et al.), U.S. Pat. No. 5,964,807 (Gan et al.), U.S. Pat. No. 5,849,331 (Ducheyne et al.), U.S. Pat. No. 5,122,154 (Rhodes), U.S. Pat. No. 5,204,106 (Schepers et al.), U.S. Pat. No. 5,888,220 (Felt et al.) and U.S. Pat. No. 5,376,120 (Sarver et al.).

[0064] It should be understood that the examples and embodiments described herein are for illustrative purposes only and that various modifications or changes in light thereof will be suggested to persons skilled in the art and are to be included within the spirit and preview of this application and the scope of the appended claims.

1-44. (canceled)
45. An annulus stent for repairing an aperture in an intervertebral disc annulus comprising a centralized vertical extension with an upper section and a lower section, and a recess between the upper section and the lower section enabling the annulus stent to form a compatible fit with the edges of an aperture.

46. The annulus stent of claim 45, wherein the upper section of the centralized vertical extension comprises a slot, the slot forming an orifice through the upper section.

47. The annulus stent of claim 46, wherein the slot is positioned within the upper section such that it traverses the longitudinal axis of the upper section.

48. The annulus stent of claim 47, wherein the slot is sized and shaped to accommodate sutures, tension bands, or staples.

49. An implantable device for therapeutically or prophylactically treating the annulus of a patient’s intervertebral disc, the annulus having an aperture having an aperture
dimension along a selected axis, said device comprising a body having a delivery configuration and an implanted configuration, wherein:

in said delivery configuration said device has at least one first dimension no larger than said aperture dimension; and

in said implanted configuration said device has at least one second dimension larger than said aperture dimension.

50. The implantable device of claim 49, wherein said second dimension lies along a different axis than said first dimension.

51. The implantable device of claim 49, wherein, in use, said device is constructed and sized to be capable of subannular reorientation.

52. The implantable device of claim 51, wherein said reorientation comprises rotation.

53. The implantable device of claim 51, wherein said reorientation comprises deforming the device.

54. The implantable device of claim 49, wherein said second dimension results from causing or allowing the device to expand from said delivery configuration.

55. The implantable device of claim 49, wherein said aperture dimension is a lateral width measured substantially perpendicular to the normal axis of the spine.

56. The implantable device of claim 49, wherein said aperture dimension is a height measured substantially parallel to the normal axis of the spine.

57. The device of claim 49, wherein at least a portion of the device is formed at least in part of synthetic biocompatible material.

58. The device of claim 49, wherein at least a portion of the device is formed at least in part of biocompatible fabric.

59. The implantable device of claim 49, wherein at least a portion of the device is formed at least in part of polyethylene terephthalate.

60. The device of claim 49, wherein at least a portion of the device is formed at least in part of polytetrafluoroethylene.

61. The device of claim 49, wherein at least a portion of the device is formed at least in part of bioresorbable material.

62. The device of claim 49, wherein at least a portion of the device is formed at least in part of material to facilitate regeneration of disc tissues.

63. The device of claim 62, wherein the material for facilitating regeneration includes at least in part a growth factor.

64. The device of claim 49, wherein at least a portion of the device is formed at least in part of flexible, resilient material.

65. The device of claim 49, wherein at least a portion of the device is formed at least in part of a polymer.

66. The device of claim 49, wherein at least a portion of the device is formed at least in part of a polymeric sheet.

67. The device of claim 49, wherein at least a portion of the device is formed at least in part of an allograft.

68. The device of claim 49, wherein at least a portion of the device is formed at least in part of an xenograft.

69. The device of claim 49, wherein at least a portion of the device is formed at least in part of a graft.

70. The device of claim 49, wherein at least a portion of the device is formed at least in part of xenograft.

71. The device of claim 49, wherein at least a portion of the device is formed at least in part of fibrous material.

72. The device of claim 49, wherein at least a portion of the device is formed at least in part of polymer fibers.

73. The device of claim 49, further comprising an attachment element for facilitating fixation of the device to anatomical features of the patient.

74. The device of claim 73, wherein said anatomical features include vertebral bodies.

75. The device of claim 73, wherein said anatomical features include the annulus fibrosus.

76. The device of claim 49, further comprising attachment means for securing said device within the patient.

77. The device of claim 76, wherein said attachment means comprises a suture.

78. The device of claim 76, wherein said attachment means comprise tension bands.

79. The device of claim 76, wherein said attachment means comprise staples.

80. The device of claim 76, wherein said attachment means comprise barbs.

81. A device for treating a defect in an intervertebral disc annulus, the device comprising of a body having a delivery configuration and an implanted configuration, wherein:

in said delivery configuration said device has at least one first dimension permitting the device to be passed into or through the defect; and,

in said implanted configuration said device has at least one second dimension that is larger than said defect.

82. An implantable device for treating an aperture in the annulus fibrosus of an intervertebral disc, the device comprising a collapsible body, wherein the body is characterized by:

a first collapsed configuration dimensioned to be at least partially delivered through the aperture; and,

a second expanded configuration having at least one dimension larger than said aperture.

83. A device for treating an intervertebral disc having an aperture in the annulus fibrosus, wherein the aperture provides a pathway for the migration of intradiscal material from the subannular space, the device comprising a barrier body wherein the body has:

a first dimension during deployment permitting said device to pass through the aperture and,

a second post-deployment dimension whereby said second dimension at least partially spans said aperture, thereby restricting the migration of intradiscal material through the aperture.

84. A method of treating an intervertebral disc, comprising the steps of:

harvesting autograft or allograft tendon material from a live or recently deceased human or other suitable donor and

transplanting the tendon material into or onto a disc to strengthen the annulus fibrosus or to augment or replace the nucleus pulposus.

85. The method of claim 84, further including the step of adding one or more therapeutic substances to the tendon material.

86. The method of claim 85, wherein the therapeutic substances include growth factors.

87. The method of claim 85, wherein the therapeutic substances include bioactive silica-based materials.

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