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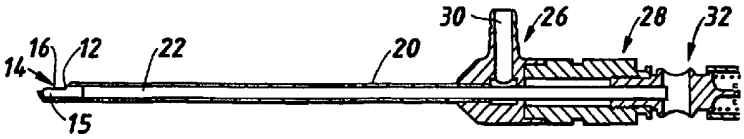


(57) Abstract

An endoscopic surgical instrument is provided that includes a surgical implement, e.g., a cutting tool, and an irrigation device that supplies fluid to the surgical implement during use of the device. The endoscopic surgical instrument includes a surgical implement disposed at a distal region of the surgical instrument, and an irrigation device associated with the surgical implement in a manner to define a path for conveying irrigation fluid from a proximal region of the surgical instrument to the surgical implement.

# ENDOSCOPIC SURGICAL INSTRUMENT

The present invention relates to endoscopic surgical instruments.

Several different kinds of surgical instruments have been developed for performing arthroscopic and other endoscopic surgical procedures. Some of these surgical instruments are powered, that is, operated by a motor; others are manual. Motor-driven instruments typically are received by a handpiece which houses the motor. Manual instruments are operated with a trigger-like handle. Examples of powered endoscopic surgical instruments are described in U.S. Patent Nos. 4,203,444, 4,274,414, 4,834,729, 4,842,578, and 4,705,038; examples of manual endoscopic surgical instruments are described in U.S. Patent Nos. 4,522,206 and 4,662,371. All of these patents are assigned to the present assignee and are incorporated herein by reference.

The instruments may include a wide variety of surgical implements for performing different types of surgical operations on body tissue. For example, some instruments are equipped with blades for cutting soft tissue, while others have burrs for abrading bone tissue. Still other implements (such as forceps and graspers) grip, rather than cut, tissue.

A typical cutting or abrading endoscopic, e.g., arthroscopic, surgical instrument includes a stationary outer tube within which an inner tube is moved (either manually or driven by a motor) during operation. The surgical implement is mounted to the distal end of the inner tube. Tissue or bone is exposed to the surgical implement through an opening in the distal end of the outer tube, and tissue

and/or bone is cut by the moving implement. The cut tissue and bone fragments are drawn through the interior of the inner tube by suction applied at the proximal end of the instrument.

Endoscopic instruments are, whenever possible, used with irrigation devices, such as fluid pumps, which supply irrigating fluid to and suction fluid from the surgical site, as this improves cutting and transport of excised tissue and bone fragments from the surgical site.

Knee arthroscopy, which is performed in a closed capsule, where little danger exists of extravasation of fluid into adjacent anatomical structures, is carried out with the joint infused with saline. The use of fluid in this manner increases the cutting efficiency of powered resectors, and the transport of resected material from the joint. Some other areas of the body where tissue is routinely resected, however, are not generally amenable to infusion of saline. For example, in sinus surgery infusion of the sinuses with saline could potentially result in dangerous extravasation of fluid into the patient's airway.

In accordance with the present invention, there is provided an endoscopic surgical instrument which is adapted for conveying irrigation fluid from a proximal region of the surgical instrument to a surgical implement disposed at a distal region of the surgical instrument and for removing fluid, tissue and bone debris from said surgical implement to said proximal region of said surgical instrument, wherein said surgical instrument comprises an outer tube surrounded by an irrigation sheath, a passage located between said irrigation sheath and said outer tube for conveying fluid to said surgical implement, and an inner tube for removing fluid from said surgical implement, said inner tube being disposed within said outer tube.

The present invention provides an endoscopic surgical instrument which includes irrigating means, which can be introduced into the body together as a single surgical device (for example, through the same cannular during endoscopy) eliminating the need for a separate irrigating device. This is particularly advantageous in applications, such as sinus surgery, where there is typically insufficient room at the surgical site for the placement of a separate irrigation device.

The invention is also directed to a method of using the instrument for endoscopic surgery, e.g., for sinus surgery, which comprises:

introducing said distal region of the surgical implement into an area of the body of a patient;

conveying an irrigating fluid from the proximal region of the surgical instrument through said passage to the surgical implement; and

using the surgical implement to perform a surgical technique on said patient.

In addition to simplifying the surgical procedure, the invention reduces the trauma to the patient that accompanies the insertion of two separate instruments, and, as noted above, allows irrigating fluid to be introduced during surgery in very small areas, e.g., the patient's sinuses, where irrigation was hitherto typically difficult.

Moreover, in preferred embodiments the instrument of the invention can deliver fluid directly to the surgical implement while suctioning the fluid away at a sufficient rate so that fluid does not infuse the surgical site. Because fluid is delivered at the cutting blade or other surgical implement, there is no need to infuse the entire surgical site. By reducing or eliminating the potential for extravasation, this feature advantageously allows the instrument to be used in applications, such as sinus surgery, in which the surgical site cannot safely be infused with saline.

Preferably the inner tube rotates or otherwise moves within the outer tube and the surgical implement is carried by or part of the inner tube.

In preferred embodiments, the outer tube has an opening at the distal region of the instrument, and the surgical implement is arranged to move within the outer tube.

Preferably, the irrigation sheath has an opening at its distal region that is in communication with the aforementioned opening in the outer tube. The instrument advantageously includes a port disposed in the proximal region for receiving irrigating fluid into the passage. The port may include a fluid flow control valve.

Other preferred embodiments include one or more of the following features. The endoscopic surgical instrument may include a hub at the proximal end of the outer tube, and an adaptor constructed to allow the irrigation sheath to be mounted onto the hub. The adaptor may be bonded to the hub, e.g., by welding or adhesive. The port may be provided in the adaptor. The irrigation sheath may be constructed of, for example, stainless steel or plastic. The outer diameter of the irrigation sheath in the region of the surgical implement is preferably less than about 0.200" (about 5mm), more preferably less than about 0.130" (about 3mm). The clearance between the irrigation sheath and outer tube is preferably less than 0.010" (0.25mm), more preferably from about 0.008" to 0.010" (about 0.20 to 0.25mm).

The endoscopic surgical instrument is constructed to allow suction to be applied at the proximal end of the surgical instrument to remove fluid from the surgical site. Suction is applied through the inner tube.

Other preferred features and advantages of the invention will become apparent from the following detailed description, given by way of example only, and from the claims.

Fig. 1 is a perspective view of an endoscopic surgical instrument with an outer irrigation sheath. Fig. 1a is an exploded view of the endoscopic surgical instrument of Fig. 1.

Figs. 2 and 3 are top and side views, respectively, of the endoscopic surgical instrument shown in Fig. 1.

Fig. 4 is a side cross-sectional view of the endoscopic surgical instrument shown in Fig. 1, taken along line 4-4 in Fig. 2.

Fig. 5 is a perspective view of an endoscopic surgical instrument with an outer irrigation sheath and a stopcock to control fluid flow.

Referring to the figures, surgical instrument 10 includes a stationary outer tube 12 (Fig. 4) with a tissue-receiving opening 14 at its tip 15, an inner tube 16 that rotates or otherwise moves within outer tube 12, and a surgical implement 17 (Fig. 2) that cuts tissue admitted through the opening 14 in the outer tube. In this embodiment, the surgical implement consists of the sharp edges 19 of the inner tube 16, shown in Fig. 2.

Surgical instrument 10 further includes an irrigation sheath 20, surrounding outer tube 12. Irrigation sheath 20 defines an annular passage 22 for fluid flow between irrigation sheath 20 and

outer tube 12. Irrigation sheath 20 includes an opening 23 (Fig. 1) at its distal tip 24 that is in communication with opening 14 in the stationary outer tube. Irrigation sheath 20 further includes an adaptor 26 at its proximal end. Adaptor 26 includes a side-facing port 30 for receiving irrigating fluid into the passage 22. Irrigating fluid is conveyed from port 30 to the distal tip 24 by passage 22, and is removed by suction (along with tissue and bone debris) through the interior of inner tube 16.

Adaptor 26 is dimensioned to be permanently attached onto the hub 28 of the surgical instrument, e.g., by ultrasonic welding, adhesive, or by being insert molded onto the hub. Hub 28 is typically formed of plastic, and is rigidly mounted at the proximal end of outer tube 12. Hub 28 rotatably receives drive shaft 32, which is rigidly mounted at the proximal end of inner tube 16.

The irrigation sheath 20 is constructed of stainless steel or plastic for strength and inertness. When surgical instrument 10 is to be used in a surgical application in which space is severely limited, e.g., sinus surgery, the distal end 11 of surgical instrument 10 has an outer diameter of less than about 0.130". To achieve this small outer diameter, irrigation sheath 20 has a wall thickness of less than 0.005", and the clearance between the inner wall of the irrigation sheath and the outer wall of the outer tube is less than 0.010", more preferably from about 0.008" to 0.010".

As shown in Fig. 5, port 30 may include a stopcock 34, to allow control of the flow of fluid into irrigation sheath 20. Alternatively, other types of fluid-control valves may be used.

In operation, the surgical instrument is first assembled by placing inner tube 16 within outer tube 12, thereby moveably

mounting drive shaft 32 in hub 28. Next, hub 28 is mounted in a handpiece (not shown) that includes a motor to turn drive shaft 32 and a device for applying suction through inner tube 16 to remove irrigation fluid and debris. The distal region 11 of surgical instrument 10 is then placed at the surgical site. When the surgeon wishes to use the surgical instrument, irrigation fluid is supplied through port 30 and removed by suction through inner tube 16, and the motor of the handpiece is activated to drive inner tube 16 and thus surgical implement 17.

Other embodiments are within the claims.

For example, adaptor 26 could be removably attached to hub 28. Hub 28 may be provided with a collar that extends distally and has a threaded interior surface that is spaced from the outer surface of outer tube 12. In this case, the proximal region 27 of the adaptor is compatibly threaded to engage the threads of the threaded collar, and is constructed to fit radially between the threaded collar of hub 28 and the outer surface of outer tube 12. Surgical instruments having a threaded hub are commercially available from Smith & Nephew Endoscopy Inc. of Andover, Massachusetts.

Moreover, while the surgical instrument described above is a powered arthroscopic surgical instrument (that is, an instrument constructed to be driven by a motor, rather than by hand), the invention may also be used with manual instruments, as well as with other types of surgical instruments.

Additionally, while the surgical implement shown in the figures is a tissue-cutting tool, other surgical implements, e.g., other cutting tools, abrading tools, grasping tools, and the like, can also be used.

Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" and "comprising", will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

The reference to any prior art in this specification is not, and should not be taken as, an acknowledgment or any form of suggestion that that prior art forms part of the common general knowledge in Australia.

CLAIMS

1. An endoscopic surgical instrument which is adapted for conveying irrigation fluid from a proximal region of the surgical instrument to a surgical implement disposed at a distal region of the surgical instrument and for removing fluid, tissue and bone debris from said surgical implement to said proximal region of said surgical instrument, wherein said surgical instrument comprises an outer tube surrounded by an irrigation sheath, a passage located between said irrigation sheath and said outer tube for conveying fluid to said surgical implement, and an inner tube for removing fluid from said surgical implement, said inner tube being disposed within said outer tube.

2. The endoscopic surgical instrument of claim 1 wherein the outer tube has an opening at the distal region of the surgical instrument and wherein said surgical implement is arranged to move within the outer tube.

3. The endoscopic surgical instrument of claim 2 wherein said irrigation sheath has an opening at its distal region, and said opening in said irrigation sheath is in communication with the opening in said outer tube.

4. The endoscopic surgical instrument of any one of claims 1 to 3 which includes a port disposed in the proximal region for receiving fluid into the passage.

5. The endoscopic surgical instrument of claim 4 wherein said port includes a valve for controlling flow of fluid through said port.

6. The endoscopic surgical instrument of any one of the preceding claims further comprising a hub disposed at the proximal end of said outer tube, and an adaptor constructed to allow the irrigation sheath to be mounted onto said hub.

7. The endoscopic surgical instrument of claim 6 when dependent from claim 4 or 5 wherein said port is provided in said adaptor.

8. The endoscopic surgical instrument of any one of the preceding claims wherein the irrigation device comprises stainless steel.

9. The endoscopic surgical instrument of any one of claims 1 to 7 wherein the irrigation device comprises plastic.

10. The endoscopic surgical instrument of any one of the preceding claims wherein the distal region of said irrigation sheath has an outer diameter of less than about 0.200" (about 5mm).

11. The endoscopic surgical instrument of claim 10 wherein said distal region has an outer diameter of less than about 0.130" (about 3mm).

12. The endoscopic surgical instrument of any one of the preceding claims wherein there is a clearance between said irrigation sheath and said outer tube, and said clearance is less than 0.010" (0.25mm).

13. The endoscopic surgical instrument of claim 12 wherein said clearance is from about 0.008" to 0.010" (about 0.20 to 0.25mm).

14. An endoscopic surgical instrument substantially as herein described with reference to the accompanying drawings.

15. A method of performing endoscopic surgery comprising:

(a) providing an endoscopic surgical instrument as claimed in any one of the preceding claims;

(b) introducing said distal region of the surgical implement into an area of the body of a patient;

(c) conveying an irrigating fluid from the proximal region of the surgical instrument through said passage to the surgical implement; and

(d) using the surgical implement to perform a surgical technique on said patient.

16. The method of claim 15 further comprising suctioning the fluid from the area of the body of the patient at a sufficient rate so that the area is not infused with the fluid.

17. The method of claim 15 or claim 16 wherein said area of the patient's body is the sinus cavity.

Dated this 10th day of March 2001

**Smith & Nephew, Inc.**

By Its Patent Attorneys

**DAVIES COLLISON CAVE**

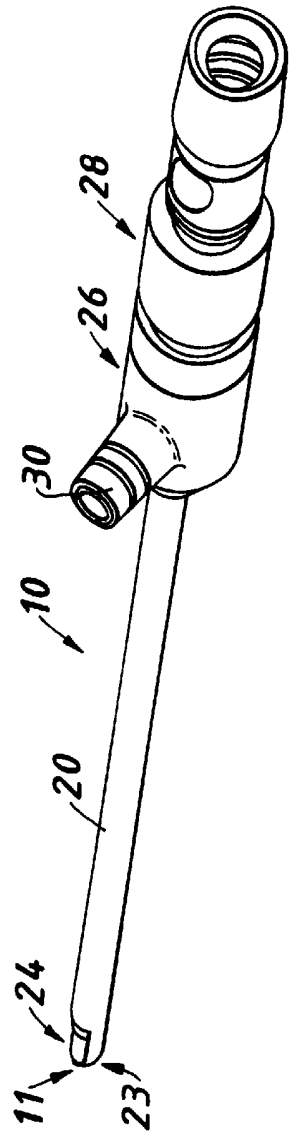


FIG. 1.

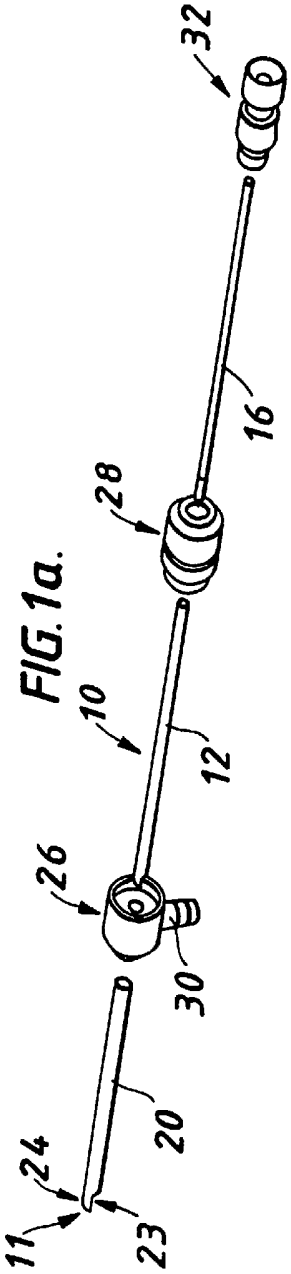


FIG. 1a.

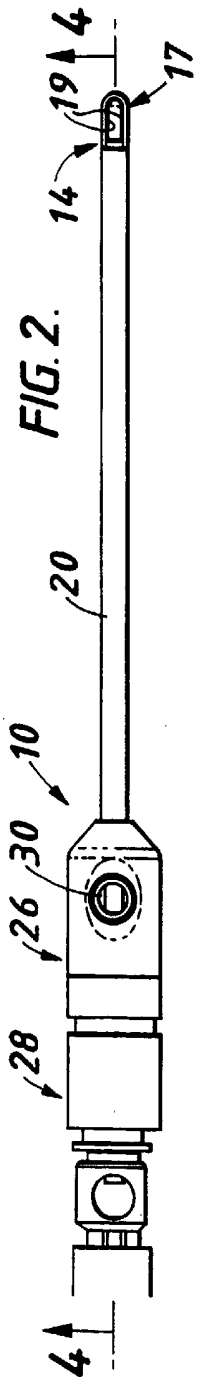


FIG. 2.

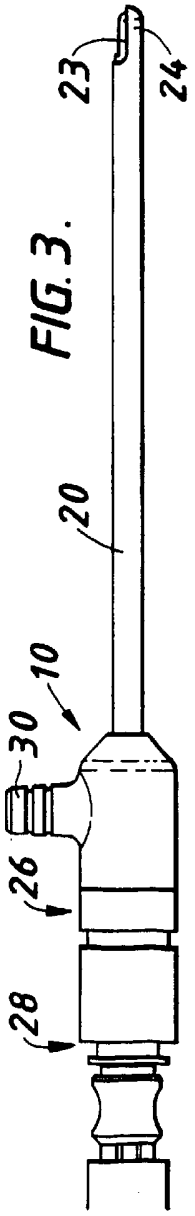


FIG. 3.

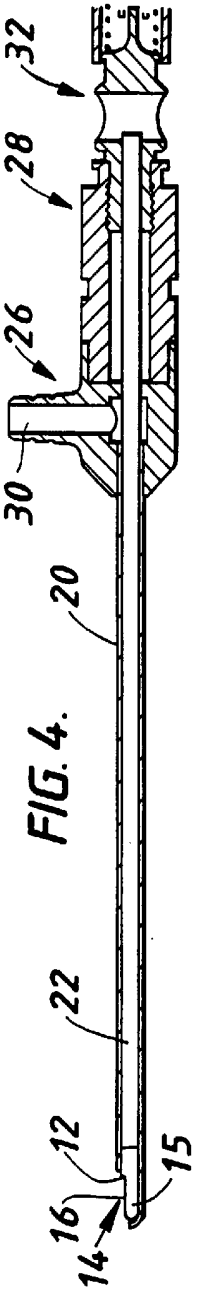


FIG. 4.

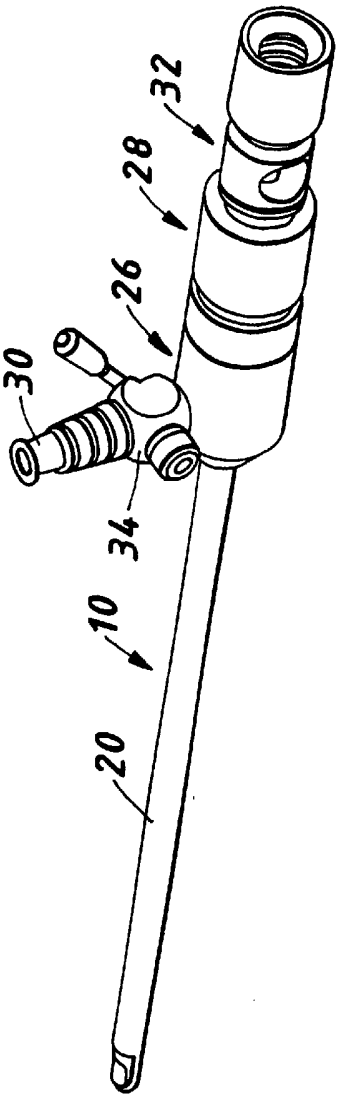


FIG. 5.