ABSTRACT: The invention is a suture with needle end, cord of latch notches, and latch collar end. The latch collar has a latch passage therethrough. The needle followed by latch notches is pulled through the tissue and the needle followed by a selective number of latch notches is continued on through the collar latch passage and severance is then made above the last notch pulled through the latch collar as it thus is latched on the tissue surface to complete a stitch much more quickly than can be done by conventionally tying a suture knot.
SUTURE APPARATUS AND METHODS

The invention relates to suture stitches and to a suture comprised of a needle end, a suture cord of latch notches and a latch collar. In order to avoid the lead notches may be completed, the latch collar and last latch notch pulled therethrough completing the suture knot, severance above said last latch notch then being made of the leading latch notches and the needle.

Hereinafore, in conventional surgery, time is required to tie the suture knot as a stitch is completed. Especially is time saving essential for the completion of surgery stitches and seams where, in heart surgery, quick application of the heart lung machine is involved. Where suture slippage can be involved, it is often necessary to tie as many as six half hitches in each knot, and where such time requirement per stitch can be so greatly reduced by substituting therefor the time required to snip a latch cord between latch notches of this invention, it can be seen how a great contribution to surgery is herein involved.

Thus, primarily in detail the invention has object of providing a suture and method of making sutures which involves a very substantial time saving per stitch since the suture, comprising latch collar from which extends the suture cord of latch notches with needle in lead can be employed to complete a stitch with needle from tissue, followed by latch notches, being passed through the collar latch passage and the suture cord (and needle) then being severed as by snipping the cord just above the last latch notch that has been pulled through the latch collar.

Also, the invention has the broad primary object of providing a suture, complete with needle, which self latches with its latch collar to complete a stitch, the needle and leading notches being detached by snipping the latch cord above the last latch notching pulled through the latch collar.

Additionally, the invention has as its other broad primary object, the provision of a method of suture stitching in which the suture is latched with itself to complete a stitch, the leading part (needle and leading latch notches) then being detached to leave a completed stitch.

Furthermore, the invention has as an important object the provision of a self-latching suture with needle, and with suture cord and latch collar of resiliently yieldable material, the suture cord severance above the selective latchng notch requiring minimum time consumption.

Additionally, the invention has as another object the provision of a method of suture stitching in which a unitary suture is lead through tissue and out therefrom through the suture rear to latch with, the lead part beyond the latch then being severed to leave a completed, unencumbered, firmly latched stitch.

Other and further objects will be apparent when the specification herein is considered in connection with the drawings, in which:

FIG. 1 is an isometric view of suture apparatus as comprised in one embodiment of the invention;
FIG. 2 is an isometric view of the latch collar end and of part of the needle and latch notch portion of another embodiment of the invention;
FIG. 3 is an elevational view of the latch collar end and of part of the needle and latch notch portion of still another embodiment of the invention;
FIG. 4 is an elevational view of the latch collar end and of part of the needle and latch notch portion of yet another embodiment of the invention;
FIG. 5 is an elevational view of the latch collar end and of part of the needle and latch notch portion of still a further embodiment of the invention;
FIG. 6 is an elevational view illustrative of the initial or needle insertion step employing any one of the forms of the invention disclosed in FIGS. 1-5, inclusive;
FIG. 7 is an elevational view illustrative of the following step after that shown in FIG. 6, in which latch notches are pulled through after the needle;
FIG. 8 is an elevational view of the following step after that shown in FIG. 7, in which the needle is followed by latch notches passed through the latch collar;
FIG. 9 is an elevational view of the following step after that shown in FIG. 8, in which the latch collar is approximated over the seam to be stitched, prior to pulling the last selective latch notch through the latch collar;
FIG. 10 is an elevational view of the final step after that shown in FIG. 9, with the stitch completed by latch collar and selective latch notch, and the outer latch notches and needle removed; and
FIG. 11 is an enlarged sectional elevational view of a portion of the latch collar and latch cord indicative of the manner in which a latch stitch is completed.

Referring now in detail to the drawings in which like reference numerals are applied to like elements in the various views, suture apparatus 10 is shown in FIG. 1 comprised of a needle 11 arched from the plane of the latch cord 12 in direction of incision with piercing point 13 outermost and widening to a needle base 14 which is connected to the outermost portion of a chain 15 of successive latch notches 16, a conventional rivet 27 being shown for this purpose in FIG. 1. Also and additionally, the outermost portion of the latch notch chain 15 may be bonded to the needle base.

Each latch notch 16 has a base or latch leg 17, which extends normal to the flat latch strip 18 in the direction of incision, with the hypotenuse side 19 of each individual latch notch 16 extending angularly along a taper or slope to the latch strip 18 at the base leg of the next outwardly latch notch 16. At the end of the latch notch chain 15, the flat strip 20 extends as a connector to a junction 23 with a latch collar 21. The latch collar 21 is shown in FIG. 1 of block form, with a latch opening 22 formed therethrough on the side opposite the junction 23.

Beyond the needle 11, the whole suture apparatus or cord 12 may be integrally formed, including the latch collar 21, of a plastic material as polyvinyl chloride, polyethylene and the like whereby the latch cord 12 possesses some substantial degree of resiliency. As formed, the opening 22 is of larger cross-sectional area on the under side 24 of the latch collar 21 than on the upper or outer side 25, or thus the sides of the opening 22 may extend with a degree of taper from under side to outer side.

Suture apparatus 10a, FIG. 2, provides latch notches 16a in form of truncated tetrahedral pyramids, the uppermost notch 16a being connected by a plastic or resilient material connector 28 to a needle base 14a. Also a connector 20a comprising an integral part of the resilient material or plastic latch cord 12a is provided to connect the latch notch chain 15a and the latch collar 21a. In this view the opening 22a through the latch collar 21a may be tapered from an opening of larger cross-sectional area on the under side, not shown, to an area of smaller cross-sectional area at the top side of the latch collar. Optionally the opening 22a may be of uniform cross-sectional area from under side to top side.

Making reference now to FIG. 3, suture apparatus 10b is provided with latch notches 16b in form of frustocones, with the upper end of the latch notch chain 15b connected by means of a resilient material or plastic connector 28b to the base 14b of a needle, both connector and needle base being of the same round cross section in area. The lower end of the latch notch chain 15b is shown connected by a conveniently formed connector 20b, of the same resilient material or plastic, to the latch collar 21b. Particularly, as shown in FIG. 3, the connector portion 29a, is of round cross section the same diameter as the latch notch base from which it extends, while the connector portion 29b merges to a flattened cross section and of the contour shown.

Notably, in FIG. 3, the latch collar 21b is of frustoconical shape, with the base lowermost. The opening 22b through the latch collar may be of cylindrical shape, or tapered with the opening 22b of slightly greater lowermost diameter than needle base 14b and connector 20b, and of slightly lesser upper-
most diameter than these elements. In FIG. 3, the opening 22b has been expanded, thus to receive the connector 28b therethrough, and the opening must be expanded to receive the latch notches 16b therethrough. This is possible since the latch collar 21b is of a resilient, flexible, deformable, or plastic material, the latch cord 12b also being of the same material.

As shown in FIG. 4, suture apparatus 10c shows needle base 14c and connector 28c, of same outer diameter, with the latch notches 16c of latch notch chain 15c being in the form of a truncated tridimensional pyramids. A connector 28c has portion 29c, of diameter to circumscribe latch notch base, extending from lowermost latch notch 16c; the portion 29c merging into a connector portion 29d, of flattened cross section, and of the contour shown in FIG. 2, to connect with the underside of the latch collar 21c. The latch collar 21c is also shown to be in the form of a truncated tridimensional pyramid with base downwardly.

The opening 22c through the latch collar is indicated as being of round cross section, and such opening may preferably be tapered with uppermost diameter slightly less than the diameter of the needle base 14c and connector 28c and with the lowermost diameter, not shown, of slightly greater diameter than these elements.

Suture apparatus 10d, FIG. 5, is constructed and of part sizes comparable to the suture apparatus shown in FIG. 3, with the exception that the latch notches 16d are of spheroid shape. The connector 20c between the lowermost spheroid center plane and the latch collar 21d, is connected to such lowermost half-spheroid by a round or cylindrical connector portion 29e which merges into connector portion 29f of flattened cross section as connected with the latch collar 21d, and of configuration shown in FIG. 5. Also, as in FIG. 3, the latch collar 21d, FIG. 5, is shown to be in form of a frustocone with opening 22d to receive first the needle point, then needle base 14d, then connector 28d, and then selective latch notches 16d of the latch notch chain 15d therethrough. Thus, it is preferable that the opening 22d be tapered from uppermost diameter slightly less than the diameters of connector 28d and needle base 14d, and with lowermost diameter slightly greater than the diameters of these elements. Thus the needle point may be passed through the latch collar opening 22d, and the opening stretched to admit the needle base 14d, connector 28d, and the selective spheroid latch notches 16d therethrough.

It is characteristic of all of the forms of invention shown in FIGS. 1—5, inclusive, that all of the elements below the needle base are of the same material, as a treated rubber, or as a resilient, yieldable or deformable material, as a plastic, Only the needle should be of a rigid material, and there can be plastics capable of being hardened to form a serviceable needle to which a connector or uppermost latch notch may be bonded or otherwise connected. The needle bases shown in FIGS. 2—5, inclusive, may be connected to the respective connectors therebelow, as by bonding interfitted abutting needle base and connector ends, as by employing fluid epoxy resin to harden as a bonding agent. In these FIGS., structural variations made to interfitted needle base and connectors for bonding are not shown, it only sufficing to indicate diagrammatically at 30 that bonding is made. Also minute rivets may be used, as indicated in FIG. 1.

Noticeably, it may be possible that the entire suture apparatus or complete stitch element or structure may be fabricated at the same time of plastic, the plastic of the needle being adapted to harden into, or being preformed of, a portion of rigidity and strength to serve as a fulcrum of a needle in piercing the flesh or tissue, and in guiding or leading the suture cord through the tissue on each side of the incision and through the latch collar. This is within the realm of capabilities of plastics, and also such needles can be constructed in manner not to shred off any portion thereof to leave the wound unclean.

Reference is now made to FIGS. 6—10, successively, the steps of making a suture stitch may be visualized. First the needle 11 is inserted with point 13 to pierce into the skin or surface layer of a surgery patient 31. The point 13, with the curved needle thereafter, is moved downwardly through the flesh or tissue 32b to extend across the incision 33 at some spaced distance below the surface or dermic layer. Then the needle point is moved upwardly so that the point 13, arched in direction of incision, pierces the dermic layer of skin surface of the patient at some distance spaced from the point of needle puncture upon entry. See FIG. 6.

Then the needle is drawn through dermic layer, tissue and/or flesh, across to extend up through tissue and/or flesh, and out through the dermic layer, pulling the leading latch notches 16 therewith. Next the needle 11 and leading latch notches 16 are pulled through the last or outward skin puncture from the tissue and/or flesh below, and all of the needle and part of the latch notches are thus free from the patient's body. (FIG. 7).

Next the needle, as freed, and the leading latch notches 16, are passed through the opening 22 in the latch collar 21. As the opening 22 is tapered, at least through one side thereof, as will be hereinbelow described, each latch notch 16 is contracted in passing through the upper end of the opening 22, then to extend to normal position with the latch leg 17 to rest upon the latch collar top surface 24, as shown in small scale in FIG. 8.

FIG. 9, to slightly larger scale than FIGS. 6—8, shows the suture or latch cord 12 being grasped by a pliers or pulling tool type of forceps 34 as a finger 35 pushes down upon the latch collar 21, thus forcing the latch collar toward a flat position with under side 25 in contact upon the dermic layer 36 of the patient 31, as the last of the selective latch notches 16 pulled through the latch collar 21.

Finally, FIG. 10 shows the completion of a stitch, with the latch collar 21 bridging across the incision 33, as its under side 25 seats on the dermic layer 36 on either side of the incision. Thus the latch or suture cord 12 extends from its junction 23 down inwardly through the flesh or tissue 32 and across the incision 33 inwardly of the dermic layer, then outwardly through the flesh or tissue 32 and through the dermic layer 36 and latch collar opening 22 with the last notch 16 to be pulled through the latch collar latching upon its upper surface 24. Slightly above this latchning notch 16 the latch chain 15 has been severed, and the leading latch notches and the needle in advance thereof are not shown. Thus these members, not shown in FIG. 10, may be assumed to have been removed and/or expended.

Refering now to FIG. 11, the latch collar 21 and latch notch chain 14 are shown in part, and to enlarged scale, with the relationship of the opening 22 and latch notches 16 thus being shown in substantially graphic detail. As the latch notches 16 are pulled through the flesh and dermic layer, these members tend to contract. Also, as the latch notches 16 are successively pulled into the entrance through the under surface 25 of the latch collar 21, up through the opening 22, as it is tapered to a smaller cross-sectional area outlet through the top or outer surface 24 of the latch collar, the latch notches are successively contracted. The notch that has just been pulled clear of the opening 22 extends outwardly to assume its original shape so that the leg 17 of the latch notch 16 seats upon the top or outer latch collar surface 24 to complete a stitch. As the latch notches, outwardly of the latch notch 16 atop the upper surface 24 of the latch collar 21, have no further function, the latch chain 15 may be severed, as along the severance line 37, FIG. 11, and the outer latch notches and needle retention latch 14d are expended, as aforesaid.

Noticeably in FIG. 11, each latch notch 16 is shaped so that the leg 17 straightens out and overextends the top surface 24 of the latch collar 21 when such particular latch collar has just been pulled upwardly completely to pass through the opening 22. The same theory of construction obviously applies to the forms of invention shown in FIGS. 2—4.

It often happens that incisions of substantial length and depth have to be made, as for instance, in heart surgery, as to install a heart pump, or in heart replacement. Since it is so
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vital that after installation, the incision must be sewed up as quickly as possible, an invention of the kind hereinafore disclosed may be extended into apparatus for enabling a plurality of stitches to be completed in quickest order to extend all around a lengthy incision as hereinafore referred to.

In this case the latch collar may be constructed to straddle the whole, or a substantial part of, the length of an incision and have a multiple of latch openings provided therein in spaced relation therearound. A suture cord with expendable needle may be provided to be passed through each opening. Apparatus of this type can thus result in a greatest time saving where time is of the greatest essence in sewing up the incision after an operation, as for purposes hereinafore described.

The invention sets out to provide surgical apparatus which will enable the quick sewing up of an incision, for the length thereof, by use of a plurality of devices each providing the structure for a suture stitch in such relative disposition and arrangement, as to the parts thereof, that each suture stitch may be made in the briefest time.

A number of separate structural embodiments are shown and described. In this regard it is set forth that the structures shown are greatly exaggerated in scale, whereas it is most important that the latch notches are small enough, (not much larger in dimension than conventional suture cords in diameter), that they do not force too large a passage through the flesh or tissue. Still there must be enough area of the latch notch lower surface to overextend the latch collar outwardly of the latch chain or core of the latch cord, that the latch chain, including the latching notch, may not be pulled back through the latch collar.

Such a number of satisfactory forms and embodiments are shown as to demonstrate that still other embodiments may be included within the extent of the invention. In addition to the drawings and hereinafore disclosure, the claims appended hereto complete the application by claim definition.

I claim:

1. A suture including a needle and a unitary, resilient, self-latching suture cord having successively after the needle, a succession of latch notches, a connector portion, and a latch collar from which the connector portion extends, the latch collar providing a shaped notch passage therethrough with the latch collar yielding resiliently to permit latch notches following the needle to be pulled in selective number through the latch passage and with said latch notches being resiliently yieldable and shaped so that the last notch pulled through the latch collar returns to initial shape and relative position to latch cord and to latch upon latch cord upper surface.

2. A suture as claimed in claim 1 in which said suture cord between said latch notches is easily severse whereby the needle with leading notches may be detached by severance above said last notch.

3. A suture as claimed in claim 1 in which said latch notches are of truncated, tetrahedral, pyramidal shape with bases downwardly.

4. A suture as claimed in claim 1 in which said latch notches are of truncated conical shape with bases downwardly.

5. A suture as claimed in claim 1 in which said latch notches are of truncated trihedral, pyramidal shape with bases downwardly.

6. A suture as claimed in claim 1 in which said latch notches are of flattened spheroid shape.

7. A suture as claimed in claim 1 in which said latch notches are of substantially triangular cross section with bases downwardly and extending on one side of the latch cord.

8. A suture as claimed in claim 1 in which said latch notches are of substantially triangular cross section with bases downwardly and extending on one side of the latch cord, in which the needle puncture end is arched to the same side as that to which the notch bases extend, and in which the base end of the needle is bonded with the lead end of the latch cord.

9. A suture as claimed in claim 1 which is comprised of a resilient plastic material.

10. A suture as claimed in claim 1 in which the latch cord connector is of flattened cross section.