(57) Abstract: Medical system and methods are provided for forming an Anastomosis, such as an intestinal bypass anastomosis for treatment of obesity or diabetes. The medical devices and methods are minimally invasive and reduce complications. One embodiment of the method includes forming a first opening in the first section and forming a second opening in the first section. A proximal portion of the second section is moved to a position adjacent the first opening, and a distal portion of the second section is moved to a position adjacent the second opening. In this manner, an intermediate portion of the second section extends along the first section and an anastomosis can then be formed between the first section and the second section.
Published:

- with international search report (Art. 21(3))
SYSTEM FOR CREATING ANASTOMOSES

FIELD OF THE INVENTION

[0001] This invention relates to medical systems and methods for forming an anastomosis, and more particularly to forming an intestinal bypass anastomosis.

BACKGROUND OF THE INVENTION

[0002] It is well known that obesity is a very difficult condition to treat. Methods of treatment are varied, and include drugs, behavior therapy, and physical exercise, or often a combinational approach involving two or more of these methods. Unfortunately, results are seldom long term, with many patients eventually returning to their original weight over time. For that reason, obesity, particularly morbid obesity, is often considered an incurable condition.

[0003] More invasive approaches have been available which have yielded good results in many patients. These include surgical options such as bariatric surgery, bypass surgery or gastroplasty. However, these procedures carry high risks, and are therefore not appropriate for many patients. Even when carried out laparoscopically, these procedures are still considered major surgery due to the high risk and complication rates. One such method is forming a gastrojejunostomy, where a portion of the small intestine (e.g. the jejunum) is anastomosed to the stomach, thereby creating a bypass of a portion of the small intestine to create a malabsorptive effect and induce weight loss.

BRIEF SUMMARY OF THE INVENTION

[0004] The present invention provides medical systems and methods for forming an intestinal bypass anastomosis that is minimally invasive with reduced complications. According to one embodiment, a method of forming an anastomosis between a first section and a second section of the digestive tract is provided in accordance with the teachings of the present invention. As one example, the anastomosis may create a passageway directly from the stomach to the small intestine to bypass a portion of the small intestine (e.g. the jejunum, thereby forming a gastrojejunostomy), which is commonly done to treat obesity, diabetes, cancer and
other diseases or defects. In one embodiment, the method includes forming a first opening in the first section and forming a second opening in the first section. A proximal portion of the second section is moved to a position adjacent the first opening, and a distal portion of the second section is moved to a position adjacent the second opening. In this manner, an intermediate portion of the second section extends along the first section and an anastomosis can then be formed between the first section and the second section.

[0005] According to more detailed aspects, the method may further include the step of attaching the proximal portion of the second section to the first section adjacent the first opening. The proximal portion may be attached through application of any one of a tack, a suture or a clip to the first and second sections. Similarly, the distal portion of the second section may be attached to the first section adjacent the second opening in a similar manner. Alternatively, a first tissue anchor may be deployed within the proximal portion of the second section, and a second tissue anchor may be deployed within the distal portion of the second section. The tissue anchors may be tensioned to position the proximal and distal portions adjacent the first and second openings, respectively, and position the intermediate portion of the second section alongside the first section.

[0006] According to further detailed aspects, the step of moving a proximal portion of the second section includes moving the proximal portion through the first opening to form a first loop in the second section, and the step of moving the distal portion includes moving the distal portion through the second opening to form a second loop in the second section. A grasping device such as forceps may be employed through an endoscope to grasp and move the proximal and distal portions, or tissue anchors may be deployed within the proximal and distal portions and tensioned to move the proximal and distal portions through the first and second openings. The first and second loops are preferably positioned on an interior side of the first section, while the intermediate portion of the second section is positioned on an exterior side of the first section.

[0007] According to still further detailed aspects, the method may also include the step of maintaining the position of the first and second loops on the interior side of the first section. Maintaining the position of the loops may be accomplished by
applying at least one a tack, a suture or a clip to the first and second loops in the second section. Tissue anchors placed within the first and second loops may also be used to maintain the position of the first and second loops through tensioning of the tissue anchor. Alternatively, an elongate member, such as a suture, a wire guide or a catheter may be passed through the first and second loops and tensioned to maintain the position of the loops. For example, a first elongate member may be passed through the first loop and a second elongate member may be passed through the second loop, which then can be independently tensioned to maintain the position of the first and second loops.

[0008] Upon completing the anastomosis, the first and second loops may be repositioned on the exterior side of the first section, and the first and second openings in the first section may be closed. An anastomotic device may be placed within the anastomosis, for example an anastomotic ring, anastomosis clip, sutures and related devices may be used to maintain the anastomosis. Generally, the step of forming an anastomosis includes forming a third opening in the first section and a fourth opening in the second section, and placing an anastomotic device within the third and fourth openings to approximate the first and second sections.

According to another embodiment, a system for forming an anastomosis between bodily lumens is provided. The system generally includes an endoscope, an elongated cutting device, an elongated grasping device, and an elongated needle having a needle lumen containing two tissue fixation devices. The endoscope includes first and second working channels through which elongate medical instruments may be employed. The two tissue fixation devices are suitable for fixing two portions of a bodily lumen in a manner such as described above, and may include tacks, clips, tissue anchors and the like, or may simply include an elongate member (e.g. suture, wire guide or catheter) that is looped through the bodily lumen to fix or otherwise hold the positions of the two portions for forming an anastomosis.

The cutting device and grasping device are structured for use with the first working channel and the elongated needle is structured for use with the second working channel. The grasping device is independently operable from the needle and tissue fixation devices such that the grasping device may be tensioned proximally while the
needle is advanced distally, and such that the tissue fixation device may be tensioned proximally while the cutting device is advanced distally.

**BRIEF DESCRIPTION OF THE DRAWINGS**

[0009] The accompanying drawings incorporated in and forming a part of the specification illustrate several aspects of the present invention, and together with the description serve to explain the principles of the invention. In the drawings:

[0010] FIG. 1 depicts a schematic view, partially in cross-section, depicting a system and method step for forming an anastomosis;

[0011] FIG. 2 depicts a schematic view, partially in cross-section, depicting a system and method step for forming an anastomosis;

[0012] FIG. 3 depicts a schematic view, partially in cross-section, depicting a system and method step for forming an anastomosis;

[0013] FIG. 4 is also a schematic view, partially in cross-section, depicting an alternate method step to that shown in FIG. 3;

[0014] FIG. 5 is also a schematic view, partially in cross-section, depicting an alternate method step to that of FIG. 3;

[0015] FIG. 6 is also a schematic view, partially in cross-section, depicting an alternate method step to that of FIG. 3;

[0016] FIG. 7 depicts a schematic view, partially in cross-section, depicting a system and method step for forming an anastomosis;

[0017] FIG. 9 depicts a schematic view, partially in cross-section, depicting a system and method step for forming an anastomosis;

[0018] FIG. 10 depicts a schematic view, partially in cross-section, depicting a system and method step for forming an anastomosis;

[0019] FIG. 11 depicts a schematic view, partially in cross-section, depicting an alternate system and method step to that disclosed in FIG. 10;

[0020] FIG. 12 depicts a schematic view, partially in cross-section, depicting an alternate system and method step to that disclosed in FIG. 10;

[0021] FIG. 13 depicts a schematic view, partially in cross-section, depicting a system and method step for forming an anastomosis;
DETAILED DESCRIPTION OF THE INVENTION

[0022] The terms "proximal" and "distal" as used herein are intended to have a reference point relative to the user. Specifically, throughout the specification, the terms "distal" and "distally" shall denote a position, direction, or orientation that is generally away from the user and towards a target site, and the terms "proximal" and "proximally" shall denote a position, direction, or orientation that is generally towards the user and away from a target site. Thus, "proximal" and "distal" directions, portions of a device, or bodily regions, may depend on the point of entry for the procedure (e.g., percutaneously or laparoscopically or endoscopically).

[0023] Turning now to the figures, FIG. 1 depicts portions of a system 20 and method for forming an anastomosis between a first section 40 of the digestive tract and a second section 50 of the digestive tract. In the depicted embodiments, the first section 40 is generally depicted as the stomach, while the second section 50 has been depicted as a portion of the small intestine, for example, to perform a gastrojejunostomy to bypass the jejunum 52 or other portion of the small intestine 50. Accordingly, as used herein the terms "stomach" and "small intestine" are interchangeable with "first section" and "second section" of the digestive tract. Moreover, it will be recognized by those skilled in the art that the terms "first section" and "second section" of the digestive tract may include any portion of the digestive tract from the mouth to the anus, as an anastomosis may also be formed between the esophagus and stomach, the stomach and large intestine, the small intestine and other portions of the small intestine or large intestine, and the small and large intestines with the colon.

[0024] The medical system 20 generally includes an endoscope 22 and a variety of instruments and devices that can work through the endoscope 22, or work alongside and in parallel with the endoscope 22. Preferably, the endoscope 22 has two working or auxiliary channels such that two instruments may be employed through the endoscope 22. As will be described further below, the system 20 preferably includes an elongated cutting device (e.g. needle knife 29), an elongated grasping device (e.g. forceps 24), and an elongated needle (e.g. 28) having a needle lumen containing two tissue fixation devices suitable for fixing two portions of a
bodily lumen in a manner such as described below, and may include tacks (e.g. 26), clips, tissue anchors (e.g. 36) and the like, or may simply include an elongate member (e.g. suture, wire guide or catheter) that is looped through the bodily lumen to fix or otherwise hold the positions of the two portions for forming an anastomosis.

[0025] However, a single channel endoscope may also be employed and the medical instruments (which will be described further hereinbelow) may be employed alongside the endoscope 22. Similarly, other elongate visualization devices, such as catheter-based fiber optic systems, or even visualization techniques such as fluoroscopy, ultrasound or the like, may be used to monitor the position of the instruments for performing the steps described herein.

[0026] As shown in FIG. 1, the endoscope 22 is passed through the mouth and esophagus 46 and into the stomach 40. The system 20 is utilized to form a first opening 42 in the stomach 40 (i.e. in the first section). A needle knife 29 (shown in FIG. 10, not depicted in FIG. 1) or other cutting device, preferably an electrosurgical cutting device, may be employed through or alongside the endoscope 22 to form the first opening 42. A balloon dilator or other dilation device (not shown) may also be used to enlarge the first opening 42 as desired. The endoscope 22 may then be passed through the first opening 42 to the exterior of the stomach 40, namely into the peritoneal cavity 44. A grasping device 24 may be used to engage a proximal portion 54 of the intestine 50. It will be recognized that various grasping devices 24 may be used, for example hooks, wire graspers, clamps, piercing or screw tip devices and the like, and forceps 24 have been depicted in FIG. 1.

[0027] As shown in FIG. 2, the medical system 20, and namely the endoscope 22 and/or grasping device 24 may be retracted proximally to move the proximal portion 54 of the intestine 50 to a position adjacent the first opening 42. Preferably, the proximal portion 54 is pulled through the first opening 42 thereby forming a first loop 56 in the intestine 50.

[0028] As best seen in FIG. 3, the proximal portion 54 in the first loop 56 formed by the intestine 50 is maintained in this position on the interior of the stomach 40 by attaching the proximal portion 54 to the wall of the stomach 40 utilizing a tack 26, which may be delivered through a needle 28 (FIG. 2). Exemplary tacks and delivery devices are shown in U.S. Patent Application Nos. 12/428,226
filed April 22, 2009, U.S. Application No. 12/632,281 filed December 7, 2009, U.S. Application No. 12/608,621 filed October 29, 2009 and U.S. Application No. 12/632,300 filed December 7, 2009, and U.S. Application No. 12/632,208 filed December 15, 2009, and the contents of all these applications are incorporated herein by reference in their entirety. Generally, the tack 26 depicted in FIG. 3 includes a central member 30 having a plurality of flexible hook-shaped elements 32 (e.g. formed of nitinol). The hook-shaped elements 32 are preferably delivered in a linear state and, upon ejection from the needle 28, retroflex into their hook shape as shown in FIG. 3. It will also be recognized that numerous other tissue fixation devices and methods may be employed including suturing techniques, staples and clips. Exemplary endoscopic suturing techniques and devices are disclosed in U.S. 61/174,583 filed May 1, 2009, and U.S. 12/348,180 filed January 2, 2009. Exemplary clips are disclosed in 12/638,190 filed December 15, 2009, and U.S. 61/289,297 filed December 22, 2009. The disclosures of all the above-mentioned patent applications are incorporated herein by reference in their entirety.

[0029] As shown in FIG. 3, the first loop 56 of the proximal portion 54 is positioned laterally along the wall of the stomach 40 while the tack 26 is passed through opposing layers of the intestine 50. Alternatively, as shown in FIG. 4, the grasping device 24 may be used to hold the proximal portion 54 and loop 56 in place while a tack 26 is deployed in an angular fashion through the wall of the stomach 40 adjacent the opening 42 and through only one layer of the intestine 50.

[0030] Other alternate methods for fixing or maintaining the position of the first loop 56 are shown in FIGS. 5 and 6. For example, the grasping device 24 may be utilized to engage the proximal portion 54 of the intestine 50 and pull it through the first opening 42. Then, a needle 34 having a tissue anchor 36 may be advanced through the second working channel of the endoscope 22 to deliver the tissue anchor 36 within the proximal portion 54 of the intestine 50. Generally, the tissue anchor 36 includes a cross bar or anchoring member 36a connected to a suture 36s which extends through the needle 34. Alternatively, the suture 36s may extend alongside the needle, or even alongside the endoscope 22. The suture 36s may then be tensioned to maintain the position of the proximal portion 54 and loop 56 on the interior side of the stomach 40. It will also be recognized that the method may
modified to eliminate the grasping device 24, wherein the tissue anchor 36 is used to engage and move the proximal portion 54 of the intestine 50. For example, the tissue anchor 36 may be delivered into the intestine 50 while still in its normal position on the exterior of the stomach 40 (i.e. within the peritoneal cavity 44), and then the suture 36s tensioned and moved proximally to draw the proximal portion 54 of the intestine 53 through the first opening 42 to form the first loop 56. Exemplary tissue anchors and related devices are disclosed in U.S. 11/946,565 filed November 28, 2007, U.S. 12/191,277 filed August 13, 2008, and 12/630,395 filed December 3, 2009, the contents of all the above-mentioned applications are incorporated herein by reference in their entirety.

[0031] In an alternate embodiment shown in FIG. 6, once the grasping device 24 has engaged and moved the proximal portion 54 of the intestine 50 through the opening 42 to form the first loop 56, an elongate device may be deployed through the loop 56, here depicted as a catheter 38 having a curved distal end for passing a suture 39 through the first loop 56. The grasping device 24 may release the proximal portion 54 of the intestine 50 and grasp the distal end of the suture 39 (or other elongate member), to allow the elongate member 39 to be looped through the first loop 56 of the intestine 50 and brought within the control of the user of the medical system 20. An instrument delivered alongside the endoscope 22 may alternatively be used to grasp the suture 39, or the catheter 38 itself may have a catch feature that allows recapture of the suture 39. It will be recognized that the hook-shaped catheter 38 or other hook-shaped or elongate member could alone be used to engage and maintain the position of the loop 56. Likewise, other elongate members such as the suture 39, wire guides (preferably steerable wire guides), catheters (preferably steerable catheters) or the like may be passed through the first loop 56 of the intestine 50 and back through the stomach 40 and esophagus 46, where both ends of the elongate member may be operated by the user. In this manner, tension on the elongate member can be used to maintain the position of the first loop 56.

[0032] Turning now to FIG. 7, similar steps to those describe above in FIGS. 1-6 are performed again with regard to a distal portion 58 of the intestine 50. The medical system 20 is again used to form a second opening 44 in the stomach 40 at
a position spaced away from the first opening 42. The medical system 20 is passed through the opening 44 and the grasping device 24 is used to engage the distal portion 58 of the intestine 50. The medial system 20, endoscope 22 and/or grasping device 24 are retracted proximally through the second opening 44 to form a second loop 60 of the intestine 50 on the interior side of the stomach 40. The position of the second loop 60 and distal portion 58 of the intestine 50 is maintained through any of the aforementioned methods and devices, for example using a needle 28 to deliver a tack 26 as shown in FIG. 8.

[0033] Accordingly, and as best seen in FIG. 8, through grasping and positioning a proximal portion 54 and a distal portion 58 of the intestine 50 adjacent first and second openings 42, 44 in the stomach 40, an intermediate portion 62 of the intestine 50 extends along the exterior of the stomach 40 thus providing an ideal position for forming an anastomosis. Similarly, as shown in FIG. 9, the tissue anchors 36 may be used to form or simply maintain the position of the loops 56, 60 of the proximal and distal portions 54, 58 of the intestine 50. Notably, in the embodiment of FIG. 9 the sutures 36s of the anchors 36 may be tensioned to control the approximation of intermediate portion 62 of the intestine 50 to the exterior wall of the stomach 40. Tensioning and adjustment of the intestine 50 can occur throughout the procedure.

[0034] Turning now to FIG. 10, an anastomosis 64 is shown formed between the stomach 40 and intestine 50, i.e. between the first section of the digestive tract and the second section of the digestive tract. That is, a third opening 66 is formed in the wall of the stomach 40 and a fourth opening 68 is formed in one wall of the intestine 50, and in particular within the intermediate portion 62 of the intestine 50. The openings 66, 68 may be formed utilizing a needle knife 29 or other cutting tool such as those described above in connection with the first and second openings 42, 44 in the stomach 40. The walls of the intestine 50 and stomach 40 may be approximated and held in place using suture 70 or another anastomotic device using suture 70 or other anastomotic devices. As shown in FIG. 11, such other anastomotic devices include an anastomotic ring 72 which is formed of a polymer and has an annular shape, preferably with a cross-section in a U-shape or a C-shape. Similarly, FIG. 12 depicts an anastomotic clip 74 being deployed to form the
anastomosis 64. Exemplary anastomotic clips are disclosed in U.S. Application Nos.
61/227,848 filed June 26, 2009 and 61/257,654 filed November 3, 2009, the
 disclosures of which are incorporated herein by reference in their entirety.

[0035] Turning now to FIG. 13, with the anastomosis 64 formed between the
 stomach 40 and intestine 50, the proximal and distal portions 54, 58 of the intestine
 50, including the loops 56, 60, may be detached from the wall of the stomach 40,
 and repositioned (e.g. using the grasping device 24) or otherwise released such that
 they are positioned on the exterior of the stomach 40 and in the peritoneal cavity 44.
 The first and second openings 42, 44 in the stomach 40 may then be closed. Many
 known or hereinafter developed methods and devices for closing perforations in the
 stomach 40 may be employed, including suturing devices and techniques, tissue
 anchors, staples, clips, tacks and the like. For example, exemplary methods and
 devices are disclosed in the above-mentioned references regarding tissue anchors,
 and further exemplary devices and systems are disclosed in U.S. Patent Application
 20, 2009, 61/256,619 filed October 30, 2009 and 12/548,868 filed August 27, 2009,
 all the above-mentioned applications are incorporated herein by reference in their
 entirety. FIG. 13 depicts a plurality of purse string tissue anchors 35 placed through
 the stomach 40 having a single suture slidably attached thereto, which can be
 tensioned to close the first and second openings 42, 44. The sutures are maintained
 in a tension state utilizing a suture lock 37. Exemplary suture locks are disclosed in
 May 22, 2008.

[0036] Accordingly, it will be recognized by those skilled in the art that a
 minimally invasive method for bypassing a portion of the digestive tract (e.g., the
 small intestine) is provided to create a malabsorptive effect and induce weight loss.
 The complications and other problems utilizing conventional surgical or laparoscopic
 techniques are minimized or avoided, while retaining control over placement of the
 anastomosis and hence the bypassed portions of the small intestine.

[0037] It will be recognized by those skilled in the art that, while the methods
described above generally include placing the instrument and devices in tissue
through an internal bodily lumen, it will be recognized that the systems, devices and methods may be used on any layer of material (e.g. fabrics, cloth, polymers, elastomers, plastics and rubber) that may or may not be associated with a human or animal body and a bodily lumen. For example, the systems, devices and methods can find use in laboratory and industrial settings for placing devices through one or more layers of material that may or may not find application to the human or animal body, and likewise the creation and closing holes or perforations in layers of material that are not bodily tissue. Some examples include sewing or stitching and related manufacturing, working with synthetic tissues, connecting or repairing polymeric sheets, animal studies, veterinary applications, and post-mortem activities.

[0038] The foregoing description of various embodiments of the invention has been presented for purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise embodiments disclosed. Numerous modifications or variations are possible in light of the above teachings. The embodiments discussed were chosen and described to provide the best illustration of the principles of the invention and its practical application to thereby enable one of ordinary skill in the art to utilize the invention in various embodiments and with various modifications as are suited to the particular use contemplated. All such modifications and variations are within the scope of the invention as determined by the appended claims when interpreted in accordance with the breadth to which they are fairly, legally, and equitably entitled.
CLAIMS

1. A system for forming an anastomosis between bodily lumens, the system comprising:
   an endoscope having first and second working channels through which elongate medical Instruments may be employed;
   an elongated cutting device;
   an elongated grasping device; and
   an elongated needle having a needle lumen containing two tissue fixation devices for fixing two portions of a bodily lumen;
   wherein the cutting device and grasping device are structured for use with the first working channel and the elongated needle is structured for use with the second working channel, and wherein the grasping device is independently operable from the needle and tissue fixation devices such that the grasping device may be tensioned proximally while the needle is advanced distally, and such that the tissue fixation device may be tensioned proximally while the cutting device is advanced distally.

2. The system of claim 1, wherein the two tissue fixation devices are tacks.

3. The system of claim 1, wherein the two tissue fixation devices are tissue anchors each having an engagement structure attached to a suture.

4. The system of claim 3, wherein the sutures extend proximally through the second working channel.

5. A method of forming an anastomosis between a first section of the digestive tract and second section of the digestive tract, the method comprising the steps of:
   forming a first opening in the first section;
   forming a second opening in the first section;
   moving a proximal portion of the second section to a position adjacent the first opening;
moving a distal portion of the second section to a position adjacent the second opening, whereby an intermediate portion of the second section extends along the first section; and
forming an anastomosis between the first section and the second section.

6. The method of claim 5, further comprising the step of attaching the proximal portion of the second section to the first section adjacent the first opening.

7. The method of claim 6, wherein the step of attaching includes applying at least one of a tack, a suture, and a clip to the first and second sections.

8. The method of claim 6, further comprising the step of attaching the distal portion of the second section to the first section adjacent the second opening.

9. The method of claim 8, wherein the steps of attaching includes applying at least one of a tack, a suture, and a clip to the first and second sections.

10. The method of claim 5, further comprising the steps of deploying a first tissue anchor within the proximal portion of the second section, and deploying a second tissue anchor within the distal portion of the second section.

11. The method of claim 10, wherein the first and second tissue anchors each include an engagement member connect to suture, and further comprising the step of tensioning the sutures to position the intermediate portion of the second section alongside the first section.

12. The method of claim 5, wherein the step of moving a proximal portion of the second section includes moving the proximal portion through the first opening to form a first loop in the second section, and wherein the step of moving a distal portion of the second section includes moving the distal portion through the second opening to form a second loop in the second section.
13. The method of claim 12, wherein the moving steps include deploying a first tissue anchor within the proximal portion of the second section and deploying a second tissue anchor within the distal portion of the second section, and tensioning the first and second tissue anchors to move the proximal and distal portions.

14. The method of claim 12, wherein the first and second loops are positioned on an interior side of the first section, and the intermediate portion of the second section is positioned on an exterior side of the first section.

15. The method of claim 14, further comprising the step of maintaining the position of the first and second loops on the interior side of the first section.

16. The method of claim 15, wherein the step of maintaining the position of the first loop includes applying at least one of a tack, a suture, and a clip to the first loop and second section, and wherein the step of maintaining the position of the second loop includes applying at least one of a tack, a suture, and a clip to the second loop and second section.

17. The method of claim 15, wherein the step of maintaining the position of the first and second loops includes placing a tissue anchor within the first and second loops, and applying tension on the tissue anchors.

18. The method of claim 15, wherein the step of maintaining the position of the first and second loops includes passing an elongate member through both the first and second loops and applying tension on the elongate member.

19. The method of claim 15, wherein the step of maintaining the position of the first loop includes passing a first elongate member through the first loop and
applying tension to the first elongate member, and includes passing a second elongate member through the second loop and applying tension to the second elongate member.

20. The method of claim 5, further comprising the step of repositioning the first and second loops of the proximal and distal portions of the second section on the exterior side of the first section.

21. The method of claim 5, further comprising the step of closing the first and second openings in the first section.

22. The method of claim 5, wherein the step of forming an anastomosis includes forming a third opening in the first section and a fourth opening in the second section, and placing an anastomotic device within the third and fourth openings to approximate the first and second sections.
**INTERNATIONAL SEARCH REPORT**

**A. CLASSIFICATION OF SUBJECT MATTER**

INV. A61B17/11

ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>US 2009/276055 A1 (HARRIS JASON L [US]) ET AL 5 November 2009 (2009-11-05) columns 105-106; figures 8,16</td>
<td>1-4</td>
</tr>
<tr>
<td>A</td>
<td>US 2009/270912 A1 (SURI VISH A [US]) 29 October 2009 (2009-10-29) paragraph [0070]; figures 1,2</td>
<td>1-4</td>
</tr>
<tr>
<td>A</td>
<td>US 2008/300618 A1 (GERTNER MICHAEL ERIC [US]) 4 December 2008 (2008-12-04) paragraph [0296]; figures 4,a,b</td>
<td>1-4</td>
</tr>
<tr>
<td>A</td>
<td>US 2008/208216 A1 (CERIER JEFFREY C [US]) 28 August 2008 (2008-08-28) paragraphs [0118], [0127], [0128]; figures 4,7,14</td>
<td>1-4</td>
</tr>
</tbody>
</table>

Further documents are listed in the continuation of Box C. See patent family annex.

* Special categories of cited documents:
  * "A" document defining the general state of the art which is not considered to be of particular relevance
  * "E" earlier document but published on or after the international filing date
  * "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
  * "O" document referring to an oral disclosure, use, exhibition or other means
  * "P" document published prior to the international filing date but later than the priority date claimed

* "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

* "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

* "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

* "A" document member of the same patent family

**Date of the actual completion of the international search**

19 July 2011

**Date of mailing of the international search report**

25/07/2011

Name and mailing address of the ISA/Authorized officer

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Lee, Ronan

Form PCT/ISA/210 (second sheet) (April 2005)
INTERNATIONAL SEARCH REPORT

Box No. II  Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.: 5-22
   because they relate to subject matter not required to be searched by this Authority, namely:
   The subject-matter of claims 5-22 appears to constitute a surgical procedure on the human body, and therefore under Rule 39.1(iv) PCT (Method for treatment of the human or animal body by surgery), these claims have not been searched; the subject-matter being deemed non-patentable.

2. ☐ Claims Nos.: 5-22
   because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.: 5-22
   because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III  Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.: 5-22

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.
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<th>Publication date</th>
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