The Recurrent Instability of the Patella Score:

A Statistically-Based Model for Prediction of Long-Term Recurrence Risk after First-Time Dislocation

M Hevesi MD, RK Martin MD FRCSC, MJ Heidenreich MD, D Leland BS, CL Camp MD, TA Milbrandt MD, TE Hewett PhD, MJ Stuart MD, DL Dahm MD, AJ Krych MD

Department of Orthopedic Surgery and Sports Medicine, Mayo Clinic, Rochester, MN
Disclosures

• M Hevesi, RK Martin, MJ Heidenreich, CL Camp, TA Milbrandt, & TE Hewett:
  • We have no financial conflicts to disclose

• MJ Stuart:
  • Reports support from the American Journal of Sports Medicine, personal fees from Arthrex, and grants from Stryker, outside the submitted work.

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Introduction:

- Patellofemoral anatomy allows for freedom of motion\(^1\)
- Patellar dislocation accounts for 2-3% of knee cases\(^2\)
- Risk factors previously well-established\(^3,4\)
  - Pediatric / teenage years
  - Dysplasia
  - High demand activities
- Accurate prognostication remains elusive
  - Multifactorial risk factors
  - Long natural history of recurrence

Purpose:

• **Aims:**
  - Describe the clinical history of a series of primary, lateral patellar dislocations
  - Determine long-term predictors of recurrent instability

• **Goal:** Create a prognostic stratification tool for predicting recurrent instability
About the REP

• Rochester Epidemiology Project\textsuperscript{1}

• Complete medical record for Olmsted County residents and neighboring areas

• Access to clinical and surgical notes and imaging

• Allows patients to be longitudinally followed
  • Regardless of treating institution

Materials & Methods:

- REP database reviewed from 1990 – 2010

**Inclusion criteria:**
  - First time, lateral patellar dislocation

**Exclusion criteria:**
  - Chronic patellar subluxation
  - No MRI available at time of injury
  - < 4 years of follow-up

- Records manually verified
- Rates of recurrence, surgery determined
Statistical Methods

• Model creation for Recurrent Instability of Patella (RIP) Score:
  • Competing risks analysis
  • Points assigned using methods analogous to Framingham Heart Study$^{1,2}$
    • Fine and Gray proportional hazards model employed
    • Sub-distribution hazards used as basis for point standardization
  • Allows for creation of **multivariable** predictive model for recurrence

• Model Checking: Performed with cumulative incidence and ROC curves

Results:

• Population:
  • 81 patients followed for mean of 10.1 years (range: 4.1 – 20.2 years)
  • 43 females, 38 males
  • Mean age: 19.9 ± 9.4 years

• Recurrent instability present in 38 patients (47%)
  • Mean time to recurrence: 3.0 years (range: 0.2 – 11.8 years)

• Surgical management employed in 30 patients
  • 7 patients did so prior to recurrence
# Univariate Recurrent Instability Predictors

<table>
<thead>
<tr>
<th>Variable</th>
<th>Recurrence</th>
<th>No Recurrence</th>
<th>$P$-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at Instability</td>
<td>16.5 (± 7.0)</td>
<td>23.0 (± 10.3)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Body Mass Index</td>
<td>22.7 (± 5.5)</td>
<td>26.7 (± 5.9)</td>
<td>0.003</td>
</tr>
<tr>
<td>Skeletally Immature</td>
<td>25 (66%)</td>
<td>17 (40%)</td>
<td>0.026</td>
</tr>
<tr>
<td>Dejour Dysplasia</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grade A or B</td>
<td>16 (42%)</td>
<td>4 (9%)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Grade C or D</td>
<td>11 (29%)</td>
<td>2 (5%)</td>
<td></td>
</tr>
<tr>
<td>Caton-Deschamps Index</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt; 1.3</td>
<td>30 (79%)</td>
<td>41 (95%)</td>
<td>0.040</td>
</tr>
<tr>
<td>≥ 1.3</td>
<td>8 (21%)</td>
<td>2 (5%)</td>
<td></td>
</tr>
<tr>
<td>TT-TG/PL</td>
<td>0.56 ± 0.14</td>
<td>0.46 ± 0.11</td>
<td>&lt; 0.001</td>
</tr>
</tbody>
</table>
**Multivariable RIP Score:**

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Point Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age &lt; 25 years</td>
<td>2 points</td>
</tr>
<tr>
<td>Skeletal immaturity</td>
<td>1 point</td>
</tr>
<tr>
<td>Dejour A-D dysplasia</td>
<td>1 point</td>
</tr>
<tr>
<td>TT-TG / PL ≥ 0.5</td>
<td>1 point</td>
</tr>
</tbody>
</table>

**Total:** 0 to 5 points
RIP Score Prognostication

• At 10 years, recurrent instability:
  • 0% (Score 0-1)
  • 31% (Score 2-3)
  • 79% (Score 4-5)

• Area Under the Curve:
  • AUC: 0.875
  • P < 0.001)
Discussion:

- Historically, 30 – 50% of patients will experience recurrent dislocation\(^1\)
- Recurrence associated with increasing rates of osteochondral injury\(^2\)
- While individual risk factors have been described, there exists no multivariable system in the literature for predicting long-term recurrent instability
  - Previous systems with limited discriminatory value\(^3,4\)
  - Outcomes often based on odds ratios
- RIP Score can be used to predict recurrence of primary lateral patellar dislocations at 10+ years of follow-up

Conclusions:

• Patients can be **readily classified** into low-, intermediate-, and high-risk categories utilizing the RIP Score based on age, skeletal maturity, trochlear dysplasia, and TT-TG/PL ratio.

• Long-term risk stratification holds **significant clinical utility** for determination of patients who are at high risk for recurrent instability following primary patellar dislocation.