Machine Learning Predictive Model for Rotator Cuff Retear: Enhanced Risk Assessment After Arthroscopic Repair

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Introduction and Background

Rotator cuff retear remains a significant complication following arthroscopic rotator cuff repair (ARCR), impacting long-term shoulder function and patient satisfaction. Traditional prediction models have limited accuracy. Artificial intelligence (AI) and machine learning (ML) techniques are increasingly utilized to identify complex risk patterns and optimize patient outcomes. This study aims to develop and evaluate a machine learning-based model for preoperative prediction of rotator cuff retears using detailed clinical and surgical data.

Material and Method

A retrospective review enrolled 192 adult patients who underwent primary ARCR performed by a single surgeon, with both pre- and post-operative MRI available within two years of surgery. Fourteen surgical and demographic features were collected, including gender, subscapularis repair, anchor numbers, knot technique, delamination, massive tear presence, biceps procedures, and experience of the surgeon. Predictive models were developed using support vector machine (SVM) and compared with logistic regression. Performance was assessed via area under the receiver operating characteristic curve (AUC), sensitivity, specificity, and accuracy.

Results

The SVM machine learning model outperformed traditional logistic regression, achieving an AUC of 0.875, sensitivity of 0.830, and specificity of 0.820. Key predictors identified included gender, subscapularis tendon repair, anchor count and technique, massive tear, and biceps augmentation. The model's accuracy surpassed previous published AI studies in orthopedic risk prediction.

Conclusions

Machine learning (SVM) offers superior preoperative risk assessment for rotator cuff retear after ARCR compared with conventional methods. This technology enables clinicians to deliver personalized care, optimize surgical planning, and potentially improve patient outcomes. Future work will focus on multicenter validation and integration into routine clinical practice.
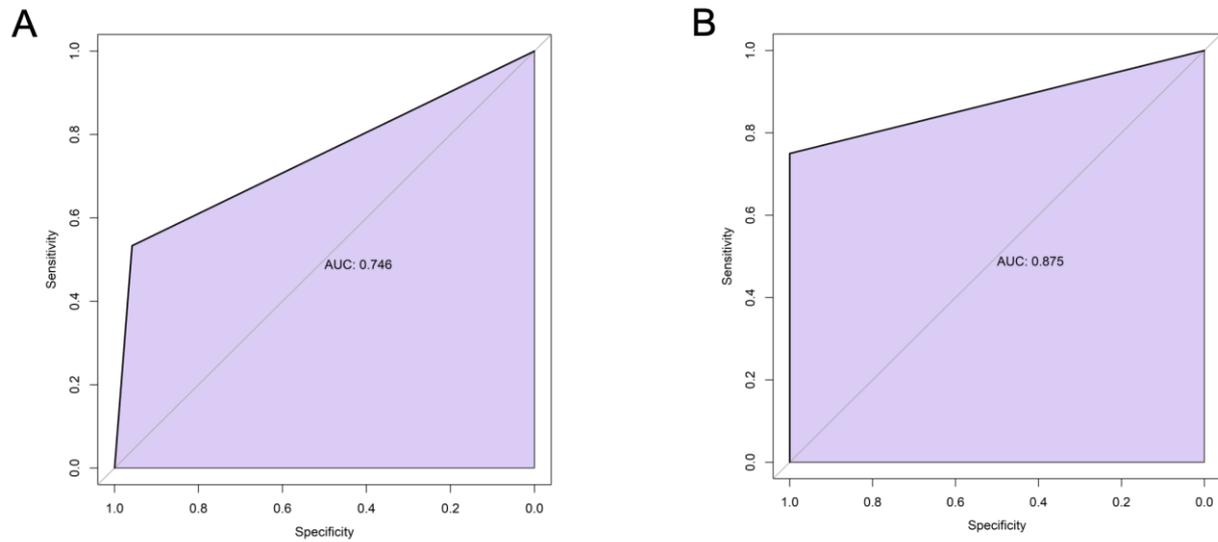
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Figure & Table 1.

A

B

Performance of the models in term of the area under the receiver operating characteristic curve (AUC) to predict retear after arthroscopic rotator cuff repair (ARCR): A) the traditional statistics model, and B) the novel machine learning models