

# Knot-Tying Proficiency Among Surgical Trainees Improved with Utilization of Video Education and Fundamentals of Arthroscopic Surgical Training (FAST) Workstation

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**INTRODUCTION:** Proficiency in knot-tying is pivotal for surgical success, yet its assessment has traditionally relied on subjective evaluation. Innovative training tools like the Fundamentals of Arthroscopic Surgical Training (FAST) workstation now enable objective measurement of knot-tying proficiency. We leveraged the FAST workstation to evaluate surgical residents' knot-tying abilities and assessed the impact of guided education on their knot strength.

**METHODS:** Participants in this study were surgical residents of various post-graduate years (PGY). In a surgical simulation laboratory, surgical residents were instructed to perform knot-tying alone in the pre-education phase. Next, participants watched a short instructional video in which a fellowship-trained orthopedic surgeon demonstrated proper knot-tying technique. After watching the video, the residents were instructed to perform knot-tying in the post-educational phase. The FAST workstation quantified the mechanical resilience of each knot, measured as suture loop elongation. Data analysis employed chi-squared tests, and Fisher's exact test was utilized when expected frequencies were below 5 in more than 20% of cells.

**RESULTS:** Forty-one surgical residents participated in this study from various PGYs. There was a significant increase in knot-tying success after the instructional video for PGY-1, PGY-2, and PGY-3 residents, but no significant difference for PGY-4 and PGY-5 residents. Among participants using the one-handed technique, there was a significant improvement in knot-tying success post-video, but no significant change for those using the two-handed technique. Furthermore, 20.83% of participants tied knots with 3 throws or less and 79.17% used 4 throws or more; both groups showed a significant improvement in knot-tying success after video instruction.

**DISCUSSION AND CONCLUSION:** Early instructional intervention on proper knot-tying technique significantly enhances the mechanical resilience of surgical knots among residents. Integrating objective knot-tying measurement systems such as the FAST workstation alongside direct instructional intervention should be considered by surgical residency training programs to improve trainees' knot-tying proficiency.

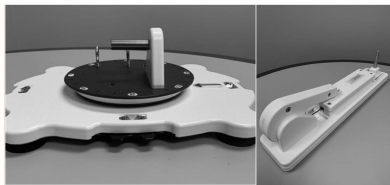


Figure 1. FAST workstation which includes the knot-tying station (left) and knot-testing station (right).

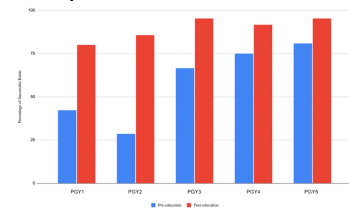


Figure 2. Bar graph comparing the frequency of successful knots before (blue) and after (red) watching the instructional video for each PGY.

Table 1. PGY and knot-tying techniques used by participants in this study and corresponding knot-tying success. (\*) denotes a statistically significant result ( $P < 0.05$ ).

	Successful Knots		p-value
	Pre-education	Post-education	
Post-graduate year			
PGY-1 (15/41)	19 (42.22%)	36 (80%)*	p < 0.001
PGY2 (7/41)	6 (28.57%)	18 (85.71%)*	p < 0.001
PGY-3 (7/41)	14 (66.67%)	20 (95.24%)*	p = 0.018
PGY-4 (5/41)	9 (75%)	11 (91.67%)	p = 0.27
PGY-5 (7/41)	17 (80.95%)	20 (95.24%)	p = 0.27
Knot-tying technique			
One-handed (22/24)	31 (46.97%)	59 (89.39%)*	p < 0.001
Two-handed (2/24)	3 (50%)	4 (66.67%)	p > 0.05
3 throws or less (5/24)	3 (14.29%)	18 (85.71%)*	p < 0.001
4 throws or more (19/24)	31 (60.78%)	45 (88.24%)*	p = 0.0015