

The Pathologic Fracture Mortality Index: A Novel Externally Validated Tool for Predicting 30-day Postoperative Mortality

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Introduction

- Current mortality-predictive tools, in the setting of completed or impending pathologic fractures, are nonspecific and often include metastatic disease as one of their components
- Shared decision making between surgeon and these patients would benefit from a simple and accurate high-fidelity tool.

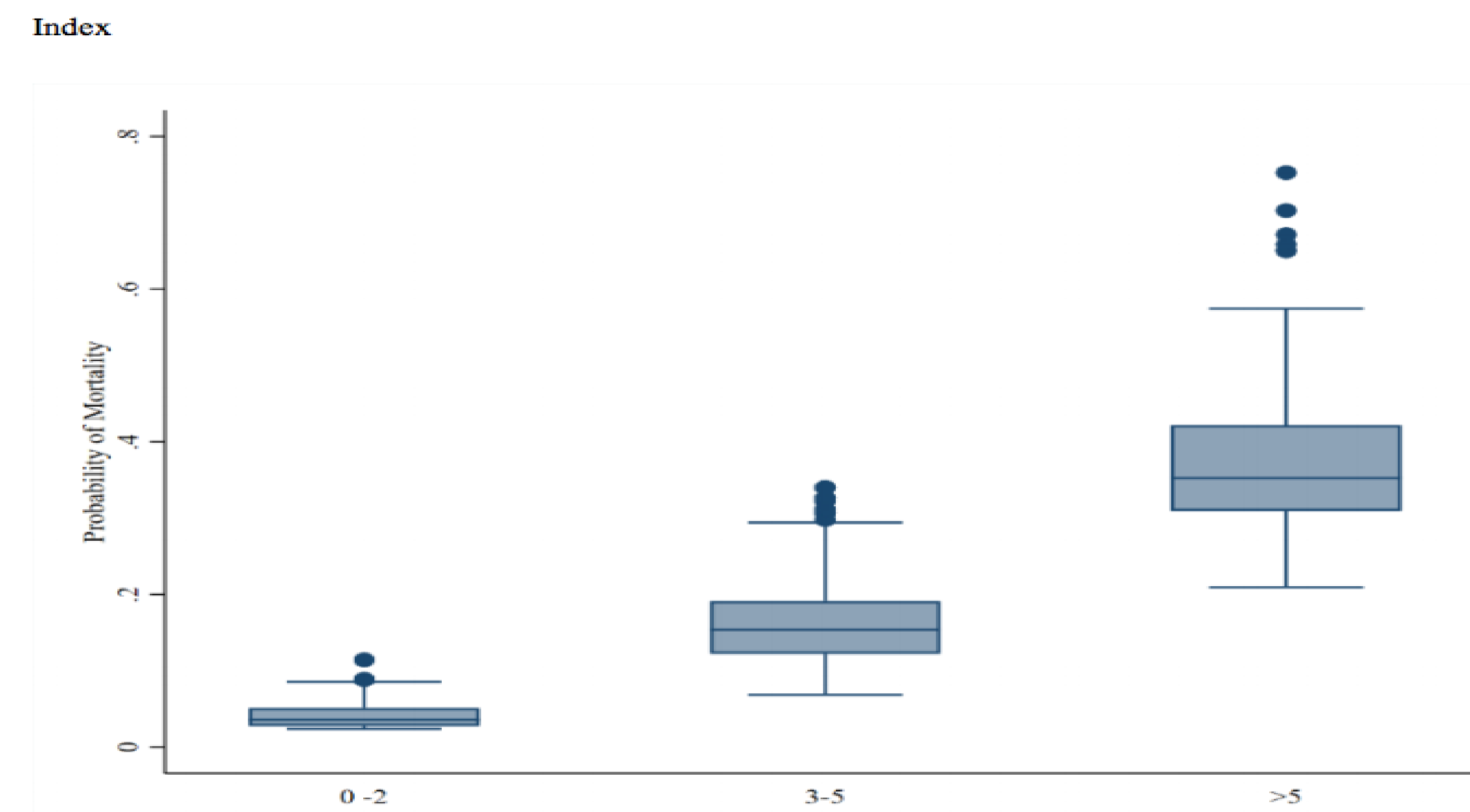
Objectives

- To develop a novel and validated clinical tool that is superior to existing methods in estimating post-operative mortality risk following fixation of impending or completed pathologic fractures.

Methods

- 1219 patients who underwent fixation for either completed or impending pathologic fractures in the National Surgical Quality Improvement Program (2012 – 2018) database were analyzed
- Listwise deletion of patients with incomplete data or additional procedures
- Patients were split into equal derivation and validation cohorts
- Multi-variable logistic regression with diagnostics were used to develop a predictive model in the derivation cohort and was then validated in the validation cohort
- Area under the curve (AUC) from Receiver Operator Curve (ROC) analysis was used to assess accuracy
- Post regression diagnostics performed included calculating the Brier score for the Derivation, Internal Validation and external validation samples to measure the accuracy of probabilistic predictions in each sample
- A score was then derived and compared to the American Society of Anesthesiologists (ASA) physical status classification and modified 5 component frailty index (mFI-5)
- Finally, the score was validated in an exclusive cohort of patients who underwent fixation for pathologic fractures at a tertiary care center for musculoskeletal oncology.
- Alpha was set at a level of 0.05 for all applicable statistical tests. All statistics were performed using STATA[®] version 15.0

Figure I. Box Plot of the Predicted 30-day Mortality Using the Pathologic Fracture Mortality Index



Results

- Of the 1219, 177 (15%) patients did not survive beyond 30 days postoperatively. AUC for our predictive model was 0.76 in the derivation and 0.75 in the validation NSQIP cohorts.
- The derived Pathologic Fracture Morbidity Index (PFMI) included six data points
- The probability of mortality increases from a median of 4% for a score of 0-2 up to 37% for a score of more than 5.
- The PFMI (AUC=0.75) was more accurate than the ASA (AUC=0.60) or the mFI-5 (AUC=0.58) ($p < 0.01$). AUC in the exclusive dataset from our institution (N=39) was 0.74.

Table I: Summary of Point System in PFMI Scoring Tool

Predictor	Point-Value
Preoperative hypoalbuminemia (<3.5 mg/dl)	3
Weight loss ($\geq 10\%$ in prior 6 months)	2
Pulmonary Disease	2
Alkaline Phosphatase	1
Dependence for daily living	1
WBC count >12000	1
Preoperative anemia	1

Figure II. Results of Receiver Operator Area Under the Curve Analysis Comparing Accuracy of PFMI, ASA, and mFI-5 for 30-day Postoperative Mortality after pathologic fracture fixation in 1,219 patients

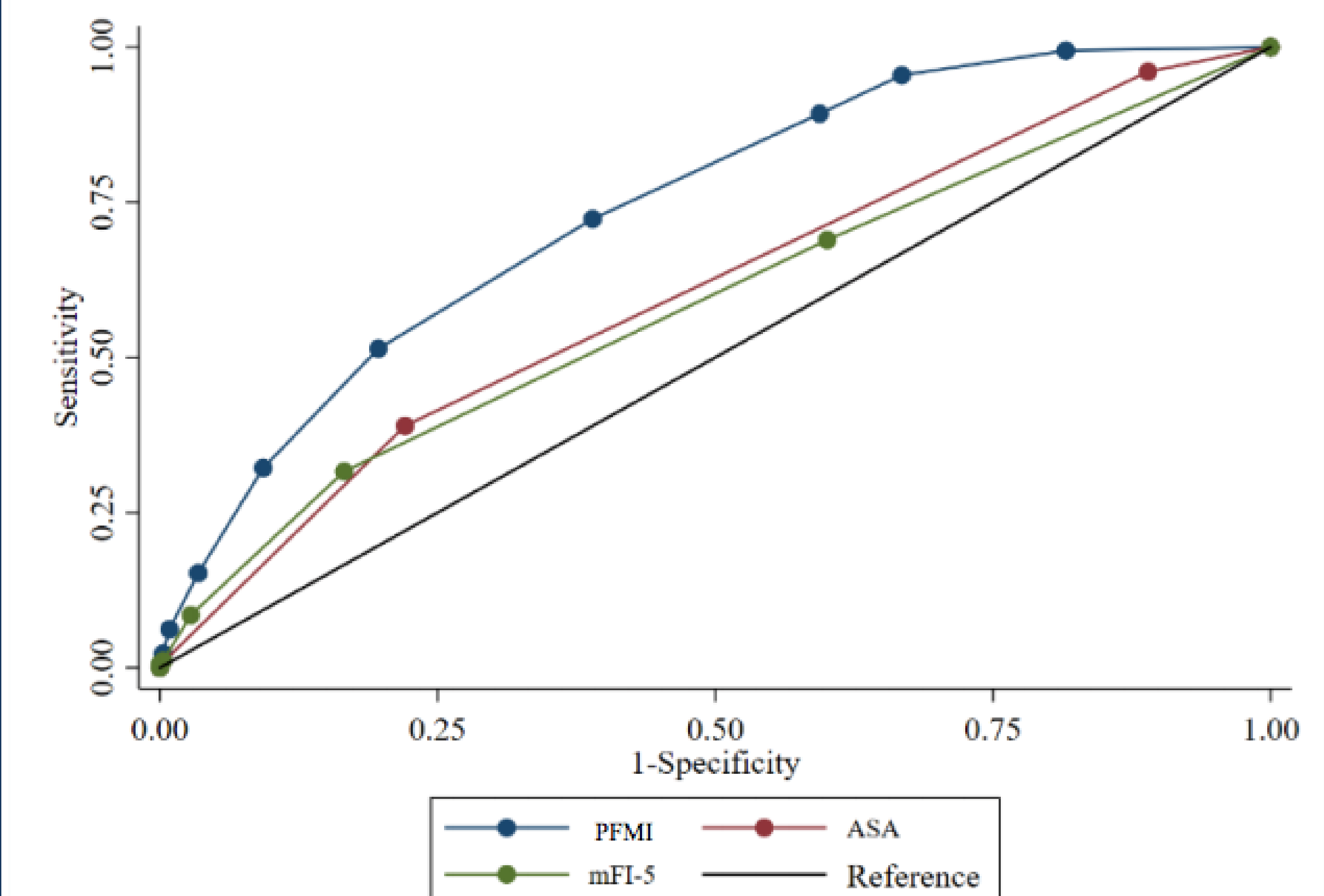
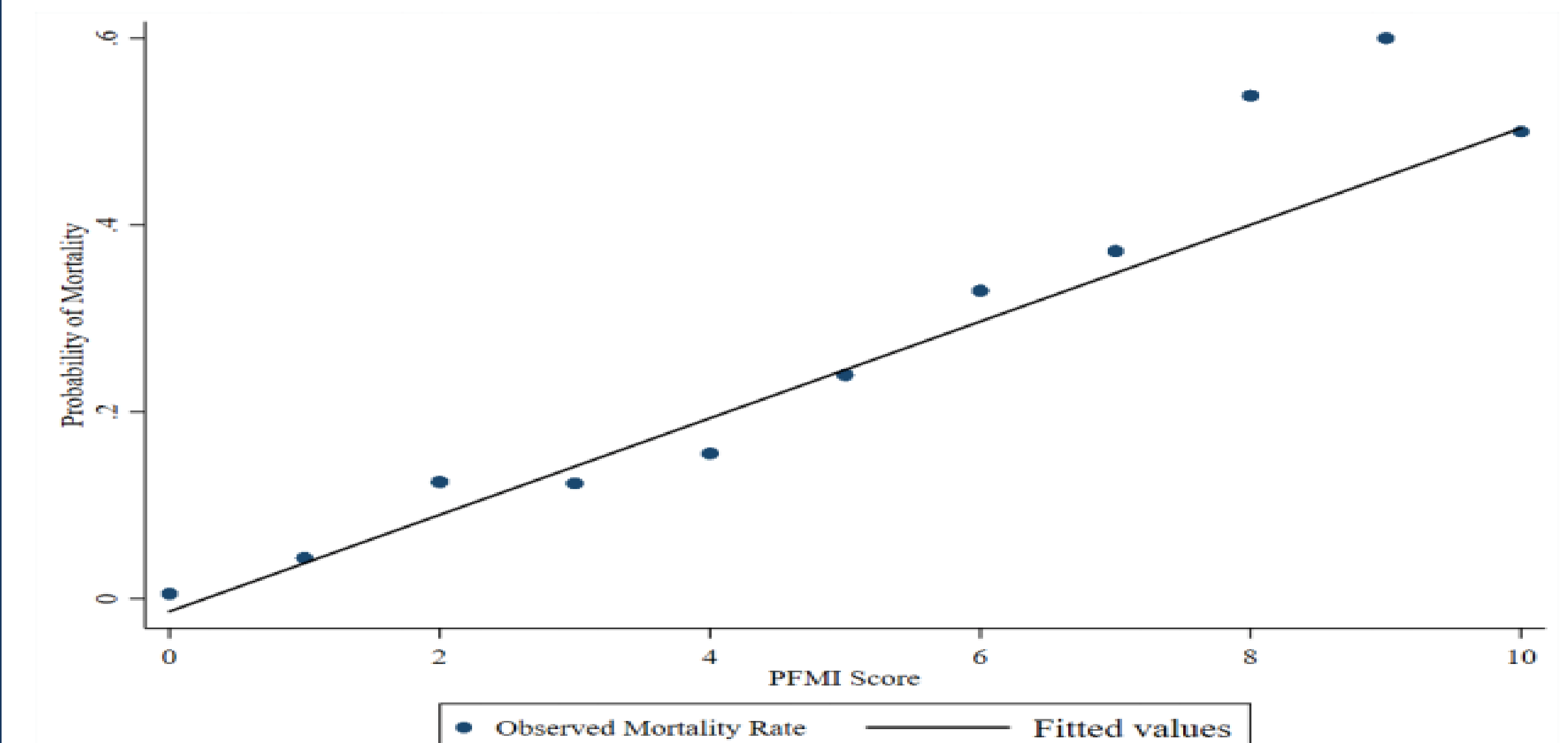


Figure III. Calibration plot of the observed mortality rates as a function of PFMI score with an overlapped best fit line.



Conclusion

The PFMI is a validated and simple tool that may be used for predicting postoperative 30-day mortality after fixation of impending or completed pathologic fractures. Future studies should involve performing an impact analysis, to quantify any clinical benefit or cost reduction that PFMI may bring in the hospital setting.