



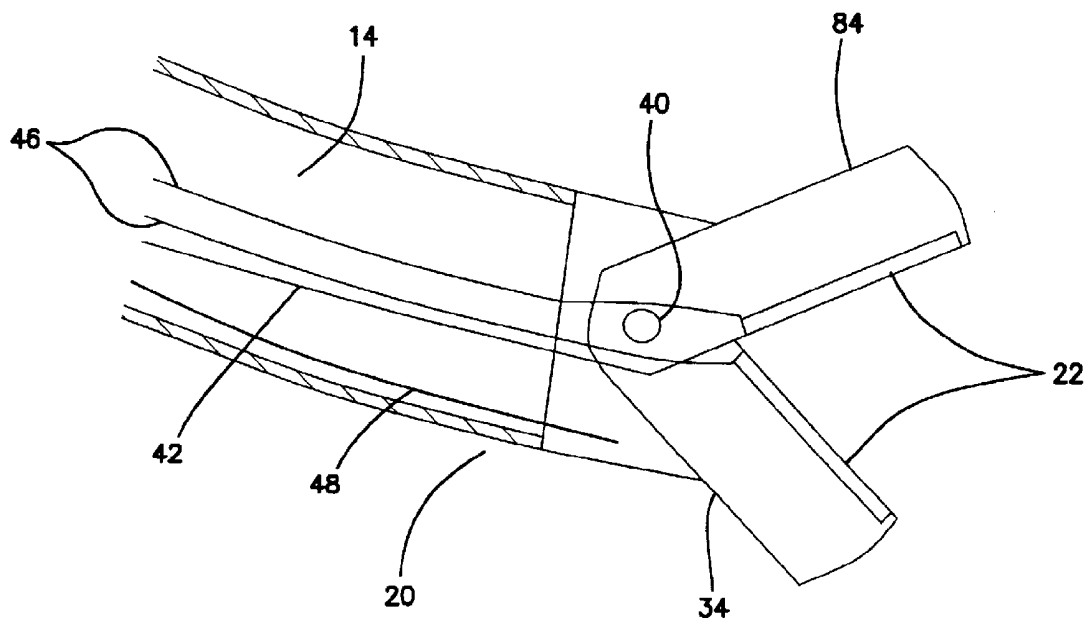
US 20140039478A1

(19) **United States**(12) **Patent Application Publication**
Hull et al.(10) **Pub. No.: US 2014/0039478 A1**(43) **Pub. Date: Feb. 6, 2014**(54) **SYSTEMS AND METHODS FOR
PERCUTANEOUS INTRAVASCULAR ACCESS
FOR ARTERIOVENOUS FISTULA**(52) **U.S. CL.**CPC **A61B 18/085** (2013.01)USPC **606/30; 606/170; 606/29**(71) Applicant: **Caymus Medical, Inc.**, San Juan
Capistrano, CA (US)(72) Inventors: **Jeffrey E. Hull**, Midlothian, VA (US);
Mark A. Ritchart, Dana Point, CA (US)(73) Assignee: **Caymus Medical, Inc.**, San Juan
Capistrano, CA (US)(21) Appl. No.: **13/956,221**(22) Filed: **Jul. 31, 2013****Related U.S. Application Data**(60) Provisional application No. 61/678,240, filed on Aug.
1, 2012.**Publication Classification**(51) **Int. Cl.****A61B 18/08**

(2006.01)

(57) **ABSTRACT**

A device for extending, elongating, or repairing a previously created arteriovenous fistula between a first blood vessel and an adjacent second blood vessel includes a main body having a primary lumen and an articulating jaw member disposed at the distal end of the main body. The jaw member is configured with two elements to allow rotation of one element about a pivot point to grasp tissue while being rotated. The jaw member is also configured to allow thermal energy delivery to one or both elements of the jaw member that allow tissue welding and cutting with DC, RF, Laser or Ultrasonic energy. A second lumen located within one element of the jaw member is configured to allow advancement over a guidewire into the second vessel while the other element of the jaw member remains within the first blood vessel at the position where the arteriovenous fistula, or aperture, exists between the first and second blood vessel.



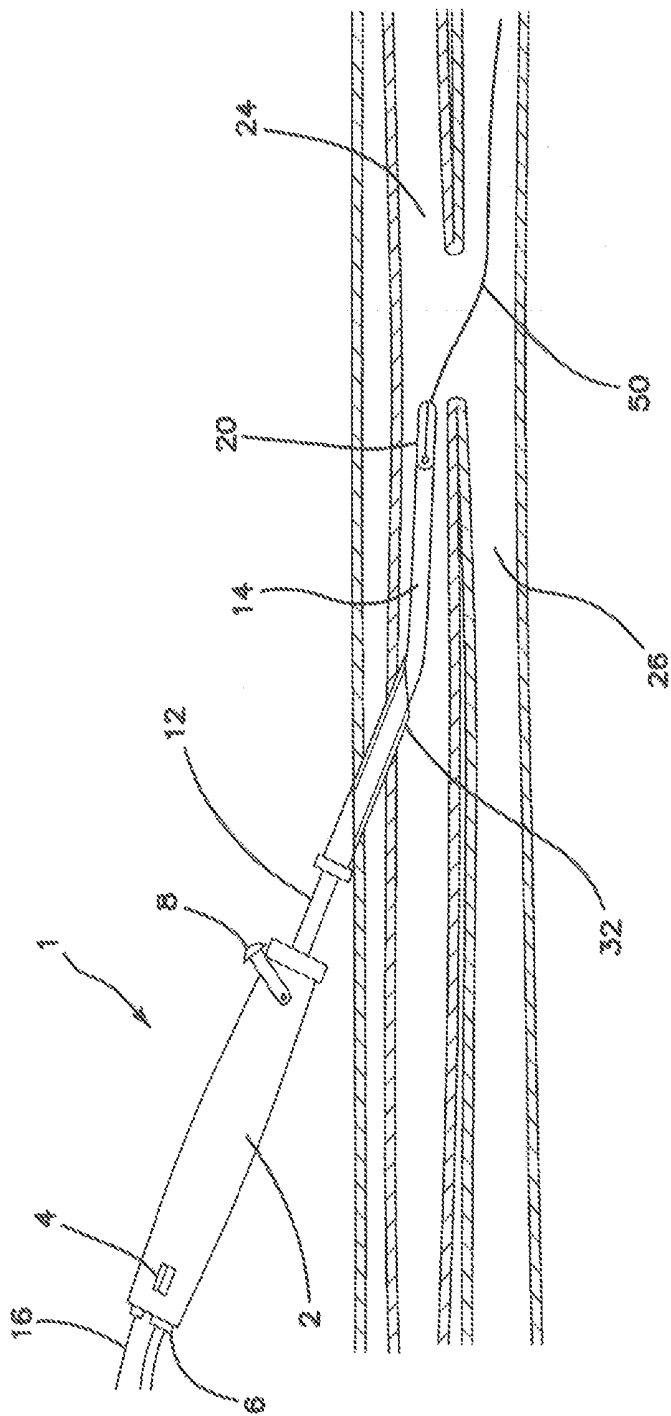


FIG. 1

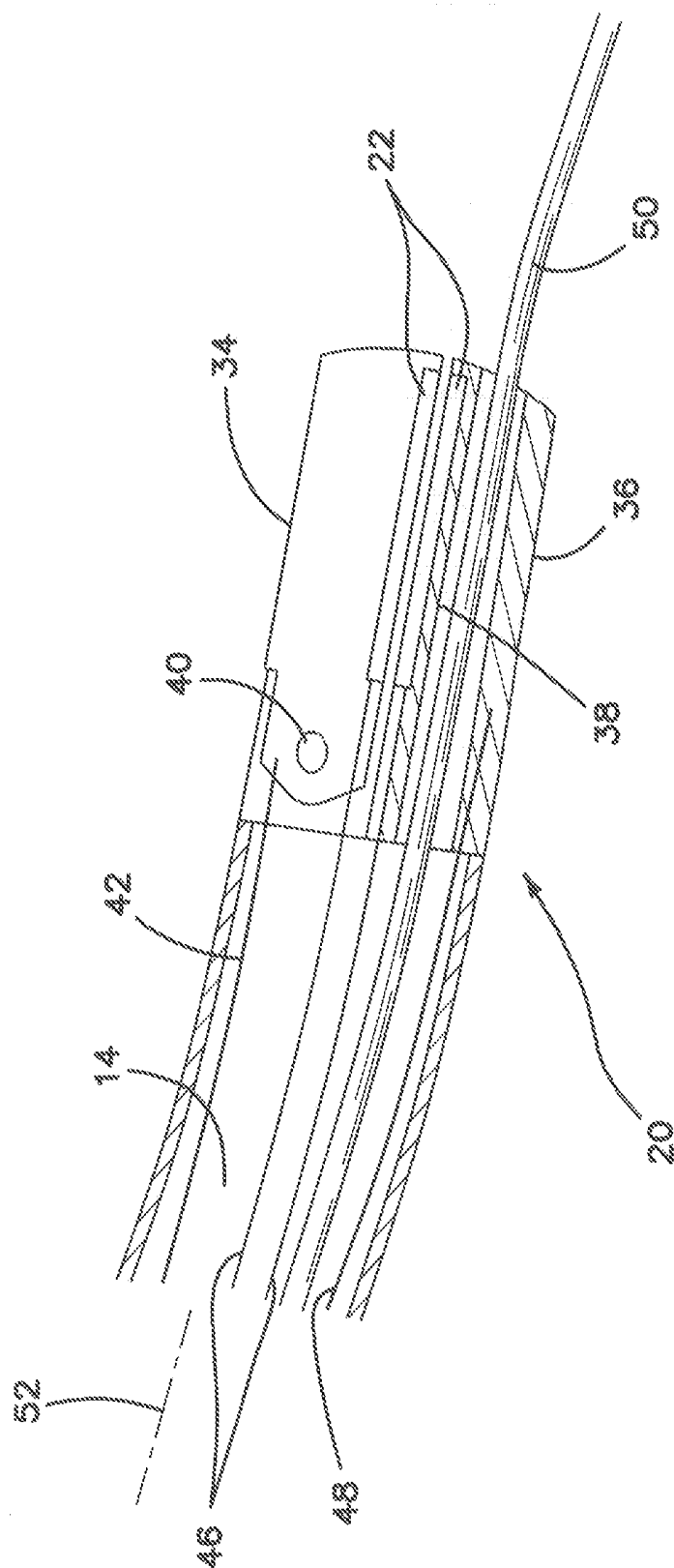
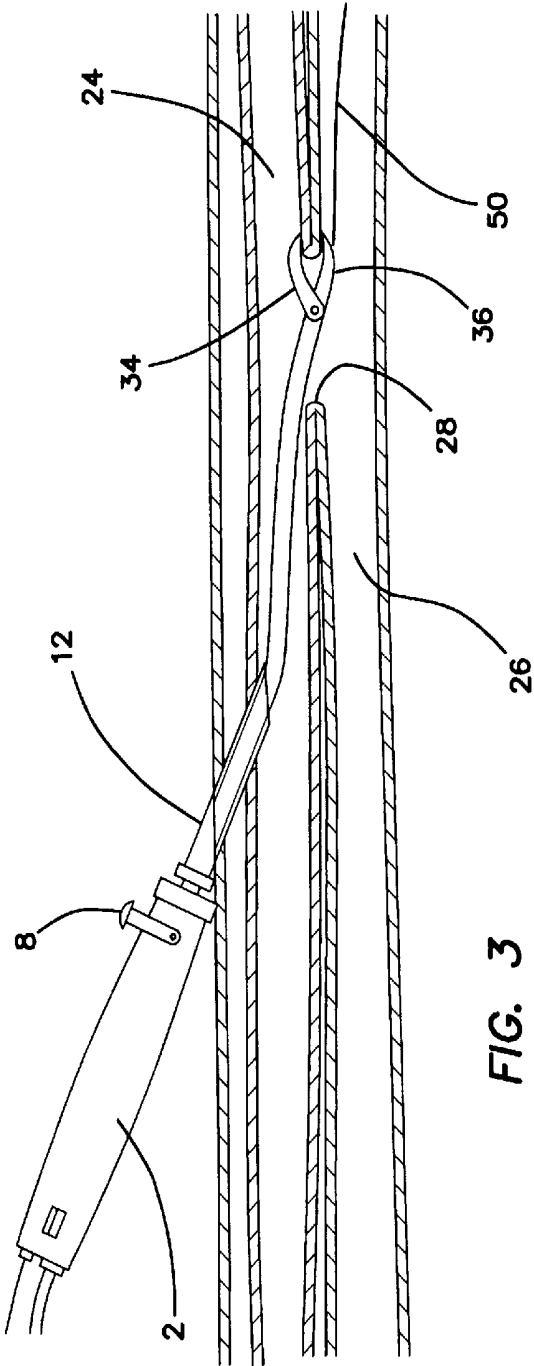


FIG. 2



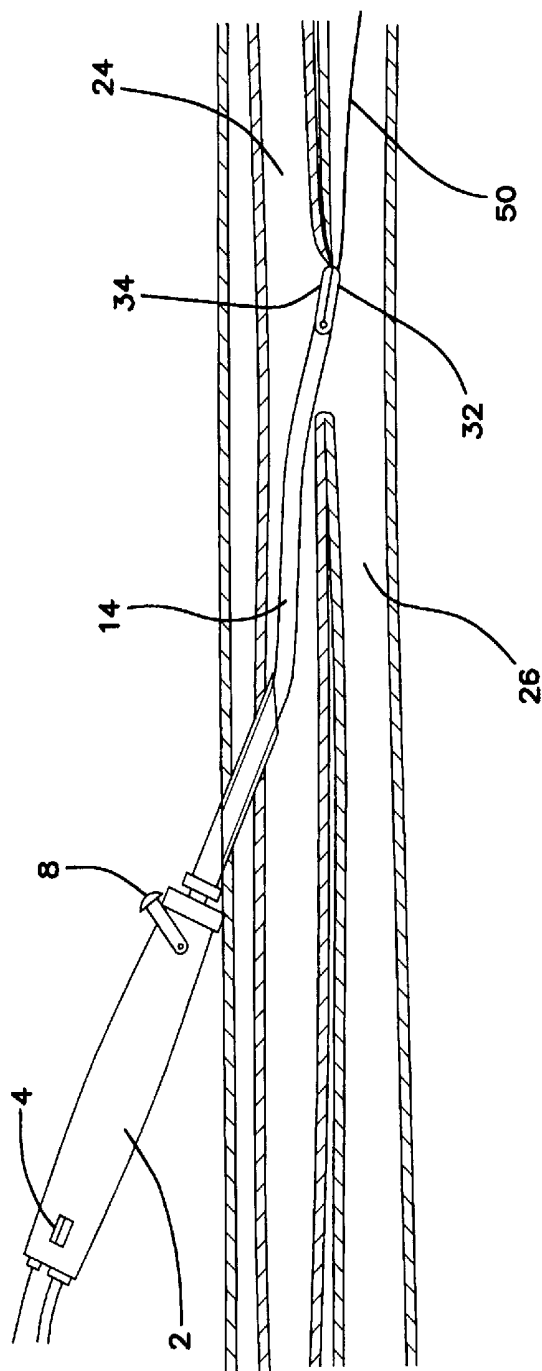


FIG. 4

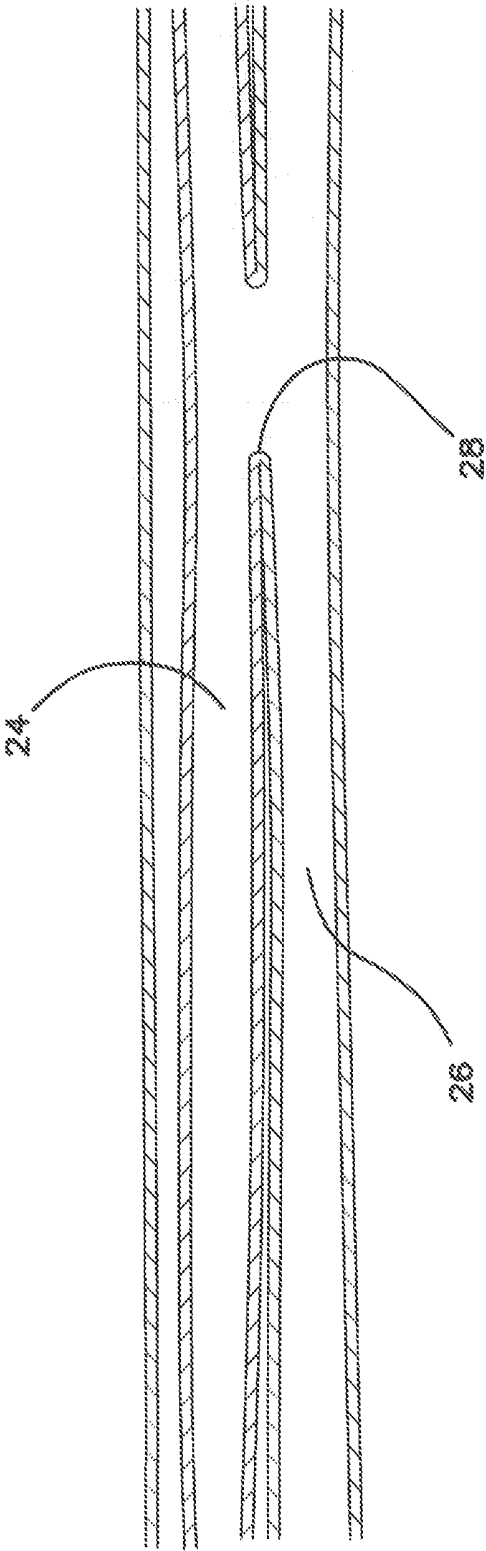


FIG. 5

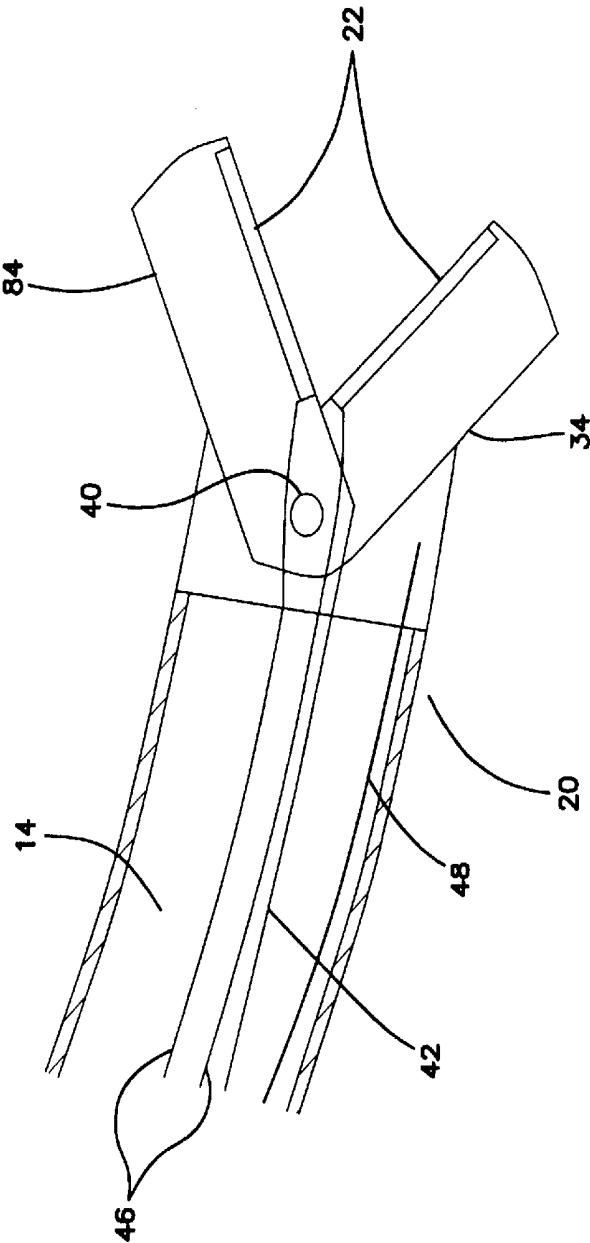


FIG. 6

SYSTEMS AND METHODS FOR PERCUTANEOUS INTRAVASCULAR ACCESS FOR ARTERIOVENOUS FISTULA

[0001] This application claims the benefit under 35 U.S.C. 119(e) of the filing date of Provisional U.S. Application Ser. No. 61/678,240, entitled Systems and Methods for Percutaneous Intravascular Access for Arteriovenous Fistula, filed on Aug. 1, 2012, which application is herein expressly incorporated herein by reference, in its entirety.

BACKGROUND OF THE INVENTION

[0002] In the body, various fluids are transported through conduits throughout the organism to perform various essential functions. Blood vessels, arteries, veins, and capillaries carry blood throughout the body, carrying nutrients and waste products to different organs and tissues for processing. Bile ducts carry bile from the liver to the duodenum. Ureters carry urine from the kidneys to the bladder. The intestines carry nutrients and waste products from the mouth to the anus.

[0003] In medical practice, there is often a need to connect conduits to one another or to a replacement conduit to treat disease or dysfunction of the existing conduits. The connection created between conduits is called an anastomosis.

[0004] In blood vessels, anastomoses are made between veins and arteries, arteries and arteries, or veins and veins. The purpose of these connections is to create either a high flow connection, or fistula, between an artery and a vein, or to carry blood around an obstruction in a replacement conduit, or bypass. The conduit for a bypass is a vein, artery, or prosthetic graft.

[0005] An anastomosis is created during surgery by bringing two vessels or a conduit into direct contact, and to create a leak-free blood flow path between them. The vessels are joined together with suture or clips, in an open surgical procedure. The anastomosis can be end-to-end, end-to-side, or side-to-side. In blood vessels, the anastomosis is elliptical in shape and is most commonly sewn by hand with a continuous suture. Other methods for anastomosis creation have been used including carbon dioxide laser, and a number of methods using various connecting prosthesis, clips, and stents. Such procedures are time consuming, clinician dependent (open to surgical error), and often result in strictures, or clotting of the vein or artery.

[0006] An arterio-venous fistula (AVF) is created by connecting an artery to a vein. This type of connection is used for hemodialysis, to increase exercise tolerance, to keep an artery or vein open, or to provide reliable access for chemotherapy.

[0007] An alternative is to connect a prosthetic graft from an artery to a vein for the same purpose of creating a high flow connection between artery and vein. This is called an arterio-venous graft, and requires two anastomoses. One is between artery and graft, and the second is between graft and vein.

[0008] A bypass is similar to an arteriovenous graft. To bypass an obstruction, two anastomoses and a conduit are required. A proximal anastomosis is created from a blood vessel to a conduit. The conduit extends around the obstruction, and a second distal anastomosis is created between the conduit and vessel beyond the obstruction.

[0009] As noted above, in current medical practice, it is desirable to connect arteries to veins to create a fistula for the purpose of hemodialysis. The process of hemodialysis requires the removal of blood from the body at a rapid rate, passing the blood through a dialysis machine, and returning

the blood to the body. The access to the blood circulation is achieved with catheters placed in large veins, prosthetic grafts attached to an artery and a vein, or a fistula where an artery is attached directly to the vein.

[0010] Fistulas for hemodialysis are required by patients with kidney failure. The fistula provides a high flow of blood that can be withdrawn from the body into a dialysis machine to remove waste products and then returned to the body. The blood is withdrawn through a large access needle near the artery and returned to the fistula through a second large return needle. These fistulas are typically created in the forearm, upper arm, less frequently in the thigh, and in rare cases, elsewhere in the body. It is important that the fistula be able to achieve a flow rate of 500 ml per minute or greater. Dialysis fistulas have to be close to the skin (<6 mm), and large enough (>4 mm) to access with a large needle. The fistula needs to be long enough (>6 cm) to allow adequate separation of the access and return needle to prevent recirculation of dialysed and non-dialysed blood between the needles inserted in the fistula.

[0011] Fistulas are created in anesthetized patients by carefully dissecting an artery and vein from their surrounding tissue, and sewing the vessels together with fine suture or clips. The connection thus created is an anastomosis. It is highly desirable to be able to make the anastomosis quickly, reliably, with less dissection, and with less pain. It is important that the anastomosis is the correct size, is smooth, and that the artery and vein are not twisted.

SUMMARY OF THE INVENTION

[0012] The present invention comprises a device to allow extension, elongation or repair of a previously created arteriovenous fistula between a first blood vessel and an adjacent second blood vessel which comprises a main body having a primary lumen and an articulating jaw member disposed at the distal end of the main body and configured with two elements to allow rotation of one element about a pivot point to grasp tissue while being rotated. The jaw member is also configured to allow thermal energy delivery to one or both elements of the jaw member that allow tissue welding and cutting with DC, RF, Laser or Ultrasonic energy. A second lumen located within one element of the jaw member is configured to allow advancement over a guidewire into the second vessel while the other element of the jaw member remains within the first blood vessel at the position where the arteriovenous fistula, or aperture, exists between the first and second blood vessel.

[0013] In one embodiment, the articulating jaw member is configured to allow rotation of both elements about a pivot point to grasp tissue and apply thermal energy.

[0014] In another aspect of the invention, a method of elongation of the passage between adjacent first and second blood vessels comprises a step of positioning a main body of the device within the first vessel and advancing one element of the jaw member through the aperture between the vessels, and into the second vessel, so that the jaw element is disposed within the second vessel. The articulating element is actuated to rotate about the pivot point of the jaw member for grasping and compressing tissue adjacent to the aperture between the first blood vessel and the adjacent second blood vessel.

[0015] The method further comprises the step of applying thermal energy to one or both elements of the jaw member to cut an extension to the aperture and weld the adjacent first and second blood vessel using DC, RF, Laser or ultrasonic energy.

[0016] More particularly, there is provided in one aspect of the invention a device for elongating, extending, or repairing a tissue aperture, which comprises a handle, a body connected to and extending distally from the handle, comprised of a flexible material and having a primary lumen, a rigid jaw member connected to and extending distally from the flexible body, and a tissue cutting element disposed on the jaw member. Preferably, the flexible material comprising the body is a polymer having a Shore A hardness of 70-90. The rigid jaw member is preferably fabricated of a rigid material comprising either a metal or a rigid polymer having a Shore A hardness greater than 90, though, of course, other equivalent materials may be utilized alternatively, in both instances.

[0017] The jaw member comprises two elements, each having distal ends, wherein one of the elements is pivotable relative to the other element to create a spacing of varying sizes between the two elements at their respective distal ends. In one of the disclosed embodiments, one of the elements is a stationary element and the other element is an articulating element, the articulating element being pivotable about a pivot point disposed on a proximal end thereof. In another disclosed alternative embodiment, both of the elements are articulating elements.

[0018] In the disclosed embodiments, the tissue cutting element comprises an electrode for energizing the tissue to be cut. Two electrodes are illustrated in the drawings. A power supply and an activation switch are disposed on the handle for activating the electrode(s). The supplied energy may be thermal energy, RF energy, laser energy, ultrasonic energy, or the like.

[0019] A lever is provided on the handle for moving at least one of the jaw member elements relative to the other one to increase or decrease the spacing between the distal ends of the elements, thereby opening or closing the jaws of the jaw member. As disclosed, a wire connects the lever to the jaw member for opening or closing the jaw member. A ratcheting mechanism is provided on the lever for applying variable incremental pressure to the jaw member.

[0020] A conductor connects the power supply and activation switch to the electrode. The electrode may be comprised of aluminum or other suitable conductive material. A secondary lumen is disposed in one of the jaw elements.

[0021] The jaw member has a closed orientation wherein both jaw elements are substantially aligned with a longitudinal axis of the primary lumen, and open orientations wherein at least one of the jaw elements is disposed at a substantial angle of varying sizes from the longitudinal axis of the primary lumen.

[0022] In another aspect of the invention, there is disclosed a method of extending, elongating, or repairing a fistula between adjacent first and second vessels. The method comprises a step of inserting a main body of a device into the first vessel so that a distal end thereof lies within a blood flow passage of the first vessel. A jaw member disposed at a distal end of the main body is opened, and the open jaw member is disposed so that a portion of tissue adjacent to the fistula is disposed between elements thereof. The elements of the jaw member are closed to clamp the portion of tissue therebetween. An electrode on the jaw member is energized to cut and weld the tissue to extend the fistula. The device is then withdrawn from the site.

[0023] The inserting step may further comprise a step of aligning a lumen in the main body over a guidewire, and sliding the device over the guidewire to the desired location.

The energizing step may comprise applying thermal energy of about 10-50 watts to the clamped tissue. During the energizing step, the tissue temperature is increased to about 100-400 degrees C. to cut and weld an extended aperture of about 1-5 mm from the primary blood vessel to the secondary blood vessel.

[0024] Imaging guidance is preferably used to insert the device into a procedural site and monitor the cutting and welding step.

[0025] The invention, together with additional features and advantages thereof, may best be understood by reference to the following description taken in conjunction with the accompanying illustrative drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] FIG. 1 is a view of one embodiment of the device of the present invention, wherein the device has been percutaneously or surgically positioned at a desired location in a blood vessel near the arteriovenous fistula;

[0027] FIG. 2 is a view illustrating the distal jaw member in isolation;

[0028] FIG. 3 is a view similar to FIG. 1, wherein one element of the jaw member illustrated in FIG. 2 has been advanced over the guidewire into the second blood vessel while the second element has been articulated to the open position within the first blood vessel;

[0029] FIG. 4 is a view similar to FIG. 3, wherein the second element of the jaw member is articulated from the open to closed position to grasp tissue and cut and weld an extension to the arteriovenous fistula aperture;

[0030] FIG. 5 illustrates the extended communicating aperture created by the device and methods of the present invention after the inventive device of FIGS. 1-4 has been withdrawn from the procedural site; and

[0031] FIG. 6 illustrates an alternate embodiment of the distal jaw member.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0032] Referring now more particularly to the drawings, one embodiment of a device constructed in accordance with the principles of the present invention is shown. As illustrated in FIGS. 1 and 2, a device 1 comprises a handle 2 with an activation switch 4, an electrical connector 6, and a jaw lever 8. A 4-7 F (French) flexible (70-90 Shore A) polymer main body 12, having a primary lumen 14 and rigid distal jaw member 20, is provided. The main body is attached to the handle 2 at the proximal end and the jaw member 20 at the distal end. The electrical connector 6 allows connection to temperature display and power supply devices for temperature feedback and DC thermal energy delivery, though other modalities such as Radio Frequency (RF) or laser can be employed. Lever 8 is constructed with a ratcheting mechanism to allow variable incremental pressure (approximately 100 mN/mm²-500 mN/mm²) to electrodes 22 on jaw member 20 (FIG. 2) as desired by the practitioner. To begin the inventive method of intravascular arteriovenous fistula extension or elongation, the practitioner selects an appropriate procedural site having each of a first blood vessel 24 and a second blood vessel 26 in close proximity to one another and having a previously created arteriovenous fistula 28 disposed therebetween (FIG. 3). In currently preferred approaches, the first blood vessel 24 comprises a vein, and the second blood vessel

26 comprises an artery, but the invention is not limited to this arrangement. Under real time imaging guidance such as ultrasound or fluoroscopy, the main body 12 is inserted into the first vessel 24 so that a distal end 32 thereof lies within the blood flow passage of the first vessel. Preferably, this insertion step is performed using percutaneous technique, but open surgery and direct visualization may also be employed.

[0033] With reference now particularly to FIG. 2, the jaw member 20 comprises an articulating element 34 and a stationary element 36, including a secondary lumen 38. The articulating element 34 is movable about a pivot point 40, and is attached to a tendon wire 42, as illustrated. It should be noted that the invention is not limited to a single articulating element 34, pivot point 40, and tendon wire 42, though only one of each is shown in this particular embodiment. Articulating element 34 and stationary element 36 are preferably constructed of a rigid material such as metal or rigid (>90 Shore A) polymer, with 1-5 mm elongate electrodes 44 attached to the opposing surfaces. Electrodes 44, preferably constructed of an electrically and thermally conductive material, such as aluminum, are attached to the electrical connector 6 on handle 2 via conductors 46, which are preferably constructed of an electrically and thermally conductive material such as copper. A temperature sensor 48, such as a thermocouple or thermistor, is attached to the stationary element 36 on one end and the electrical connector 6 on the opposite end. Tendon wire 42, preferably constructed of 18-24 Ga (Gauge) wire, is attached to the articulating element 34 on one end and to the jaw lever 8 on the other end. Stationary element 36 includes the secondary lumen 38, as noted above. These elements, including the primary lumen 14 of the main body shaft 12, provide an externally communicating passage to allow advancement of the device 1 over a guidewire 50.

[0034] Referring now particularly to FIGS. 2 and 3, the orientation of the articulating element 34 of the jaw member 20 can be rotationally adjustable between a range of rotation about the pivot point 40. A first, or closed, position is illustrated in FIG. 2 where the articulating element 34 is substantially aligned with the longitudinal axis 52 of the primary lumen 14 and the secondary lumen 38. As will be described more fully below, the closed orientation is utilized during the initial device insertion steps, as well as the device withdrawal steps, while variable rotated orientations are the operative for creating the extension or elongation of the arteriovenous fistula 28. This variable orientation may be desirable by the practitioner to incrementally adjust the opening of the jaw member 20 to achieve an optimal size extension of the aperture 28 between primary vessel 24 and secondary vessel 26.

[0035] Referring again to FIG. 3, once the main body 12 is inserted into the first vessel 24 and advanced to the desired site determined by the practitioner using ultrasound or fluoroscopic imaging, as previously described, it may be desired to adjust the rotation of the articulating element 34 to increase the angle of the opening of jaw member 20, by rotating the lever 8 of main body handle 2. Since the jaw member 20 is configured to have echogenic and radiopaque properties to allow the practitioner to visualize the orientation under real time imaging guidance, this will allow the practitioner to more effectively adjust the opening of jaw member 20 through direct visualization as it is advanced into the desired position in the arteriovenous fistula aperture 28 between the primary blood vessel 24 and the secondary blood vessel 26 to achieve the desired length of extension of the aperture. This step may be repeated as desired by the practitioner rotating

lever 8 of main body handle 2 to adjust the open position of articulating element 34, until the desired arteriovenous fistula aperture extension has been achieved.

[0036] With reference now to FIG. 4, once the practitioner has oriented the stationary element 36 of the jaw member 20 as desired through the arteriovenous fistula aperture 28 and within secondary blood vessel 26, the lever 8 of the handle 2 is rotated to the fully closed position to compress the blood vessels within the jaw member 20. Activation switch 4 is activated to deliver thermal energy of between about 10-50 W to the jaws 20, sufficient to raise the tissue temperature to about 100-400 degrees C. to cut and weld an extended aperture 28 of 1-5mm from the primary blood vessel 24 to the secondary blood vessel 26. This may be done under direct imaging guidance to verify energy delivery in the area desired by the practitioner, due to the creation of micro bubbles visible under transcutaneous ultrasound in the area of direct thermal energy. The practitioner may also verify acceptable extension of the aperture through direct visualization of the larger opening in the aperture under imaging guidance.

[0037] With reference now to FIG. 5, once the extension of arteriovenous fistula aperture 28 from primary blood vessel 24 to secondary blood vessel 26 has been achieved as previously described, the practitioner withdraws device 1 completely from the body, thus leaving an extended aperture 28 in the anastomosis between the primary vessel 24 and the secondary vessel 26.

[0038] FIG. 6 illustrates a detail view of an alternate embodiment of jaw member 20 that is configured with two articulating elements 34, rather than a stationary element and an articulating element, as in the embodiment of FIGS. 1-5. As is evident to those skilled in the art, an advantage of this embodiment is the ability to open the jaws 34 to a substantially wider extent than is the case with the first embodiment. In all other respects, the embodiment of FIG. 6 is utilized in the same manner as is the embodiment of FIGS. 1-5.

What is claimed is:

1. A device for elongating, extending, or repairing a tissue aperture, comprising:

a handle;

a body connected to and extending distally from the handle, comprised of a flexible material and having a primary lumen;

a rigid jaw member connected to and extending distally from the flexible body; and

a tissue cutting element disposed on the jaw member.

2. The device as recited in claim 1, wherein the flexible material comprising the body is a polymer.

3. The device as recited in claim 2, wherein the polymer comprising the body has a Shore A hardness of 70-90.

4. The device as recited in claim 1, wherein the rigid jaw member is fabricated of a rigid material comprising either a metal or a rigid polymer having a Shore A hardness greater than 90.

5. The device as recited in claim 1, wherein the jaw member comprises two elements, each having distal ends, wherein one of the elements is pivotable relative to the other element to create a spacing of varying sizes between the two elements at their respective distal ends.

6. The device as recited in claim 5, wherein one of the elements is a stationary element and the other element is an articulating element, the articulating element being pivotable about a pivot point disposed on a proximal end thereof.

7. The device as recited in claim 5, wherein both of the elements are articulating elements.

8. The device as recited in claim 1, wherein the tissue cutting element comprises an electrode for energizing the tissue to be cut.

9. The device as recited in claim 8, and further comprising a power supply and an activation switch disposed on the handle for activating said electrode.

10. The device as recited in claim 5, and further comprising a lever on the handle for moving at least one of the jaw member elements relative to the other one to increase or decrease the spacing between the distal ends of the elements, thereby opening or closing the jaws of the jaw member.

11. The device as recited in claim 10, and further comprising a wire connecting the lever to the jaw member for opening or closing the jaw member.

12. The device as recited in claim 11, and further comprising a ratcheting mechanism on said lever for applying variable incremental pressure to the jaw member.

13. The device as recited in claim 9, and further comprising a conductor for electrically connecting the power supply and activation switch to the electrode.

14. The device as recited in claim 5, wherein the jaw member has a closed orientation wherein both jaw elements are substantially aligned with a longitudinal axis of the primary lumen, and open orientations wherein at least one of the jaw elements is disposed at a substantial angle of varying sizes from the longitudinal axis of the primary lumen.

15. The device as recited in claim 5, and further comprising a secondary lumen disposed in one of the jaw elements.

16. A method of extending, elongating, or repairing a fistula between adjacent first and second vessels, comprising:
inserting a main body of a device into the first vessel so that a distal end thereof lies within a blood flow passage of the first vessel;
opening a jaw member disposed at a distal end of the main body;
disposing the open jaw member so that a portion of tissue adjacent to the fistula is disposed between elements thereof;
closing the elements of the jaw member to clamp the portion of tissue therebetween;
energizing an electrode on said jaw member to cut and weld the tissue to extend the fistula; and
withdrawing the device.

17. The method as recited in claim 16, wherein the inserting step comprises aligning a lumen in the device over a guidewire, and sliding the device over said guidewire to the desired location.

18. The method as recited in claim 16, wherein the energizing step comprises applying thermal energy of about 10-50 watts to the clamped tissue.

19. The method as recited in claim 18, wherein the tissue temperature is increased to about 100-400 degrees C. to cut and weld an extended aperture of about 1-5 mm from the primary blood vessel to the secondary blood vessel.

20. The method as recited in claim 16, wherein imaging guidance is used to insert the device into a procedural site and monitor the cutting and welding step.

* * * * *

专利名称(译)	用于动静脉瘘的经皮血管内通路的系统和方法		
公开(公告)号	US20140039478A1	公开(公告)日	2014-02-06
申请号	US13/956221	申请日	2013-07-31
[标]申请(专利权)人(译)	CAYMUS医疗		
申请(专利权)人(译)	CAYMUS MEDICAL , INC.		
当前申请(专利权)人(译)	CAYMUS MEDICAL , INC.		
[标]发明人	HULL JEFFREY E RITCHART MARK A		
发明人	HULL, JEFFREY E. RITCHART, MARK A.		
IPC分类号	A61B18/08		
CPC分类号	A61B18/085 A61B18/1445 A61B18/1492 A61B18/24 A61B2018/00404 A61B2018/00601 A61B2018/146 A61B18/148 A61B2018/00619 A61B2018/00982		
优先权	61/678240 2012-08-01 US		
外部链接	Espacenet USPTO		

摘要(译)

一种用于在第一血管和相邻的第二血管之间延伸，延长或修复先前产生的动静脉瘘的装置，包括具有主腔的主体和设置在主体的远端处的铰接钳口构件。钳口构件配置有两个元件，以允许一个元件绕枢轴点旋转，以在旋转时抓住组织。钳口构件还构造成允许热能传递到钳口构件的一个或两个元件，其允许利用DC，RF，激光或超声能量进行组织焊接和切割。位于钳口构件的一个元件内的第二腔被配置成允许在导丝上前进到第二血管中，而钳口构件的另一个元件在动静脉瘘或孔之间存在的位置处保持在第一血管内。第一和第二血管。

