ORIGINAL

Incidence of primary patellar dislocation in Colombia

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KEYWORDS
Patellofemoral Joint; Patellar Dislocation; Incidence

Abstract

\textbf{Introduction and objectives:} Primary acute patellar dislocations (PAPD) account for 3\% of all traumatic knee lesions, and several studies have estimated the general incidence of patellar dislocation to be between 2 and 77.4 per 100,000 person-years. Few studies have evaluated the incidence of primary lateral patellar dislocation in Latin America. The aim of the study was to evaluate the incidence of patellar dislocation in patients from a reference center in the Colombian southwest, report trends in the incidence of dislocation, and describe the rate of surgical treatment.

\textbf{Materials and methods:} We performed an observational, analytical, cross-sectional study including all patients older than 9 years old with primary lateral patellar dislocation (PLPD), between January 2011 and June 2018, in a tertiary care center in Latin America.

\textbf{Results:} In our population, the incidence of primary lateral patellar dislocation (PLPD) was 32.38 per 100,000 person-years. The age group between 14 and 18 years old had the highest incidence (187.74 per 100,000). In the 10 to 13-year-old group, females had a significantly higher incidence (179.05 vs 59.85 /100,000, p-value < 0.001).

\textbf{Conclusions:} With an incidence of 32.38 per 100,000 person-years, primary patellar dislocation is a frequent orthopaedic injury in our population. The peak incidence by age group was in adolescents between 14 to 18 years old.
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Introduction

Patellar dislocation is defined as a non-recurring or recurrent loss of the relationship between the patella and the trochlear groove of the femur. Usually, the patella dislocates in a lateral direction, representing 2-3% of all knee injuries. Primary acute patellar dislocations are the first cause of traumatic hemarthrosis of the knee in children and the second in adults after anterior cruciate ligament tears. It occurs most commonly in the second decade of life and is more common in females.

The reported incidence of patellar dislocation is highly variable. Previous studies have estimated the general incidence of patellar dislocation to be between 2 - 77.4 per 100,000. For instance, Waterman et al. reported an incidence of 2.29 per 100,000, while there are reports in the United States military of 77.4 per 100,000. Furthermore, it has been shown that patients in the second decade of life (10 to 19 years), particularly those aged 15 to 19 years, have the highest risk of injury. Previous studies have shown that the incidence in the < 20 years age group was 29 to 107 per 100,000, falling to 9 per 100,000 in the third decade.

The differences in reported incidences are probably secondary to the selected cohorts, the period of time, and the study design. These differences were the motivation to carry out our study, which aims to evaluate the incidence of patellar dislocation in patients from a reference center in the Colombian southwest, report trends in the incidence of dislocation, and describe the rate of surgical treatment.

Methods

Context: This study was conducted at Fundación Valle del Lili (FVL), a university hospital in Cali, Colombia. FVL is a tertiary health center in Southwest Colombia with specialists trained for the care of patients with complex orthopedic injuries, making this institution an orthopedic referral center.

Ethical considerations. The Biomedical Research Ethics Committee from Fundación Valle del Lili approved the study (IRB No. 1183). Following the ethical principles of medical research described in the Declaration of Helsinki and considering the regulations of Resolution 8430/1993 of the Ministry of Health and Social Protection of Colombia.

Type of study and population: An observational, analytical, cross-sectional study was conducted, including all patients older than 9 years old who sustained primary lateral patellar dislocation (LPD). The study period was from January 2011 to June 2018. There were no exclusion criteria.

Assessment: All patients were evaluated by an orthopedic sports medicine surgeon. The evaluation included questions about their first episode and further dislocations, type of treatment received and physical examination.

Data collection and processing: Data was retrospectively collected from electronic medical records, including demographic and clinical characteristics. This information was recorded in an electronic database used exclusively by FVL.

Statistical analysis: Age- and sex-specific rates of patellar dislocation were calculated by using the number of first-time lateral patellar dislocations (incident cases) as the numerator and population estimates based on FVL census as the denominator, with linear interpolation between census years. Only patients who consulted FVL at the time of patellar dislocation and who fulfilled the study criteria were included in the incidence calculations. Overall incidence rates were age and sex-adjusted to the 2011 to 2018 population of Fundación Valle del Lili, Cali, Colombia.
Table 1  Patellar dislocation recurrence with different cut points.

<table>
<thead>
<tr>
<th>Age</th>
<th>n</th>
<th>Without dislocation recurrence</th>
<th>With dislocation recurrence</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 15</td>
<td>101</td>
<td>58 (57.43%)</td>
<td>43 (42.57%)</td>
</tr>
<tr>
<td>≥ 16</td>
<td>85</td>
<td>50 (58.82%)</td>
<td>35 (41.18%)</td>
</tr>
<tr>
<td>≥ 17</td>
<td>61</td>
<td>40 (65.57%)</td>
<td>21(34.43%)</td>
</tr>
<tr>
<td>≥ 18</td>
<td>53</td>
<td>38 (71.70%)</td>
<td>15(28.30%)</td>
</tr>
<tr>
<td>≥ 19</td>
<td>48</td>
<td>36 (75.00%)</td>
<td>12(25.00%)</td>
</tr>
<tr>
<td>≥ 20</td>
<td>43</td>
<td>33 (76.74%)</td>
<td>10(23.26%)</td>
</tr>
<tr>
<td>≥ 21</td>
<td>40</td>
<td>32 (80.00%)</td>
<td>8(20.00%)</td>
</tr>
</tbody>
</table>

Table 2  Incidence rate for patellar dislocation by age group and sex.

<table>
<thead>
<tr>
<th>Age group</th>
<th>Female cases</th>
<th>Male cases</th>
<th>Total cases</th>
<th>Female Incidence (per 100,000 person-year)</th>
<th>Male Incidence (per 100,000 person-year)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-13</td>
<td>27</td>
<td>10</td>
<td>37</td>
<td>179.05</td>
<td>59.85</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>14-18</td>
<td>32</td>
<td>34</td>
<td>66</td>
<td>189.75</td>
<td>185.88</td>
<td>0.84</td>
</tr>
<tr>
<td>19-25</td>
<td>11</td>
<td>12</td>
<td>23</td>
<td>40.04</td>
<td>49.22</td>
<td>0.33</td>
</tr>
<tr>
<td>26-35</td>
<td>5</td>
<td>5</td>
<td>10</td>
<td>9.45</td>
<td>12.16</td>
<td>0.56</td>
</tr>
<tr>
<td>36-45</td>
<td>4</td>
<td>6</td>
<td>10</td>
<td>7.71</td>
<td>15.65</td>
<td>0.13</td>
</tr>
<tr>
<td>46-65</td>
<td>4</td>
<td>1</td>
<td>5</td>
<td>4.19</td>
<td>1.46</td>
<td>0.27</td>
</tr>
<tr>
<td>Total</td>
<td>83</td>
<td>68</td>
<td>151</td>
<td>31.99</td>
<td>32.87</td>
<td>0.91</td>
</tr>
</tbody>
</table>

95% confidence interval (95% CI) for the incidence rates were constructed using the assumption that the number of incident cases per year followed a Poisson distribution. Incidence trends were examined using Poisson regression models, with smoothing splines for age and calendar year. All analyses were performed using STATA 14 statistical software.

Results

The cohort includes 466,292 patients, of which 151 had a primary lateral patellar dislocation diagnosis. Of the 151 cases, 83 were female (54.97%), 66 of the cases (43.70%) were in the age group between 14 and 18 years old, and 97 cases (64.24%) presented trochlear dysplasia (Type A 47, type B 18, type C 19 y type D 12).

Of the 151 patients diagnosed with primary patellar dislocation from 2011 to 2018, 34 (22.5%) underwent surgery. Return to sport was possible for 23 of the total subjects (15.23%). 80 patients (52.98%) experienced a recurrence of patellar dislocation during the study period. Table 1, shows the recurrence of patellar dislocation by age group.

The global incidence of primary lateral patellar dislocation was 32.38 per 100,000 person-years. The highest incidence of patellar dislocation by age group was found between 14 and 18 years old: 187.74 per 100,000 person-years. When performing the Wilcoxon test, there was no evidence of a difference in incidence between females and males for this age group (p = 0.84). However, in the 10 to 13-year-old group, females had a significantly higher incidence (179.05 vs. 59.85/100,000 person-years, p < 0.001). Table 2, shows the incidence of LPD by age group and sex.

During the study period there was a significant decrease in the incidence of LPD in females aged 14-18 years between 2011-2014 and 2015-2018. The descent showed a change from 134.95 to 47.06 per 100,000 person-years. Other changes across the study period between groups are shown in Table 3 and Figure 1.

Discussion

The overall incidence of primary patellar dislocation in this study was 32.38 per 100,000 person-years, which is similar to that has been reported by Sanders TL et al. (23.2/100,000), Gravesen et al. (42/100,000),12 and Nietosvaara et al. (43/100,000).10 Though, there are studies that show even higher incidences such as the retrospective series in the US military population (77/100,000)2 and the study from Silpanpää et al. in Finnish male conscripts (77.4/100,000).14 These differences may reflect less physical activity by the civilian population than in the military, which is a previously evidenced risk factor for this pathology.15

This study shows that the age group with the highest incidence for primary patellar dislocation is between 14 to 18 years old, with an incidence of 187.74 per 100,000 person-years. These data are in agreement with the findings found in the literature, such as the case of the investigation carried out in the population of Olmsted County, Minnesota, which reported an incidence in the same age group of 147.7 per 100,000 person-years, the prospective study carried out by Nietosvaara et al. which reported an incidence of 107 per 100,000 person-years in ages between 9 and 15 and Gravesen et al. (108/100,000) in a population of women aged 10 to 17 years.11 Conversely, there also results from other publications that show a lower incidence, such as Atkin DM et al. (31/100.000) between 10 and 19 years and Fithian et al. (29/100.000). The higher incidence observed in adolescents could be explained by the rapid bone growth (skeleton), change in angle Q with growth, increased level
of physical activity and laxity of the ligaments, which are the factors that could contribute to this occurrence.\textsuperscript{15}

Regarding the incidence of primary patellar dislocation concerning gender, literature has suggested that it is significantly higher in women. Hsiao et al. reported an adjusted incidence of 0.63/1000 in females compared to 0.39/1000 in males.\textsuperscript{1} In the results from our study, there were no differences between gender for the overall incidence and for most of the age groups. The only group where there was difference between sexes was for the 10-13 years old group, with a higher incidence for girls compared to boys. This could be explained on the fact that girls get to their adolescence growing peek at a younger age than boys.

It was observed that in the group of females between the ages of 14 and 18, there was a significant decrease in the incidence between the periods 2011-2014 and 2015-2018, with an initial incidence of 134.95 per 100,000 and final of 47.06 per 100,000 respectively (p-value < 0.001). This phenomenon is similar to what Sanders TL et al. described in this same group with a P value = 0.025.\textsuperscript{8} However, it is not clear why this phenomenon might have occurred.

**Limitations:** The main limitation of this study is the retrospective design which makes it more prone to bias. The calculated incidence rates only show those cases that were formally diagnosed by a physician from our institution and therefore did not include those patients who dislocated and did not consult or those who were not correctly diagnosed. To control this selection bias, all patients found in the database during the study period were eligible, and we actively reached them by contacting them via phone calls and email to schedule a follow-up appointment. Finally, the risk of selection bias was also reduced because the study was carried out in a high volume national medical reference center that offers healthcare to a wide range of patients.

### Table 3  Trends in patellar dislocation from 2011 to 2018 by sex.

<table>
<thead>
<tr>
<th>Age and Sex</th>
<th>2011-2014</th>
<th>2015-2018</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cases</td>
<td>n</td>
<td>Incidence rate</td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-13 years</td>
<td>11</td>
<td>13250</td>
<td>83.02</td>
</tr>
<tr>
<td>14-18 years</td>
<td>22</td>
<td>16302</td>
<td>134.95</td>
</tr>
<tr>
<td>19-25 years</td>
<td>5</td>
<td>26820</td>
<td>18.64</td>
</tr>
<tr>
<td>26-35 years</td>
<td>3</td>
<td>46024</td>
<td>6.52</td>
</tr>
<tr>
<td>36-45 years</td>
<td>1</td>
<td>44657</td>
<td>2.24</td>
</tr>
<tr>
<td>46-65 years</td>
<td>2</td>
<td>98028</td>
<td>2.04</td>
</tr>
<tr>
<td>Total</td>
<td>44</td>
<td>245081</td>
<td>17.95</td>
</tr>
<tr>
<td>Male</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10-13 years</td>
<td>5</td>
<td>14371</td>
<td>34.79</td>
</tr>
<tr>
<td>14-18 years</td>
<td>16</td>
<td>14788</td>
<td>108.20</td>
</tr>
<tr>
<td>19-25 years</td>
<td>5</td>
<td>21352</td>
<td>23.42</td>
</tr>
<tr>
<td>26-35 years</td>
<td>1</td>
<td>31083</td>
<td>3.22</td>
</tr>
<tr>
<td>36-45 years</td>
<td>3</td>
<td>30697</td>
<td>9.77</td>
</tr>
<tr>
<td>46-65 years</td>
<td>0</td>
<td>63202</td>
<td>0.00</td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
<td>175493</td>
<td>17.09</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>74</td>
<td>420574</td>
<td>17.60</td>
</tr>
</tbody>
</table>

**Figure 1  Relationship between primary patellar dislocation incidence, year and sex.**
fact of having a physician evaluating every case, decreases
the risk of overestimation.

Implications moving forward: The findings of this study
will drive further efforts and research to identify high-
risk populations and modifiable risk factors for patellar
dislocation. This information will promote the creation of
preventive initiatives to reduce primary dislocation and
recurrence and avoid long-term complications that increase
patient morbidity and entail increased costs for the health
system. Understanding the burden that patellar dislocation
has in society can improve awareness and efforts to improve
its treatment.

Conclusions

With an incidence of 32.38 per 100,000 person-years, pri-
mary patellar dislocation is a frequent orthopedic injury in
our population. The peak incidence by age group was in
adolescents between 14 to 18 years old.

Author contributions

Conceptualization: J.P.M.-C., J.C.; Data curation: J.C.,
J.P.M.-C.; Formal analysis: J.C., J.P.M.-C., J.F.L.; Fund-
ing acquisition: J.P.M.-C.; Methodology: J.C., J.P.M.-C.,
Roles/Writing - original draft: J.C., J.P.M.-C., J.F.L.,
J.J.M.A.; Writing - review & editing: J.C., J.P.M.-C., J.F.L.,
J.J.M.A.

Declaration of interest

None.

Conflicts of interest

None.

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None.

References

1. Oestern S, Varoga D, Lipross S, Kaschwisch M, Finn J, Buddrus
2. Johnson DS, Turner PG. Management of the first-time lateral
3. Hsiao M, Owens BD, Burks R, Sturdivant RX, Cameron KL.
Incidence of acute traumatic patellar dislocation among active-
4. Stefancin JJ, Parker RD. First-time traumatic patellar dis-
5. Longo UG, Lopini M, Berton A, Marinozzi A, Maffulli N, Denaro
V. The FIFA 11+ program is effective in preventing injuries in
elite male basketball players: a cluster randomized controlled
6. Atkin DM, Fithian DC, Marangi KS, Stone M, Lou, Dobson BE,
Mendelsohn C. Characteristics of patients with primary acute
lateral patellar dislocation and their recovery within the first 6
7. Fithian DC, Paxton EW, Stone M, Lou, Silva P, Davis DK, Elias
DA, et al. Epidemiology and Natural History of Acute Patellar
AJ. Incidence of First-Time Lateral Patellar Dislocation: A 21-
Year Population-Based Study. Sport Heal A Multidiscip Approach.
9. Khormaei S, Kramer DE, Yen YM, Heyworth BE. Evaluation and
management of patellar instability in pediatric and adolescent
patellar dislocation in children and adolescents: a randomized
11. Schneider DK, Grawe B, Magnussen RA, Ceasar A, Parikh SN,
Wall EJ, et al. Outcomes after Isolated Medial Patellofemoral
Ligament Reconstruction for the Treatment of Recurrent Lateral
Patellar Dislocations. Vol. 44 American Journal of Sports
12. Waterman BR, Belmont PJ, Owens BD. Patellar dislocation in the
United States: role of sex, age, race, and athletic participation.
incidence of acute and recurrent patellar dislocations: a re-
trospective nationwide epidemiological study involving 24.154
2018 Apr 1;26:1204–9.
14. Sillanpää P, Mattila VM, Iivonen T, Visuri T, Pihlajamäki H. Inci-
dence and risk factors of acute traumatic primary patellar
15. Mitchell J, Magnussen RA, Collins CL, Currie DW, Best TM,
Comstock RD, et al. Epidemiology of Patellofemoral Instab-
ility Injuries Among High School Athletes in the United States.
16. Beasley LS, Vidal AF. Traumatic patellar dislocation in children
and adolescents: treatment update and literature review. Curr