Establishment and Validation of an Imaging Prediction Model for Combined Anterior Cruciate Ligament Injury and Patellar Instability

[1]Jiebo Chen, [1]Xueying Zhang, [1]Jinzhong Zhao

1 National Centre for Orthopedics; Department of Sports Medicine, Shanghai Sixth People's Hospital Affiliated to Shanghai Jiao Tong University School of Medicine, Shanghai 200233, China
Email of Presenting Authors: chenjiebodsm@hotmail.com; zxysunflower@gmail.com; jzzhao@sjtu.edu.cn

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INTRODUCTION: Underestimation of concomitant patellofemoral instability (PI) in patients with anterior cruciate ligament (ACL) injury has aroused extensive attention. However, the characteristics of the combined injury is not well recognized. Hence, we aimed to characterize the features of the combined injury, and determine the radiographic risk factors.

METHODS: Fifteen radiological parameters were identified after discussion and pilot-tested. Radiographic measurements were compared using the analysis of variance model with Tukey post hoc analysis. A stepwise binomial logistic regression was performed and a nomogram model combining the significant risk factors was created. The model performance was validated by C-index, calibration plot, and decision curve.

RESULTS: A total of 204 patients (mean [SD] age, 25.1 [6.7] years; 108 [52.9%] male) were included. The final model was updated through regression analysis using 4 parameters as significant risk factors: lateral femoral condyle ratio (OR (95% CI), 1.194 (1.023 to 1.409)), medial anterior tibial subluxation (mATS) (OR (95% CI), 1.234 (1.065 to 1.446)), medial posterior plateau tibial angle (mPPTA) (OR (95% CI), 1.266 (1.088 to 1.500)), and trochlear depth (OR (95% CI), 0.569 (0.397 to 0.784)). C-index for the nomogram was 0.802 (95% CI, 0.731 to 0.873) and was confirmed to be 0.784 through bootstrapping validation. Calibration plot established a good agreement between prediction and observation. Decision curve analysis showed that if threshold probability was over 10%, using the nomogram adds more benefit than either all or none scheme. **(Figure 1)**

DISCUSSION: Lateral femoral condyle ratio, mATS, mPPTA, and trochlear depth are strong adverse predictors of patellofemoral instability in patients with ACL injury.

SIGNIFICANCE/CLINICAL RELEVANCE: This study characterizes the radiological features of the combined injury. Patellofemoral instability should be noted when treating ACL injuries.

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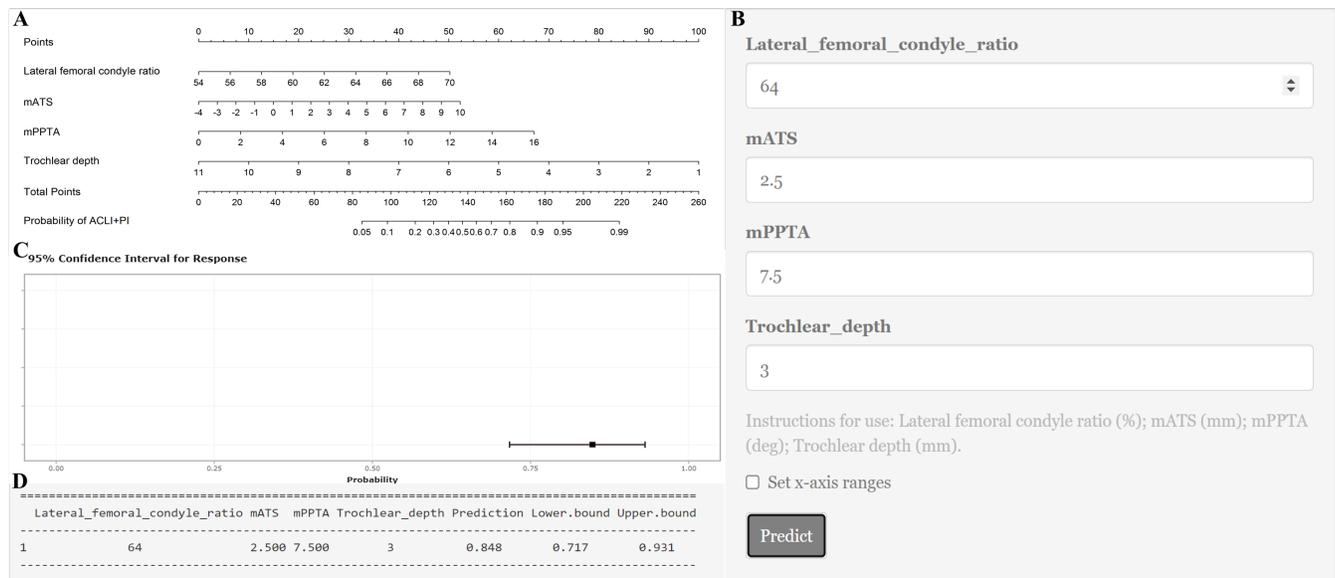
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Figure 1
A The nomogram outputs include lateral femoral condyle ratio, mATS, mPPTA, and trochlear depth. B–D This example shows the probability (95% CI) of gaining ACLI+ PI in ACLI patients with lateral femoral condyle ratio equal to 64%, mATS 2.5 mm, mPPTA 7.5°, and trochlear depth 3 mm.