Oral Communication

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Personalization of Postural Rehabilitation Strategies in Multiple Sclerosis Using Artificial Intelligence: A Machine Learning Approach

Topic: Miscellaneous

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BACKGROUND

Postural disorders in multiple sclerosis (MS) patients significantly impair autonomy and quality of life. While rehabilitation using posturography platforms is a promising approach, individual variability in treatment response remains a challenge. Artificial intelligence (AI) has emerged as an innovative tool to overcome these limitations. This study aimed to develop a machine learning-based predictive model to personalize postural rehabilitation programs for MS patients by integrating clinical and posturographic data.

METHODS

This retrospective study involved 82 patients diagnosed with multiple sclerosis (MS) who underwent balance training using the TecnoBody® postural rehabilitation platform at the Physical and Rehabilitation Medicine Department of Ibn Rochd University Hospital in Casablanca, from January 2022 to January 2025. Data analyzed included demographic parameters (age, gender), clinical scores (Expanded Disability Status Scale [EDSS], Romberg test, muscle strength testing, standardized balance tests), and posturographic data (postural deviations, oscillations, and stability limits). The study aimed to integrate these clinical and posturographic data into a machine learning (ML) framework to personalize postural rehabilitation. Several supervised ML algorithms, including XGBoost, Random Forest, Support Vector Machine (SVM), and Logistic Regression, were applied to optimize the use of the rehabilitation platform for each MS patient.

RESULTS

The XGBoost model (accuracy: 88%, area under the curve [AUC]: 0.91) and the Random Forest model (accuracy: 86%, AUC: 0.89) demonstrated superior performance, significantly outperforming conventional approaches with statistical significance ($p < 0.05$). Feature importance analysis revealed that the most influential predictive variables were age (18%), EDSS score (32%), Romberg test results (28%), and trunk and lower limb muscle strength (22%). These parameters enabled the stratification of patients into distinct subgroups: those who showed postural improvement greater than 30% and those who were non-responders. Validation tests conducted on 10 patients confirmed the robustness of the model, with an accuracy rate of 80%. The model allowed the generation of individualized rehabilitation trajectories, adjusting the frequency of rehabilitation sessions based on the predictive profiles of each patient.

CONCLUSION

This AI model integrates clinical and posturographic data to personalize postural rehabilitation for MS patients, offering an objective decision-making framework to maximize intervention effectiveness and optimize resource allocation. Prospective validation confirmed a strong correlation between actual clinical outcomes and predicted responses, supporting its implementation in rehabilitation programs.

Statement of Disclosures

None

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