Risk Factors for Patellar Instability Using a Quantitative Analysis of Trochlear Dysplasia

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Objectives

- Patellar instability is a common presenting knee complaint in sports medicine clinics.
- Multiple studies have described several anatomic and demographic risk factors for patellar instability.
- Trochlear dysplasia has been shown to be a dominant risk factor for patellar instability.
- Classically the Dejour classification has been used to assess Trochlear dysplasia but it suffers from poor inter and intra observer reliability.
- Other more quantitative methods to assess trochlear dysplasia have been described but to date there are no predictive algorithm to help a clinician assess for patellar instability.
- The purpose of this study was to create a reliable predictive model for patellar instability.

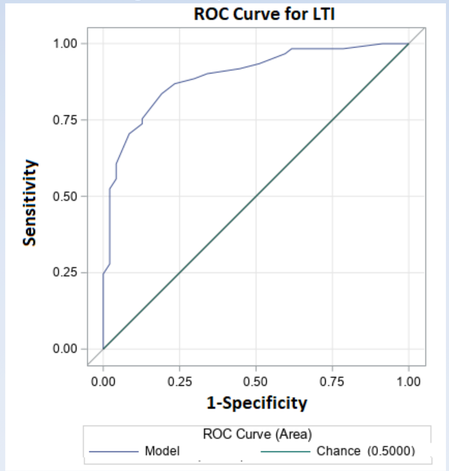
Methods

- A chart review was approved by the Connecticut Children's IRB.
- Patients were included if they presented to our sports medicine clinics and subsequently diagnosed with patellar instability between January 2013 and December 2017. All patients had a knee MRI.
- A matched population of patients without a history of patellar instability but with an ACL injury were also reviewed for this study
- The following parameters were collected from the MRI images: lateral trochlear inclination (LTI), Sulcus angle, proximal TTTG, distal TTTG, Caton-Deschamps (CD) ratio, and patellotrochlear index (PTI)

Statistical Analysis

- Receiver-operator characteristic (ROC) curves were constructed for each variable of interest and area under the curve (AUC) values of greater than 0.7 were considered statistically significant. (Fig. 1)
- Threshold values for each variable of that reached and AUC of 0.7 were calculated based on the probabilities, intercept and variable estimate. Probability values were set at 90% specificity.
- A predictive model was created using SAS 9.4 software using a stepwise approach on a set of data with 193 subjects (98 with patellar instability). The model was constrained to the best fit with least number of predictors.
- The model was then tested on a second set of data with 86 subjects (44 with patellar instability) to assess model accuracy.

Fig. 1: Example ROC curve



Results

- The ROC analysis indicated that the most predictive variables for patellar instability were:
  - Sulcus angle, distal TT-TG, LTI, LPI, and LCI
- The model developed takes the form of a generalized logistic regression model (Eq. 1).
- The model had 84% accuracy with a 78% sensitivity and 88% specificity when tested on the validation data set.
  - These values are based on a probability of 90% or greater.
- The model is most accurate when the probability value is above 90% or below 40%.

$$p = \frac{1}{1 + e^{-z}} \quad \text{Eq. 1}$$

Where p is the probability, and z is the equation based on model variable coefficients

Discussion

- This study establishes an accurate and reliable predictive model based on measurable anatomic risk factors to assess a patient's risk for recurrent patellar instability.
- The model provides personalized discrete values for a patient's risk of recurrent instability, which no model has done previously.
- Interestingly this model found that anatomic measures of patellar alta, and demographic parameters such as patient age were not strong predictors of patellar instability.
- This study is not without limitations. This study lacks data on angular and rotational limb alignment. Additionally, there were some differences between the test and validation set mainly BMI.
- The model requires five measurements.

Conclusion

- The model described in this study establishes a reliable predictive model for patellar instability that is driven by direct measures including LTI, Sulcus Angle, and the LCI, as well as indirect measures of distal TT-TG, and LPI.
- Patellar height was not a prime drive of the model suggesting that patella alta is a less common risk factor for patellar instability.
- This model may be used to help physicians establish and individual's risk for recurrent instability and improve the shared decision making processes between patient and physician.

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