SURGICAL INSTRUMENT FOR STITCHING UP TISSUES WITH LENGTHS OF SUTURE WIRE

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ABSTRACT

A surgical instrument for stitching up tissues with lengths of suture wire, comprising a body made as a stem provided with a handle at one end and with a die at the other end for the lengths of suture wire to be bent. The die is shaped as a curved needle having a guide groove on its concave surface for a length of suture wire. The instrument incorporates also a magazine for the lengths of suture wire and a pushrod for driving the wire along the die guide groove. The pushrod has at its operative end a curved guide groove serving for final bending of the length of wire upon its coming off the die guide groove.

3 Claims, 7 Drawing Figures
SURGICAL INSTRUMENT FOR STITCHING UP TISSUES WITH LENGTHS OF SUTURE WIRE

The present invention relates to medical equipment and has particular reference to surgical instruments for stitching up tissues with lengths of suture wire; it can find application in placing additional sutures on interbronchial and tracheo-bronchial anastomoses, as well as for applying sutures in hard-of-access places.

One prior-art surgical instrument for stitching up tissues with suture wire is known, comprising a pincers-like body formed by two jaws hinge-jointed at one of their ends and a spring placed theretwix to force said jaws apart. The vacant end of each jaw carries a die shaped as a curved needle having the guide groove on its concave portion and adapted for the suture wire to bend, said wire being fashioned as a staple having two legs and a web. The inner surface of each jaw has a slot which is in fact an extension of the die groove and runs to the staple magazine made fast on either of the jaws. The magazine is shaped as a rectangular box having an open-ended longitudinal passage for a pushrod to pass.

The inner surfaces of the magazine walls located in the jaws, are provided with slots spaced at a definite interval apart to form staple recesses. Said magazine slots accommodate the staple legs so that one of the legs is found in a slot of one of the magazine walls, while the other leg is in a slot of the opposite wall, the staple stem being located on the side of the hinge joint interconnecting the jaws. With the jaws of the body brought together, the slots of one of the magazine recesses get combined with the slots in the jaws. When the jaws are brought apart, the magazine remains on one of them.

The pushrod adapted for ejecting the main suture wire, curved as a staple, travels along the instrument jaws. The cross-sectional dimensions of the pushrod are such as to make it free to pass through the open-ended passage in the magazine to drive out one staple at a time. The pushrod working stroke is limited by an eccentric stop.

The magazine is free to move with respect to the pushrod at a pitch which corresponds to the staple spacing in the magazine. The pitchwise magazine movement is carried out by spring-loaded levers which are actuated by cams provided on the pushrod.

When in the working position, the jaws are fixed in the instrument body with the help of projections provided on the pushrod.

When operating with said instrument, the surgeon retracts the pushrod to the extreme position towards the hinge joint of the body. This results in that the working ends of the jaws are spring-actuated to be brought apart. Then the surgeon pricks the margins of the tissue being sutured, draws together the jaws, and forces the pushrod towards the dies, with the result that the cams provided on the pushrod actuate the spring-loaded levers which cause the magazine to move over the length of a pitch corresponding to the staple spacing in the magazine. Thereupon the projections of the pushrod fix the body jaws in the working position. As the pushrod keeps moving, its butt end touches the staple stem and moves the staple towards the die.

While moving, one of the staple legs slides along the slot of one jaw, while the other leg does so along that of the other jaw. The staple legs reach the die curved portion, get bent and stitch up the tissue, each staple leg being shaped into a ring. The height of such ring is adjustable with the help of the eccentric stop against which the pushrod rests when in the extreme working position.

To remove the instrument from the stitched-up tissue, the pushrod is to be retracted to the extreme position towards the body hinge joint, with the result that the jaws are drawn apart and the needles are withdrawn from the tissue. To apply the next suture, the procedure is repeated.

The afore-discussed instrument, however, suffers from a number of disadvantages. When necessity arises for the application of an additional suture to the cartilaginous portion of the bronchial or tracheal anastomosis, one needle of the instruments is easy to introduce, while for the other needle to insert, it is necessary to evert the bronchial or tracheal ring, which is impeded by the adjacent sutures, with the result that the suture applied by the instrument proves to be inferior.

The instrument cannot be used for the application of a suture in a deep and narrow operative field, since in such a field, the jaws cannot be drawn apart and the tissue being sutured fails to be caught by the two needles. It is an essential object of the present invention to provide an instrument for stitching up tissues with suture wire, whose construction would enable the application of additional sutures to the cartilaginous portion of the bronchial or tracheal anastomosis and make it possible to stitch up a tissue in a deep and narrow operative field.

This object is accomplished by the provision of a surgical instrument for stitching up tissues with the lengths of suture wire, incorporating a body with a handle for its holding, located at one end; and a die located at the opposite end of the body and made as a curved needle having a guide groove for a length of suture wire, said groove being located on the concave portion of the curved needle section. The die serves for the length of suture wire to bend during its being pushed along said guide groove; there is a pushrod capable of sliding along the body towards the die and adapted for driving the length of a suture wire along the guide groove thereof; and a magazine for the lengths of suture wire, fixed to the body between the die and the pushrod. It is a particular feature of the present invention that the body is fashioned as a stem, whereas a curved guide groove is provided at the operative end of the pushrod near a flat adapted to interact with the butt end of a length of suture wire, the groove serving for the final bending of the suture wire upon its coming off the die guide groove.

It is recommended that the wire magazine be made as a bush having longitudinal slots on its outer surface and being mounted rotatably with respect to and inside a cylindrical casing that envelopes said bush, the inner surface of said casing forming recesses for the lengths of suture wire along with the surfaces of the longitudinal slots on the bush. It is likewise advisable to provide the magazine with means for periodically turning the bush by an interval corresponding to the spacing of two adjacent slots so as to bring the bush from one of its working positions to the other, the recess for a length of suture wire being in fact an extension of the die guide groove in either of the working positions.

It is desirable, with a view to providing the periodic turning of the bush, that the cylindrical casing be mounted with a possibility of a limited rotary motion
with respect to the body and be spring-loaded in the direction of limiting of its rotation.

It, is also advantageous that the casing be provided with a ratchet pawl adapted to interact with the slots of the bush to provide a unidirectional turn of the latter with respect to the casing, as well as with an open-ended slot made in the lateral wall and narrowing towards the die.

One of the edges of the slot is inclined with respect to the generating line of the casing and adapted for interacting with the pushrod in such a way that when said edge interacts with the end of the pushrod, moving along the slot of the bush in the direction of expelling a length of suture wire, a turn of the casing with the ratchet pawl with respect to the bush occurs, while the return of the pushrod to the initial position and its coming off the slot of the bush is followed by a turn of the spring-loaded casing alongside with the bush.

The construction of the proposed instrument makes it possible to apply auxiliary sutures to interbronchial, tracheobronchial and metatracheal anastomoses established in a sphenoid resection of the bronchus without exerting the cartilaginous ring of the bronchus or trachea, whereby the sutures applied beforehand remain intact.

The instrument also enables suturing in deeply located and narrow places of the operative field.

Moreover, the proposed instrument is likewise applicable in cases where use is made of the already known instruments, e.g., in applying sutures on soft tissues.

In what follows, the present invention is illustrated by the description of a preferred embodiment given with reference to the accompanying drawings, wherein:

FIG. 1 is a general, fragmentarily cutaway view of a surgical instrument, for stitching up tissues with lengths of suture wire, according to the invention;

FIG. 2 is an enlarged-scale sectional view taken along the line II—II in FIG. 1;

FIG. 3 is an enlarged-scale sectional view taken along the line III—III in FIG. 2;

FIG. 4 is an enlarged-scale sectional view taken along the line IV—IV in FIG. 2;

FIG. 5 is a schematic view of the pushrod end, die and suture wire shown at the final stage of the suture application procedure, according to the invention;

FIG. 6 is an enlarged-scale view of the pushrod end, die and casing, according to the invention;

FIG. 7 is an enlarged, perspective view of the forward end of the inventive instrument for stitching tissues (corresponding to the lower portion of FIG. 1, as shown); 1, the surgical instrument

Now referring to FIGS. 1 and 2, according to the invention, for stitching up tissues with lengths of suture wire, has a body 1 made as a stem whose operative end carries a die made as a curved needle 2 provided with a guide groove 3 located on the concave portion of the curved section of the needle 2 and adapted for bending a length 4 (FIG. 2) of the suture wire while being ejected along the guide groove 3. The length 4 of suture wire is essentially a straight stem whose end 5 is pointed while the other end 6 is blunt. The body 1 comprises a magazine for the lengths 4 of suture wire, which is slidable along the body 1 and is made as a bush 7 having longitudinal slots 8 (FIG. 3) on its outer surface.

The bush 7 is enveloped by a cylindrical casing 9 so as to be free to turn inside said casing, the inner surface of the latter forming, together with the surfaces of the longitudinal slots 8 on the bush 7, recesses 10 (see FIG. 3) to accommodate the lengths of suture wire. The cylindrical casing 9 has a flange 11 with an annular recess (FIG. 2), wherein is accommodated a ratchet pawl 13 (FIG. 3) rotatable around a pivot 14, and a spring 15 acting upon a tailpiece 16 of the ratchet pawl 13, whereby a tip 17 of the ratchet pawl 13 passes through an aperture 18 in the cylindrical casing 9 to rest against the lateral wall of the slot 8 in the bush 7.

A rod 19 is coupled with the body 1 (FIG. 2), said rod carrying a handle 20 with two holes 21 (FIG. 1) for the surgeon's fingers. A spring 23 (FIGS. 1, 4) is held to the rod 19 (FIG. 2) with a screw 22 to turn the casing 9 into the working position. The vacant end of the spring 23 engages a slot 24 (FIG. 3) in the flange 11 of the cylindrical casing 9.

The turn of the casing 9 under the action of the spring 23 is limited by a pin 25 (FIG. 2) locked in with the casing 9 and adapted to interact with a pin 26 locked in with the rod 19. See elements 25, 26 in FIG. 7. The latter has a longitudinal two-step slot 27 (FIG. 4); the width of a first step 28 of the slot 27 is equal to the width of a pushrod 29 (FIG. 2) fixed on a hollow rod 30 provided with a ring 31 (FIGS. 1, 2) for the surgeon's finger. The rod 30 along with the pushrod 29 is movable along the body 1 towards the die, i.e., the needle 2.

The width of a second step 32 (FIG. 4) of the slot 27 is equal to that of a projection 33 (FIG. 2) on the pushrod 29, as well as to the width of the slot 8 in the bush 7 of the magazine and to that of the groove 3 of the needle 2. With the instrument in the operative or working position, the second step 32 of the slot 27, the groove 3 of the needle 2, and one of the slots 8 of the bush 7 are at the same level. The pitch of turn of the bush 7 is equal to the spacing of the slots 8 (FIG. 3).

Provided at the operative end of the pushrod 29 (FIGS. 2, 3), near a flat 34 on the projection 33 (said flat portion being adapted to interact with the butt of the blunted end 6 of the length 4 of suture wire) is a curved guide groove 35 adapted for final bending of the length 4 of suture wire upon its coming off the guide groove 3 of the needle 2.

The cylindrical casing 9 (FIG. 6) has an open-ended slot 36 made in the lateral wall thereof and narrowing towards the needle 2, one of the edges 37 of said slot being inclined with respect to the generating line of the casing 9 so that said edge 37 intersects with the end of the pushrod 29 moving along the slot 8 in the bush 7 (FIG. 3) in the direction of ejecting the length 4 of suture wire, so that a turn of the casing 9 occurs together with the ratchet pawl 13 with respect to the bush 7.

The return of the pushrod 29 (FIG. 6) and its coming off the slot 8 is followed by a turn of the casing 9 along 3), the bush 7, effected by the spring 23 (FIG. 3) until the pin 25 (FIG. 2) engages the pin 26. The narrow portion of the slot 36 (FIG. 6) is equal in width to the pushrod 29. The stroke of the pushrod 29 towards the needle 2 is limited by a wedge block 38 (FIG. 1) resting against a bevelled surface 41 of the rod 30, said wedge block being fixed in place on the handle 20 with a screw 39 and travelling together with said handle along a slot 40 of the hollow rod 30. A guard 43 is held with a screw 42 on the hollow rod 30 (see FIGS. 1, 7).

The operation of the surgical instrument for stitching up tissues 44 (see FIG. 5) with the lengths of suture wire is as follows.
With the instrument in the initial position, the body 1 with the needle 2 and the pushrod 29 with the hollow rod 30 and the ring 31 assume a position wherein all these components are withdrawn as far as possible from the needle 2. In that position, the projection 33 (FIG. 2) of the pushrod 29 is off the slot 8 of the bush 7, while the pushrod 29 is outside the slot 36 of the cylindrical casing 9.

The slot 8 (FIG. 2) of the bush 7, accommodating the length 4 of suture wire, is matched with the second step 32 of the slot 27. The length 4 of suture wire is prevented from falling out from the slot 8 by the projection of the cylindrical casing 9 formed by the edge 37 (FIG. 6) of the narrowing slot 36. The wedge block 38 (FIG. 1) is set to a position wherein it limits the stroke of the pushrod 29 to the required length.

In case of application of an auxiliary suture to bronchial anastomosis, the needle 2 is introduced into one margin of the tissue 44 (FIG. 5) being sutured and is brought closer to the other margin, while in case of stitching up soft tissues both margins 44 are pricked onto the needle 2. Then the surgeon presses down the handle 20 (FIG. 1) and the ring 31 with his fingers to move the pushrod 29 towards the needle 2.

The pushrod 29, upon entering the narrowing slot 36 (FIG. 2), rests against the length 4 of suture wire, drives it forward and exerts pressure upon the edge 37 (FIG. 6), thus turning the cylindrical casing 9. At the same time, the tip 17 (FIG. 17) of the ratchet pawl 13 comes out from the slot 8 of the bush 7 and, after the end of the pushrod 29 (FIG. 6) has come out from the casing 9, the tip engages the next slot 8 of the bush 7.

As the pushrod 29 (FIG. 6) keeps moving the length 4 of suture wire passes along the groove 2 to get bent as shown in FIG. 5. Having pierced the tissue being sutured, the bent end of the length 4 of suture wire catches the guide groove 35 and, as a result of further motion of the pushrod 29, the wire length 4 gets completely bent into a ring.

When the handle 20 (FIG. 2) and the ring 31 are drawn apart, the pushrod 29 is retracted from the needle 2, and once the projection 33 of the pushrod 29 has come out from the slot 8 of the bush 7, the spring 23 (FIG. 3) exerts pressure upon the wall of the slot 24 to turn the cylindrical casing 9. At the same time, the ratchet pawl 13 turns the bush 7.

As a result, the pin 24 (FIG. 2) rests against the pin 26, i.e., the bush 7 is turned through a distance equal to the spacing of the slots 8 in the bush 7. Then the needle is extracted from the tissue. The instrument is now ready for applying the next suture.

What is claimed is:
1. A surgical instrument for stitching up tissues with lengths of suture wire, comprising: a body in the form of a stem; a handle provided at one end of said body and a die at the other end, said die having the form of a curved needle with a guide groove provided in an inner concave portion thereof and serving to push the lengths of wire therealong; a rotatable magazine for the lengths of wire, freely mounted on said body; a pushrod reciprocably mounted with respect to said body; and a projection of said pushrod having a flat portion for engaging a length of the wire, and a curved groove therein for the final bending of the length of wire after it has left said guide groove; said pushrod pushing out the length of the wire from said magazine during its movement toward said die, pushing it along said guide groove, and bending it to form a ring.

2. The surgical instrument as defined in claim 1, wherein said magazine includes a rotatable bush with spaced-apart longitudinal slots on its outer surface; a rotatable cylindrical casing enveloping said bush and forming recesses together with said slots for the lengths of suture wire; and means for periodically turning said bush by a distance corresponding to the spacing between said slots, and for periodically turning said casing to its initial position.

3. The surgical instrument as defined in claim 2, wherein said turning means includes a spring and pins for limiting the rotation of said casing with respect to said body; further comprising a ratchet pawl made fast on said casing, interacting with said slots and effecting the combined turning of said bush and said casing in one direction; and wherein said casing has in its lateral wall an open-ended slot narrowing toward said die; one of the edges of said open-ended slot being inclined for interaction with said projection to turn said casing to a position when said pawl engages one of said slots of the bush.

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