

# AI-Driven Models for Predicting Rotator Cuff Retear Risk After Arthroscopic Rotator Cuff Repair

Jong Ho Kim<sup>1</sup>, Jae-Yoon Baek<sup>1</sup>, EUNJI YOON<sup>1</sup>, Min Jeon<sup>2</sup>, Dohyun Jung<sup>2</sup>, taehyung Kim<sup>2</sup>

<sup>1</sup>Orthopaedics, <sup>2</sup>Computer Engineering

**INTRODUCTION:** This study aims to develop AI-based machine learning and deep learning models for predicting the preoperative risk of re-tear in patients undergoing arthroscopic rotator cuff repair (ARCR) at six months postoperatively.

**METHODS:** Data from 277 patients were analyzed, with 193 used for training (173 cases with intact repairs and 20 cases with re-tears identified via magnetic resonance imaging (MRI) at postoperative six months) and 84 for testing (73 intact repairs and 11 re-tears). The research was conducted in four stages. First, preoperative and postoperative clinical data (e.g., sex, age, tear size on MRI, comorbidities, range of motion, clinical scores) were collected. Next, data preprocessing and feature extraction were performed to identify critical factors influencing re-tear risk. Then, various machine learning and deep learning algorithms, including Logistic Regression, Random Forest, Support Vector Machine, Multi-Layer Perceptron, and Convolutional Neural Network models, were developed and compared to determine the optimal model. To address data imbalance, techniques such as Synthetic Minority Oversampling (SMOTE), ensemble methods, and boosting algorithms were applied. Finally, the models' performance was evaluated using metrics such as accuracy, precision, recall, and F1-score.

**RESULTS:** All models demonstrated high predictive accuracy, exceeding 90%, with precision, recall, and F1-scores surpassing 70%. The most effective model, a Multi-Layer Perceptron combined with SMOTE, achieved perfect scores across all performance metrics (100% accuracy, precision, recall, and F1-score).

**DISCUSSION AND CONCLUSION:** This study presents a robust framework for developing predictive models to estimate rotator cuff re-tear risk, offering a reliable tool to support treatment planning and rehabilitation after ARCR. By providing accurate risk assessments, the models hold promise for facilitating personalized treatment strategies, enhancing patient outcomes, and minimizing the likelihood of re-tears.