

1

3,413,079

**ALKANOIC ACID AND HYDROXY ALKANOIC
ACID SALT SOFTENING OF TANNED COL-
LAGEN STRANDS**

Ernest J. Rich, Jr., Edison, N.J., assignor to Ethicon, Inc.,
a corporation of New Jersey
No Drawing. Filed Sept. 30, 1965, Ser. No. 491,887
7 Claims. (Cl. 8—130.1)

ABSTRACT OF THE DISCLOSURE

The invention involves heating an extruded collagen strand at 125° to 137° C. for 1 to about 3 hours in a solution of sodium acetate, potassium acetate, sodium or potassium lactate or the ammonium salts of acetic and lactic acid. The collagen strands are first lubricated with .4% dehydrated castor oil emulsified with .4% gelatin before the heat treatment.

The present invention relates to a method of improving the handling characteristics of tanned extruded collagen sutures.

Collagen sutures are customarily packaged in small containers containing a "tubing fluid" in a coiled or looped condition. When the surgeon opens the package and removes the sterile suture from the tubing fluid, the suture may show a tendency to kink or curl. This tendency is effected by such factors as the diameter of the collagen suture and the extent to which it is tanned, the composition of the tubing fluid, the length of time that the suture remained in the package prior to use and the radius of curvature of the suture while in the coiled (packaged) condition. This tendency of a collagen suture to kink or curl may be observed if the suture, after removal from the tubing fluid, is straightened and placed on a level smooth surface. This characteristic of some sutures and other plastic materials to return to the coiled or looped form that existed during packaging and storage, has been referred to as "memory." Collagen sutures that exhibit this "memory" effect are also too stiff and wiry for the surgeon to handle most effectively, it being particularly difficult with such material to form tight and secure knots.

Surgeons prefer the handling characteristics of a collagen strand that is limp and supple as such a strand will conform closely to soft body tissues without undue pressure and may be tied down and securely placed in the exact desired position.

It is the object of the present invention therefore, to improve the handling characteristics of extruded tanned collagen sutures.

Another object of this invention is to reduce the tendency of an extruded collagen suture to kink and curl.

In accordance with the present invention, the handling characteristics of extruded tanned collagen sutures are improved by heating such sutures that have been treated with the salt of a weak organic acid at temperatures in the range of about 125° C. to about 137° C. for approximately one to three hours. Sodium acetate is a preferred salt for purposes of the present invention, but potassium acetate, and sodium and potassium lactate and the ammonium salts of weak organic acids are also suitable. Heating a collagen suture at temperatures up to 137° C. in the absence of prior treatment of the suture with the salt of a weak organic acid improves the handling properties of the suture but has a detrimental effect on its dry knot tensile strength.

It will be understood that the foregoing general description and the following detailed description as well

2

are exemplary and explanatory but are not restrictive of the invention. In all of the examples that follow, the collagen ribbon is prepared by the method described in Example X of United States Patent No. 3,114,372.

EXAMPLE I

A collagen ribbon approximately 4 mils thick and 60 mils wide in chrome tanned and twisted into a round strand by the method described in Example I of United States Patent No. 3,189,401. The dried and rounded strand is passed through an aqueous emulsion of dehydrated castor oil having the following composition:

	Parts by weight
15 Dehydrated castor oil	0.4
Gelatine	0.4
Ammonia	0.8
Water	98.4

20 The strand is then dried by passing through an oven at 35° C. and is taken up on a drum and cut into appropriate lengths. The bundle of sutures so obtained is then allowed to stand overnight at ambient conditions. One half of the bundle is placed in an oven at 125° C. for two hours and the other half is placed in an oven at 137° C. for two hours. Samples of the material are also retained for testing without any heat setting. The dry knot strength of these samples is summarized in Table No. 1.

EXAMPLE II

Material from the same lot of collagen ribbon used in Example I is finished by passing it through the same process in which it is chrome tanned and twisted into a round strand, dried and then passed through an aqueous bath containing 3.0% sodium acetate and 0.4% dehydrated castor oil emulsified with 0.4% gelatine. The strand is then dried by passing through an oven at 35° C. and is taken up and cut into appropriate lengths. The bundle of sutures are allowed to stand overnight at ambient conditions and then one half of the bundle is placed in an oven at 125° C. for two hours. The other half is placed in an oven at 137° C. for two hours. Samples were also retained for testing without any heat setting. The dry knot strength of these samples is summarized in Table No. 1.

EXAMPLE III

Collagen ribbon is finished to form sutures by the process described in Example I. The sutures are then heat set by wrapping them in paper and placing them in an oven at 60° C. The oven temperature is then slowly increased to 125° C. over a 10-hour period and the 125° C. temperature maintained for one hour. In a similar manner, samples are heated to 137° C. and held for one hour. The dry knot strength of these samples is summarized in Table No. 1.

EXAMPLE IV

Collagen ribbons are finished to form sutures by the process described in Example II. The sutures are then wrapped in paper and heat set at 125° C. and 137° C. as described in Example III. The dry knot strength of these samples is summarized in Table 1.

EXAMPLE V

Collagen ribbon is tanned and twisted to form a round strand by the procedure described in Example II above. The sodium acetate present in the emulsion of dehydrated castor oil is replaced with an equal quantity (3% by weight) of a salt of a weak organic acid. In separate experiments potassium acetate, potassium lactate, ammonium lactate, ammonium acetate, sodium lactate and po-

tassium acetate are substituted for the sodium acetate. The dry knot strength of these samples is summarized in Table 1.

EXAMPLE VI

Collagen ribbon is tanned and twisted to form a round strand in accordance with the procedure described in Example II above. In separate experiments the amount of sodium acetate present in the emulsion of dehydrated castor oil is varied between 1% and 10% by weight. The dry knot strength of these samples is summarized in Table 1.

TABLE NO. 1

Ex.	Size	Salt used	Percent	Dry knot (pounds)		
				Non heat set	Heat set 125° C.	Heat set 137° C.
I	2/0	None		4.79	4.68	4.70
I	2/0	do.		4.80	4.96	4.76
II	2/0	NaAc.	3		5.25	5.49
II	2/0	NaAc.	3		5.19	5.18
III	2/0	None		4.8	4.6	4.4
III	2/0	do.		5.4	4.9	5.1
IV	2/0	NaAc.	3.0	5.3	5.7	5.4
IV	2/0	NaAc.	3.0	5.1	5.7	5.6
V	2/0	KAc.	3.0	5.0	5.0	4.7
V	2/0	NH ₄ Ac.	3.0	5.1	5.5	5.1
V	2/0	Na Lact.	3.0	5.7	5.6	5.3
V	2/0	K Lact.	3.0	5.2	5.2	5.7
V	2/0	NH ₄ Lact.	3.0	5.4	5.3	5.1
VI	2/0	NaAc.	2	5.28	5.55	5.39
VI	2/0	NaAc.	3	5.26		5.51
VI	1	None		9.95	8.99	
VI	1	NaAc.	1	10.01	10.05	
VI	2/0	None		4.98	4.73	
VI	2/0	NaAc.	5	5.20	5.06	
VI	2/0	NaAc.	10	5.29	4.72	

What is claimed is:

1. In the method of producing a flexible extruded collagen strand the steps of:
tanning an extruded collagen strand;
applying a solution containing the salt of a weak organic acid from the group consisting of short chain

alkanoic and short chain hydroxyalkanoic acids to the strand; and,
heating the strand at a temperature of about 125° C. to about 137° C. for from about one to about three hours.

2. In the method of producing a flexible extruded collagen strand the steps of:
tanning an extruded collagen strand;
drying the tanned collagen strand so obtained;
applying a solution containing the salt of a weak organic acid from the group consisting of short chain alkanoic and short chain hydroxyalkanoic acids to the strand;
heating the strand at a temperature below 100° C. for a period of time sufficient to dry the strand; and,
heating the strand at a temperature of about 125° C. to about 137° C. for from about one to about three hours.

3. The method of claim 1 wherein the salt is sodium acetate.

4. The method of claim 1 wherein the salt is sodium lactate.

5. The method of claim 1 wherein the salt is potassium acetate.

6. The method of claim 1 wherein the salt is potassium lactate.

7. The method of claim 1 wherein the concentration of the salt in solution is between about 1% and 5% by weight.

References Cited

UNITED STATES PATENTS

2,374,202 4/1945 Highberger et al. 8—127 XR
2,828,181 3/1958 Sookne 8—127.5

FOREIGN PATENTS

536,104 5/1941 Great Britain.

NORMAN G. TORCHIN, Primary Examiner.

DONALD LEVY, Assistant Examiner.

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,413,079

November 26, 1968

Ernest J. Rich, Jr.

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 4, line 33, "2,374,202" should read -- 2,374,201 --.

Signed and sealed this 10th day of March 1970.

(SEAL)

Attest:

Edward M. Fletcher, Jr.

Attesting Officer

WILLIAM E. SCHUYLER, JR.

Commissioner of Patents