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A Model Using Patient-Specific Data to Predict Severe Cartilage Damage of the Hip

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Summary:

A predictive nomogram was generated with use of patient specific factors, which can be applied in clinic to determine the risk of severe hip cartilage damage in patients with hip symptoms, to determine the need to proceed to advanced imaging methods or undergo surgical intervention.

Abstract:

Background

Hip cartilage damage has been associated with local anatomic abnormalities, such as cam deformity and acetabular dysplasia. Severe cartilage damage at the time of hip arthroscopy can be predictors of poor clinical outcome, worsening osteoarthritis and total hip replacement. Although magnetic resonance imaging is considered a gold standard to evaluate the cartilage status in the hip in surgical candidates, its diagnostic accuracy is limited.

Purpose

To determine whether patient-specific factors can be used to predict the presence of severe cartilage damage in the hip without the need of advanced imaging in non-osteoarthritic patients who are candidates for hip arthroscopy.

Methods

The cartilage status of 2396 symptomatic hip joints was prospectively recorded during primary arthroscopic hip surgery. The prevalence of severe (Outerbridge grade III or IV) cartilage damage on the acetabulum and the femoral head was recorded intra-operatively. The relationship between severe cartilage damage and preoperative patient characteristics (age, gender, BMI, period from pain onset to observation and radiographic measurements) was examined using multivariable logistic regression analysis with restricted cubic splines.

Results

Severe cartilage damage on the acetabulum was present in 995 (41%) hips and on the femoral head in 257 (11%) hips. In the acetabular model, increased age ($\beta = 69.5$, $P < .001$), male gender ($\beta = 66.7$, $P < .001$) and joint space narrowing ($\beta = 32.8$, $P < .001$) were most highly predictive for severe cartilage damage. BMI ($\beta = 14.2$, $P = .007$), period from onset of symptoms to surgery ($\beta = 13.4$, $P = .009$) and alpha angle ($\beta = 11.5$, $P = .022$) were also statistically significant independent risk factors of severe cartilage damage on acetabulum. Center Edge (CE) angle was the most impactful predictor of severe femoral head cartilage damage ($\beta = 78.5$, $P < .001$). Increased age ($\beta =$

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54.0, $P < .001$), larger Tönnis angle ($\beta = 24.2$, $P < .001$), joint space narrowing ($\beta = 9.9$, $P = .007$) and BMI ($\beta = 6.2$, $P = .045$) were independently significant predictors for femoral head cartilage damage. Predictive nomograms were established for acetabular and femoral head severe cartilage lesions, and the area under the receiver operating characteristic curve was 0.700 and 0.795 for the acetabulum and femoral head models, respectively.

Conclusion

Specific risk profiles were identified for severe cartilage damage in the acetabulum and femoral head. A predictive nomogram was generated with use of patient specific factors, which can be applied in clinic to determine the risk of severe hip cartilage damage in patients with hip symptoms, to determine the need to proceed to advanced imaging methods or undergo surgical intervention.

Clinical relevance: The prediction models have two benefits: 1. They could identify independent predictors of severe cartilage damage via standard statistical inference; and 2. For clinicians inclined to use the models directly, predictions of likelihood of cartilage damage can be made for new patients using the prediction nomogram, which can also be implemented as a simple input/output software application.