SUTURE RING FOR HEART VALVE

A seamless suturing ring of textile material for a heart valve which has a cylindrical collar with a portion extending radially outwardly therefrom provided with formed openings for suturing to the heart tissue and a peripheral selvage edge.
SUTURE RING FOR HEART VALVE

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of my application Ser. No. 541,789 filed Apr. 11, 1966, now abandoned.

BACKGROUND OF THE INVENTION

As a result of disease processes, the valves of the heart become incompetent and blood regurgitates or "leaks" back against the general direction of flow of the circulation. Artificial valves are now manufactured which may be used to replace the natural valves of the heart. These artificial valves are replaced in the heart by suturing the valves into the heart.

In installing such an artificial valve, the surgeon removes a certain amount of tissue which form the natural valve and then secures the artificial valve by sewing it to living tissue. This invention deals primarily with the suture or sewing ring which is attached to the valve by means of which the valve is sewed into the heart.

In some cases the suture or sewing ring which provides a radially outstanding skirt is trimmed by scissors or some sharp instrument, and such a trimming often releases small particles which may become a serious effect on life if they get into the bloodstream. Sometimes attempts are made to fuse the edge of the synthetic material to attempt the stopping or fraying of the edge of the material. Such fusing will prevent the blood from circulating through pores of the suture ring which circulation is desirable.

There are also problems involved in the securing of the suture ring to the valve which may allow blood to get into parts where it does not circulate.

SUMMARY OF THE INVENTION

A knit fabric which is fashioned into a suitable shape and heat shrunk into a tight porous construction. The fibers from which the fabric is formed are Dacron or Teflon.

Registered Trademark for a fluorocarbon fiber, or some fibers which will be compatible with the human body. The fiber must have properties of non-toxicity and carcinogenic resistance to degenerative change in the human body and must resist biological degradation and have a high degree of flexibility, pliability and durability under long term stressing and also non-wettability to prevent clotting of the blood.

The general form of the suture ring will be that of a cylindrical collar with an outer diameter greater than the diameter of the collar. The collar will be used for attachment to the valve and the outstanding ring will be provided with openings greater than the pores of its general extent through which needles and sewing materials may be placed more easily for attachment to the natural tissues of the body. A selvage will be provided around the peripheral edge of this outstanding suture ring so as to provide a better holding means for the sewing which passes through the openings in the skirt and also will prevent fraying of this edge in a non-unnecessary fusing which would block the porosity of the openings through the fabric.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of the suture ring;
FIG. 2 is a perspective view of the valve;
FIG. 3 is a perspective view of the suture ring and valve attached;
FIG. 4 is an enlarged plan view of the knitted fabric in the skirt area containing the holes for the sutures;
FIG. 5 is a sectional view of a fragmental portion of the valve body on a larger scale and showing an initial step for securing the suture ring in place;
FIG. 6 is a view similar to FIG. 5 showing the suture ring inserted in the channel of the body of the valve;
FIG. 7 is a view similar to FIG. 6 but illustrating a modified form in that the channel is at an angle to the valve body different from that shown in FIG. 6;
FIG. 8 is a perspective view of a modified form of suture ring;
FIG. 9 is a sectional view illustrating the suture ring of FIG. 8 attached to a modified form of valve body showing the prongs of the cage passing through holes in the collar portion of the suture ring.

FIG. 10 is a view similar to FIG. 9 but showing the suture ring attached in a slightly different way;
FIG. 11 is a perspective view of a still further modified form of suture ring;
FIG. 12 is a perspective view of the suture ring of FIG. 11 attached to the valve body which is shown broken away.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIGS. 1-7 of the drawings, 10 designates generally the seamless suture ring which is a one-piece knitted material from some suitable fiber such as above mentioned and which may, for example, be taken as Dacron. It is knitted in one circular piece and fashioned to shape and then heat shrunk to provide a cylindrical collar portion 11 from one edge of which a skirt 12 extends radially outwardly from the collar to an extent. A plurality of sets of openings are provided at radially spaced locations one of which is a row close to the peripheral edge 14 of the suture ring with other sets of rows spaced therefrom. The peripheral edge 14 is in a selvage form to prevent fraying of the edge of the suture ring 12 and also to support the sewing which may pass through the openings.

A plurality of rows or sets of openings are formed at 15, 16 and 17 circularly of the skirt 12, and as shown in the enlarged diagrammatic view of FIG. 4, these openings are formed by casting off one needle on to another at spaced intervals which is here shown as every other needle circularly about the fabric with the holes in the rows being formed in staggered relation. The row 17 is adjacent the selvage which selvage is reinforced by passing a plurality of strands 18 through the knitted loops at the edge and also to hold the opening 17 intact. A helical strand 19 may be wrapped around the plurality of strands 18 as shown in FIG. 4 to provide a stronger selvage. This would be a hand operation. The outer set of openings 17 are about 1 millimeter from the edge, while a second set of openings 16 are formed about 5 millimeters inwardly from this selvage, and the third row or set of openings 15 are provided a further 5 millimeters inwardly from the selvage, although these distances may be varied.

This provides a non-bulky selvage edge which gives good support to the threads when the needles are passed inwardly close to this selvage edge or inward of the strands 18. The first row of suture holes 17 are formed by hanging the yarn on every other needle. The next row of stitches will push through old loops and unloop all of the openings to form a new row of stitches on adjacent needles. The suture holes 16 are provided inward of the selvage edge by casting one loop 20 over the other loop 21 to have two loops 20, 21 on every other needle and leaving every other needle without a loop. When the needle bed is passed over, the empty needle will pick up a new loop 22 to continue with the uniform loop effect.

A valve is designated generally 25 (FIG. 2) and is usually formed of metal or plastic which is compatible with the human body having a ring 26 in the form of a channel providing inner wall 27 and outer wall 28 with a bridging portion 29 leaving an opening 30 between the walls. Fingers 31 extend upwardly from the bridging portion 29 and are curved inwardly and joined at their upper ends to provide a ball retaining cage such as illustrated. The valve is in the form of a ball or sphere 32 and is usually formed of some resilient material such as silicone latex or silicone rubber. It provides a seal against the curved inner edge of the ring 26 although it may move off of this seat in order to permit the passage of fluid, such as blood, as the pumping heart action occurs.

The suture ring 19 is attached to the valve body 25 by first inserting a soft ring 35 of silicone latex material or a material similar to the valve 33 into the opening 30 between the walls 27 and 28, which will be in a soft pliable state. The collar 11 is then inserted in the channel 30 as seen in FIG. 6 which will force the silicone latex 35 now designated as 36 about the collar as seen in FIG. 6 and will cause it to impregnate the collar and will completely fill the opening in the channel leaving no
chance for any blood to enter. This silicone latex ring and the collar thus completely fills the channel and cements the collar into the channel, leaving the skirt 12 extending radially outwardly from the body as seen in FIG. 3.

The ring 26 as shown in FIGS. 2, 5 and 6 in some instances may be arranged as shown at 26’ in FIG. 7 so that the walls 27’ and 25’ will be at an angle of substantially 45° to the general axis of the valve rather than parallel to the axis as shown previously. By this arrangement the height of the collar is less than shown in FIG. 1.

In some cases the suture ring designated as 40 in FIG. 8 may have additional openings 41 formed in the collar 42 in a similar manner to that as above set forth except that the openings will be larger, by casting one loop to the right and the next loop to the left, so as to accommodate the prongs of the cage. Further the cage 25’ will have the prongs 31’ spaced at their upper ends as at 43 so that the ends 44 of these prongs may be passed through the openings 41 in the collar. In FIG. 9 the collar 42 is placed inside the ring 26’ of the valve body, the prongs are passed thru the openings 41 and the upper edge of the collar 47 is turned outwardly over the ring 26’ and sewed as at 48 to the skirt 49 of the suture ring. In FIG. 10 the collar 42 is placed along the outside of the ring 26’, the prongs 31’ are passed thru the openings 41 and the collar is turned inwardly as at 50 and sewed to the skirt 49 as at 51.

In FIG. 11 the suture ring 55 is formed with spaces 56 at intervals dividing the collar 57 into quarter segments 58, and this collar 57 is passed thru the spaces between the prongs 31 or 31’ and doubled over as at 59 and sewed to the skirts as at 60. The edges of the segments 58 are selvedged.

In cases where the collar of the suture ring extends over the upper edge of the ring such as 26’, the ball valve 32 will contact the edge of the suture ring which covers the annulus 26’, thus covering all of the base of the caged valve.

In some cases the suture ring may be made of a velour fabric which is done by using two plied yarns of Dacron twisted together. One end may be of 140 denier which is twisted and heat set and then untwisted. The other end may be of 250 denier of regular yarn not heat set which is plied with the first yarn above mentioned by twisting. The two plied Dacron yarns are then knitted, after which they are heat shrunk at 260°F. which will cause the unshrunk yarn to shrink and raise the preshrunk yarn into small loops which provide a velour material with a silky feel which it is found to facilitate in growth and attachment of the heart tissues or inhibits growth of the heart tissues to it.

The suture ring will be formed in a size which in most instances will not need to be trimmed. However, with the plurality of sets of openings spaced at different radial distances, a trimming may be had by cutting circularly the row before the holes of a set of openings, and by reason of this knitted construction, the edge will still be locked together and no frayed edge will appear.

By provision of a knit material such as this, there are sufficient number of pores or openings so as to permit circulation of blood through these pores which assist in preventing clotting and also allow tissues to grow therethrough and assist in holding the valve in place. Likewise as the fabric is all in one piece, clotting is prevented and also by reason of the blood being completely blocked from entering the channel by which the suture ring is secured to the valve clotting is prevented.

However, experiments heretofore have shown that a knitted fabric is only textile construction possessing the desired elasticity although this has the inherent structural characteristic of running or forming "ladders" of drooped stitches whenever one or more of its constituent loops are ruptured. By reason of the knitted construction above described, it is possible to prevent a reasonable degree of runs or ravel.

1. A suting ring for connecting an artificial heart valve body with the heart tissues by sutures comprising a one-piece textile fabric having a cylindrical collar of single thickness for surrounding a portion of an artificial heart valve body and having a fashioned skirt portion of a single-thickness periphery radically outstanding from the cylindrical collar axis to a substantial extent from said collar and at an angle thereto with a selvage peripheral edge to prevent fraying, said skirt portion having a plurality of annularly disposed holes of a size larger than the porosity of the fabric mesh with said holes disposed inwardly from the peripheral selvage edge thereof.

2. A suturing ring as in claim 1 wherein said ring is seamless.

3. A suturing ring as in claim 1 wherein said ring is seamless and formed of textile fibers knitted together.

4. A suturing ring as in claim 1 wherein the textile fabric is a velour to assist in the growth of heart tissues thereto.

5. A suturing ring as in claim 1 wherein said collar has slits extending axially thereof for purposes of attachment to an artificial heart valve.

6. A suturing ring as in claim 1 wherein said collar has preformed enlarged openings for the passage of cage prongs of an artificial heart valve therethrough.

7. A flexible suture ring as in claim 1 wherein said fabric skirt has one loop cast over the next loop adjacent each of said holes whereby in the case of rupture running will stop at the holes.

8. A heart valve comprising a valve body having an axially outwardly opening channel, a movable valve member contained in said body, a flexible suturing ring for connecting said valve body with the heart tissues by sutures, said suturing ring having a cylindrical collar connected to said valve body by said collar extending into the open channel of the body and adhesive means completing the filling of said channel holding and sealing said collar therein, said ring comprising a one piece textile fabric of a single thickness throughout having a fashioned skirt portion periphery radically outstanding from the cylindrical collar axis to a substantial extent from said collar and at an angle thereto with a selvage peripheral edge to prevent fraying, said skirt portion having a plurality of annularly disposed holes of a size larger than the porosity of the fabric mesh with said holes disposed inwardly from the peripheral selvage edge thereof.