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(54) **ULTRASONIC DEVICE FOR TISSUE COAGULATION**

ULTRASCHALLGERÄT FÜR DIE GEWEBEKOAGULATION

DISPOSITIF ULTRASONORE POUR LA COAGULATION DE TISSUS

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Description

I. FIELD OF THE INVENTION

[0001] The present invention relates generally to surgical instruments, and more particularly, to an ultrasonic surgical device for use in coagulation of tissues of a patient.

II. BACKGROUND OF THE INVENTION

[0002] Hemostasis of bleeding or potentially bleeding tissues is of premium importance in open or laparoscopic surgery. Several methods are currently used to coagulate tissues to achieve the desired hemostasis. Sutures are safe, reliable, and commonly used on larger vessels or structures, but are difficult to use on small vessels or structures or in situations involving diffuse bleeding. Monopolar electrosurgery works by electrically heating and burning the tissue to achieve coagulation. It is effective on the smaller vessels and structures but may cause undesirable thermal trauma to adjacent tissues due to stray electrical conduction in a wet surgical environment. Bipolar electrosurgery also works by electrically heating the tissues and provides improved control of stray electrical conduction relative to monopolar electrosurgery. Bipolar instruments may suffer from tissue adherence to the electrodes, causing the coagulated tissue to be reopened and bleed again as the probes are removed. Ultrasonic instruments use frictional heat generated by rapid vibration rubbing of the tissue to create hemostasis.

[0003] Ultrasonic surgical devices for cutting and coagulation of tissue are known. All of these devices utilize longitudinal vibrations in an ultrasonic member to accomplish a desired surgical effect such as cutting with simultaneous coagulation. Clamping mechanisms have been disclosed which claim to improve cutting and coagulation performance by enhancing the tissue contact between the vibrating member and the clamp surface. U.S. Patents Number 3,862,630 and 3636,943, both to Balamuth, disclose two types of ultrasonic surgical devices: a first device for simultaneously cutting and coagulating tissue, and a second device for joining together layers of tissue. The device for joining together layers of tissue has a vibrating ultrasonic member and a clamp mechanism, the working surface of the clamp mechanism being perpendicular to the direction of the longitudinal vibrations of the tool, so that tissues are compressed between the working surface of the clamp and the end surface of the vibrating ultrasonic member. This "end-on" design blocks tissue access to the clamped region between the ultrasonic member and clamp mechanism from the axial direction, requiring that tissue be accessed laterally, and thereby severely limits application of the device for surgical application because tissue cannot be accessed in a scissor-like fashion.

[0004] U.S. Patent Number 5,322,055 to Davidson discloses an ultrasonic surgical device for simultaneously cutting and coagulating tissue having a vibrating ultrasonic member and a clamp mechanism, the ultrasonic member having a surgical blade with an elongated edge parallel to the axis of longitudinal vibration at the distal end of the vibrating ultrasonic member. This patent alleges enhanced cutting performance due to the surgical blade with the elongated edge and also improves performance by providing tissue access to the ultrasonic member and the clamp mechanism from the axial direction. The clamp mechanism is designed to close completely (i.e., touch) against the vibrating ultrasonic member to achieve the described cutting and coagulation effects. The improved cutting action in this design is allegedly caused by the vibration of the surgical blade with an elongated edge and the complete closure of the blade against the clamp mechanism.

[0005] US 2002/002380 Al discloses an ultrasonic surgical instrument that includes a clamping mechanism positioned opposite an ultrasonic blade for clamping tissue against the ultrasonic blade for coagulation and cutting of tissue. The instrument also includes a first and a second support surface positioned laterally on opposite sides of the ultrasonic blade. The first and second support surfaces are isolated from the blade and face at least a portion of the clamping surface. When the clamping mechanism clamps tissue against the ultrasonic blade, the first and the second tissue support surfaces clamp tissue against the clamping surface providing a wide compression zone.

[0006] US 6 004 335 A discloses an ultrasonic hemostatic and cutting instrument.

[0007] U.S. Patent Number 6,193,709 to Manna discloses an ultrasonic surgical device for simultaneously cutting and coagulating tissue having a vibrating ultrasonic member and a clamp mechanism, the ultrasonic member having a blade at the distal end of the vibrating ultrasonic member, the blade forming an acute angle with respect to the axis of longitudinal vibration. The patent alleges that the angled design enhances tissue contact between the clamp mechanism and the blade during operation and thereby improves performance. The clamp mechanism is designed to close completely (touch) against the vibrating ultrasonic member to achieve the described cutting and coagulation effects. Improved cutting action in this design is due to the vibration of the blade with the acute angle with respect to the axis of longitudinal vibration and the complete closure of the blade against the clamp mechanism.

[0008] U.S. Patent Number 6,193,709 to Miyawaki discloses an ultrasonic surgical device for treatments such as incision and coagulation having a vibrating ultrasonic member and a clamp having a follow-up mechanism so that the clamp can follow a deflective displacement of the distal end portion of the vibrating ultrasonic member. This patent asserts that the follow-up mechanism eliminates potential gaps between the vibrating ultrasonic member and the clamp mechanism as the clamp mechanism is closed onto the vibrating ultrasonic member,

thereby improving grasping and treatment performance. The clamp mechanism is designed to close completely (i.e., touch) against the vibrating ultrasonic member to achieve the described treatments such as incision and coagulation.

[0009] None of the patents discloses a device for limiting the closure of the clamp mechanism relative to the vibrating ultrasonic member for the purpose of creating a predetermined clearance there between so that an improved coagulation effect is achieved. Holding the clamp against the ultrasonic member in the prior art devices will inevitably result in the cutting of the tissue. The surgeon has no way of knowing how far the process has occurred from the intended coagulation to undesirable cutting. Indeed, these prior art devices are designed to achieve simultaneous cutting and coagulation as the clamp closes completely against the vibrating ultrasonic member, regardless of the shape of the jaw surface of the clamp mechanism and the shape of the vibrating ultrasonic member. It is often desirable in the course of surgery to coagulate tissue without cutting. It is impossible to reliably separate these two processes in the prior art devices. Thus, there is a need to improve the coagulation performance of ultrasonic surgical devices and further to provide independent cutting and coagulation capabilities.

[0010] Deficiencies in the performance of prior art coagulation devices have been noted in the literature. (See, for example, Spivak H. et al., "The Use of Bipolar Cautery, Laparsonic Coagulating Shears, and Vascular Clips for Hemostatis of Small and Medium-sized Vessels," Surgical Endoscopy, 12(2):183-85 (Feb. 1998) and Landman, J. (Washington University), "Comparison of the Ligasure System, Bipolar Electrosurgery, Harmonic Scalpel, Titanium Clips, Endo-GIA, and Sutures for Laparoscopic Vascular Control in a Porcine Model," presented at the Society of American Gastrointestinal Endoscopic Surgeons, St. Louis, Missouri, (April 10-21, 2001). Both of these studies included the ultrasonic laparosonic coagulating shears ("LCS") manufactured and distributed by Johnson & Johnson using technology believed to be covered by the Davidson '055 Patent referenced above. Spivak et al. tested the capability of the LCS device and others to coagulate small and medium sized blood vessels in pigs by increasing the associated blood pressure to the point of failure or a maximum load of 300 mm. Hg. While the authors personally concluded that the devices "can be considered safe," the devices were not uniformly successful. The LCS device was successful in all of the "small vessel" tests but had two complete failures in the twelve tests of medium-sized vessels and two additional instances where the medium-sized vessel commenced bleeding before the defined pressure limit was reached. This is an unacceptable failure rate of 33%. As noted by the authors, the LCS needs to be properly sized and the surgeon properly trained in order to use the LCS successfully on medium-sized vessels. In addition, the authors recommended that "the surgeon have a good alternative method in case initial hemostasis fails Similarly, Landman compared various modalities for sealing vessels. On arteries, the LCS succeeded 5/6 times for an 83% success rate; on veins the LCS succeeded 3/6 times for a 50% success rate. Thus, there is clearly a need for significant improvement in a surgical coagulation device.

[0011] This object is achieved with the features of the claims.

[0012] A means to substantially improve the coagulation performance of ultrasonic surgical instruments has now been discovered. First, the coagulation performances can be improved by separating the coagulation and cutting functions of the instrument so that they are done sequentially rather than simultaneously. Indeed, it has proven helpful to perform the coagulation prior to the cutting rather than simultaneously or in the opposite order. A sequential approach allows time for the tissue to be coagulated and cooled so that it sets before any cutting action occurs. Indeed, tissue bleeding may be totally avoided in this manner. The present invention accomplishes the sequential coagulating and cutting steps with a single grasp of the instrument, meaning that the tissue grasp does not have to be released to alter the instrument for cutting purposes once coagulation is achieved. Second, the coagulation performance is substantially improved by providing a predefined clearance between a jaw surface and a vibrating ultrasonic applicator so that a tissue flow will occur in a carefully controlled manner. The "tissue flow" (i.e., the propensity of the tissue to move plastically upon sufficient heating) in the predefined clearance creates a zone of coagulated tissue that is much less likely to re-bleed than tissue that is simultaneously cut and coagulated with previously disclosed methods. It has now been discovered that if the predefined clearance is carefully controlled to be between about 0.075 to about 1.9 millimeters, and preferably between about 0.075 and about 0.75 millimeters, then the most effective coagulation performance is obtained. It has been found that if the predefined clearance is less than about 0.075 mm, simultaneous cutting action may occur. If the predefined clearance is greater than about 1.9 mm, it has been found that insufficient tissue flow is achieved and complete coagulation may not occur.

III. SUMMARY OF THE INVENTION:

[0013] The present invention provides a novel, improved ultrasonic surgical device for coagulating tissue. The device of the present invention has a surgical handle with an ultrasonic transducer mounted therein for generating ultrasonic vibrations. An ultrasonic applicator is attached to the ultrasonic transducer for transmitting longitudinal ultrasonic vibrations and extends distally from the surgical handle. The ultrasonic applicator is generally and substantially round in cross-section at the distal end and has a diameter between approximately 2 millimeters and 6 millimeters. A clamp with a jaw surface is supported on an elongated support member that is releasably attached to the surgical handle that generally surrounds

the ultrasonic applicator along its length. The clamp and jaw surface are designed so that the clamp cannot be completely closed against the vibrating ultrasonic applicator, but is stopped at a predefined clearance, i.e., distance between the jaw surface and the vibrating ultrasonic applicator. This predefined clearance provides a zone for controlled tissue flow as the vibrating ultrasonic member heats the tissue. The shape and thickness of the predefined clearance determine the quality and final shape of the coagulated tissue. The predefined clearance may be varied between between about 0.075 to about 1.9 mm, and preferably between about 0.075 and about 0.75 mm, depending on the type and structure of the targeted tissue to be coagulated. The surgical device can include means for adjusting the clearance within this range. Thus, the vibrating ultrasonic applicator is not a vibrating "blade" and is not used for the cutting of tissues, but only for improved coagulation. The zone of controlled tissue flow also contributes to improved coagulation by creating an improved coagulation effect and by avoiding simultaneous cutting during coagulation. The thickness and shape of the tissue flow is carefully controlled.

[0014] If a cutting capability is desired with the surgical device, a separate non-ultrasonic cutting element may be provided that can be advanced and retracted to accomplish the cutting function as a separate step. The cutting element may be advanced after the coagulation has been completed, and the jaw is still closed to the maximum permitted extent. Preferably, the cutting element may be a surgical blade with a sharpened leading edge that cuts the coagulated tissue as it is advanced. Other forms of mechanical cutting tools can be employed. The surgeon can wait to advance the cutting tool until sufficient time has elapsed for the tissue to have been coagulated and "cooled" to minimize bleeding during the cutting process.

[0015] The device of the present invention may also be employed in an improved method of coagulation comprising the application of ultrasonic surgery via an applicator having a round cross-section to tissue held by a clamp located at a fixed distance from the applicator's surface. A surgical method may also be employed using that coagulation method to coagulate or cauterize tissue prior to cutting with a mechanical cutting tool attached to, but separate from, the ultrasonic applicator.

[0016] Thus, the present invention provides an improved ultrasonic surgical instrument for tissue coagulation alone or with a separate cutting of tissue. To accomplish this, the present invention includes an ultrasonic surgical instrument with a predetermined clearance between the surfaces of a clamp holding the tissue against a vibrating ultrasonic member having a substantially circular cross-section so that controlled flow of the tissue can occur without ultrasonic cutting. In addition, the present invention includes an ultrasonic surgical instrument where the cutting means is contained in the same instrument but is independent of the ultrasonic vibrations. Other features or variations of the present invention for improved coagulation may be apparent to one skilled in the art from the enclosed specification, drawings and claims.

[0017] The invention may be best understood by reference to the detailed description of some preferred embodiments and the illustrations of preferred embodiments in the accompanying figures.

IV. BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The following drawings show specific embodiments that help appreciate the novel features of the present invention.

Figure 1a is a partial cut-away, side-view of one embodiment of the device of the present invention. The drawing depicts the device with the clamp in an open position and the mechanical cutting tool in a retracted position.

Figure 1b is a partial cut-away, side view of one embodiment of the device of the present invention. The drawing depicts the device with the clamp in the closed position and the mechanical cutting tool in a retracted position.

Figure 1c is a partial cut-away, side view of one embodiment of the device of the present invention. The drawing depicts the device with the clamp in the closed position and the mechanical cutting tool in an advanced position for cutting.

Figure 2 is detailed partial cut-away, side-view representation of the distal portion of the ultrasonic device including the electronic applicator, clamp and mechanical cutting tool.

Figure 3a is an end-on view of the ultrasonic device showing a clamp with a concave jaw surface in the closed position.

Figure 3b is an end-on view of the ultrasonic device showing a clamp with a convex jaw surface in the closed position.

Figure 3c is an end-on view of the ultrasonic device showing a clamp with a flat jaw surface in the closed position.

Figure 4 is a partial cut-away, side-view of one embodiment of the device of the present invention in which the stop for establishing the pre-defined clearance is located on the handle of the ultrasonic device.

[0019] Common reference numerals have been used on all drawings for convenience.

V. DETAILED DESCRIPTION

[0020] Referring to the drawings, Figure 1a is a schematic representation of one preferred embodiment of the invention. Figure 1 illustrates a partial cut-away view of the present invention including an ultrasonic surgical instrument, generally designated **10.** The instrument has a surgical handle **11** to be held and manipulated by the

surgeon. The surgical handle **11** may be fabricated from either machined or molded plastic components. An ultrasonic transducer **12** is mounted within the surgical handle **11** for generating ultrasonic vibrations. The ultrasonic vibrations may be generated using any common and well-known means such as the use of PZT crystals held in compression.

[0021] An ultrasonic applicator **13** is attached to the ultrasonic transducer **12** and extends distally from the ultrasonic transducer **12.** The preferred method of attachment is a threaded joint. The ultrasonic applicator may be fabricated from any suitable metallic material including, for example, titanium alloys, aluminum alloys or stainless steel alloys. The preferred material is titanium alloy Ti6A14V. Standard machining processes such as lathe or mill processes can be used.

[0022] As mentioned previously, ultrasonic applicators employed in the present invention are generally round in cross-section at the point of application of energy to the tissue. These applicators do not have edges that would focus and disseminate ultrasonic energy in a manner promoting cutting, but instead are designed to provide energy in a uniform manner consistent exclusively with the coagulation of tissue. Indeed, cutting functionality, if needed, is provided in a separate mechanical component of the surgical instrument to avoid compromising the design of the ultrasonic applicator.

[0023] The combined length of the ultrasonic transducer **12** and the ultrasonic applicator 13 must be designed to have the desired resonant frequency of vibration. The range of vibration frequencies is generally 20 kHz to 60 kHz. Any vibration frequency in this range can be utilized.

[0024] An elongated support member **14** is releasably attached to the surgical handle **11** and generally surrounds the ultrasonic applicator **13** along its length. The elongated support member **14** may be fabricated from metal or plastic materials. The preferred material is plastic such as DelrinR (acetyl copolymer) or "ABS" (acrylonitrile-butadiene-styrene). A clamp **15** with a jaw surface **16** is supported on the distal end of the elongated support member **14.** The clamp may be fabricated from metal or plastic using either standard machining processes or standard molding process (metal or plastic). The preferred method and material is a molded metal clamp mechanism as this provides for maximum stiffness of the part and the best clamping performance. The jaw surface 16 may have a variety of cross-sectional shapes, for example, those depicted in Figures 3a-3c. The jaw surface **16** may also have a serrated or grooved surface to improve grasping performance.

[0025] The clamp **15** may be opened and closed relative to the side of the ultrasonic applicator **13.** In Figure 1a, the clamp is depicted in the open position. An actuation handle **17** is connected to the surgical handle **11** and is used to actuate the clamp **15** between the open and closed positions. A clamp transmission rod **18** connects the actuation handle **17** and the clamp **15.**

[0026] An actuation slider **19** is connected to the surgical handle **11** and is used to advance and retract a cutting element **20** in a direction parallel or generally parallel to the ultrasonic applicator. The cutting element **20** may be a stainless steel blade or a formed cutting shape on the end of a blade connecting rod **21.** The blade connecting rod **21** connects the actuation slider **19** and the cutting element **20.** The connecting rod **21** is preferably fabricated from stainless steel wire that can be soldered or welded to the cutting element **20.**

[0027] Figure 2 shows a more detailed side-view of the distal end of the ultrasonic surgical instrument **10** as depicted in Figure 1a, with the clamp **15** and associated jaw **16** in the open position relative to the ultrasonic applicator **13.** Surface **32** of the clamp assembly **30** is separated from surface **31** of the support member **14.** The mechanical cutting tool or blade **20** attached to blade connecting rod **21** is in the retracted position. The cutting element **20** can be advanced to cut tissues that have been coagulated between the jaw surface **16** and the ultrasonic applicator **13.** (See Figure 1c.) Thus, the cutting element **20** is advanced and retracted through the clearance between the jaw surface **16** and the ultrasonic applicator **13.** In a further embodiment, the clamp 15 and jaw surface 16 may have a vertical slot through with the edge of the blade also passes as it is extended and retracted. This would allow the use of a wider mechanical cutting element and assist in ensuring that the blade cuts all of the tissue held in the space between the jaw surface and the ultrasonic applicator. Figure 1b shows the same ultrasonic surgical instrument **10** depicted in Figure 1a, except that the actuation handle **17** has been rotated to the closed position, thereby pulling the clamp transmission rod **18** toward the ultrasonic transducer **12** causing rotation and closing of the clamp **15** relative to the ultrasonic applicator **13.** The movement of the transmission rod **18** is limited by a stop, in this the contacting of surface **32** of the clamp housing **30** against surface **31** of the support **14.** This occurs so that the jaw face **16** of clamp **15** is "closed" at a predefined distance or clearance from the surface of ultrasonic applicator **13.** (See Figures 3a through 3c.) This distance can be pre-set and varied by controlling the length of the transmission rod **18.** It is within the skill of the art to provide means so that this length can be varied by the physician or an assistant during the course of the surgical procedure without requiring removal of the surgical instrument from the patient. For example, the effective length of the rod from the clamp support **30** to the actuator **17** can be varied by using a rotatable transmission rod threaded into a portion of the handle **11.** In Figure 1b, the cutting blade or tool **20** is in the retracted position.

[0028] Figure 1c illustrates the ultrasonic surgical device **10** of Figure 1a with the clamp in the closed position and the cutting blade **20** in the extended position. This was accomplished by the movement of actuating slider **10** in a direction toward the distal end of the ultrasonic surgical device, thereby moving the blade connecting rod **21** and the blade **20** in the same direction. As this is

accomplished, the tissue held between the clamp **15** and the ultrasonic applicator **13** is cut by the blade **20.**

[0029] Figures 3a through 3c show three different configurations of the jaw surface and the predefined clearance.

[0030] Figure 3a is an end-view showing the ultrasonic applicator **13** and the elongated support member **14** and the clamp **15** in a fully "closed" position. The jaw surface **16** is concave, which provides for improved width of tissue coagulation between the jaw surface **16** and the ultrasonic applicator **13.** The predefined clearance **22** is the space between the jaw surface **16** and the ultrasonic applicator **13** when the clamp **15** is closed to its maximum extent, typically between about 0.075 to about 1.9 millimeters, and preferably between about 0.075 and about 0.75 millimeters. Optimal values for the predefined clearance will vary with intended application.

[0031] Figure 3b is an end-view showing the ultrasonic applicator **13** and the elongated support member **14** and the clamp **15** in a fully closed position. The jaw surface **16** is convex which provides for a reduced width of tissue coagulation with improved transition at the edges to the uncoagulated tissue. The predefined clearance 22 is the space between the jaw surface **16** and the ultrasonic applicator **13** when the clamp **15** is fully closed, again typically between about 0.075 to about 1.9 millimeters, and preferably between about 0.075 and about 0.75 millimeters. Optimal values for the predefined clearance will vary with intended application.

[0032] Figure 3c is an end-view showing the ultrasonic applicator **13** and the elongated support member **14** and the clamp **15** in a fully closed position. The jaw surface **16** is flat which provides for a combination of the results obtained with shapes as shown in Figures 2a and 2b. The predefined clearance **22** is the space between the jaw surface **16** and the ultrasonic applicator **13** when the clamp 15 is fully closed, typically between about 0.075 to about 1.9 millimeters, and preferably between about 0.075 and about 0.75 millimeters. Optimal values for the predefined clearance will vary with intended application.

[0033] The pre-determined clearance between jaw **16** of clamp **15** and ultrasonic applicator **13** can be established in a number of ways. As depicted in Figures 1a through 1c and in Figure 2 this can be established by a stop of clamp housing surface **32** against surface **31** of the support. Other mechanical stops can be used. One such stop is depicted in Figure 4, which illustrates an ultrasonic surgical device as in Figure 1a. In this case, however, the stop is physical element 26 extending from the dandle **11** and prohibiting closure of actuator **17** against the housing. This replaces the contacting of surfaces **31** and **31** as the stop mechanism. One skilled in the art, would know how to make the effective length of stop **26** variable, so that the predetermine separation **22** between the jaw and applicator can also be varied. For example, the stop **26** could be screwed within a limited range into a hole in the handle **11** so that it could be effectively lengthened or shortened as desired. Other techniques for establishing a predefined clearance between the jaw **16** and the ultrasonic applicator **13** would be known to one skilled in the art and could be substituted for the examples described herein.

[0034] As previously noted the device of the present invention is particularly useful in separating and maximizing each of the coagulation and cutting functions. It also provides a convenient way for the surgeon to know at all times the position of the clamp relative to the ultrasonic applicator and the position of the cutting element or blade. Thus, the surgeon can easily monitor and focus on these tasks.

[0035] The description and drawings contained herein disclose illustrative embodiments of the invention. Given the benefit of this disclosure, those skilled in the art will appreciate that various modifications, alternate constructions, and equivalents may also be employed to achieve the advantages of the invention. For example, given the benefit of this disclosure, those skilled in the art will be able to implement various forms of the clamp, the stop and the mechanical cutting tool within the spirit of the invention. Therefore, the invention is not to be limited to the description and illustrations contained herein, but is defined by the following claims.

Claims

1. An ultrasonic surgical apparatus (10) for the coagulation of animal issue having a handle (11) for manipulation by a surgeon, an ultrasonic transducer (12) for generating ultrasonic vibration, and an ultrasonic application (13) attached to the ultrasonic transducer (12) and extending from the handle (11) for delivery of ultrasonic vibrations to the animal tissue, wherein said apparatus further comprises:

a distal portion on the ultrasonic applicator (13) having a generally round cross-section with a diameter between approximately 2 and 6 millimeters to provide a broad surface for coagulation and to avoid cutting of the animal tissue;

an elongated support member (14) releasably attached to the surgical handle (11) and extending to the distal portion of the ultrasonic applicator (13); and

a movable jaw (15) with a jaw surface (16) attached to the elongated support member (14) adjacent the distal portion of the ultrasonic applicator (13) for movement toward said distal portion to a closed position at a predefined clearance (22) of between about 0.075 to about 1.9 millimeters, from said distal portion, wherein the movable jaw (15) is configured to grasp and hold the animal tissue during coagulation while allowing the animal tissue to flow and coagulate.

2. An ultrasonic surgical apparatus (10) for the treating

of animal tissue having a handle (11) for manipulation by a surgeon, an ultrasonic transducers generating ultrasonic vibration, and an ultrasonic applicator (13) attached to the ultrasonic transducer (12) and extending from the handle (11) for delivery of ultrasonic vibrations to the animal tissue, wherein said apparatus further comprises:

a distal portion on the ultrasonic applicator (13) having a generally round cross-section with a diameter between approximately 2 and 6 millimeters to provide a broad surface for coagulation and to avoid cutting of the animal tissue;
an elongated support member (14) releasably attached to the surgical handle (11) and extending to the distal portion of the ultrasonic applicator (13);
a movable jaw (15) with a jaw surface (16) attached to the elongated support member (14) adjacent the distal portion of the ultrasonic applicator (13) for movement toward said distal portion to a closed position at a predefined clearance (22) of between about 0.075 to about 1.9 millimeters from said distal portion, wherein the movable jaw (15) is configured to grasp and hold the animal tissue during coagulation while allowing the animal tissue to flow and coagulate as the animal tissue is heated by vibration of the ultrasonic applicator; and
a mechanical cutting device (20, 21) for movement parallel to the ultrasonic applicator (13) to cut the animal tissue located between the ultrasonic applicator (13) and the movable jaw (15).

3. The ultrasonic surgical apparatus of Claim 1 or 2 wherein the predefined clearance (22) is between about 0.075 and about 0.75 millimeters.

4. The ultrasonic surgical apparatus of Claim 3 wherein the jaw surface (16) in the closed position is generally parallel with the surface of the elongated support member (14).

5. The ultrasonic surgical apparatus of Claim 3 or 4 wherein the jaw surface (16) is concave, convex, or flat.

6. The ultrasonic surgical apparatus of Claim 3, 4, or 5, wherein the predetermined clearance (22) is determined by a stop (31, 32) located on the elongated support member (14).

7. The ultrasonic surgical apparatus of Claim 3, 4, or 5, wherein the predetermined clearance (22) determined by a stop (26) located on the handle (11).

8. The ultrasonic surgical apparatus of Claim 3, 4, 5, 6 or 7, wherein the predetermined clearance (22) may be varied without requiring removal of the ultrasonic surgical apparatus from the patient during a medical procedure.

9. The ultrasonic surgical apparatus of any one of Claims 2 to 8 wherein the mechanical cutting device is a blade (20).

Patentansprüche

1. Chirurgische Ultraschallvorrichtung (10) zur Koagulation von animalischem Gewebe mit einem Griff (11) zur Manipulation durch einen Operateur, einem Ultraschallwandler (12) zum Erzeugen von Ultraschallschwingung und einem Ultraschallapplikator (13), der am Ultraschallwandler (12) angebracht ist und sich vom Griff (11) erstreckt, zur Abgabe von Ultraschallschwingungen an das animalische Gewebe, wobei die Vorrichtung ferner aufweist:

einen distalen Abschnitt am Ultraschallapplikator (13) mit einem allgemein runden Querschnitt mit einem Durchmesser zwischen etwa 2 und 6 Millimetern, um eine breite Oberfläche zur Koagulation vorzusehen und um Einschneiden des animalischen Gewebes zu verhindern;
ein längliches Stützteil (14), das am chirurgischen Griff (11) lösbar angebracht ist und sich zum distalen Abschnitt des Ultraschallapplikators (13) erstreckt; und eine bewegliche Backe (15) mit einer Backenfläche (16), die am länglichen Stützteil (14) benachbart zum distalen Abschnitt des Ultraschallapplikators (13) angebracht ist, zur Bewegung zum distalen Abschnitt in eine geschlossene Position mit einem vordefinierten Zwischenraum (22) zwischen etwa 0,075 bis etwa 1,9 Millimetern vom distalen Abschnitt, wobei die bewegliche Backe (15) so konfiguriert ist, dass sie das animalische Gewebe während der Koagulation ergreift und hält, während sie ermöglicht, dass das animalische Gewebe fließt und koaguliert.

2. Chirurgische Ultraschallvorrichtung (10) zur Behandlung von animalischem Gewebe mit einem Griff (11) zur Manipulation durch einen Operateur, einem Ultraschallwandler (12) zum Erzeugen von Ultraschallschwingung und einem Ultraschallapplikator (13), der am Ultraschallwandler (12) angebracht ist und sich vom Griff (11) erstreckt, zur Abgabe von Ultraschallschwingungen an das animalische Gewebe, wobei die Vorrichtung ferner aufweist:

einen distalen Abschnitt am Ultraschallapplikator (13) mit einem allgemein runden Querschnitt mit einem Durchmesser zwischen etwa 2 und 6 Millimetern, um eine breite Oberfläche zur Ko-

agulation vorzusehen und um Einschneiden des animalischen Gewebes zu verhindern;
ein längliches Stützteil (14), das am chirurgischen Griff (11) lösbar angebracht ist und sich zum distalen Abschnitt des Ultraschallapplikators (13) erstreckt;
eine bewegliche Backe (15) mit einer Backenfläche (16), die am länglichen Stützteil (14) benachbart zum distalen Abschnitt des Ultraschallapplikators (13) angebracht ist, zur Bewegung zum distalen Abschnitt in eine geschlossene Position mit einem vordefinierten Zwischenraum (22) zwischen etwa 0,075 bis etwa 1,9 Millimetern vom distalen Abschnitt, wobei die bewegliche Backe (15) so konfiguriert ist, dass sie das animalische Gewebe während der Koagulation ergreift und hält, während sie ermöglicht, dass das animalische Gewebe fließt und koaguliert, wenn das animalische Gewebe durch Schwingung des Ultraschallapplikators erwärmt wird; und
ein mechanisches Schneidgerät (20, 21) zur Bewegung parallel zum Ultraschallapplikator (13), um das animalische Gewebe zu schneiden, das zwischen dem Ultraschallapplikator (13) und der beweglichen Backe (15) liegt.

3. Chirurgische Ultraschallvorrichtung nach Anspruch 1 oder 2, wobei der vordefinierte Zwischenraum (22) zwischen etwa 0,075 und etwa 0,75 Millimetern beträgt.

4. Chirurgische Ultraschallvorrichtung nach Anspruch 3, wobei die Backenfläche (16) in der geschlossenen Position allgemein parallel zur Oberfläche des länglichen Stützteils (14) ist.

5. Chirurgische Ultraschallvorrichtung nach Anspruch 3 oder 4, wobei die Backenfläche (16) konkav, konvex oder flach ist.

6. Chirurgische Ultraschallvorrichtung nach Anspruch 3, 4 oder 5, wobei der vorbestimmte Zwischenraum (22) durch einen Anschlag (31, 32) bestimmt ist, der am länglichen Stützteil (14) liegt.

7. Chirurgische Ultraschallvorrichtung nach Anspruch 3, 4 oder 5, wobei der vorbestimmte Zwischenraum (22) durch einen Anschlag (26) bestimmt ist, der am Griff (11) liegt.

8. Chirurgische Ultraschallvorrichtung nach Anspruch 3, 4, 5, 6 oder 7, wobei der vorbestimmte Zwischenraum (22) variiert werden kann, ohne Entfernung der chirurgischen Ultraschallvorrichtung vom Patienten während einer medizinischen Prozedur zu erfordern.

9. Chirurgische Ultraschallvorrichtung nach einem der Ansprüche 2 bis 8, wobei das mechanische Schneidgerät eine Klinge (20) ist.

Revendications

1. Appareil chirurgical ultrasonore (10) pour la coagulation du tissu animal, ayant une poignée (11) pour la manipulation par un chirurgien, un capteur ultrasonore (12) pour générer une vibration ultrasonore, et un applicateur ultrasonore (13) fixé sur le capteur ultrasonore (12) et s'étendant à partir de la poignée (11) pour distribuer des vibrations ultrasonores au tissu animal, dans lequel ledit appareil comprend en outre :

une partie distale sur l'applicateur ultrasonore (13) ayant une section transversale généralement ronde avec un diamètre compris entre approximativement 2 et 6 millimètres pour fournir une large surface pour la coagulation et éviter de couper le tissu animal ;
un élément de support allongé (14) fixé de manière amovible à la poignée chirurgicale (11) et s'étendant sur la partie distale de l'applicateur ultrasonore (13) ; et
une mâchoire mobile (15) avec une surface de mâchoire (16) fixée sur l'élément de support allongé (14) adjacent à la partie distale de l'applicateur ultrasonore (13) pour le mouvement vers ladite partie distale dans une position fermée, à un jeu prédéfini (22) compris entre environ 0,075 et environ 1, 9 millimètres, à partir de ladite partie distale, dans lequel la mâchoire mobile (15) est configurée pour saisir et maintenir le tissu animal pendant la coagulation tout en permettant au tissu animal de circuler et de coaguler.

2. Appareil chirurgical ultrasonore (10) pour le traitement du tissu animal ayant une poignée (11) pour la manipulation par un chirurgien, un capteur ultrasonore (12) pour générer des vibrations ultrasonores, et un applicateur ultrasonore (13) fixé au capteur ultrasonore (12) et s'étendant à partir de la poignée (11) pour distribuer les vibrations ultrasonores au tissu animal, dans lequel ledit appareil comprend en outré :

une partie distale sur l'applicateur ultrasonore (13) ayant une section transversale généralement ronde avec un diamètre compris entre approximativement 2 et 6 millimètres pour fournir une large surface pour la coagulation et éviter de couper le tissu animal ;
un élément de support allongé (14) fixé de manière amovible sur la poignée chirurgicale (11) et s'étendant vers la partie distale de l'applicateur ultrasonore (13) ;

une mâchoire mobile (15) avec une surface de mâchoire (16) fixée sur l'élément de support allongé (14) adjacente à la partie distale de l'applicateur ultrasonore (13) pour le mouvement vers ladite partie distale dans une position fermée, à un jeu prédéfini (22) compris entre environ 0,075 et environ 1,9 millimètres à partir de ladite partie distale, dans lequel la mâchoire mobile (15) est configurée pour saisir et maintenir le tissu animal pendant la coagulation tout en permettant au tissu animal de circuler et de coaguler, au fur et à mesure que le tissu animal est chauffé par la vibration de l'applicateur ultrasonore ; et

un dispositif de coupe mécanique (20, 21) pour le mouvement parallèle à l'applicateur ultrasonore (13) afin de couper le tissu animal -situé entre l'applicateur ultrasonore (13) et la mâchoire mobile (15).

3. Appareil chirurgical ultrasonore selon la revendication 1 ou 2, dans lequel le jeu prédéfini (22) est compris entre environ 0,075 et environ 0,75 millimètres.

4. Appareil chirurgical ultrasonore selon la revendication 3, dans lequel la surface de mâchoire mobile (16) dans la position fermée est généralement parallèle à la surface de l'élément de support allongé (14).

5. Appareil chirurgical ultrasonore selon la revendication 3 ou 4, dans lequel la surface de mâchoire (16) est concave, convexe ou plate.

6. Appareil chirurgical ultrasonore selon la revendication 3, 4 ou 5, dans lequel le jeu prédéterminé (22) est déterminé par une butée (31, 32) positionnée sur l'élément de support allongé (14).

7. Appareil chirurgical ultrasonore selon la revendication 3, 4 ou 5, dans lequel le jeu prédéterminé (22) est déterminé par une butée (26) positionnée sur la poignée (11).

8. Appareil chirurgical ultrasonore selon la revendication 3, 4, 5, 6 ou 7, dans lequel le jeu l'appareil chirurgical ultrasonore du patient pendant une procédure médicale.

9. Appareil chirurgical ultrasonore selon l'une quelconque des revendications 2 à 8, dans lequel le dispositif de coupe mécanique est une lame (20).

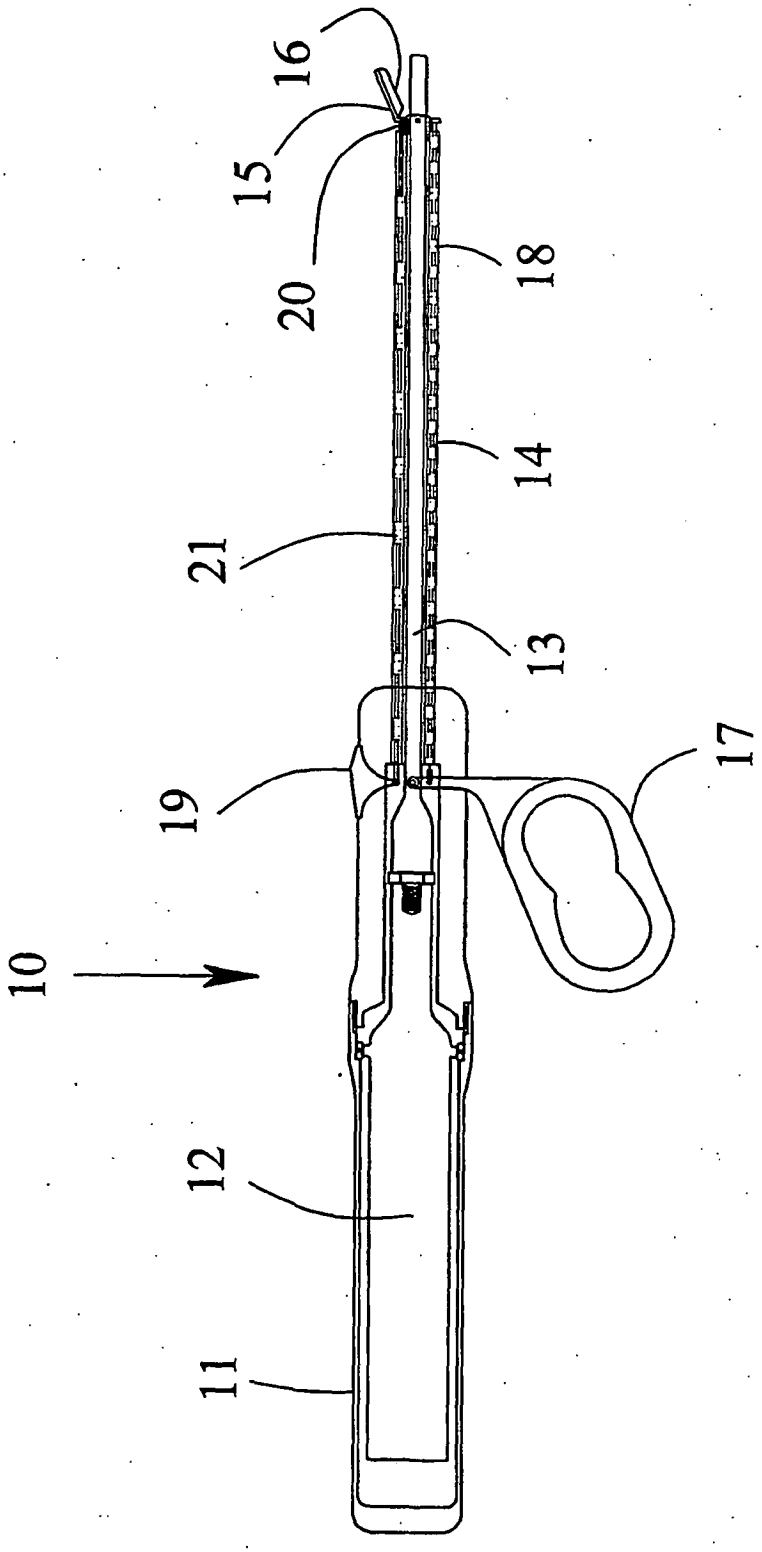


Figure 1a

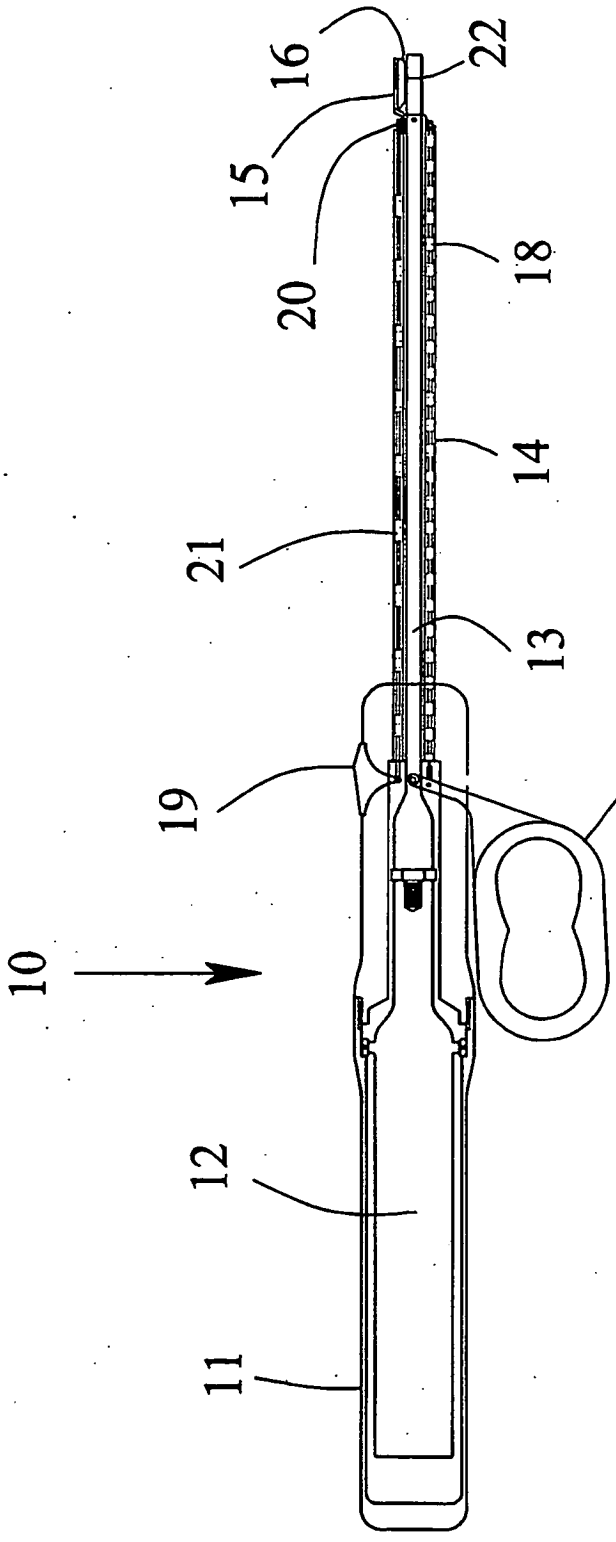


Figure 1b

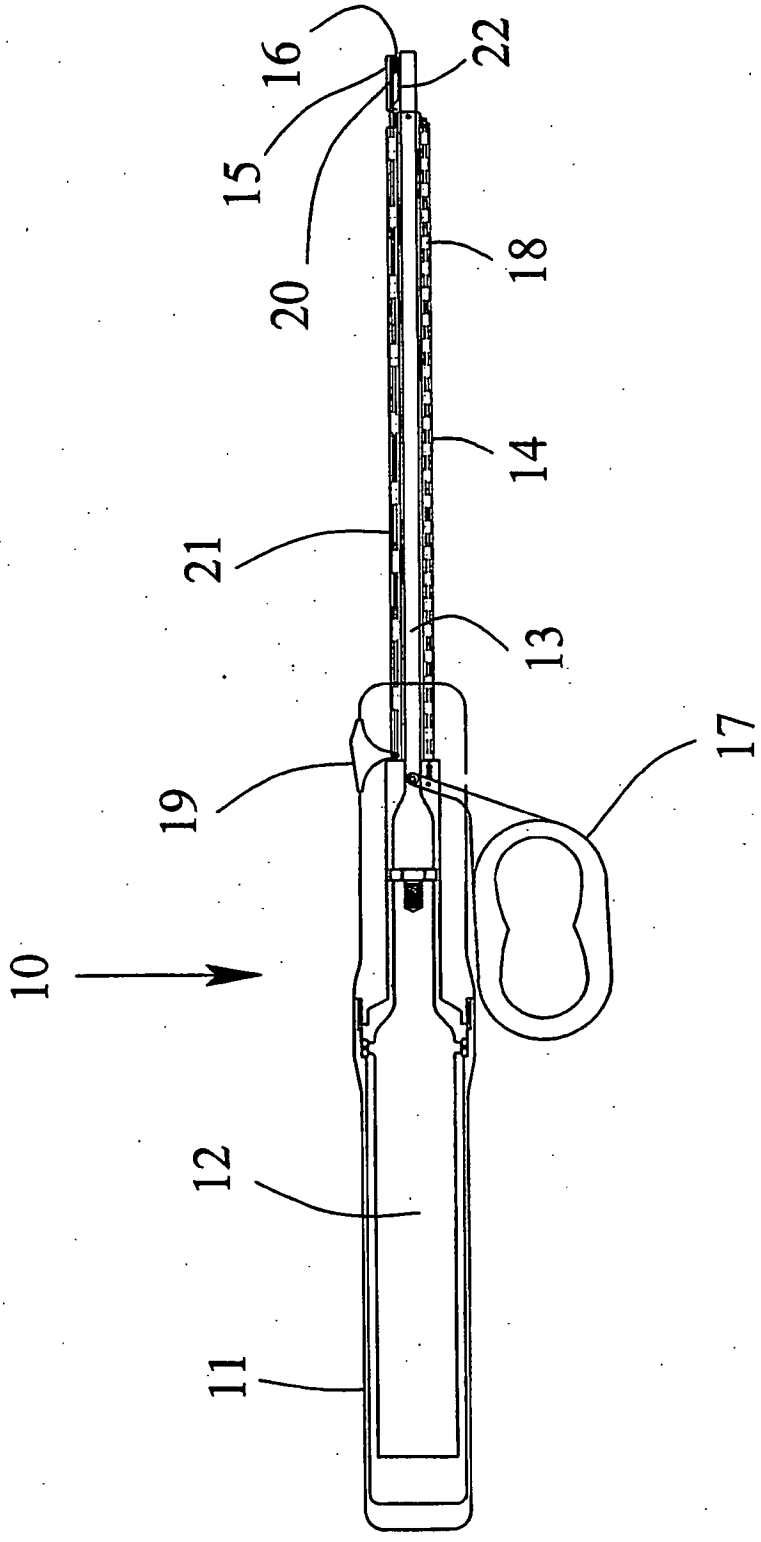


Figure 1c

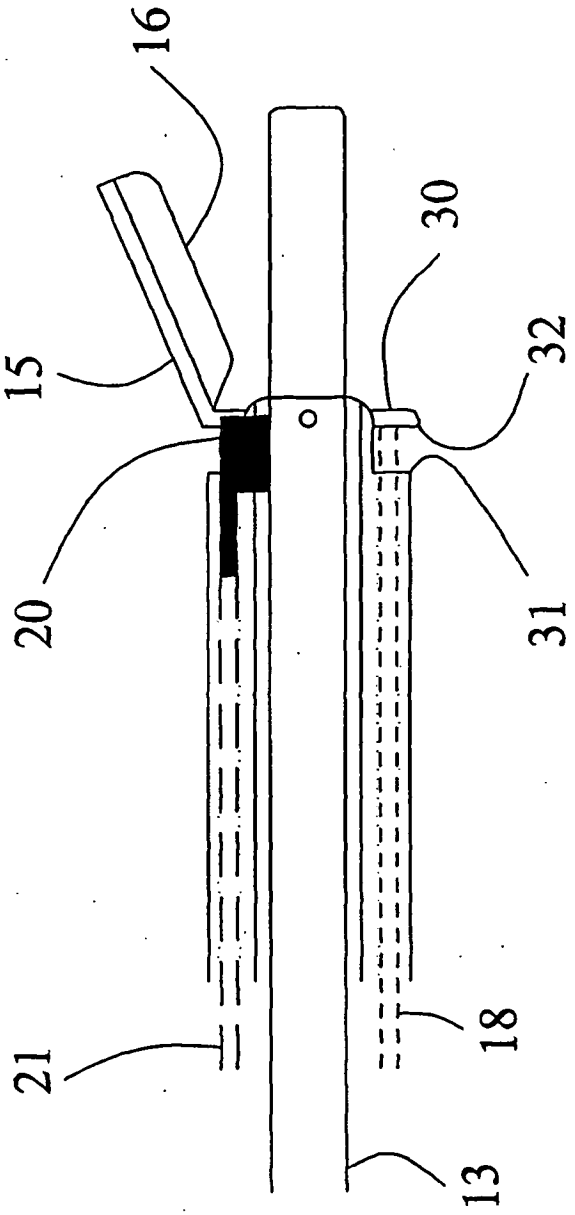
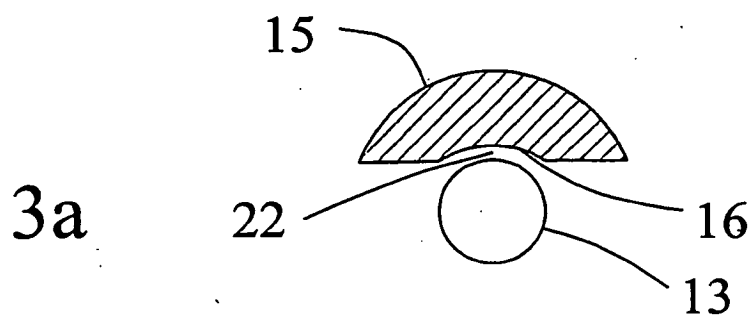
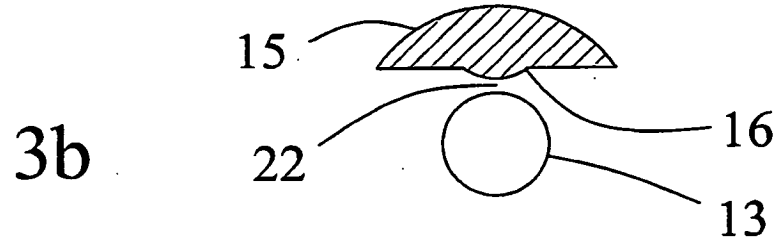


Figure 2





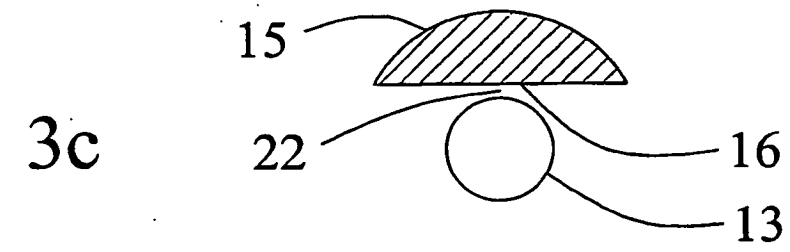


Figure 3

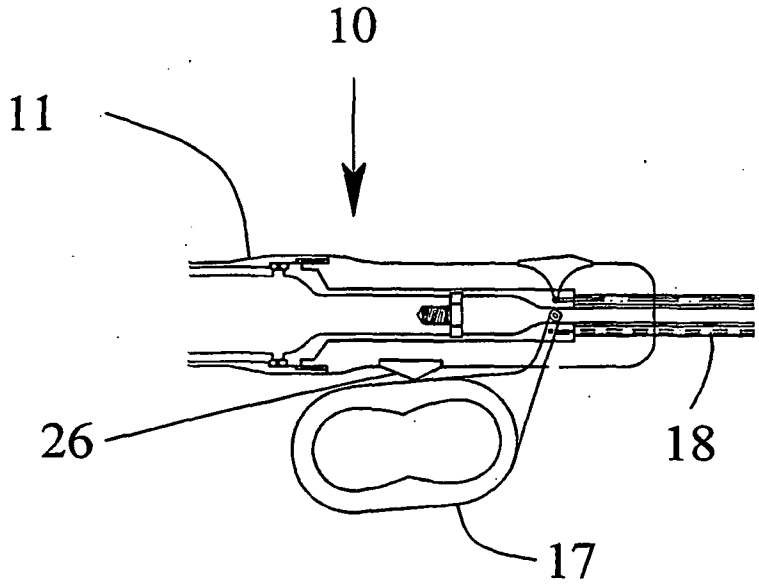


Figure 4

REFERENCES CITED IN THE DESCRIPTION

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专利名称(译)	用于组织凝固的超声波装置		
公开(公告)号	EP1551321B1	公开(公告)日	2011-10-12
申请号	EP2003736854	申请日	2003-06-04
[标]申请(专利权)人(译)	声外科技术有限公司		
申请(专利权)人(译)	SOUND外科技术有限责任公司		
当前申请(专利权)人(译)	SOUND外科技术有限责任公司		
[标]发明人	CIMINO WILLIAM W		
发明人	CIMINO, WILLIAM, W.		
IPC分类号	A61N7/02 A61B17/32 A61B17/28 B29C65/74 A61B17/00 A61B18/00 A61B18/18 A61N		
CPC分类号	A61N7/02 A61B2017/00504 A61B2017/320093 A61B2017/320094 A61B2017/320095		
优先权	60/386119 2002-06-04 US		
其他公开文献	EP1551321A2 EP1551321A4		
外部链接	Espacenet		

摘要(译)

一种用于动物组织凝固的超声外科手术装置，具有超声波施加器和可动钳口，其具有邻近超声波施加器的远端部分的钳口表面，用于朝向施加器移动到约0.075至约1.9之间的预定间隙的闭合位置。涂抹器的毫米数。该装置还可以包括机械切割元件，该机械切割元件可以延伸到间隙中以切割组织，并且可以在不从患者移除涂抹器的情况下改变预定间隙。组织凝固和切割可以最大化并单独进行，并且可以由外科医生容易地监测。

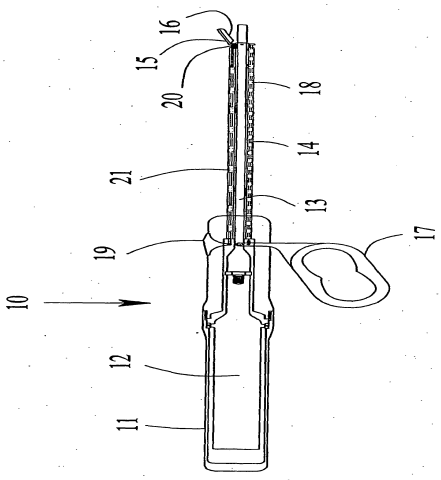

Figure 1a