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TECHNICAL NOTE

Making strong cords from surgical sutures

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The authors present a simple and cost effective technique of preparing strong cords from surgical sutures. The technique requires suture material, a drill, a clip and it takes less than a minute to prepare. The mechanical strength of the cord obtained by this method was compared to the mechanical strength of a single suture. Cords containing eight thicknesses of the suture material failed at slightly under eight times the single suture strength. A loop made out of cords of number 2 Vicryl or Dexon failed at loads of more than 1000 N. The authors have found these cords extremely useful and effective for reconstruction of the dislocated acromio-clavicular joint and also for the fixation of trans-femoral osteotomies.

Keywords : sutures ; cords ; technique ; mechanical strength.

INTRODUCTION

Strong suture material is often required in orthopaedic surgery either to stabilise a joint or for fixation of a ligament to bone or for repair of tendons (*4, 5*). Materials such as the Dacron tape can be used for this purpose but they are not available routinely in all operating theatres. Also, ready to use tapes or cords of absorbable suture material are not available at all. Our experience with the laborious process of manually platting materials to produce a strong suture led us to develop a much quicker technique of producing a strong and stable cord with excellent handling characteristics, using equipment found in any operating theatre. In this short paper we describe and illustrate our technique and present results of mechanical testing of the cord in comparison to single sutures.

TECHNIQUE

Four sutures are tied together at both ends with a single knot to produce an eight strand braid. One knot is held with an artery forceps and the other placed in the chuck of the power or hand drill (fig 1). The drill is rotated keeping tension on the material until a tight helix is formed without buckling. A Lane's tissue forceps is hung onto the middle of the helix. The two knotted ends are

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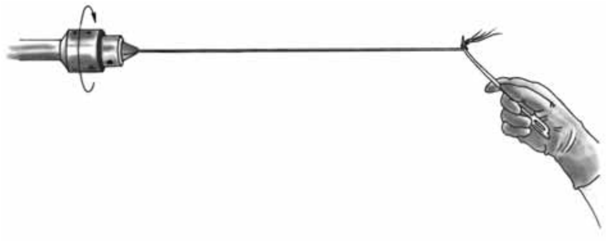

Fig. 1. First step.

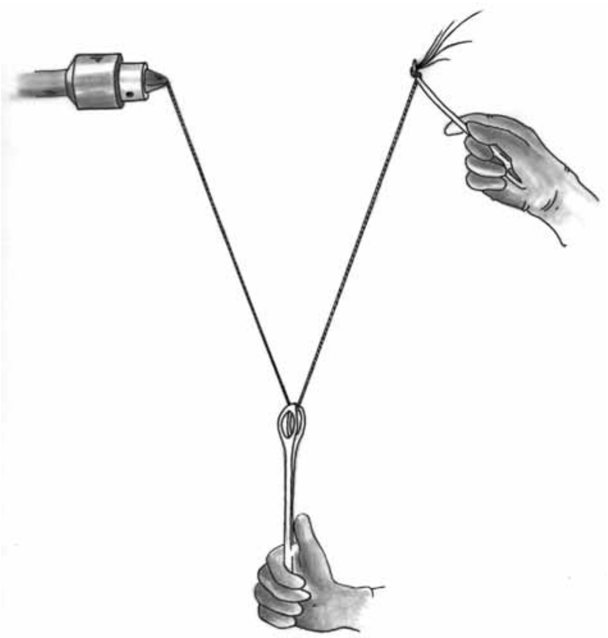

Fig. 2. — Second step.

Fig. 3. — Third step.

Fig. 4. — Final step : the cord is ready for use.

brought together and the forceps pulled to prevent kinking (fig 2). The forceps is now allowed to spin freely as the cord twists on itself (fig 3). The cord stops twisting automatically after the whole length has been entwined. At this stage the cord is stable and ready for use (fig 4).

MECHANICAL TESTING

Mechanical testing of the cords was undertaken at the Engineering Department of the local University. Comparative mechanical tests were carried out between single sutures and the eight-suture cord. Two types of suture material were used : 5 metric (0.5 mm diameter ; number 2) coated Vicryl

(Johnson & Johnson Int.) and 5 metric Dexon II (Sherwood Davis & Geck). The single suture and the cord were tied into a loop of approximately 200 mm circumference using a reef (square) knot with an extra securing throw. The loop was then mounted over two 10 mm diameter pins in a materials testing machine (M100K, Lloyd Instruments Ltd) (fig 5). During the test the pins were drawn apart by the testing machine at 10 mm/min until the loop failed. The load and corresponding extension values were recorded. Mechanical testing was carried out at room temperature (20 +/- 2°C) and five specimens in each group were tested.

RESULTS

Load to failure values are shown in table I. In all cases both the single suture and the cord failed at the knot forming the loop. In some of the Vicryl cords, final failure was preceded by slipping of the knot. However, since the knots were tightened under tension, the slippage always stopped before the loose ends pulled through.

Apart from initial "take up" of the suture, the loops extended proportionately with loads applied. The elongation of the loops at failure is shown in table II and was approximately 30 mm for a 200 mm loop. Shorter loops of suture material would have correspondingly less extension at failure.

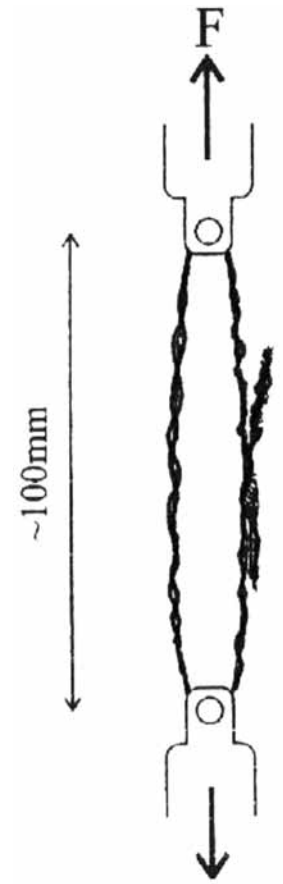

Fig. 5. — Mechanical testing of the cords.

DISCUSSION

Our results show that for both Vicryl and Dexon, the cord was slightly less than eight times as strong as the single suture despite having eight times as much material in the cross section. This is a common feature of cords and ropes of all kinds and is related to the differing stress concentrations introduced in the region of the knot in single and multi-stranded structures. All specimens failed at the knot forming the loop and it is well known that knots

Table I. — Load to failure (Newton) for sutures and cords

	Vicryl Suture	Dexon II Suture	Vicryl Cord	Dexon II Cord
Mean	171	180	1146	1238
St. Dev.	6	13	107	67

Table II. — Extension at failure (millimetres) of sutures and cords

	Vicryl Suture	Dexon II Suture	Vicryl Cord	Dexon II Cord
Mean	19.7	27.0	32.0	35.0
St. Dev.	2.4	5.8	0.8	1.7

reduce strength in comparison to un-knotted material (*1*).

Vicryl cords showed a greater tendency to slip at the knot than Dexon II, the reason for this being a function of the coefficient of friction of the material from which the individual sutures are made and the transverse stiffness of the sutures themselves, which determines how tight the knot can be pulled with a given force. A Vicryl suture has a noticeably higher transverse stiffness than the same size Dexon II suture, although inspection of the load displacement curves shows the axial stiffness to be similar (*2, 3*). Transverse stiffness of sutures is influenced by manufacturing parameters, such as tightness of braiding and the number and thickness of the fibres used. Differences in these parameters together with the likely difference in materials (as opposed to suture) properties may explain the difference in transverse stiffness.

We tested loops of four strands of number 2 Vicryl and Dexon which failed at loads much more than the normal body weight. Any suture material and any numbers of sutures can be used for making these cords. Therefore cords of almost any strength could be produced, the strength of the cord being dependent on the material used, the number of strands and the knotting ability of the cord. The technique of production is extremely simple, quick and the cords are easy to handle. In clinical applications, we have used absorbable cords for tying the clavicle to the coracoid process in reconstruction of the acromio-clavicular joint, which unlike a Bosworth screw does not need a second procedure for removal (*4*). We also use these cords for closing femoral osteotomies in the trans-femoral approach rather than using wire cables (*5*). We are confident that as the use of these cords increases so will their applications.

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