



Robot-Assisted versus Freehand CT-Guided Lung Biopsy: A Comparative Clinical Study

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INTRODUCTION

CT-guided transthoracic needle biopsy (CT-TTNB) is central to the diagnosis of pulmonary nodules.

Pneumothorax and pulmonary hemorrhage remain clinically important procedure-related risks.

Robotic navigation may stabilize the needle trajectory and reduce repeated positioning and CT acquisition.

OBJECTIVE Compare procedural efficiency and safety after propensity score matching.

METHODS

DESIGN Single-center retrospective comparative cohort.

OUTCOMES Consistency of pathological results, Needle adjustments, insertion CT scans, procedure time, pneumothorax, hemorrhage, and chest-tube placement.

DISCUSSION AND CONCLUSION

CONCLUSION

Robotic-assisted CT-guided PTNB achieved higher diagnostic concordance, markedly reduced needle adjustments and CT scans during needle insertion.

Lower pneumothorax and hemorrhage rates were observed without prolonging procedure time.

LIMITATIONS

Retrospective, single-center design and a small matched cohort.

Residual imbalance in underlying pulmonary disease ($P=.035$).

FUTURE PLAN

Prospective multicenter validation of safety, diagnostic performance, and patient-reported experience.

REFERENCES & ACKNOWLEDGEMENTS

ACKNOWLEDGEMENT Fujian Medical University Union Hospital.

REFERENCE

[1] Deng C, Jiang Y, Lin Y, Cui F, Xue X, Zhang H, et al. The Effectiveness of Robotic-assisted Navigation System for Preoperative Lung Nodule Localization: a Prospective, Single-center, Non-inferiority, Randomized Clinical Study. Int J Surg. 2025. <http://dx.doi.org/10.1097/js9.0000000000004033>.

ADJUSTED EFFECTS

Robot-assisted vs freehand

Chest-tube placement

Freehand 3 patients; robotic 0
Overall complications
OR 0.18 (95% CI 0.05–0.61), $P=.006$

Pneumothorax
OR 0.12 (0.03–0.51), $P=0.004$

Hemorrhage
OR 0.20 (0.05–0.77), $P=0.019$

LESION SIZE

OR 0.94 (0.89–0.99) per mm for overall complications; $P=.024$

RESULTS

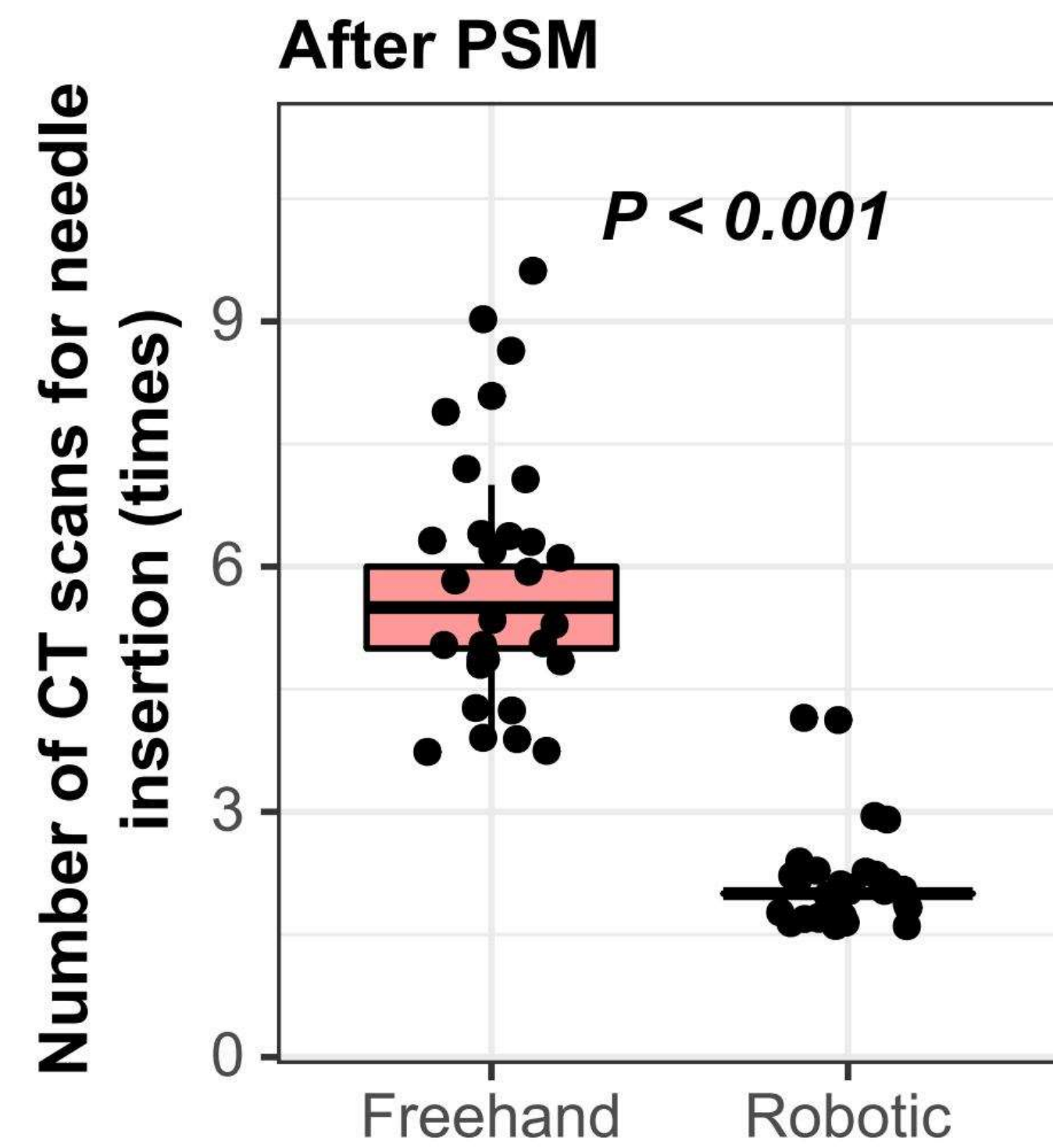
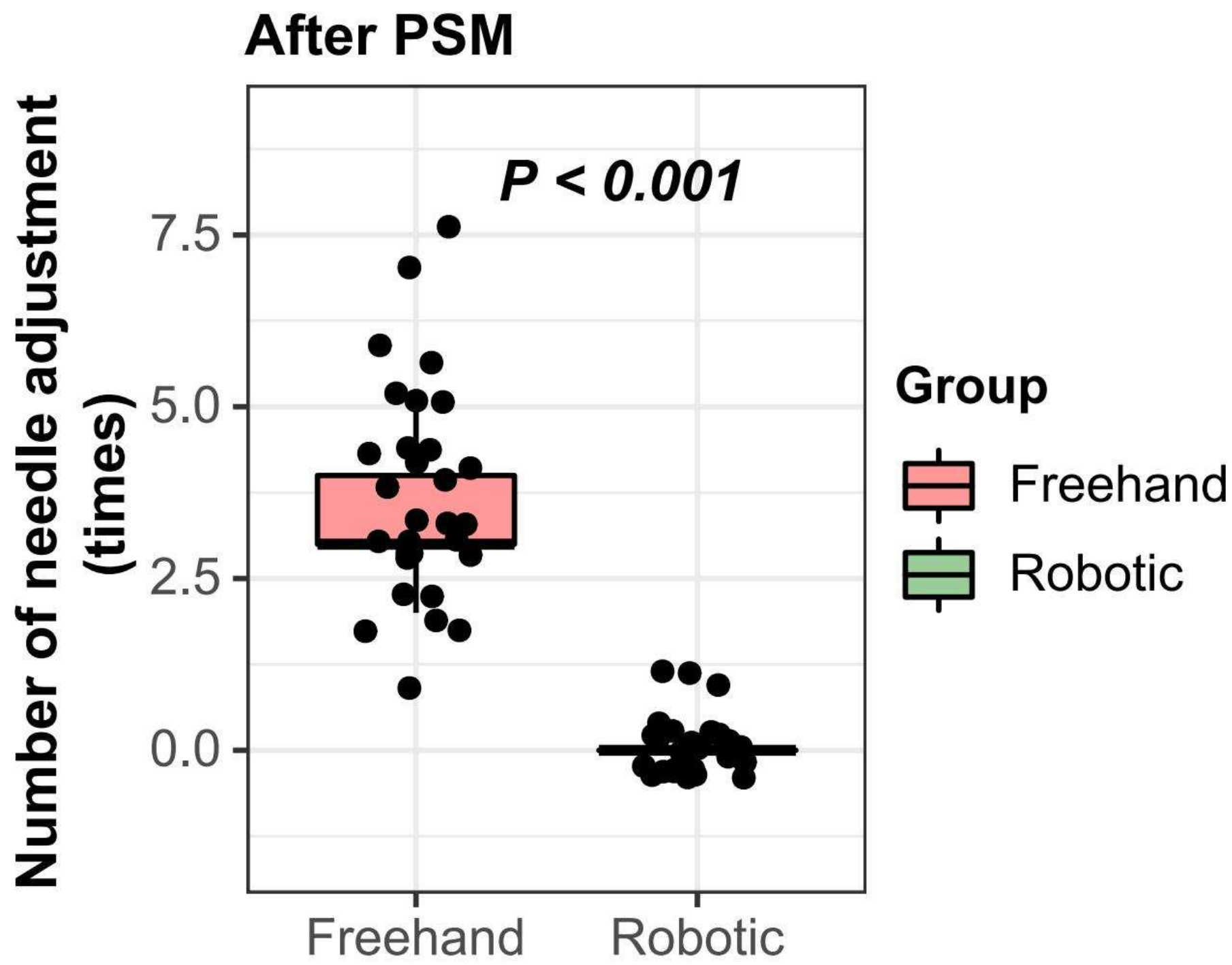
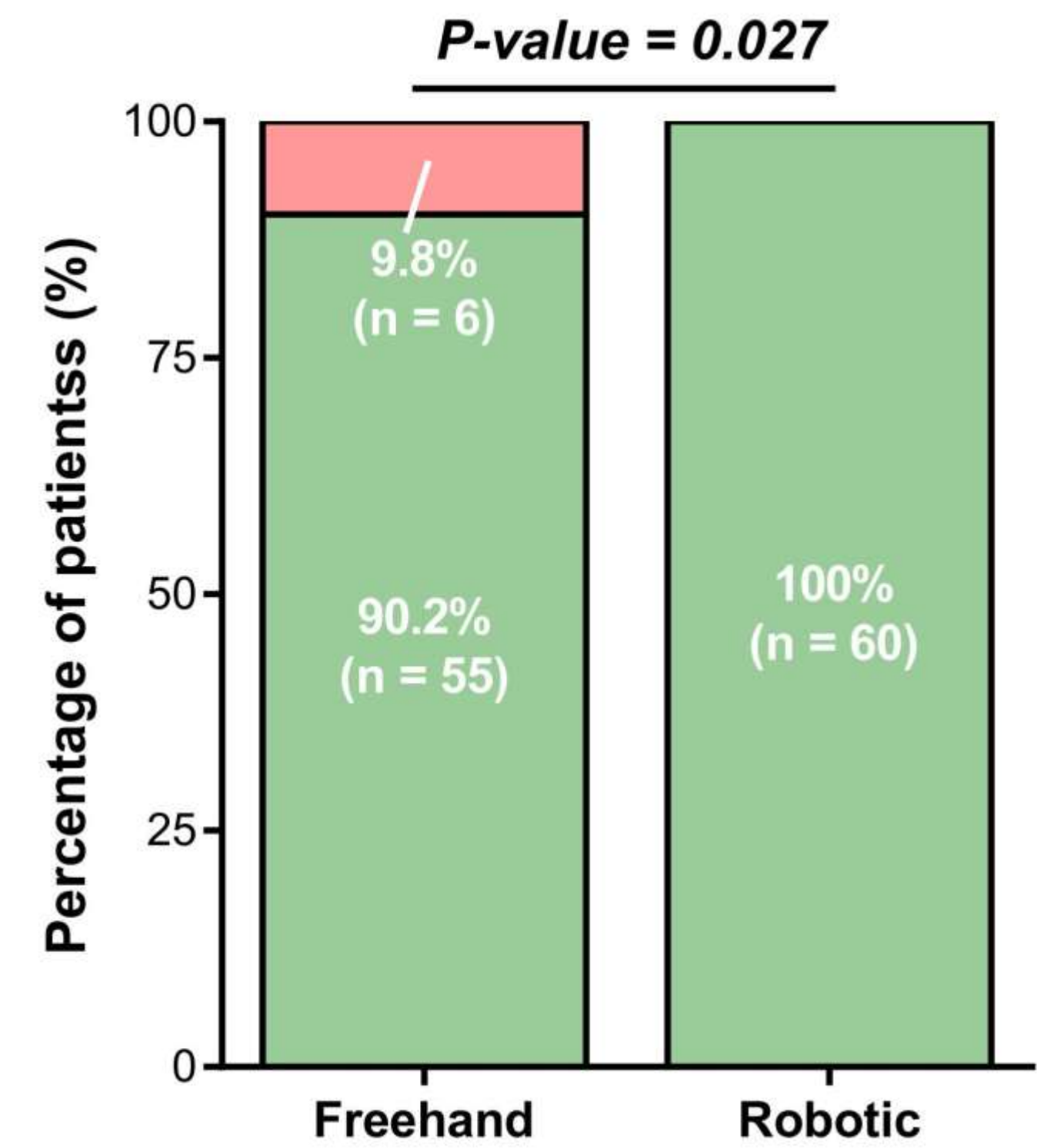
Baseline Balance: After PSM, 60 patients were included (30 freehand vs. 30 robotic-assisted), with generally comparable baseline characteristics.

Diagnostic Concordance: The robotic-assisted group achieved significantly higher diagnostic concordance than the freehand group (100.0% [60/60] vs. 90.2% [55/61], $P=0.027$).

Procedural Efficiency: Robotic-assisted biopsy required fewer needle adjustments (0 vs. 3, $P<0.001$) and fewer CT scans during needle insertion (2.0 vs. 5.5, $P<0.001$).

Safety: Pneumothorax (13.3% vs. 50.0%, $P=0.006$) and hemorrhage (13.3% vs. 43.3%, $P=0.020$) were significantly reduced in the robotic-assisted group.

Independent Protective Effect: Robotic assistance was independently associated with a lower risk of overall complications (OR=0.18, 95% CI: 0.05–0.61; $P=0.006$).



Matched safety outcomes (%)

