RETENTION SUTURE BRIDGE

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References Cited
UNITED STATES PATENTS
1,852,098 4/1932 Anderson..................... 128/335


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ABSTRACT

This invention is a retention-suture bridge designed to position and secure a retention-suture above and out of contact with an incision closure and suture exit points while maintaining lateral fixation of the suture at the points where it exits the skin, and thus effectively join the corresponding tissue layers, approximate the original marginal pressure of the skin and underlying tissues, and ultimately prevent or reduce infection and scarring.

22 Claims, 18 Drawing Figures
RETENTION SUTURE BRIDGE

In large abdominal incisions, successful closure generally requires in addition to skin sutures at the exposed outer layers, the use of transverse tension sutures, usually designated stay or retention sutures, which are drawn through both sides of an incision, passing through numerous layers of tissue, such as fascia, fat, muscle, etc., so as to join each layer to its appropriate counterpart and to hold severed tissue in juxtaposition. After closure the incision area usually has certain swelling owing to edema caused by the physical and chemical trauma of surgery, thus causing tightening of the sutures. Body movement or muscular strain is likely to place additional tension in the sutures.

In the typical cases where the sutures are allowed to maintain contact with the skin under them, the strain and swelling results in increased suture tension, with the suture impressing itself deeply into the skin causing redness of erythema, infection which slows or otherwise impairs healing, necrosis of tissue cells and/or increased scarring and cross-hatching.

Various techniques and devices have been used in attempts to obviate these problems. Initial attempts involved loose tying of sutures to allow for swelling, but this left the incision not fully and securely closed. In one class of devices widely and currently used, a section of rubber catheter tubing is cut to a length the same as the distance between suture exit points, with the exposed portion of each suture threaded through the bore of a cut section. Such devices have the disadvantage of failing to maintain lateral fixation, because the flexible tubing buckles, with the additional problem mentioned above, of pressure contact by the tube along its length against the skin and particularly at the exit points. Rigid tubes of fixed and varying length have been used; however, they also bear along their length upon the skin surface, causing cross-hatch scarring of considerable extent. Flat pieces of wood, metal and plastic of fixed length with notches in opposite ends have also been employed, but these have the same disadvantages as rigid tubing. Another class of devices employs an arch with short notches in opposite ends of its length. This device makes contact with the skin near the suture exit points and throughout its length with the resulting pressure, irritation, and scarring. A variation of this technique involved a higher arch connecting two feet on opposite sides with long notches located in its feet on opposite ends directed toward each other. These notches transect the entire foot, and the points where they stop provide a fixed distance. To the extent that these latter devices actually contacted the suture exit points, danger resulted of secondary infection caused by such contact, and the use of notches at the ends of such a device did not allow for variation of the distance between suture exit points or variation in the distance between suture-receiving points. Also, such notched devices are usable only on the class of sutures known as figure-of-eight sutures, wherein the suture defines a lower and an upper loop; such sutures form a lower loop about deep layers of tissue, with the suture ends extending outward from the skin in diverging directions for forming the upper loop. The device cooperates by pulling these suture ends in diverging directions which tightens the lower loop, but allows the upper part of the incision within the upper loop to remain loose or open with both a single loop or figure-of-eight suture arrangement.

It is therefore a prime object of the present invention to provide an improved suture retention device. It is a further object of the present invention to provide an improved surgical suture retention device which does not contact the incision area or the suture exit points. It is a still further object of the present invention to provide an improved surgical suture retention device which can accommodate a variety of distances between suture exit points without irritation of the skin at the suture exit points. It is another object of the present invention to provide an improved surgical suture retention device which provides a high degree of stability and a construction admitting of positive body contact.

The foregoing objects are carried into effect by a surgical retention device structured as a bridge formed by an arch with feet on opposing ends. In use, each end of a suture extends upward from the skin, and is engaged at respective spaced points on the arch by appropriate suture-receiving means, or specific suture-engaging elements forming part of the arch. The distance between the points on the arch at which the sutures can be received is adjustable as desired for the various length and type of suture used. The entire device makes contact with the skin only at the feet lateral to the suture exit points.

In the preferred embodiment, several engaging means exist on each side of a one-piece device so that the sutures can rise upward directly to appropriate points on the bridge, even though the exit points from the skin may be relatively close or wide-spaced. This adaptability precludes the need for bridges of varying size. In a further embodiment, a two-piece device is raised off the skin at the central portion, and contains at least one suture receiving means on either piece. The pieces are fittable with each other so as to provide varying distances between the suture receiving means. Across the central portion of the arch the suture ends are directed toward each other, and tied together after both are pulled snugly to create sufficient tension to draw skin and underlying tissue on opposite sides of incision together.

In another embodiment, there is provided means on the bridge for adjusting tension of the suture after it is tied. In a further embodiment, there is a suture guide means for stabilizing the portion of the suture situated atop the bridge.

The feet provided are preferably wider than the bridge area and generally circular in shape, covered with a suitable compressible material and angulated for firm and stable contact with the underlying skin area.

The foregoing objects and brief description of the invention, as well as, further objects and advantages of the invention, will become more apparent from the following detailed description of preferred and alternative embodiment of the invention wherein:

FIG. 1A is a perspective view of a preferred embodiment of a suture bridge in accordance with the invention.

FIG. 1B is a cross-sectional view of the preferred embodiment of FIG. 1A.

FIG. 1C is a perspective view of a modification of the device of FIG. 1B.

FIG. 1D is a perspective view of another embodiment thereof.

FIG. 2 is a fragmentary plan view of a bridge.

FIG. 3 is similar to FIG. 2 with a different suture engaging means.
FIG. 4 is a perspective view of a flat bridge with a tension-adjusting means for the suture. FIG. 5 is similar to FIG. 4 with a different tension-adjusting means.

FIG. 6 is similar to FIG. 4 with another tension-adjusting means.

FIG. 7 is a perspective view of a bridge with a suture-hooking means.

FIG. 8 is a partial perspective view of a bridge with a suture-guide means.

FIG. 9 is similar to FIG. 8 with a different suture-guide means.

FIG. 10, 11, 12 and 12a are perspective views of four embodiments of a two-piece suture bridge constructed in accordance with this invention.

FIG. 13 is an elevation view of a bridge with pivotable feet.

FIG. 14 is a perspective view of a pair of bridges with a stabilizer element.

With reference of FIGS. 1A, 1B, 1C, a bridge 10 is shown, having a length of span capable of extending over an incision 12 located in tissue layers 14, as shown schematically in FIG. 1B. The bridge is constructed of a central portion 16, terminating at opposite ends thereof with rounded feet members 18 and 20. The feet members 18 and 20 have body parts that are wider than the central portion 16 in a direction extending across the central portion 16.

The bridge 10 is arched along its length with a curvature suitable for maintaining the central portion 16. Each foot has a junction-end attached to one end of the central portion and an opposite terminal end, out of contact with the skin 14. The planes of the feet portions 18 and 20 extend substantially along the curve described by the arch of the central portion 16 or along a slightly flatter curve defined by a greater radius of curvature which corresponds to certain surfaces of the body when a bridge of this type is applied. The planes of the feet portions intersecting at an obtuse angle of less than 180° such as about 135° in FIG. 1B, under portions of the feet 18 and 20 are each covered with a suitable spongy material 22 and 24 for softening contact between the feet and the skin.

The central portion 16 includes a plurality of equally spaced apertures 26A, B, C, D and 28A, B, C, D on each side of the center 30. As shown, three or more apertures are present upon each side of the center, in greater or lesser proportions and spacings. The apertures receive exposed suture ends directly from the suture exit points in the skin surrounding the incision. The variation in number and position of the apertures permit the bridge to be used on many different incision closures despite considerable variation in the location of suture exit points about the incision. Thus, the sutures can be extended vertically or angled upward from the suture exit points to corresponding apertures, or if the sutures are convergent resulting from a single loop closure, the sutures would be angulated as they approach the bridge. If a figure-of-eight suture loop is chosen, then the suture ends would diverge before engaging the apertures. In each case the suture ends are maintained above and out of contact with the incision and the tissue between and adjacent the exit points. Consequently contact and irritation to this tissue is minimized or eliminated, with a corresponding reduction of necrosis, infection, swelling, and scarring.

Cleaning of the now-exposed incision area is possible, healing is hastened, and the patient's discomfort is greatly reduced.

Thus, by way of example in FIG. 1B, a suture 13 passes about the incision 12 and emerges at suture exit points 13A and 13B. The respective exposed suture ends emerge through these exit points, pass through the apertures 26D and 28D which are spaced apart by a selected distance, respectively positioned in the central portion 16 of the bridge 10 directly or at least generally above the suture exit points 13A and 13B. The single inventive bridge unit is thus shown to permit use of all of the foregoing suture techniques as well as to accommodate the various suture exit point distances. In all of the uses, the bridge never comes into contact with the incision or a suture exit point.

The angle which the feet portions 18 and 20 present to the horizontal plane is a further aid. Tensioning of the suture about an incision 12 causes a certain natural bulge in the skin area 14 about the incision. The angulation of the feet combines with the forced curvature of the skin to make the flat under portion of the surface 22 and 24 to the skin 14. The relatively even mating of the under portion of the surface 22 and 24 to the skin 14 aids in maintaining stability of the bridge by distributing the bridge pressure substantially evenly over the entire area of the feet, and prevents the bridge from slipping, as well as, distributing the pressure of the bridge over a greater skin surface area, thereby facilitating comfort. Also the natural direction of the pressure applied by the feet 18 and 20 to the skin 14 further aids in closing the incision 12 and thereby promotes healing.

The apertures of FIGS. 1A and 1B are preferably formed and separated by tapered segments 30 having cylindrical cross-sections, and thus narrower on the bottom and wider across the center, thus facilitating ease of threading and presenting a rounded surface to the suture.

The dome center piece 32 serves to strengthen the central portion 16 of the bridge as well as providing, through the use of a suture tunnel, the central aperture 34, a convenient point to tie off the suture. The suture tunnel 34 is preferably tapered and the suture tie knot 35 made at the exit from the smaller opening. The smaller opening prevents the suture tie knot 35 from slipping through.

The interior edges of the central portion 16, those closest to the skin, are rounded to soften skin contact. It is noted that the spongy pads 22 and 24 may be omitted, and that the slight difference in angle between the feet 18 and 20 and the central portion 16 will still maintain the curved central portion 16 above and out of contact with the skin surface 14.

Summarizing the operation of the invention by way of example in surgical procedures, a suture connected to a needle is sewn into selected tissue layers about an incision, on one side thereof, to a desired depth with respect to the incision and merges on the opposite side, thus forming the suture into at least a partial loop having a closed end and limbs extending therefrom. The suture limbs extend generally upward through exit points in the tissue on adjacent sides of the incision, with the exit points being at preselected and observable distance apart. A corresponding distance is determined.
between selected apertures in the suture bridge, which is now placed over the incision so that the sutures may pass, for example upward through the appropriate apertures 26 and 28 in the bridge 10. Ease of threading is accomplished by the tapering of the aperture separations 30 such that the apertures are larger on the interior surface. Each aperture location serves as a holding point to maintain the suture limb elevated above and out of contact with the exit point, the incision, and tissue between and adjacent the exit points. The limbs are directed toward each other, with one of the suture ends passing through the tunnel in the dome 32 on the top surface of the bridge to meet the other suture on the other side. Threading through the tunnel 34 is facilitated by a tapering of the tunnel 34, wider where suture 13 enters. The suture ends are tied to one another at the point of exit from the tunnel so that the tie knot 35 rests over the end of the tunnel with the smaller hole. The feet of the suture rest firmly on the skin lateral to the exit points. The base of the feet apply the pressure of the bridge equally to skin at all points owing to the angulation of the skin upwards toward the incision from tension and corresponding angulation of the feet downwards in a lateral direction. If the feet were horizontal, only the inner part would contact the skin. The bridge itself can be made of any suitable surgical material. Preferably, the bridge is molded as an integral unit from a suitable plastic such as methyl methacrylates which may be chemically sterilized, or from a polypropylene which can be sterilized in an autoclave.

In the embodiment of FIG. 1C, the apertures are replaced by tapered holes, having the same function as the apertures. In the embodiment of FIG. 1D, the feet portions 36 and 38 are joined to the central portion 40 of the bridge by means of vertical upstanding portions 42 and 44.

Referring now to FIG. 2, the suture engaging means are slots 46 running transversely with respect to the longitudinal axis or the length, of the bridge and located within the central portion of the body member 48. The suture may be received and retained by selected slots disposed above the suture exit points, or as close as possible thereto, and out of contact with the skin. The slots may be provided with an orthogonally positioned notch 50 for securing the suture against lateral slippage, as shown in FIG. 3.

It is understood that the curvature of the central portion of the bridge is designed for the purpose of maintaining the suture engaging central portion out of contact with the underlying skin area. The central portion containing the suture engaging or receiving means can itself take any desired shape provided the remainder of the central portion of the feet portions together cause the suture engaging or receiving central portion to occupy a position suitable raised from the skin surface so as to be out of contact therewith.

Thus, as shown in FIG. 4, the suture retention means of the bridge central portion is flattened as a beam having width considerably greater than height (similarly in FIGS. 1–12), and includes a first group of pegs 52 formed at the side of the support surface 53 and another peg 54 formed on top of the surface 53. The suture 55 is positioned in a desired pair of the suture receiving slots 56 and by selective positioning about the pegs 52 and 54 can be adjusted in tension as desired. The same effect can be accomplished by providing a plurality of pegs 58 atop the slotted surface 53 as shown in FIG. 5.

Referring to FIG. 6, a further embodiment of a suture tensioning structure is shown having a superstructure 60 atop the slotted surface 53. The superstructure is provided with a plurality of parallel grooves 62 running the length of the superstructure and adapted to receive the suture 55. By placement of the suture in different grooves, the desired tensioning may be achieved.

Adjustment of the sutures can be accomplished with the structure shown in FIG. 7. The slotted surface 53 is provided with edge pegs 64 and top pegs 66 for tensioning, as described in connection with FIGS. 4 and 5. Upon one or preferably both sides of the pegs is provided a rabbetted groove 68. The depth of the groove is sufficient to permit insertion of a hook shaped tool 70 which can raise the suture 55 and place it wherever desired tensioning dictates.

The protrusion 32 shown in FIG. 1A, and useable for anchoring or captively holding the suture, can be formed in different ways. In FIG. 8, the peg or protrusion 72 is an upright cylinder around which the suture 55 ties. In FIG. 9, the suture anchors to the post 74 which is formed of a domed post top and a rectangular slab lower section formed on or mounted to the surface area 76 of the bridge. The undercut area of the peg permits the suture to be tied off without the danger of slippage.

In FIGS. 10, 11, 12 and 12A, a further embodiment of the bridge is shown wherein the adjustable distance between suture receiving means can be effected with only a single suture receiving means located on either side of the bridge center. Specifically, the bridge 78 includes first and second end segments 80 and 82 which can include the feet portions at the outer ends as for example described in FIG. 1A and 1D. Each end segment includes one suture receiving means which may be in the form of slots 84 and 86 respectively, as shown in FIG. 10 and 12, or as apertures 88 as shown in FIG. 11. The upper portion 80 shown in FIG. 10 attaches to the lower portion 82 at variable points 90 by virtue of mating strips and rabbeted grooves. Positive fit can be assured by providing dovetailed mating, or the units can be formed with rounded or rectangular grooves and mating strips and attached by some suitable means such as tape, rubber straps, adhesive and the like. In FIG. 11, the attachment is accomplished by formation of a channel 92 running the length of the left hand piece 91, and having transverse slots 94 in the upper portion thereof. Corresponding pegs 96 can have a press or interference fit into a selected slot 94, thereby adjustably determining the distance between the suture receiving apertures 88.

A further arrangement is illustrated in FIG. 12 wherein a saw tooth pattern 98 in mating segments provides the adjustability of distance between suture receiving points 84 and 86. The segments can be secured together by the means discussed above, such as rubber bands 104; the two segments can be made as telescoping or threaded members such as tubes as shown in FIG. 12a.

A further embodiment, that is applicable to both one-piece and two-piece bridges as in FIGS. 1C and 10
respectively, is flexible feet. The junction 18a in FIG. 1C may be flexible, or this junction may be formed as a pivot 18c in FIG. 13. This feature permits the feet to accommodate different shapes while maintaining the exposed suture out of contact with the closure.

In use, the suture retaining bridges are usually employed in a series, FIG. 14 shows a plurality of bridges 106, 108 positioned above on incision 110, with the slight angulation between feet portion 112, 114 and the arched portion of the bridge; bar 116 may be used to engage and stabilize the various bridges with respect to each other and to the underlying skin.

The foregoing embodiments are intended as exemplary only, and various further modifications as well as permutations and combination of the foregoing described embodiments will be apparent to those skilled in the art without departure from the spirit and scope of the invention as defined herein.

I claim:

1. A bridge device for use with a retention suture looped about an incision, the suture thus partially below the surface of the skin with two exposed end parts of the suture extending out of and above exit points in the skin, the bridge device (described with reference to a side elevation view) comprising a longitudinal central portion defining length, transverse breath, a bottom surface, and two ends, and a foot portion at each end of the central portion, each foot portion defining a body part with a junction-end connected in abutment to one end of said central portion of the bridge, a terminal end opposite the junction end, and a contact surface extending along the bottom of the foot, the bottom surfaces of the central portion and junction ends being flush at said abutment connection, said feet being oriented such that the entire contact surface of the body part and terminal end of each foot is lower in elevation than the entire bottom surface of the central portion of the bridge, the bridge further comprising at least two suture receiving means spaced a selected distance apart lengthwise on said central portion, said suture receiving means each adapted to engage said exposed suture end part (extending upward from an exit point) at a contact point along its length, said receiving means thus maintaining said contact points of said exposed suture end parts apart by said selected distance, said contact surfaces of the feet being totally outward of said suture receiving means on the central portion, whereby the bridge is placeable upon the skin with its longitudinal axis generally transverse to the incision, the exposed parts of the suture being extendible from said exit points to said suture receiving means and secured upon said central portion, thus maintaining the exposed parts above the exit points out of contact with the skin.

2. A device according to claim 1 wherein the central and feet portions comprise a one-piece construction.

3. A device according to claim 2 wherein the suture receiving means comprise longitudinally spaced-apart slots disposed transversely with respect to the longitudinal axis of the central portion, the suture ends being receivable and retained apart in and by selected slots.

4. A device according to claim 2 wherein the suture receiving means comprise a plurality of openings spaced apart longitudinally along the central portion, the suture ends being receivable and retained apart in selected openings.

5. A device according to claim 1 wherein the bridge comprises two complementary portions, relatively adjustable axially.

6. A device according to claim 1 wherein said contact surfaces are generally flat and continuous.

7. A device according to claim 1 wherein said central and feet portions of the bridge define a generally crescent-shaped arch.

8. A device according to claim 7 wherein said central portion is curved thus defining a first radius of curvature, and wherein a circle tangent to said feet portions would define a slightly greater radius of curvature.

9. A device according to claim 1 wherein said end portions and central portions of the bridge together comprise a generally flat beam which is curved to define a generally flat plane, a cross-section of the beam having greater width transverse to the plane than height within the plane.

10. A device according to claim 1 wherein said suture-receiving means comprises at least one pair of suture-receiving elements spaced apart and defining a line that extends between and through them lengthwise on said central portion.

11. A device according to claim 10 wherein said suture-receiving means is formed by at least two apertures in said central portion.

12. A device according to claim 1 wherein said obtuse angle is about 145°.

13. A device according to claim 10 further comprising suture guide means on said central portion intermediate said suture-engaging elements.

14. A device according to claim 13 wherein the suture guide means captively engages the suture.

15. A device according to claim 13 wherein the suture guide means is formed as a tunnel through which the suture is threaded.

16. A device according to claim 13 wherein the suture guide means is formed as a vertical peg extending up from the superior surface and around which the suture can be tied.

17. A device according to claim 16 wherein the peg is undercut at its base so that the diameter of superior portion of the peg exceeds the diameter of inferior portion of the suture is tied and secured.

18. A device according to claim 1 wherein the bridge has a flexible part between the central portion and at least one end portion permitting this end portion to pivot relative to the central portion.

19. A device according to claim 18 wherein said flexible part is a hinge joint.

20. A bridge device for use with a retention suture looped about an incision, the suture thus partially below the surface of the skin with two exposed end parts of the suture extending out of and above exit points in the skin, the bridge device (described with reference to a side elevation view comprising a longitudinal central portion defining length, transverse breath, a bottom surface, and two ends, and a foot portion at each end of the central portion, each foot portion defining a body part with a junction-end connected in abutment to one end of said central portion of the bridge, a terminal end opposite the junction end, and a contact surface extending along the bottom of the foot, the bottom surfaces of the central portion and junction ends being flush at said abutment connection, said feet being oriented such that the entire contact surface of
the body part and terminal end of each foot is lower in elevation than the entire bottom surface of the central portion of the bridge, the bridge further comprising at least two suture receiving means spaced a selected distance apart lengthwise on said central portion, said suture receiving means each adapted to engage said exposed suture end part (extending upward from an exit point) at a contact point along its length, said receiving means thus maintaining said contact points of said exposed suture end parts apart by said selected distance, said contact surfaces of said feet being totally outward of said suture receiving means on the central portion, the bridge further comprising means on said central portion adjacent said suture receiving means for engaging a part of the suture secured thereon and varying the tension in said suture while the suture remains secured, whereby the bridge is placeable upon the skin with its longitudinal axis generally transverse to the incision, the exposed parts of the suture being extendible from said exit points to said suture receiving means and secured upon said central portion, thus maintaining the exposed parts above the exit points out of contact with the skin.

21. A device according to claim 20 wherein the means for varying tension comprises a plurality of upstanding projections on an upper surface of the bridge, the suture being selectively positionable about at least one projection.

22. A bridge device for use with a retention suture looped about an incision, the suture thus partially below the surface of the skin with two exposed end parts of the suture extending out of and above exit points in the skin, the bridge device (described with reference to a side elevation view) comprising a longitudinal central portion defining length, transverse breadth, a bottom surface, and two ends, and a foot portion at each end of the central portion, each foot portion defining a body part with a junction-end connected in abutment to one end of said central portion of the bridge, a terminal end opposite the junction end, a contact surface extending along the bottom of the foot, the bottom surfaces of the central portion and junction ends being flush at said abutment connection, said feet being oriented such that the planes extending generally along the two contact surfaces of said feet intersect and define between them an obtuse angle that diverges downward with the entire contact surface of the body part and the terminal end of each foot being lower in elevation than the entire bottom surface of the central portion, the bridge further comprising at least two suture receiving means spaced a selected distance apart lengthwise on said central portion, said suture receiving means each adapted to engage said exposed suture end part (extending upward from an exit point) at a contact point along its length, said receiving means thus maintaining said contact points of said exposed suture end parts apart by said selected distance, said contact surfaces of the feet being totally outward of said suture receiving means on the central portion, whereby the bridge is placeable upon the skin with its longitudinal axis generally transverse to the incision, the exposed parts of the suture being extendible from said exit points to said suture receiving means and secured upon said central portion, thus maintaining the exposed parts above the exit points out of contact with the skin.

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