SURGICAL SPONGE


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ABSTRACT
A surgical sponge useful for delicate surgical procedures is made by providing a strip of nonwoven fibers which are securely bonded against delamination, and bonding a plastic retrieval thread to the surface of the strip by heat-softening a portion of the thread to cause it to flow partially into the surface of the strip. The resulting sponge may also have a band of radiopaque material bonded to its surface by heat-softening the plastic material of the band.

4 Claims, 5 Drawing Figures
SURGICAL SPONGE

BACKGROUND OF THE INVENTION

This invention relates to surgical sponges and, more particularly, to surgical sponges suitable for use in laminectomies, craniotomies, nerve surgery or other delicate surgical procedures.

It has been the practice in the above types of surgery to utilize a relatively small, thin strip of bonded nonwoven fibers as a sponge. This type of miniature sponge is necessary because of the small operating field and the delicate nature of the procedure. However, because of its size, it is necessary to attach some means, such as, a retrieval thread, to the sponges in order to insure that the sponges will not be left in the wound and to provide a "handle" for applying and withdrawing the sponges from the wound site.

Prior surgical sponges of this type utilized retrieval threads that were stitchted directly to one or both surfaces of the sponge and often, when desired, a strip of radiopaque material was combined with the thread and simultaneously stitchted to the sponge. When fabricated in this manner, the sponges were rough on both sides, in that the stitching extended entirely through the sponge. Also, the combination of retrieval thread and radiopaque material was unsafe because the accidental release of one element would result in the release of the other element, thus, rendering the sponge free of detection means and capable of being inadvertently left in the wound.

In addition, the stitching operation utilized to fabricate the sponges was necessarily a hand operation resulting in an excessively large manufacturing cost.

SUMMARY OF THE INVENTION

The disadvantages of the prior surgical sponges are eliminated by the present invention which provides a unique sponge construction comprising a strip of nonwoven bonded fibers having a plastic retrieval thread secured to one surface thereof solely by a flattened portion of the thread that has been heat-softened to flow partially into and between the fibers of the strip.

One or more bands of radiopaque material may also be bonded to the surface of the sponge in the same manner and at the same time, but at a different location, as the plastic retrieval thread.

The various elements of the sponge may be simultaneously fabricated by properly positioning the strip, plastic retrieval thread and radiopaque bands under the horn of an ultrasonic welding device and then bringing the horn into contact with the thread and bands.

Thus, in a single manipulative step, an improved surgical sponge may be fabricated which possesses numerous advantages over all known prior sponges.

For a better understanding of the invention, as well as other objects and further features thereof, reference is made to the following detailed description to be read in conjunction with the accompanying drawings, wherein:

FIG. 1 is a plan view of the surgical sponge of the present invention with portions broken away for clarity;

FIG. 2 is a cross sectional view taken along line 2—2 in FIG. 1;

FIG. 3 is a side elevational view schematically illustrating the process for manufacturing the surgical sponge shown in FIG. 1;

FIG. 4 is a cross sectional view taken along line 4—4 in FIG. 3; and

FIG. 5 is a plan view of another embodiment of the surgical sponge with parts broken away for clarity.

Referring to FIGS. 1 and 2, the preferred embodiment of the surgical sponge of this invention is shown generally at 10 and is constructed from a relatively thin strip of nonwoven fibers 11 which have been securely bonded together to prevent delamination or "lining" of the fibers. Strip 11 is preferably constructed from rayon fibers which have been carded in a well known manner and then needleloomed into sheets, which sheets are then cut into strips of the desired length and width. The rayon fibers are preferably a dull, virgin, 3 denier rayon with a nominal staple length of approximately 1-1/2 inches. This type of material has been manufactured and used for surgical sponges in the past and it has been found that, when bonded with a mixture of starch and polyvinyl alcohol, the strips will retain their integrity and the material has been tested and found to absorb in excess of 25 times its weight in water.

A retrieval thread 12 is bonded to one surface of strip 11 and comprises a flattened portion 13 which has been heat-softened to provide a secure bond between thread 12 and the surface of strip 11. As stated, above, surgical sponge 10 is primarily intended for use in very delicate surgical procedures and the operating field is considerably smaller in this type of operation than is normally found in more massive surgery. For this reason, the relatively small, thin sponges are used and a means must be provided in association with these sponges for retrieving them after they have been applied to a wound site and have absorbed a considerable amount of body fluid. Retrieval thread 12 has been provided for this purpose and the bond between the thread and the surface of strip 11 is, therefore, very important. The length of thread 12 is not critical so long as it can be placed at a sufficient distance outside the wound to be recognizable and easily handled by the surgeon and his assistants.

Retrieval thread 12 is preferably made from a continuous multifilament polyester fiber. However, it has been found that other plastic materials, such as, nylon and polypropylene will also provide a secure bond. However, the polyester material results in the best combination of end product properties, such as, strength of bond and softness of the thread.

In addition to retrieval thread 12, a pair of bands 14 and 15 composed of radiopaque material is also securely bonded to the surface of strip 11. Although two bands of radiopaque material are illustrated in the preferred embodiment of this invention, it will be appreciated that only one band may be desirable for exceptionally small surgical sponges and two or more may be utilized in larger sponges. Although numerous radiopaque materials may be usable with this invention it has been found that vinyl with barium sulfate dispersed therein is very effective and forms a very secure bond with the surface of strip 11.

The preferred method for manufacturing the surgical sponge of the present invention is an important part of the invention and will now be described in detail. Referring to FIG. 3, the procedure for heat-softening the retrieval thread 12 and the radiopaque bands 14 and 15 is schematically illustrated. In order to avoid the necessity of utilizing additional materials, such as, adhesives, and in order to eliminate the deleterious effects of the
application of heat to obtain the necessary bond between the retrieval thread 12, bands 14 and 15 and the surface of strip 11, an ultrasonic welding device has been adopted. This device is specifically described in U.S. Pat. No. 3,440,117 and comprises a radio frequency generator 20, a conductor 21 for transmitting alternating current energy at about 20 kilocycles per second from the generator 20 to a sonic converter unit 22. Sonic converter 22 is fitted with a horn 23 for transferring sonic energy to the thread 12 and bands 14 and 15. The sonic converter 22, generally, is a device which converts electrical energy to mechanical vibration and, to this end, includes one or more piezoelectric discs which vibrate under the influence of alternating current in electrical energy. The vibrations are amplified and appear as longitudinal vibration at the tip of horn 23.

In order to accomplish the simultaneous assembly of all of the elements of the surgical sponge 10, strip 11 is placed upon a support member 24 which is located directly below ultrasonic welding horn 23. Retrieval thread 12 and bands 14 and 15 are then placed upon strip 11 substantially as shown in FIG. 1. Referring to FIG. 4, the lower portion of horn 23 has been specially constructed so that a plurality of ribs 25 extend downwardly therefrom. Ribs 25 are constructed to contact only so much of the material of retrieval thread 12 and bands 14 and 15 as is necessary to sufficiently heat-soften the materials so that they will flow into the upper surface of strip 11 and form a secure bond between the material and the fibers that comprise the surface. As can be seen in FIG. 2, the action of horn 23 on the upper surfaces of thread 12 and bands 14 and 15 substantially flattens these materials and forces them into the upper surface of strip 11 and firmly bonds them to said surface.

In some instances, e.g. where a more flexible surgical sponge is desired, it has been found to be desirable to reduce the area of the bonding interface between strip 11 and retrieval thread 12. The preferred sponge construction for accomplishing this is illustrated in FIG. 5 wherein the sponge 10a comprises a strip 11a having a retrieval thread 12a bonded to the surface thereof. However, unlike the sponge in FIG. 1, the bond occurs only at spaced intervals B along the length of partially flattened portion 13a on thread 12a. The unbonded areas act as “hinges” and, thus, provide regions of increased flexibility.

In order to provide this type of bond, ribs 25 on the lower portion of horn 23 (see FIG. 4) may be longitudinally notched so that contact is made between horn 23 and retrieval thread 12a only at the predetermined spaced intervals, thus, creating a bond at only such intervals.

It will thus be apparent that the present invention provides a unique surgical sponge construction that has many advantages over the prior known sponges. By eliminating the need for stitching or utilizing adhesives, a surgical sponge can now be constructed that is completely smooth on one side for application to the wound site. In addition, the radiopaque bands may now be applied at a location different from that of the retrieval thread and thereby provide additional safety in the event that the retrieval thread is accidentally pulled away from the surface of the strip. It will also be apparent from the foregoing specification that the method of manufacturing the surgical sponge of this invention is extremely economical in that all of the parts may be assembled in one operation and no additional materials, such as, adhesives are required in the assembly of the parts.

What is claimed is:

1. A surgical sponge useful for delicate procedures comprising: a substantially flat strip of securely bonded nonwoven fibers; a plastic retrieval thread bonded to only one surface of said strip, said bond being achieved solely by a flattened portion of said thread that is interlocked with the surface fibers of said strip; and a band of radiopaque material bonded to the surface of said strip at a location different from said thread.

2. The sponge of claim 1 wherein the bond between said radiopaque material and said strip is achieved solely by the interlocking contact between said material and the surface fibers of said strip.

3. The sponge of claim 2 wherein said nonwoven fibers are rayon, said plastic retrieval thread is a continuous multi-filament polyester and said radiopaque material is vinyl containing barium sulfate.

4. A surgical sponge useful for delicate procedures comprising: a substantially flat strip of securely bonded nonwoven rayon fibers; and a continuous multifilament polyester retrieval thread bonded to only one surface of said strip, said bond being achieved solely by a flattened portion of said thread that is interlocked with the surface fibers of said strip.