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(54) **TREATING DEGENERATIVE DISC DISEASE THROUGH THE TRANSPLANTATION OF DEHYDRATED TISSUE**

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(57) **ABSTRACT**

A method of treating a diseased or traumatized intervertebral disc is based upon the transplantation of one or more dehydrated biologic tissues into the disc space. In the preferred embodiment, dehydrated nucleus pulposis tissue is used, which may be combined with live nucleus cells. The dehydration allows the insertion of the transplanted cells and/or tissue through a smaller annular hole. Dehydration also decreases the volume of the material transferred, thus allowing the surgeon to insert more into the disc space. Once in the body, the materials hydrate by imbibing fluid from the surrounding area. In the case of nucleus pulposis tissue, the subsequent hydration helps to restore disc height and help prevent extrusion of disc material through the hole in the annulus. One or more therapeutic substances may be added, including culture media, growth factors, differentiation factors, hydrogels, polymers, antibiotics, anti-inflammatory medications, or immunosuppressive medications. These additional substances may or may not be dehydrated as well, depending upon efficacy, initial versus final volume, and so forth.

TREATING DEGENERATIVE DISC DISEASE THROUGH THE TRANSPLANTATION OF DEHYDRATED TISSUE

REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation-in-part of U.S. patent application Ser. No. 09/639,309, filed Aug. 14, 2000, which claims priority of U.S. Provisional Patent Application Serial No. 60/148,913, filed Aug. 13, 1999, the entire content of both being incorporated herein by reference.

FIELD OF THE INVENTION

[0002] This invention relates generally to the treatment of diseased or traumatized intervertebral discs, and more particularly, to transplantation of transplantation of dehydrated tissue including nucleus pulposis in conjunction with such treatment.

BACKGROUND OF THE INVENTION

[0003] Intervertebral discs provide mobility and a cushion between the vertebrae. At the center of each disc is the nucleus pulposus which, in the adult human, is composed of cells and an insoluble extracellular matrix which is produced by the nucleus itself. The extracellular matrix is composed of collagen, proteoglycans, water, and noncollagenous proteins. The nucleus pulposus is surrounded by the annulus fibrosis, which is composed of cells (fibrocyte-like and chondrocyte-like), collagen fibers, and non-fibrillar extracellular matrix. The components of the annulus are arranged in 15-25 lamellae around the nucleus pulposus.

[0004] The cells of the nucleus pulposus have chondrocyte-like features. In an adult human, the cells of the nucleus pulposis obtain nutrients and eliminate waste by diffusion through blood vessels in the endplates of the vertebrae adjacent to the disc. Blood vessels do not course into the nucleus pulposis. The relative vascular isolation of the nucleus pulposis imparts isolation of nucleus pulposis cells from the body's immune system.

[0005] To date, the treatment of degenerative disc disease has relied for the most part on eliminating the defective disc or disc function. This may be accomplished by fusing the vertebra on either side of the disc. In terms of replacement, most prior-art techniques use synthetic materials to replace the entire disc or a portion thereof. My pending U.S. patent application Ser. No. 09/415,382 discloses disc replacement methods and apparatus using synthetic materials.

[0006] Unfortunately, disc replacement using synthetic materials does not restore normal disc shape, physiology, or mechanical properties. Synthetic disc replacements tend to wear out, resulting in premature failure. The problems associated with the wear of prosthetic hip and knees are well known to those skilled in orthopedic surgery. The future of treating degenerative disc disease therefore lies in treatments which preserve disc function. If disc function could be restored with biologic replacement or augmentation, the risk of premature wearout would be minimized, if not eliminated.

SUMMARY OF THE INVENTION

[0007] This invention is directed to a method of treating a diseased or traumatized intervertebral disc through the transplantation of one or more dehydrated biologic tissues into the disc space. In the preferred embodiment, dehydrated nucleus tissue is used, which may be combined with extracellular matrix materials.

[0008] Broadly according to the method, live biologic tissue is harvested from a human or animal donor. The tissue is dehydrated, after which the harvested tissue is introduced into the disc being treated through a hole formed in the annulus fibrosis. Dehydration allows the insertion of the transplanted cells and/or tissue through a smaller annular hole. Dehydration also decreases the volume of the material transferred, thus allowing the surgeon to insert more into the disc space. Once in the body, the materials hydrate by imbibing fluid from the surrounding area. In the case of nucleus pulposis tissue, the subsequent hydration helps to restore disc height and help prevent extrusion of disc material through the hole in the annulus.

[0009] A preferred embodiment includes the step of harvesting nucleus pulposis cells, with or without extracellular matrix material, dehydrating and morselizing the cells and/or tissues. A passageway is formed through the annulus fibrosis, and the dehydrated components are introduced into the disc through the passageway using, for example, a needle and syringe or small cannula. Alternatively the step of transplanting may include percutaneously or laparoscopically injecting the dehydrated constituents into the disc being treated. Nucleus cells are added to the dehydrated tissue at the time of insertion.

[0010] One or more therapeutic substances may be added, including culture media, growth factors, differentiation factors, hydrogels, polymers, antibiotics, anti-inflammatory medications, or immunosuppressive medications. These additional substances may or may not be dehydrated as well, depending upon efficacy, initial versus final volume, and so forth.

DETAILED DESCRIPTION OF THE INVENTION

[0011] As discussed above, this invention resides in a method of treating a diseased or traumatized intervertebral disc through the transplantation of one or more dehydrated biologic tissues into the disc space. In the preferred embodiment, dehydrated nucleus tissue is used, which may be combined with extracellular matrix materials. The relative vascular isolation of the nucleus pulposis imparts isolation of nucleus pulposis cells from the body's immune system. This invention exploits the lack of an immune system response to the transplantation of nucleus pulposis cells and extracellular matrix harvested from another human or animal.

[0012] According to the method, the nucleus pulposis or other tissues are preferably harvested from a live human, though recently deceased human or animal donors may alternatively be used. Depending upon the extent of the harvest, the recipient may function at least in part as a donor, or the tissues from others, including fetal or embryo sources, may be used, preferably having a familial relationship to minimize or avoid the need for immunosuppressive substances. Guidelines for tissue procurement including surgical technique of removal, number of hours between death of the donor and tissue procurement, and testing of the donor for infectious disease, are well described in the literature.

[0013] Similarly, the guidelines for storage of living tissues are well known to those skilled in the art. The text "Organ Preservation for Transplantation" by Karow and Pego, 1981, describes such methods. Briefly, the tissue storage method must maintain cell viability and preserve sterility. Examples of present storage methods include: refrigeration, refrigeration with tissue culture medium such as: hemolyzed serum, autologous serum, Medium 199 with 5% dextran (McCarey-Kaufman medium), Medium 199 with chondroitin sulfate, Medium 199 supplemented with inorganic salts, short chain fatty acids, and/or ketone bodies, and cryopreservation techniques, among others. Details are provided in U.S. Pat. Nos. 4,695,536 and 4,873,186, the entire contents of which are incorporated herein by reference.

[0014] The tissue is dehydrated using known techniques. To minimize exposure to the recipient's immune system, the constituents are preferably inserted through a small hole in the annulus fibrosis using a blunt-tipped needle or cannula forced through the laminae. Upon withdraw of the needle, after injecting the transplanted nucleus pulposis, the separated fibers of the lamella return to their normal position, thereby sealing the annulus.

[0015] The annulus fibrosis is thicker in the anterior and lateral portion of the disc. Thus, in the preferred embodiment, the needle would be inserted into the anterior or lateral portion of the disc. Those skilled in the art will realize the needle could be directed into the lateral portion of the disc percutaneously with fluourscopic guidance and into the anterior portion of the disc laparoscopically.

[0016] The dehydrated materials may be morselized to allow insertion into the disc through a small cannula or needle. With respect to the nucleus pulposis, the increased surface area after morsellization may also aid diffusion of nutrients and wastes products to and from transplanted disc cells. Alternatively large sections of the transplanted nucleus pulposis could be added to the disc if the annular defect was sealed after transplantation.

[0017] The transplanted nucleus is preferably added to the patient's nucleus pulposis. Alternatively, the patient's nucleus could be removed with standard techniques (enzymatically (chymopapain) or with the aid of a laser, suction device, shaver, or other surgical instrument). If the nucleus is removed the hole in the annulus should be small and sealed to prevent the ingrowth of vascular tissue. Vascular ingrowth could lead to a graft versus host reaction.

[0018] Once in the body, the materials hydrate by imbibing fluid from the surrounding area. In the case of nucleus pulposis tissue, the subsequent hydration helps to restore disc height and help prevent extrusion of disc material through the hole in the annulus. Additional therapeutic substances may be added, including resorbable culture medium, tissue growth or differentiation factors (recombinant generated morphogenetic proteins, PDGF, TGF-β, EGF/TGF-α, IGF-I, PFGF), hydrogels, absorbable or non-resorbable synthetic or natural polymers (collagen, fibrin, polyglycolic acid, polylactic acid, polytetrafluoroethylene, etc.), antibiotics, anti-inflammatory medication, immunosuppressive medications, etc. could be beneficial. These additional substances may or may not be dehydrated as well, depending upon efficacy, initial versus final volume, and so forth.

I claim:

1. A method of treating a diseased or traumatized intervertebral disc having a nucleus and annulus fibrosis, comprising the steps of:

harvesting nucleus pulposis cells from a human or animal donor;

dehydrating the harvested tissue; and

transplanting the dehydrated tissue into the disc being treated.

2. The method of claim 1, further including the steps of:

morselizing the dehydrated tissue;

forming a passageway through the annulus fibrosis; and

introducing the dehydrated cells matrix into the disc being treated through the passageway.

3. The method of claim 1, further including the step of adding one or more therapeutic substances to the dehydrated tissue prior to the implantation thereof.

4. The method of claim 3, wherein the therapeutic substances include one or more of the following:

culture media, growth factors, differentiation factors, hydrogels, polymers, antibiotics, anti-inflammatory medications, or immunosuppressive medications.

5. The method of claim 1, wherein the dehydrated tissue are injected into the disc being treated through a needle and syringe or small cannula.

6. The method of claim 1, wherein the dehydrated tissue is percutaneously or laparoscopically injected into the disc being treated.

7. The method of claim 1, further including the step of adding live nucleus pulposis cells to the dehydrated nucleus tissue.

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专利名称(译)	通过移植脱水组织治疗退行性椎间盘疾病		
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[标]申请(专利权)人(译)	FERREE BRET一个		
申请(专利权)人(译)	费里布雷特A.		
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其他公开文献	US6648918		
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摘要(译)

治疗患病或受创伤的椎间盘的方法是基于将一种或多种脱水的生物组织移植到椎间盘空间中。在优选的实施方案中，使用脱水的髓核组织，其可以与活核细胞组合。脱水允许移植的细胞和/或组织通过较小的环形孔插入。脱水还减少了转移材料的体积，从而允许外科医生更多地插入椎间盘空间。一旦进入体内，材料就会通过吸收周围区域的液体而水合。在髓核组织的情况下，随后的水合有助于恢复椎间盘高度并有助于防止椎间盘物质通过瓣环中的孔挤出。可以添加一种或多种治疗物质，包括培养基，生长因子，分化因子，水凝胶，聚合物，抗生素，抗炎药物或免疫抑制药物。这些附加物质也可以或可以不脱水，这取决于功效，初始体积与最终体积等。