

The surgical use of celluloid thread / by W.W. Keen and Randle C. Rosenberg.

Contributors

Keen, William W. 1837-1932.
Rosenberger, Randle C.
Royal College of Surgeons of England

Publication/Creation

Philadelphia : [publisher not identified], 1900.

Persistent URL

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[Reprinted from THE PHILADELPHIA MEDICAL JOURNAL, March 10, 1900.]

21 NOV

THE SURGICAL USE OF CELLULOID THREAD.¹

By W. W. KEEN, M.D., LL.D.,

of Philadelphia,

Professor of the Principles of Surgery and of Clinical Surgery, Jefferson Medical College,

AND

RANDLE C. ROSENBERGER, M.D.,

Demonstrator of Bacteriology and Normal Histology, Jefferson Medical College.

SEEING in the *Centralblatt f. Chirurgie*, for September 23, 1899, a reference to some celluloid thread recently devised by Prof. Pagenstecher, I wrote to him, asking that I might have some sent in order to test its merits. As soon as I received it I delivered it to Dr. Rosenberger, of the Jefferson Medical College Hospital Laboratory, and submit herewith the very satisfactory report made of experiments. It will be observed that both by the report and by examination of the specimens that I hand to you that the tensile strength is very great even for very small sizes, that it is very flexible and does not easily become untied, that even without any sterilization after it had been sent from Germany in an ordinary pasteboard box, handled by myself without sterilizing my hands, and by Dr. Rosenberger without any sterilization of his hands, the thread was almost absolutely sterile. (See Exp. III.)

The tensile strength is increased by almost every method of treatment for its sterilization, dry heat more than doubling it (Exp. VI), and, what is quite as important, there is, apparently, no method of sterilization which is not applicable to it. It elongates slightly, *e. g.*, 1.5 kg. elongated a piece 30 cm. long to 30.5 cm. It absorbs fluids to about 41%. This seems to be its only disadvantage (Exp. II). One silk thread absorbed more, the other less, than the celluloid thread (Exp. IX.)

In my private work and at the Jefferson Medical College Hospital, Profs. Horwitz, DaCosta, Hearn, and

¹ Read at the meeting of the College of Physicians, March 7, 1900.

I have used it with very great satisfaction thus far, though the use has been too recent to give a final opinion on its merits, especially as to the question of its absorbability. Dr. Rosenberger is now at work on some experiments as to this point, and we will be able to report the results before long.

Inasmuch as it has been used in a large number of operations by Prof. Pagenstecher (PHILADELPHIA MEDICAL JOURNAL, December 2, 1899), I have no doubt that it will prove to be a most useful material, both for suture and ligature. Compared with catgut and silk, it is much cheaper, and if it proves on extended use to be as valuable, it will go far to solve the question of the best material for sutures and ligatures.

REPORT BY RANDLE C. ROSENBERGER, M.D.

[From the Laboratories of the Jefferson Medical College Hospital.]

The material to be examined consists of a celluloid thread, grayish-brown in color, more or less smooth, and showing upon microscopic examination to consist of interwoven fibrils with smooth edges. Measured in the dry condition it takes size 29 by the B. and S. gauge (0.011257 inch).

EXPERIMENT I.

To determine tensile strength:

Pieces of raw thread 1 meter in length supported a weight of 1630 gms. The experiment was performed as follows:

1. The thread was wrapped around a gas fixture and around the handle of a bucket below. Water was poured into the bucket until the thread broke, when the bucket and contained water were weighed. The thread broke in nearly every instance about 8 inches from the handle. 2. The thread was tied to the fixture above and to the bucket below. When tied the thread broke at the knot or in its immediate vicinity.

EXPERIMENT II.

To determine absorption of fluid:

Hygrometry: Two pieces of the thread were taken, each weighing 155 mg. One piece was placed in the incubator, the other in water. The thread was dried to a constant weight in 72 hours at which time it weighed 152 mg.; loss 2%. Before weighing the piece which was soaked in water it was thoroughly mopped with filter paper to rid it of excess

of moisture. The thread immersed in water attained a constant weight in 72 hours at which time it weighed 220 mg., a gain of 41%.

EXPERIMENT III.

To determine infectivity of raw thread :

As it came from the package small pieces of the thread without previous sterilization were placed in bouillon. These were incubated, and not until 72 hours was a growth noticed. The only organism obtained was the *bacillus subtilis*.

EXPERIMENT IV.

To determine the effect of corrosive sublimate in aqueous solution :

The thread was soaked in a 1% aqueous solution of mercuric chlorid for 24 hours. At the end of this time there was no appreciable effect upon the structure of the thread and it measured 26 by the gauge (0.01594 inch.)

Influence of corrosive sublimate on tensile strength:

After soaking in a 1% aqueous solution of mercuric chlorid for 24 hours it supported a weight of 2560 gms. (Normal 1630 gms.; the application increased the tensile strength.) Immersed for 24 hours in a 1% aqueous solution of mercuric chlorid, then transferred to fluid culture-media and incubated, no growth developed.

Immersion for $\frac{1}{2}$ hour gave the same result.

Influence on gauge : A scarcely perceptible swelling.

EXPERIMENT V.

To determine the action of corrosive sublimate in alcoholic solution:

1. Tensile strength : After soaking in a saturated alcoholic solution of mercuric chlorid for 24 hours it supported a weight of 3120 gms. (Increases tensile strength.) Immersion in saturated alcoholic solution of corrosive sublimate for 15 minutes rendered the thread sterile.

Influence on gauge : Slight swelling.

EXPERIMENT VI.

To determine the action of formalin:

Tensile strength : After soaking in formaldehyde (40% aqueous solution) for 24 hours it supported a weight of 2110 gms. (Tensile strength increased.) Slight swelling.

Infectivity: Immersion in formalin for $\frac{1}{2}$ hour renders the thread sterile.

EXPERIMENT VII.

Thermal disinfection: (1) Moist heat. (a) At normal pressure. (b) Autoclave at 5 K. (2) Dry heat.

(a) At normal pressure (100° C.).

Tensile strength: After placing in a steam sterilizer for 1 hour it supported a weight of 2815 gms. (Increased) Slight swelling.

Infectivity: Sterile after one hour's exposure.

Influence of boiling: Placed in a sterile bouillon tube and boiled for 20 minutes in a water-bath and then incubated, no growth developed.

(b) Autoclave at 5 K.: After placing in the autoclave for 20 minutes at 5 kilo pressure it supported a weight of 2750 gms. Great increase (50%) in strength. Slight swelling.

Infectivity: Sterile.

(2) Dry heat: After placing in the hot-air sterilizer at 150° C for 20 minutes it supported a weight of 3590 gms. (Enormous increase in tensile strength, over 100%.) Slight swelling.

Infectivity: Sterile.

EXPERIMENT VIII.

To determine the action of other chemicals:

(a) Soaked for 24 hours in chloroform there was no appreciable change, except slight swelling.

(b) Soaked in absolute alcohol for 24 hours there was no appreciable change except slight swelling.

(c) Soaked in ether for 24 hours there was apparently no change except slight swelling.

(d) Soaked in a 1% solution of sodium hydrate for 24 hours there was no appreciable change except slight swelling.

(e) Soaked in pure nitric acid it is disintegrated in a very short time. Placed in 1% solution of nitric acid for 24 hours there was no appreciable change except slight swelling.

(f) Soaked in pure clove oil for 24 hours there was no appreciable effect except slight swelling.

(g) Soaked in equal parts of alcohol and ether for 24 hours there was no appreciable effect except slight swelling.

Remarks.—The thread shows an unusual resistance to a large number of agents. It can evidently be fully disinfected in a number of ways without being in the least injured. As dry heat notably increases its tensile strength this method is to be strongly commended.

EXPERIMENT IX.

Comparison with silk:

Specimen consists of two pieces of silk thread 20 cm. in length—one a plaited silk thread—the other twilled silk thread.

Upon microscopic examination with a $\frac{2}{3}$ inch objective the plaited thread is seen to consist of a number of fibrils interwoven or plaited together, but possessing on the whole a smooth surface. In the dried condition it weighed 210 mg., but when soaked in water it weighed 300 mg., a gain of 42.9%. The gauge by the B. and S. measurement in the dried condition was 20 (0.03196 inch), but after soaking in water it measured 18 (0.0403 inch), showing that it absorbed water which caused some swelling.

The twilled thread upon microscopic examination is seen to consist of delicate fibrils and on the whole possessing a smooth surface. In the dried condition it weighed 180 mg., when soaked in water it reached a constant weight of 220 mg., a gain of 22.2%. The gauge by the B. and S. measurement in the dried condition was 16 (0.0582 inch); after soaking in water it measured 13 (0.07196 inch), showing that it absorbed a certain amount of water with considerable swelling. In both instances when the thread was weighed after soaking it was thoroughly mopped with filter-paper to rid it of excess of moisture.

THE
Philadelphia Medical Journal
(WEEKLY)

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