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Predictors of Response to Robot-Assisted Upper Limb Rehabilitation in Subacute Stroke

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Background & Aim

Background:
Although robot-assisted upper limb rehabilitation is increasingly implemented after stroke, treatment response in the early subacute phase remains heterogeneous. Clinically applicable predictors and practical screening thresholds are needed to guide patient selection.

Aim:
To identify clinical predictors and baseline cutoff values of the Fugl–Meyer Assessment for Upper Extremity (FMA-UE) associated with meaningful motor improvement after robot-assisted upper limb rehabilitation in early subacute stroke.

Materials & Methods

In this retrospective single-center study, 214 patients within 3 months of first-ever unilateral stroke underwent robot-assisted upper limb rehabilitation. A responder was defined as achieving ≥9-point improvement in the FMA-UE. Multivariate logistic regression identified independent predictors of treatment response. Receiver operating characteristic (ROC) analysis was performed to determine optimal baseline cutoff values.

Study Design

2015-2023
Single-center; Retrospective study

214 patients with early subacute stroke
(<3 months)

Robot-assisted upper limb rehabilitation

Outcome = FMA-UE
(Responder ≥9 FMA-UE)

Figure 1. Study design and flow of participant inclusion and analysis

Results

Robot-assisted rehabilitation significantly improved upper limb motor and functional outcomes (all p<0.001). Independent predictors of treatment response included shorter time since onset, higher proximal FMA-UE and MBI scores, lower distal FMA-UE scores, and lower triglyceride levels. The multivariate model demonstrated good discrimination (AUC=0.836, 95% CI 0.781–0.891). ROC analysis identified a baseline FMA-UE total score ≥6.5 as the optimal cutoff (AUC=0.731; sensitivity 0.73; specificity 0.70), outperforming proximal and distal sub scores.

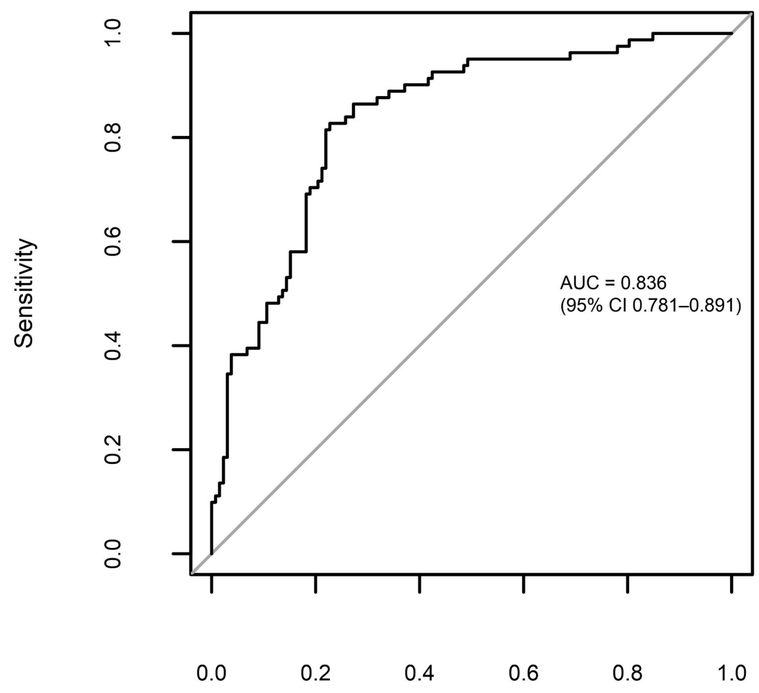

Figure 2. ROC curve of the multivariate logistic regression model for predicting FMA-UE responders (>9-point improvement).

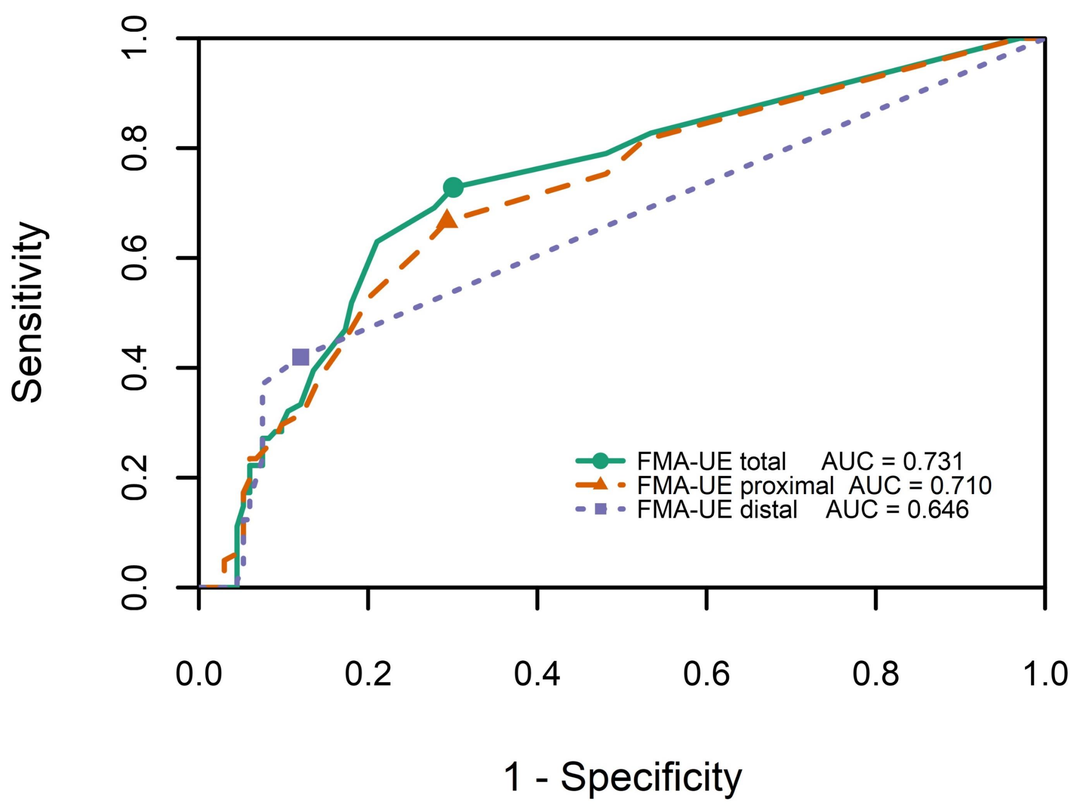

Figure 3. ROC curves and optimal cutoff values of baseline FMA-UE total, proximal, and distal scores for predicting treatment response.

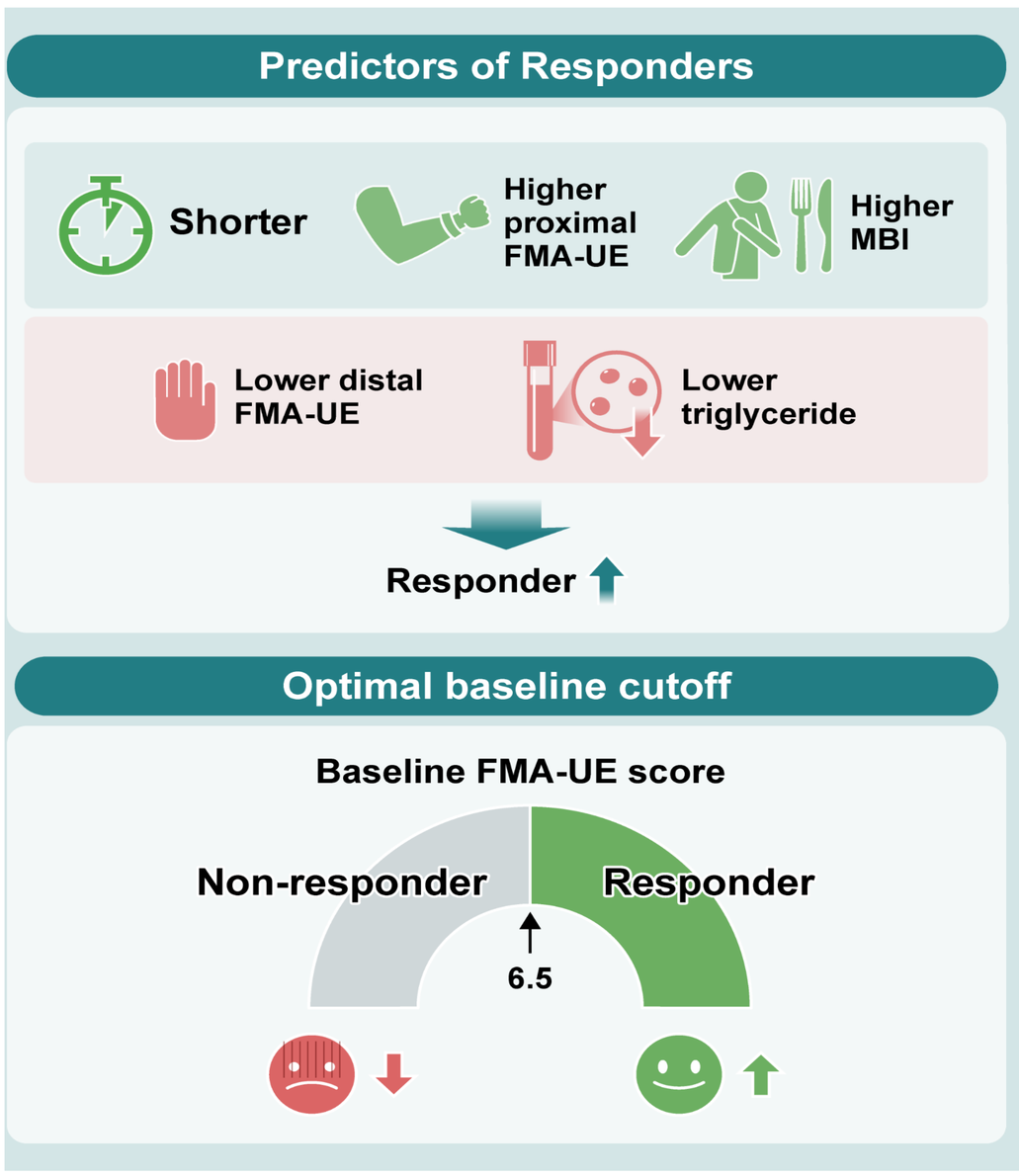

Figure 4. Independent predictors of treatment response & baseline FMA-UE total score ≥6.5 as the optimal cutoff of predicting treatment response.

Conclusion

In early subacute stroke, preserved proximal motor function, better baseline functional capacity, earlier rehabilitation initiation, and favorable metabolic status were associated with greater benefit from robot-assisted upper limb rehabilitation. A baseline FMA-UE cutoff of 6.5 may facilitate patient stratification and optimized candidate selection.

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Ethical approval

This study was approved by the Institutional Review Board of Severance Hospital (IRB No.4-2025-0500).