



Research Article

Square knot Integrity of Commonly Used Absorbable Sutures: how Many Throws is Enough?

Vaite Graham, Kandice Keogh, Jason JY Kim*

Department of Surgery, Urology Division, Gold Coast University Hospital, Queensland, Australia

*Corresponding author: Jason JY Kim, Department of Surgery, Urology Division, Gold Coast University Hospital, Queensland, Australia

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Abstract

Introduction: Knot integrity is paramount when securing surgical loops. Our research study aims to determine the minimum number of throws needed to secure various types of commonly used absorbable sutures in surgery.

Methods: Five commonly used absorbable sutures were individually tested; 0 and 2-0 Vicryl, 3-0 Monocryl, and 0 and 3-0 PDS. Twenty tests for each suture were carried out with three, four and five throws using a square knot technique, applied via hand tying technique onto a tensioning device. A difference of proportions test was performed between each group.

Results: All suture loops tested behaved similarly regardless of type and gauge. Loops secured with only three square throws all slipped and failed tension testing. Suture loops secured using four square throws were found to be adequately secured. Complete knot security was found when five throws were used. No statistical difference was found between suture loops secured with four or five throws.

Conclusion: Our study shows that knot security is independent of suture type or size. A minimum of four square throws is required and an additional 5th throw is optional for absolute security.

Keywords: Knot technique; Square knot; Surgical knot; Suture

Introduction

Suture tying is a fundamental skill required in all surgical specialties. Knot and suture integrity is essential to safely carry out various aspects of surgery, such as hemostasis, anastomosis, tissue closure, or securing medical lines and devices. The integrity of a suture loop is dependent on multiple factors, the knot is the weakest part of the loop and therefore its strength and integrity is of utmost importance. [1,2] A square knot technique is one of many knots used in surgery. [3] A square knot has been shown to be most reliable when it is applied correctly using a technique where the surgeon's hands cross each other at 180 degrees with each throw. [3-5] If this is not done properly an inadvertent slip knot is formed despite a 'square knot' configuration, leading to increased knot slippage.⁵ Our research study aims to determine the minimum number of throws needed, when applied via a proper square knot technique, to secure various types of commonly used

sutures in surgery. We also set out to determine whether suture material and gauge influence the number of throws needed for knot security.

Materials and Methods

Five commonly used absorbable sutures were individually tested in this study 0 and 4-0 Vicryl (Polyglactin 910), 3-0 Monocryl (Poliglecaprone 25) and 0 and 3-0 PDS (Polydioxanone). Ten tests for each suture were carried out with three, four and five throws using a square knot technique applied via hand tying onto a tensioning device, ensuring that a correct technique with crossing over of hands was used. Even distracting tension was then applied to the suture to test the knot. A 'secure knot' result was achieved when the tension applied resulted in fracture of the suture prior to slippage of <2mm from the center-point of the knot. Difference of proportions test was performed between four and five throws to determine whether a statistical difference was achieved with the fifth throw.

Results

All suture loops behaved similarly regardless of type and gauge. Suture loops secured with only three square throws all slipped and failed tension testing. Test results using four and five throws are listed in Table 1. Suture loops secured using four square throws were found to be adequately secured (average 10% failure rate). Total loop security was achieved when five throws were used (0% failure rate). No statistical difference was found between using four or five throws.

Suture type	Number of throws	Slipped knots (out of 20 tests)	% knots failed	p-value
0 Vicryl	4	3	15	0.358
	5	0	0	
2-0 Vicryl	4	2	10	0.536
	5	0	0	
3-0 Monocryl	4	1	5	0.755
	5	0	0	
0 PDS	4	3	15	0.358
	5	0	0	
3-0 PDS	4	1	5	0.755
	5	0	0	
Total	4	10 [‡]	10	0.167
	5	0 [‡]	0	

[†] all loops secured using 3 throws slipped and failed testing, and therefore were not included in analysis and this table.

[‡] out of 100 tests.

Table 1: Suture loop testing using 4 or 5 throws[†].

Discussion

Knot tying is an integral part of competency. Loop security is dependent on many factors, including suture tensile strength, knot type, and surgical technique. A square knot, when applied correctly, has been shown to be amongst one of the strongest surgical knots. [3-5] Our study shows that square knot integrity and strength is independent of suture type or size. When using a proper square knot technique, a minimum of four throws are required for adequate loop security. An additional fifth throw is optional to ensure absolute security.

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