THE SQUARE KNOT: RATIONALE OF TECHNIQUE*

A ONE-HANDED "THUMB-ROLL" MANEUVER

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INTRODUCTION

THE square knot consists essentially of loop within a loop. (Fig. 1.) Concerning its production, Livingston[1] in a masterly paper, demonstrated that it must depend, fundamentally and physiologically, on but two types of maneuvers, either:

(a) "the maneuver of ambidexterity," in which identical movements of first one, then the other hand, produce the square knot;

(b) "the maneuver of bimotility," in which a square knot is obtained when the two component ties are made by opposite motions of the same hand.

Thus a criterion may be established, namely: that the value of a knot-tying technique should be measured by the relative movements of the hands and fingers, rather than the varied relations of the cords (which in the final analysis are dependent on the former).

In other words, that procedure is best which (a) entails the least movement of the fingers and hands; (b) obviates or reduces to a minimum cumbersome motions, as crossing of the hands, and especially supination, and extension of the fingers, the awkwardness of which has been amply demonstrated;[1] (c) insures control of the tying procedure during all stages of the maneuver; (d) avoids displacement of the first simple knot (Fig. 2), which would result in a loose and insecure tie; (e) is fastest.

If the needs of the surgeon be analyzed, it becomes apparent that no one procedure, be it bimanual, one-handed, or instrumental, offers itself as the ultimate in perfection for all occasions. For the usual situation, the bimanual technique serves well. With respect to variations in this maneuver[1–8] discussion here is out of place, though the criteria presented above apply just as well; and the same general rules can be applied to the instrumental techniques[1,9–14] which are of distinct value when a "no-hand-touch" asepsis is required, etc. Also, with this in mind, it should be an easy task to ascertain the value of those methods primarily consisting of tricks[15] and flashy maneuvers with but little practical advantage.

The scope, then, of this paper lies with the technique of the one-handed knot, which has its chief value when one of the surgeon's hands is occupied with a long suture or needle-holder, a condition that not infrequently occurs.

I desire to present first the maneuver I employed—one as effective as it is simple—and then to compare it, in the light of the criteria presented above, with the one-handed procedures which have had the merit of publication.

TECHNIQUE

General Directions (of value no matter what manual procedure is employed). Mention should be made of the fact that there is no so-called one-hand maneuver which utilizes one hand exclusively; the second is absolutely necessary in tightening the knot made by the one hand, if displacement of the first knot or a loose tie is to be avoided.

In the case of a ligature, the square knot should always be tied to effect the long axis of the knot (Fig. 1) in parallel relation to the sagittal plane of the surgeon's body; or the long axis of the wound to be sutured should be in relation to the frontal plane

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of the body. For this, the surgeon may find it necessary to twist his trunk slightly.[1] The value of this is that it obviates crossing of the hands when the knot is tied, the hands moving rather toward and away from the body.

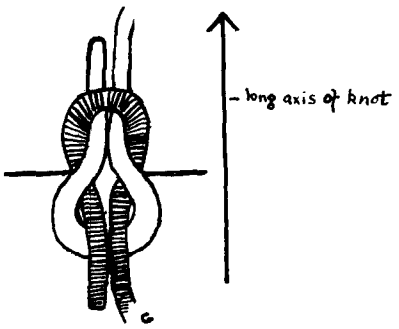

Fig. 1.

The One-Hand Thumb-Rolling Maneuver. Only the thumb and index finger are employed.

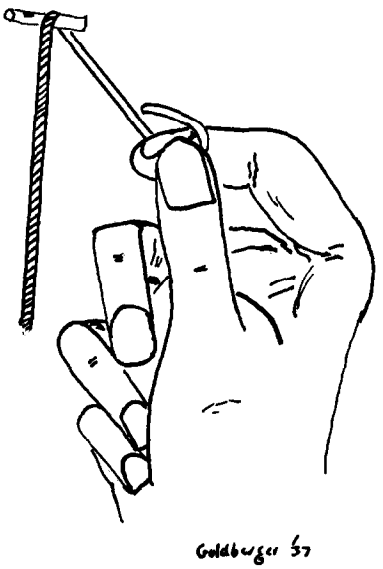

Fig. 3.

1. Grasp the short end with the thumb and index finger of the right hand. (Fig. 3.)

2. Bring the sides of the long and short ends together. (Fig. 4.)

3. Slide the thumb toward the tip of the index finger, and slide the index finger similarly, causing the short end to roll over and around the long end in a counter-clockwise direction, until a complete rotation has been effected.

4. Continuing to hold the short end between the thumb and index finger, pull the right hand away from the body, and the left toward the body slightly. This completes the first tie, a simple knot. (Fig. 5a.)

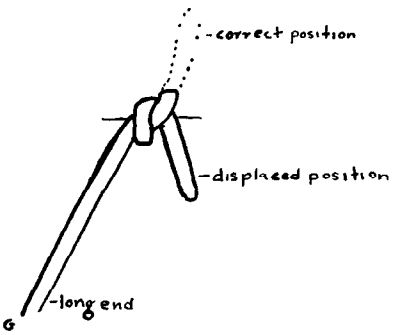

Fig. 2.

5. Twirl the index finger, with the aid of the thumb, around the short end, reversing the direction of the free end. (Figs. 5b, c.) This serves to reverse the first maneuver.

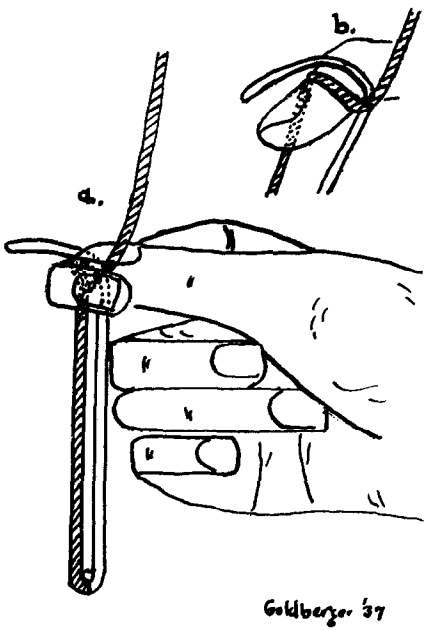

Fig. 4. A, lateral view. B, looking from above on index finger. Thumb has been raised.

6. Bring the sides together, as in step 2. (Fig. 6.)

7. Again, roll the short end counter-clockwise over and around the long end.

8. Tighten the second tie, pulling with the right hand toward the body, and with the left, away. This completes the square knot.

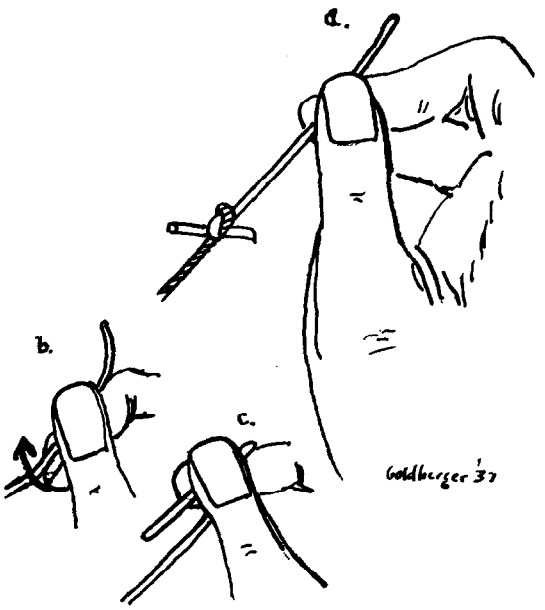

Fig. 5.

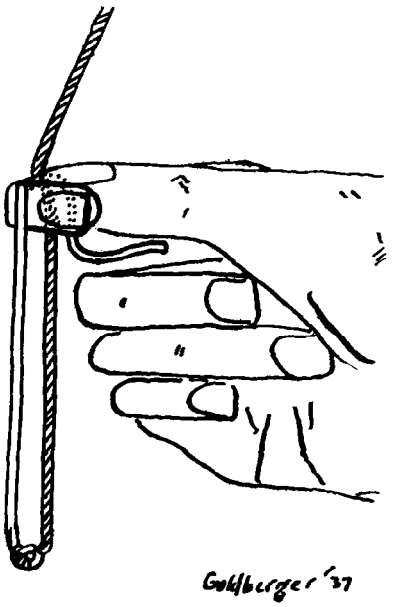

Fig. 6.

DISCUSSION

As has been said before, the efficacy of a knot-tying technique can be judged by the number of hand and finger movements necessary; the number of times the hand must be supinated and pronated; how many times there are changes in the suture (or ligature) hand relationship, not related directly to the tie; the degree of control obtained; and the speed. (Table 1.) With respect to speed, this is a factor so dependent on one's familiarity with the technique used that its inclusion as an index of comparison is not warranted.

Table 1
ONE-HANDED KNOT-TYING MANEUVERS

Technique	No. Finger and Hand Movements	No. Times Supination and Pronation	No. Changes of Cord-Hand Relationship	Displacement of First Knot
Author's	8	0	1	no
Livingston[1]	8	3	1	no
Meynen[16]	8	3	1	no
Sullivan[17]	not a square knot but "surgical."			
Monks*[18]	10	3	3	yes
Richardson[3]	9	1	2	a badly tied knot
Kubo[19]	not a square knot, but "surgical."			

* This technique necessitates crossing of the hands twice.

The same standards were employed in calculating the number of finger and hand movements (or steps) etc. in the procedure described above, as for the others noted in Table 1.

On the basis of the values obtained above, I can no more than conclude that the procedure I employ, compared to those I was able to find mention of, is the simplest. The effectiveness, of course, of any method which follows the general principles outlined above must be the same. That is to say, a square knot is a square knot whether it was tied in two or twenty seconds, or with one hand or four instruments.

SUMMARY

1. The general principles of tying the square knot have been enunciated.

2. Indications for various techniques have been described.

3. A new and simple procedure for the so-called one-handed square knot has been presented.

4. Comparison has been made between this and what other methods had been found in the literature.

REFERENCES

1. Livingston, E. M. Study of the square knot. *Am. J. Surg.*, 6: 121 (Feb.) 1929.
2. Bryant, J. D. Operative Surgery. 1: 69. New York, 1901. D. Appleton & Co.
3. Bickman, W. S. Operative Surgery. 1: 238–244. Phila., 1924. W. B. Saunders Co.
4. Bulinin, I. Zur Frage der Technik des Schützens von chirurgischen Knoten. *Arch. f. klin. Chir.*, 179: 526, 1934.
5. Sullivan, W. J. Technic of a knot. *J. A. M. A.*, 80: 180 (Jan.) 1923.
6. Von Mezo, B. Ein einfache und schnelle Methode zur Knüpfung des chirurgischen Knotens. *Zentalbl. f. Chir.*, 48: 886 (June) 1921.
7. Zimches, I. L. Zur Technik des chirurgischen Knoten. *Zentralbl. f. Chir.*, 56: 602 (March) 1929.
8. Eliason, E. L. Method of tying a flat knot. *J. A. M. A.*, 76: 268, 1921.
9. Grant, A. R. The tying of a surgical knot. *Ann. Surg.*, 67: 439 (April) 1918.
10. Farr, R. E. Three forceps and four forceps knot. *Surg., Gynec. & Obst.*, 31: 408 (Oct.) 1920.
11. Forrester, C. R. G. Imperative Traumatic Surgery. New York, 1929. Paul B. Hoeber. Page 403.
12. Weigl, F. Instrumentelle Fadenknotung. *Med. Klin.*, 20: 1113 (Aug.) 1924.
13. Fecher, K. Zur instrumentelle Knotenbildung. *München. med. Wchnschr.*, 69: 1217 (Aug.) 1922.
14. Varela, V. D. Instrumentelle Knotenbildung. *Zentralbl. f. Chir.*, 47: 266 (March) 1920.
15. Havens, F. Z. Trick in tying a knot. *Surg. Clin. North America*, 15: 1229 (Oct.) 1935.
16. Meynen, F. G. Method of tying a square knot. *J. A. M. A.*, 85: 579 (Aug.) 1925.
17. Sullivan, W. J. One-handed surgical knot. *Am. J. Surg.*, 39: 8 (Jan.) 1925.
18. Monks, G. H. Tying the knots of ligatures and sutures with one hand. *Ann. Surg.*, 56: 780, 1912.
19. Kubo, I. Ein Methode des chirurgischen Knotens. *Arch. f. Obren., Nasen. u. Kehlkopfh.*, 122: 178 (Aug.) 1929.