A surgical tube for aiding severed nerves to join, composed primarily of a slow-dissolving material and having small, discrete areas which dissolve faster. These discrete areas may be provided by particles of a different, faster-dissolving material that are embedded in the tube wall, or by a greatly reduced thickness of the tube wall itself at these areas.

7 Claims, 13 Drawing Figures
APPARATUS FOR AIDING SEVERED NERVES TO JOIN

BACKGROUND OF THE INVENTION

Severed nerves in the human body sometimes grow and heal after the nerve ends are brought into alignment and close proximity, or direct contact, with each other.

In U.S. Pat. No. 2,127,903 to Bowen, it has been proposed to heal a severed nerve by suturing the nerve ends and anchoring a sheath of absorbable animal membrane around them.

SUMMARY OF THE INVENTION

The present invention is directed to aiding severed nerve ends to join by holding them end-to-end inside a slow-dissolving tube that, however, has small, discrete areas that dissolve relatively soon to leave small openings which permit body fluids to contact the nerve ends inside the tube and promote the growth and healing process.

Accordingly, it is a principal object of this invention to provide a novel and improved apparatus for aiding severed nerve ends to join.

Another object of this invention is to provide such an apparatus which comprises a slow-dissolving tube for receiving the severed nerve ends which has small, discrete areas that dissolve much sooner than the rest of the tube so as to provide openings that enable body fluids to contact the nerve ends inside the tube.

Further objects and advantages of this invention will be apparent from the following detailed description of several presently-preferred embodiments, shown in the accompanying drawings in which:

FIG. 1 is a perspective view of a surgical tube in accordance with a first embodiment of the present invention;

FIG. 2 is a perspective view showing the FIG. 1 tube between two severed nerve ends that are to be joined;

FIG. 3 is a perspective view, partly broken away for clarity, showing the severed nerve ends inserted into the tube;

FIG. 4 is a longitudinal section taken along the line 4-4 in FIG. 3;

FIG. 5 is a view similar to FIG. 3 and showing the tube after its small, discrete, fast-dissolving areas have dissolved in the body, but before the slow-dissolving principal part of the tube has dissolved;

FIG. 6 is a perspective view of a second, T-shaped embodiment of the present surgical tube having a transverse stem for applying vacuum to the interior of the tube where the severed nerve ends are received;

FIG. 7 is a longitudinal section taken along the line 7-7 in FIG. 6;

FIG. 8 is a perspective view of a Y-shaped surgical tube receiving the severed nerve ends, with a transverse stem as one leg of the Y, in accordance with a third embodiment of this invention;

FIG. 9 is a longitudinal section through the FIG. 8 surgical tube;

FIG. 10 is a perspective view of a different form of generally Y-shaped surgical tube in accordance with a fourth embodiment of this invention;

FIG. 11 is a longitudinal section through the FIG. 10 tube;

FIG. 12 is a perspective view of a fifth embodiment of the present surgical tube, having aligned, transverse inlet and outlet stems; and

FIG. 13 is an enlarged longitudinal section through a wall of a surgical tube which has small, discrete areas which dissolve relatively rapidly because they are thin, in accordance with another embodiment of this invention.

Before explaining in detail the disclosed embodiments of the present invention, it is to be understood that the invention is not limited in its application to the details of the particular arrangements shown since the invention is capable of other embodiments. Also, the terminology used herein is for the purpose of description and not of limitation.

DETAILED DESCRIPTION

Referring first to FIGS. 1-4, the surgical tube shown there is a cylindrical tube 20 having open opposite ends 21 and 22 into which the severed nerve ends 23 and 24 can be inserted slidably. The inside diameter of the tube is slightly greater than the diameter of the nerve ends to permit such slidable insertion to be performed quickly and easily. After the nerve ends are inserted into the tube, the opposite ends of the tube preferably are sealed with medical sealing material, as shown at 25 and 26 in FIGS. 3 and 4.

For most of its extent the tube 20 has a wall thickness and a composition, such as animal tissue, such that it is dissolved, absorbed or digested in the human body relatively slowly. For example, it may take six months for the complete wall thickness of the tube to be completely dissolved.

In accordance with the present invention, the tube 20 is provided with small, localized, discrete areas that are dissolved, absorbed or digested by the body much more rapidly than the principal part of the tube. For example, these localized areas may dissolve completely in about 24 hours.

In the embodiment of FIGS. 1-5, these small, discrete areas are provided by discrete particles 27 of a relatively fast-dissolving material, such as sugar which are embedded in the tube wall and occupy the full thickness of the tube wall at these small areas. After a relatively short time in the body, these particles dissolve completely, leaving small discrete openings 27a in the surgical tube, as shown in FIG. 5. These small, discrete openings permit the passage of body fluids into contact with the nerve ends inside the tube to enhance the healing action as the severed nerve ends gradually join together. After this healing process is fully completed, or substantially so, the principal material of the surgical tube 20 also dissolves completely in the body.

As shown in FIG. 13, the fast-dissolving, small, discrete areas of the surgical tube may be provided by thin-walled web portions of the tube. For example, the tube wall 30 may have indentations or recesses 31 and 32 in its outside and inside faces, leaving only a thin web 33 between them that will dissolve much more rapidly than the full-thickness remainder of the tube. Alternatively or additionally, a recess or indentation 34 may be formed in only one face of the tube, leaving only a fast-dissolving thin web 35 behind it. It is to be understood that these thin web, fast-dissolving portions of the tube are made of the same material as the slow-
dissolving much thicker remainder of the tube; they dissolve faster simply because they are thinner.

As shown in FIGS. 6 and 7, the present surgical tube 20 may be T-shaped, with a transverse, serrated stem 40 midway between its opposite ends. This stem has a central passage 41 communicating with the interior of the tube where the nerve ends are received. The stem may be attached to a hose, indicated in phantom at 42 in FIG. 7, to enable vacuum to be applied to the interior of the tube while the nerve ends 23 and 24 are being inserted, as so to draw them into direct contact or close proximity with each other. After this has been done, the nerve-receiving opposite ends 21 and 22 of the tube are sealed by medical sealing material 25 and 26, and after removal of the vacuum hose 42 at the end of the stem 40 may be closed by such sealing material, also.

The stem 40 is of the same construction as the tube proper, being composed primarily of a slow-dissolving material and having small, discrete particles 27 of the fast-dissolving material.

FIGS. 8 and 9 show another embodiment of this surgical tube in which the severed nerve ends are received in straight legs 20a and 20b of the tube which are inclined at an obtuse angle to each other. The transverse, serrated stem 40 is joined to these legs 20a and 20b at the intersection between them so as to provide with them a Y-shaped surgical tube. Both legs 20a and 20b and the stem 40 have small, discrete particles 27 of the fast-dissolving material embedded in them.

FIGS. 10 and 11 show another embodiment which is generally similar to that of FIGS. 8 and 9, except that it has opposite, nerve end-receiving legs 20c and 20d which curve toward each other and merge together smoothly where the stem 40 is connected to them. Both legs 20c and 20d and the stem 40 have small, discrete particles 27 of the fast-dissolving material embedded in them.

FIG. 12 shows yet another embodiment whose configuration is as disclosed and claimed in my copending U.S. pat. application, Ser. No. 258,737, filed June 1, 1972, now U.S. Pat. No. 3,786,817. In this embodiment straight tube 20 is provided with two longitudinally spaced, transverse stems 50 and 51 having central passages 52 and 53, respectively, which communicate with the nerve ends that are inserted into the opposite ends 21 and 22 of the tube. One of these stems serves as an inlet and the other as an outlet for filling the interior of the tube with a suitable healing ambience or substance that enhances the healing and joining together of the nerve ends during the period immediately following the insertion of the nerve ends into the tube. Both stems 50 and 51 and the remainder of the tube 20 contain small discrete particles of the fast-dissolving material. The tube ends 21 and 22 are sealed with medical sealing material after the severed nerve ends have been inserted and before the healing ambience is added. After the healing ambience has been added, the open ends of the stems 50 and 51 may be squeezed closed or closed by medical sealing material.

It is to be understood that in each of the embodiments of FIGS. 6-12, as well as in the embodiment of FIGS. 1-5, all or part of the surgical tube may have the small, discrete faster-dissolving areas provided by thin web portions of the tube wall or stem wall, in place of the particles 27 of a faster-dissolving material different from the material of which the tube is primarily composed. The slow-dissolving main body of the tube may consist of layers which dissolve successively.

1 claim:

1. Apparatus for aiding severed nerves to join comprising a tube having open opposite ends into which the nerve ends can be inserted, said tube being composed principally of a material that dissolves slowly in the body and having small discrete areas wherein which dissolve in the body substantially faster than the remainder of the tube to provide small openings for the passage of body fluids into contact with the nerve ends inside the tube, said small, discrete areas being provided by embedded bodies of a different material than the principal material of the tube which dissolves in the body faster than the principal material of the tube.

2. Apparatus according to claim 1, wherein said tube has a transverse stem leading into its interior between its ends, said stem having small, discrete areas wherein which dissolve in the body substantially faster than the remainder of the tube.

3. Apparatus according to claim 2, wherein said small, discrete areas in said stem are provided by embedded bodies of a different material which dissolves in the body faster than the principal material of the tube.

4. Apparatus according to claim 2, wherein said tube and stem together are substantially T-shaped.

5. Apparatus according to claim 2, wherein said tube and stem together are substantially Y-shaped.

6. Apparatus according to claim 1, wherein said tube has a transverse inlet stem and a transverse outlet stem spaced from said inlet stem along the length of the tube and both communicating with the interior of the tube, said stems both having small discrete areas therein which dissolve in the body substantially faster than the remainder of the tube.

7. In a surgical tube for aiding severed nerves to join together, said tube being dimensioned to receive the nerve ends in its opposite ends and throughout most of its extent having a wall thickness and a composition effective to prevent the tube from completely dissolving in the body for several days, the improvement which comprises:

means providing small, discrete areas in the tube wall which dissolve in the body substantially faster than the remainder of the tube to leave small openings permitting body fluids to pass into contact with the nerve ends inside the tube, said last mentioned means comprising small, discrete web portions of the tube wall which are substantially thinner radially than the remainder of the tube wall.

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