

Introduction

Laparoscopic hysterectomy is a commonly performed procedure. However, one high-risk complication is vaginal cuff dehiscence, which is increased in laparoscopic approaches compared to abdominal or vaginal hysterectomies. Currently, there is no standardization regarding thread material and suturing technique for vaginal cuff closure. Furthermore, laparoscopic suturing is a challenging task that requires constant practice for correct and efficient execution. Therefore, this study aimed to compare extracorporeal and intracorporeal suturing techniques for vaginal cuff closure using a pelvic trainer model.

Material and Methods

Eighteen experts in laparoscopic surgery performed vaginal cuff closures with interrupted sutures using intracorporeal knotting (Vicryl 2-0), extracorporeal knotting (Vicryl 2-0), and continuous, unidirectional barbed sutures (V-Loc™ 180 3-0) (**Figure 1**). While using an artificial tissue suturing pad in a Pelvitainer (**Figure 2**), experts performed vaginal cuff closure using each technique according to block randomization. Task completion time, tension resistance (**Figure 3**), stitch precision, knot strength and the number of errors were recorded. After completing the exercises, participants answered a questionnaire concerning the suturing techniques and their performance.

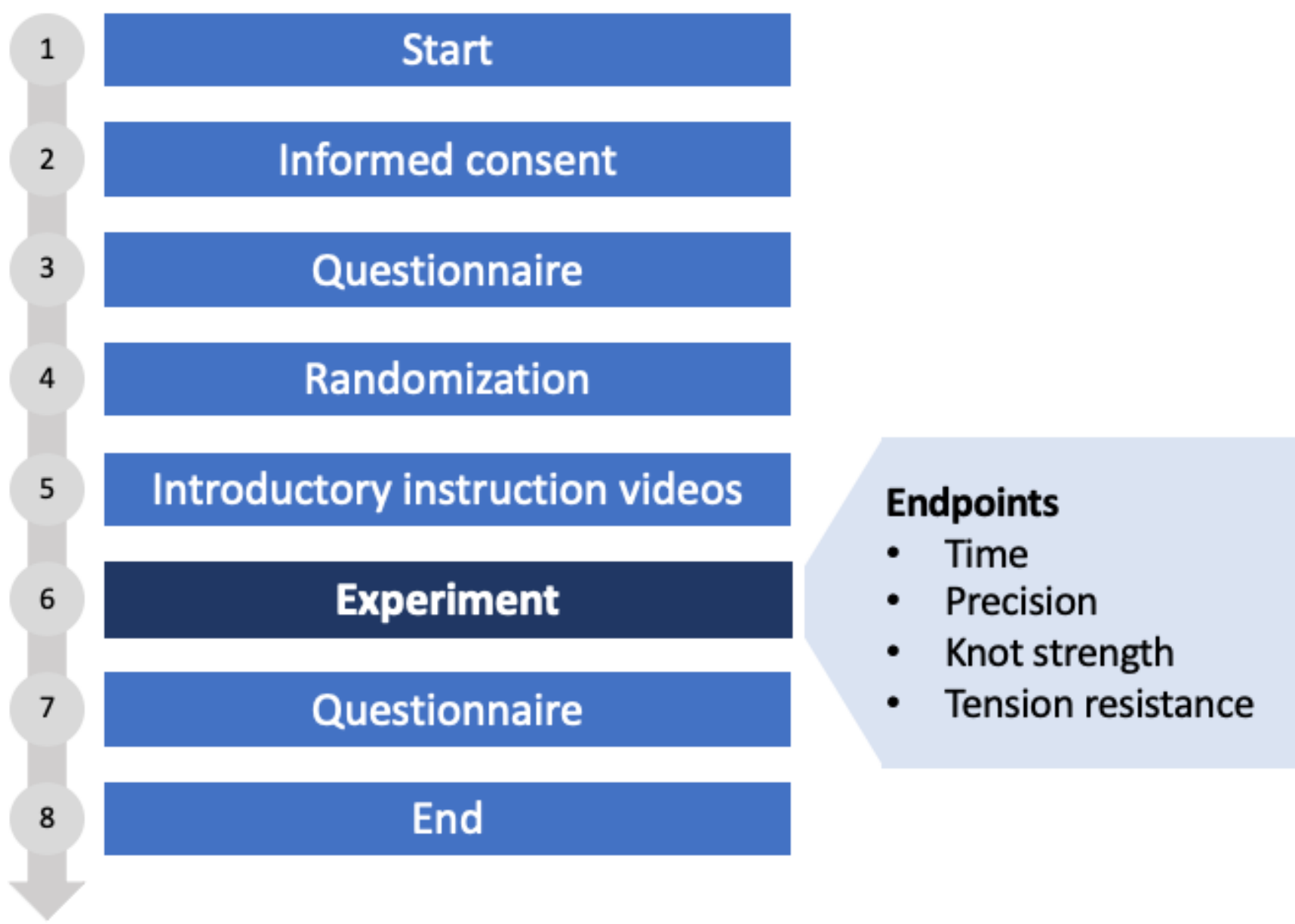


Figure 1 Flow diagram of the study design and the defined endpoints

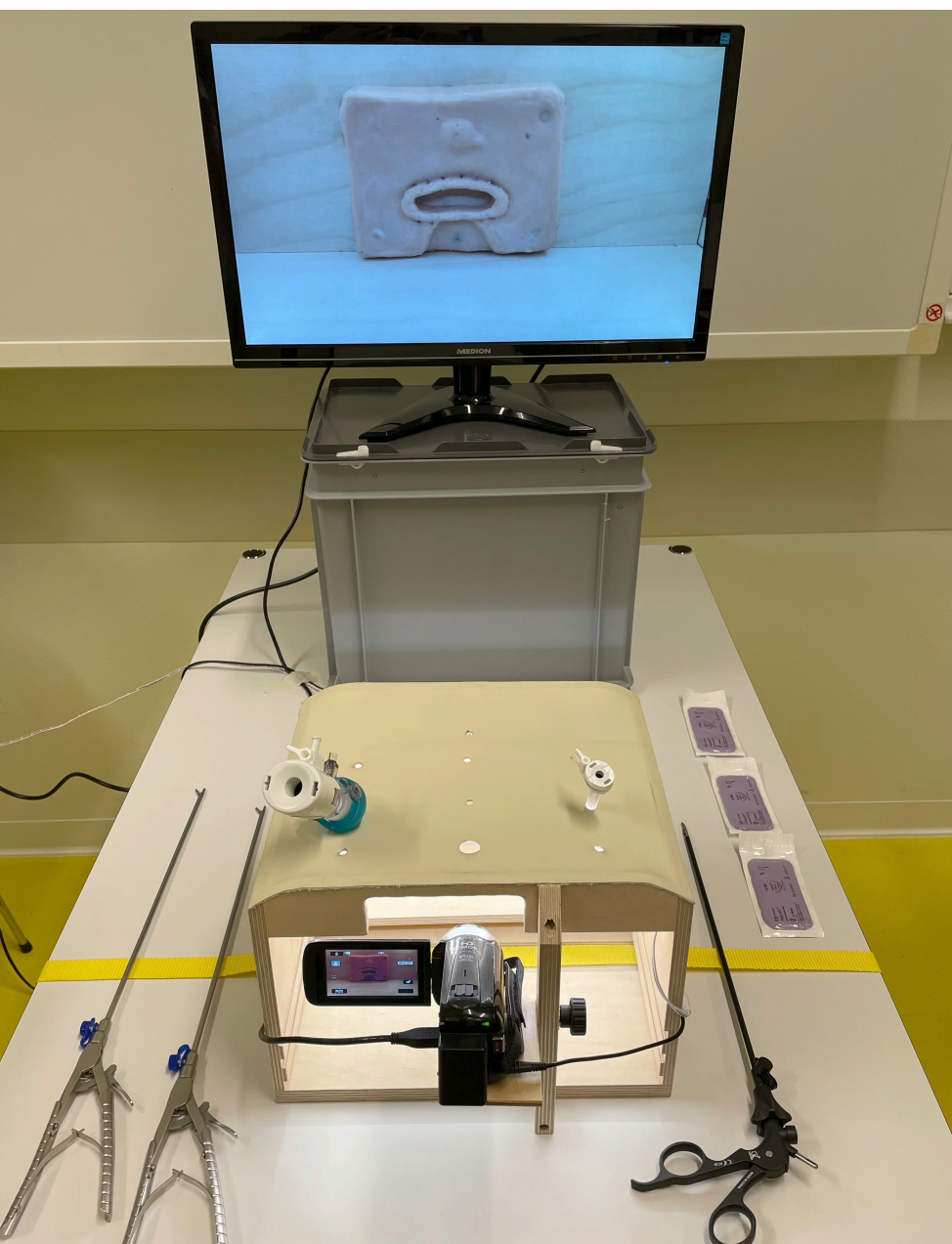


Figure 2 Pelvitainer, experiment set up

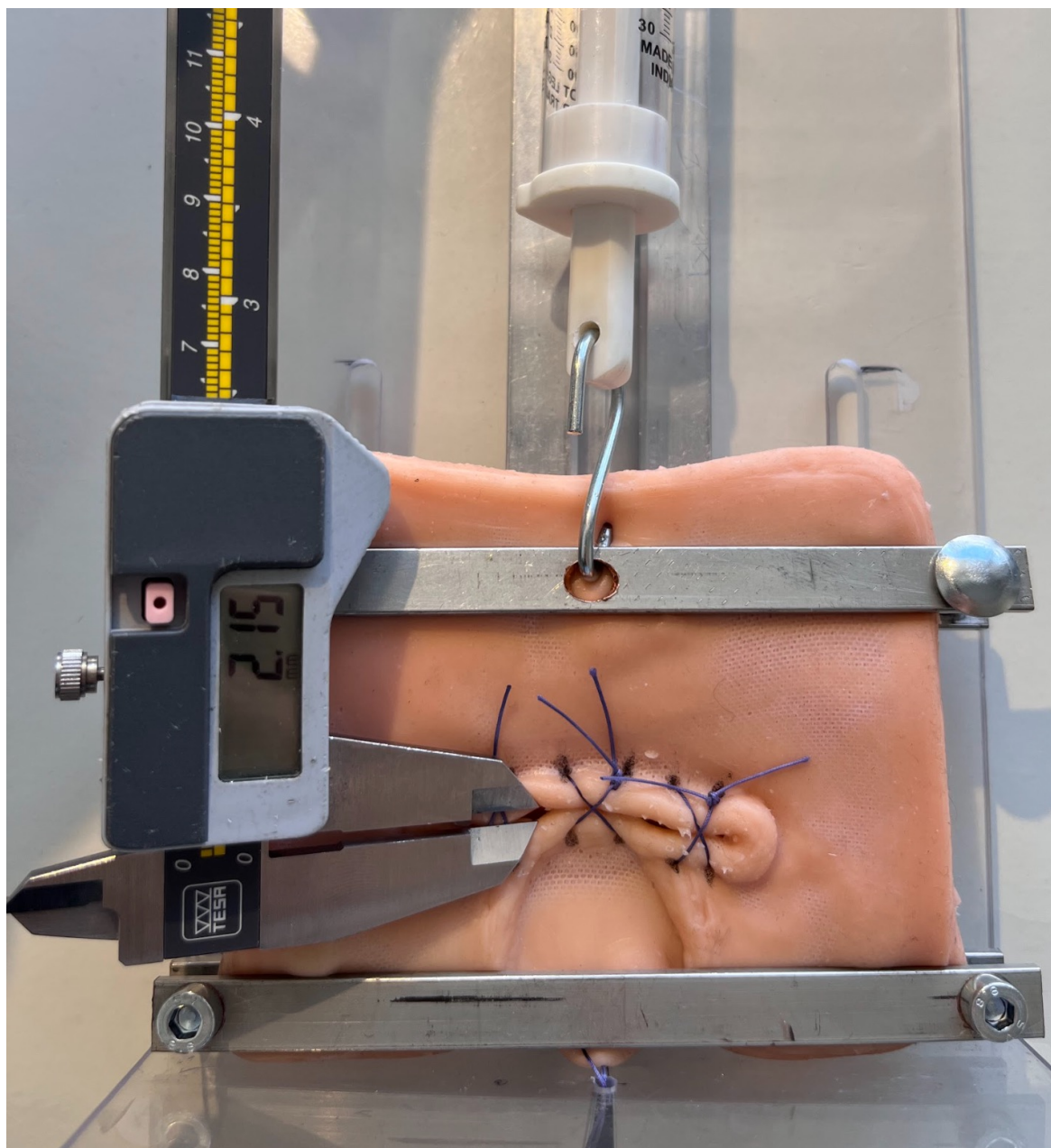


Figure 3 Tension resistance measurement

Results

- Barbed suturing technique showed improved tension resistance compared to intracorporeal and extracorporeal knotting ($p=0.002$, $p=0.003$) (**Figure 4B, Table 1**)
- Barbed suturing technique allowed to complete the cuff closure significantly faster compared to intracorporeal and extracorporeal knotting ($p < 0.001$, $p < 0.001$) (**Figure 4A, Table 1**)
- Intracorporeal knotting technique was performed faster ($p=0.04$) and achieved greater tension resistance ($p=0.023$) compared to extracorporeal knotting (**Figure 4A/B, Table 1**).
- There was no significant difference in precision between the three suturing techniques (**Table 1**).
- Experts who performed more laparoscopic surgeries per year were significantly faster in completing the tasks ($p=0.007$).
- Surgeon's years of experience did not correlate with suturing time ($p=0.293$).

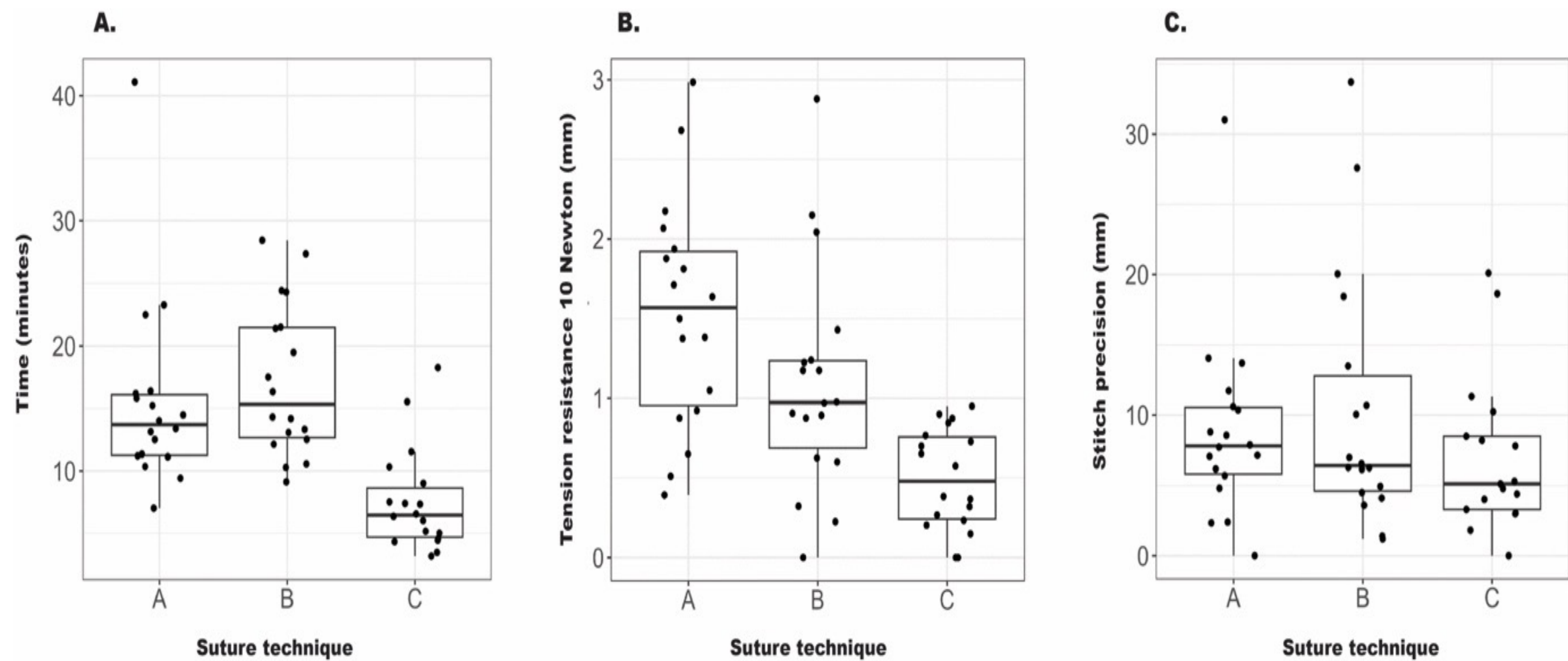


Figure 4 A comparison of the three different suturing techniques (A = intracorporeal knotting, B = extracorporeal knotting, C = barbed suture with V-Loc) for **A.** time, **B.** tension resistance, and **C.** precision according to the geometric mean ratio

Parameter	Contrast	p-value ^a
Time	Intracorporeal interrupted / Extracorporeal interrupted	0.04
	Intracorporeal interrupted / Barbed continuous	<0.001
	Extracorporeal interrupted / Barbed continuous	<0.001
Stitch precision	Intracorporeal interrupted / Extracorporeal interrupted	0.811
	Intracorporeal interrupted / Barbed continuous	0.12
	Extracorporeal interrupted / Barbed continuous	0.132
Tension resistance		
0 Newton	Intracorporeal interrupted / Extracorporeal interrupted	0.832
	Intracorporeal interrupted / Barbed continuous	0.002
	Extracorporeal interrupted / Barbed continuous	0.003
10 Newton	Intracorporeal interrupted / Extracorporeal interrupted	0.099
	Intracorporeal interrupted / Barbed continuous	<0.001
	Extracorporeal interrupted / Barbed continuous	0.003

Table 1 Comparison of different suturing techniques by time, tension resistance, precision
^a The p -values were calculated using a mixed-effects model. A p -value <0.05 was considered significant.

Conclusion

- Vaginal cuff closure with continuous barbed suturing was significantly faster and had improved tension resistance.
- Barbed suturing was a time-saving technique in this ex-vivo study and should be recommended for use in clinical practice when available.