

The Thumbs-up Method:

A Novel Technique for Extracorporeal Knot Tying in Minimally Invasive and Robotic Cardiac Surgery

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KEY MESSAGE Stable extracorporeal knot advancement can be achieved without assistant traction by using the surgeon’s thumb as a pulley.

Background & Objective

- Patient-side surgeons must perform reliable extracorporeal knot tying in a narrow MICS/robotic field.
- Conventional two-operator technique: assistant traction is required; excessive or insufficient traction may cause premature locking or loosening.
- Conventional single-operator technique: often time-consuming because the pusher is repeatedly attached/detached; short suture length can make handling difficult.
- Robotic arms and ports occupy the anterior/superior space, reducing freedom of knot-pusher movement.

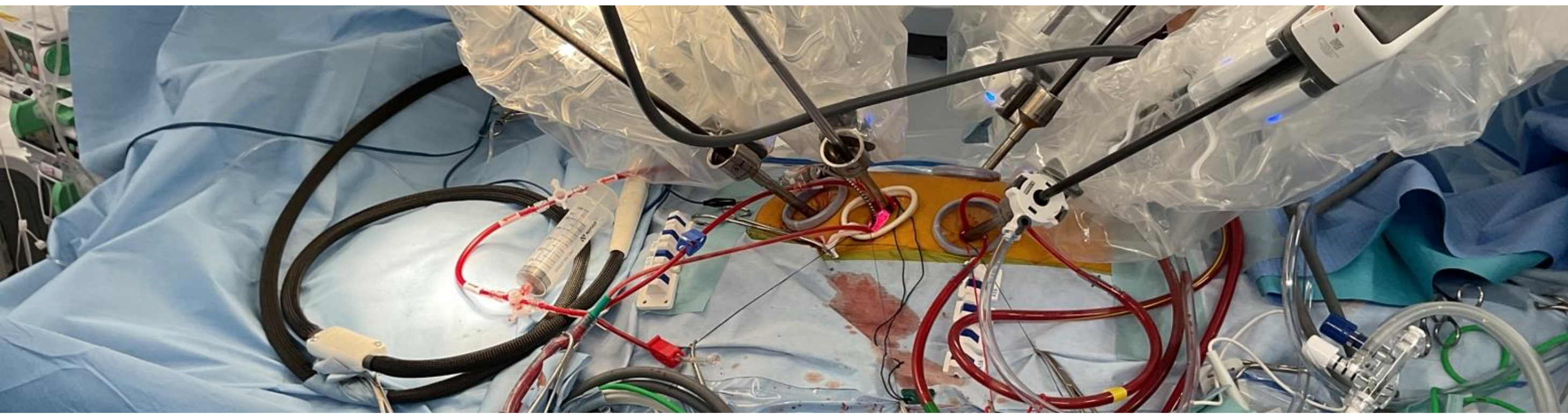


Figure 1. Restricted extracorporeal working field during robotic cardiac surgery.

Objective

To introduce a simple, reproducible technique that enables controlled knot advancement without assistant traction in restricted working spaces.

Dry-lab Evaluation

Design

- Six surgeons (PGY 6–20) performed three techniques: single-operator, two-operator, and Thumbs-up.
- Five trials per technique per surgeon; order randomized to reduce learning/fatigue effects.

Model

- MICS-1 Go Kit; 6-cm circular port; target silicone pad 15 cm from the port.

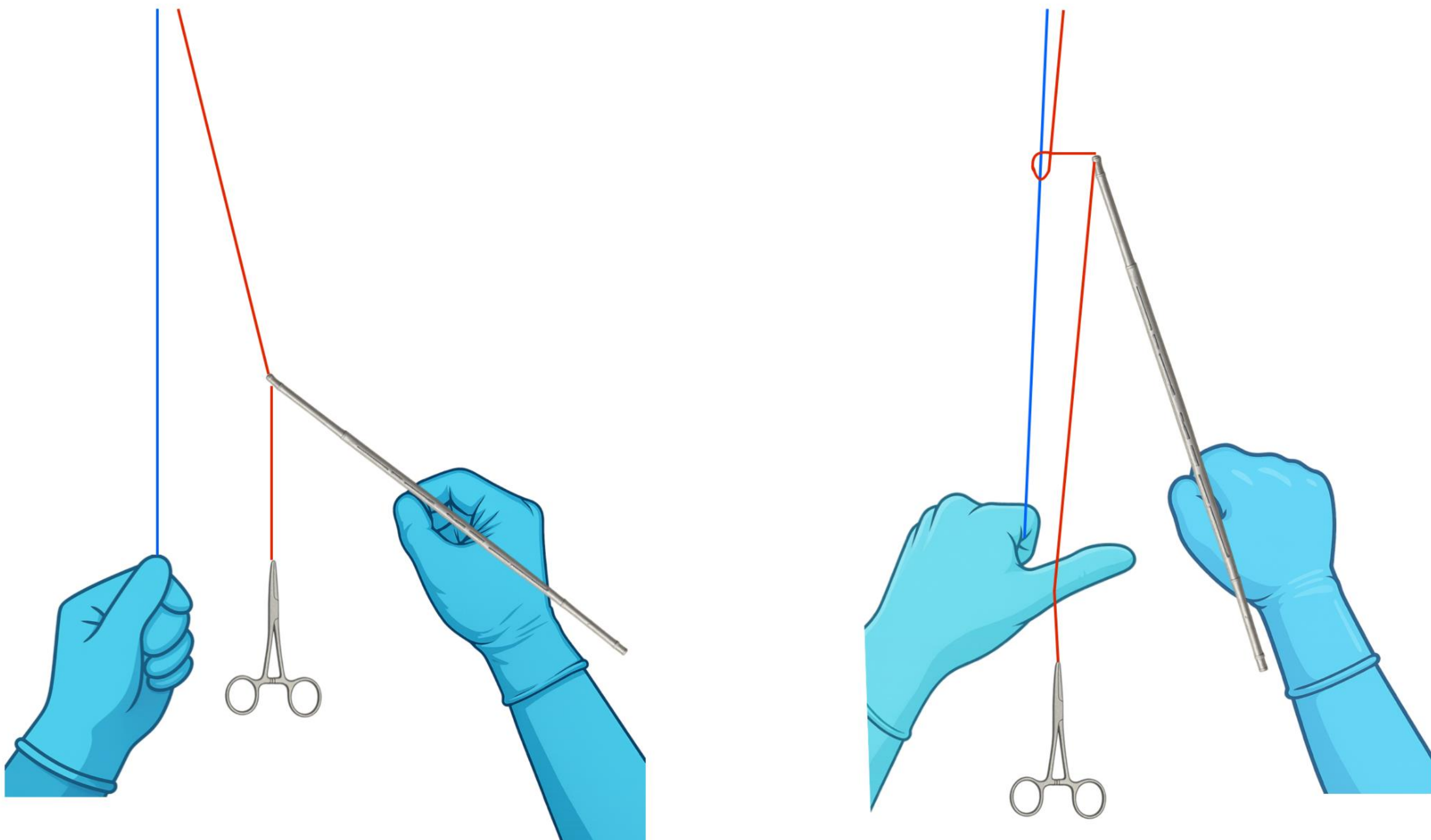
Endpoints

- Knot-tying time: start of tying to fully seated knot.
- Knot integrity: slack loops, incomplete seating/throws, or slippage counted as defects.

Technique: The Thumbs-up Method

Device: Adams–Yozu type knot pusher

FIGURE 2 Thumb-as-pulley mechanism



The wrapping limb is weighted with a mosquito clamp and placed in the side groove. The surgeon’s thumb functions as a pulley to maintain stable tension during knot advancement.

Step-by-step workflow

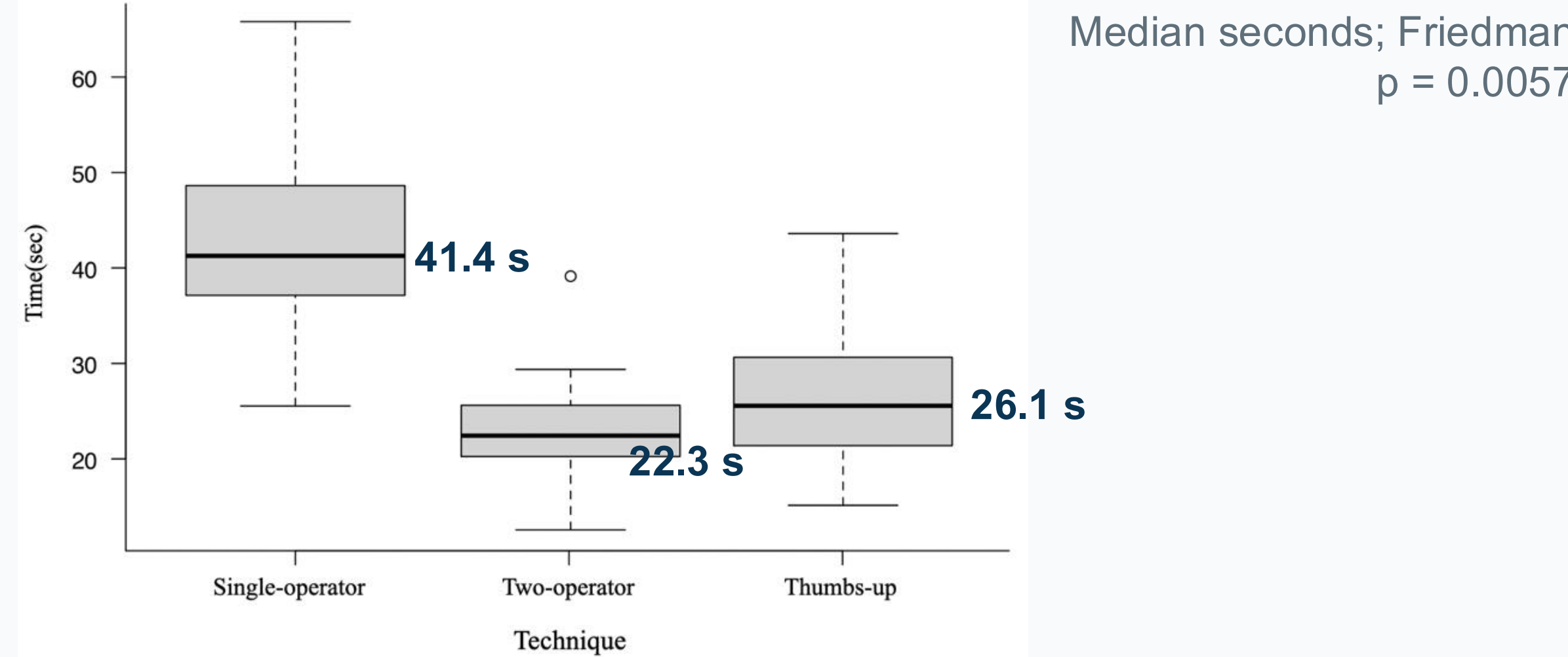
- 1 Set the limb**
Clamp the free end of the wrapping limb and place it in the R-marked groove.
 - 2 Create the knot**
Form the sliding knot with the left hand while keeping the post limb stable.
 - 3 Thumb pulley**
Hook the wrapping limb over the raised left thumb to generate consistent tension.
 - 4 Advance**
Push the knot stack while maintaining a square configuration*.
 - 5 Seat & lock**
Seat each throw under direct visualization, minimizing loosening or premature locking.
- Troubleshoot**
If the limb tends to leave the groove, rotate the pusher slightly outward.

Key point: preserve a square configuration* while advancing the knot

*The post limb, knot, knot-pusher tip, and wrapping limb should remain in a stable square configuration.

Results, Advantages & Conclusion

Knot-tying time



Knot defects

Cochran’s Q p = 0.174

Single

3/30

10.0%

Two-op

1/30

3.3%

Thumbs-up

0/30

0%

Interpretation

The Thumbs-up method showed comparable efficiency to the two-operator technique and no knot defects in this dry-lab setting. Pairwise comparisons did not reach statistical significance after correction.

Practical advantages from the original technique

- Reduces dependence on assistant traction.
- Useful when robotic arms limit anterior/superior extracorporeal space.
- Particularly helpful for deep targets such as papillary muscle loop fixation.
- The concept may be adaptable to other knot pushers when limb orientation is adjusted.

Conclusion

The Thumbs-up method is a simple and reproducible technique for stable extracorporeal knot advancement in restricted working spaces. Further clinical evaluation is warranted.

