

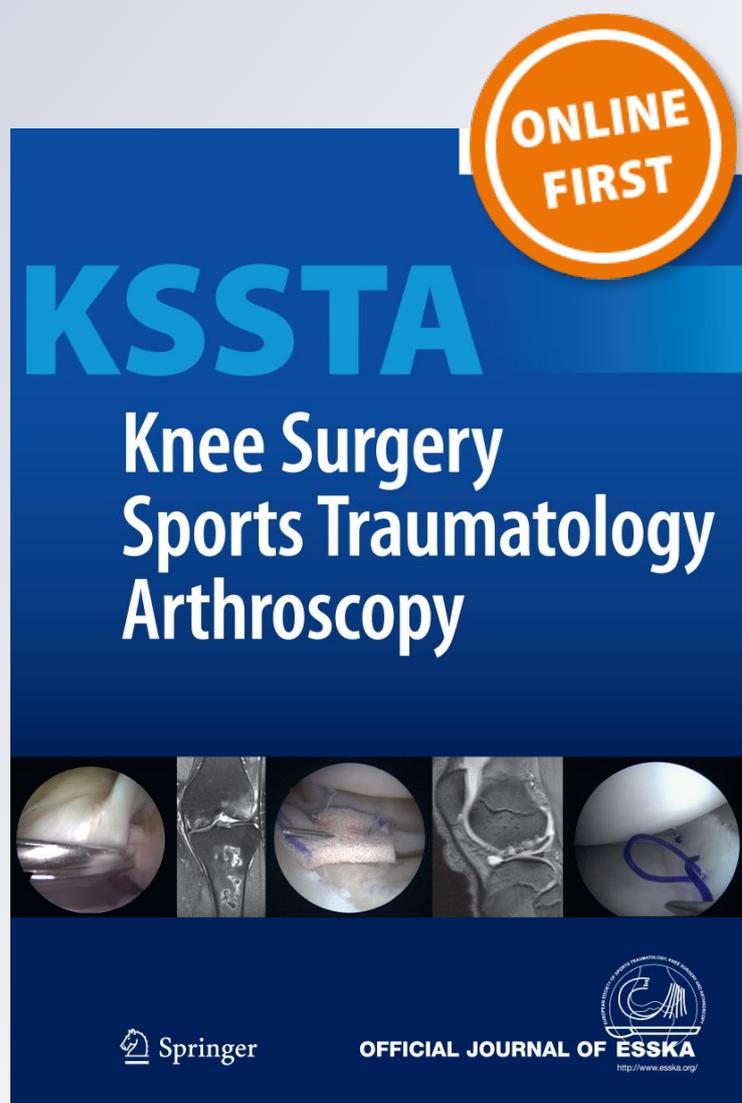
High incidence of acute and recurrent patellar dislocations: a retrospective nationwide epidemiological study involving 24.154 primary dislocations

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Knee Surgery, Sports Traumatology, Arthroscopy

ISSN 0942-2056

Knee Surg Sports Traumatol Arthrosc
DOI 10.1007/s00167-017-4594-7



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High incidence of acute and recurrent patellar dislocations: a retrospective nationwide epidemiological study involving 24,154 primary dislocations

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Received: 3 March 2017 / Accepted: 6 June 2017

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Abstract

Purpose The purpose of this study was to investigate the Danish population as a whole from 1994 to 2013 to find the incidence of acute and recurrent patellar dislocation.

Methods The study was performed as a descriptive epidemiological study. The Danish National Patient Registry was retrospectively searched from 1994 to 2013 to find the number of acute and recurrent patellar dislocation. National population data were collected from Statistics Denmark.

Results The period 1994–2013 saw a total registration of 24,154 primary patellar dislocations. A mean incidence of 42 (95% CI 37–47) per 100,000 person-years at risk was found, and young females aged 10–17 had the highest incidence of 108 (95% CI 101–116). In a 10-year follow-up, patients were at an overall risk of 22.7% (95% CI 22.2–23.2) of suffering a recurrent dislocation, with young girls aged 10–17 experiencing the highest risk, namely 36.8% (95% CI 35.5–38.0). The overall risk of suffering a patellar

dislocation in the contralateral knee was 5.8% (95% CI 5.5–6.1) and 11.1% (95% CI 10.4–11.7) for patients aged 10–17.

Conclusion A high incidence rate of primary patellar dislocation was found both as a mean in the population (42/100,000), and particularly in patients aged 10–17 (108/100,000). The risk of recurrent dislocation in the affected knee (22.7%) and the contralateral knee (5.8%) was high, which could indicate the influence of an underlying pathomorphology. This is relevant knowledge to the clinician, as he/she should be aware of the high risk of recurrent dislocation when deciding on treatment, especially in young patients.

Level of evidence IV.

Keywords Patellar dislocation · Acute patellar dislocation · Recurrent patellar dislocation · Incidence · Epidemiology

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Introduction

Patellar dislocation is a relatively common injury, which constitutes 3.3% of all knee injuries [13]. Incidence rates vary from 7 to 77 per 100,000 person-years in various studies [1, 7, 21]. Age, gender and physical activity have been suggested as predisposing factors [1, 6, 21]. Over the past decade, increased attention has been brought to biomechanical factors, which influence the patellofemoral joint, and the major predisposing factors include trochlear dysplasia, patella alta, femoral antetorsion and an increased tibial tubercle-trochlear groove distance [2, 4, 9–11, 23]. Patellar dislocation often happens while engaging in sports activities, where the knee is slightly flexed, rotated inwards, in valgus position and with the foot fixed to the surface

[12, 17, 19]. After an acute patellar dislocation, the risk of recurrent dislocation has been reported to be up to 40%, irrespective of the treatment [12, 15].

The varying incidence rates could be due to differences in selected cohorts, differences in study designs and the lack of common definitions. In spite of the overall morbidity caused by patellar dislocations, the incidence of primary patellar dislocations has been poorly described.

This study is the first publication to investigate the epidemiology of patellar dislocations in a large nationwide cohort. The aim of this study was to investigate the incidence and treatment of primary and recurrent dislocations over a 20-year period with up to 10 years of follow-up actions. The present study could help to improve the diagnostic process and treatment in patients before and after patellar dislocation.

Materials and methods

This study was conducted as a retrospective registry study with national population data from the Danish National Patient Registry (DNPR) and Statistics Denmark. Since 1976, all patients seeking medical care in a hospital (emergency room/walk-in consultation/hospitalized) in Denmark have been registered with their unique social security number in the national patient registry. Danish legislation imposes hospitals in Denmark to report data to DNPR. Patients are registered from the day they seek help until the day they are either discharged from hospital or the day their case as an outpatient is closed. Data recorded in DNPR include age, gender, municipality, date of injury, type of injury, the affected site, surgical interventions and the date of discharge. Injuries are registered according to the ICD-10 classification system, which was implemented in Denmark in 1994.

The Danish National Patient Registry was searched from 1 January 1994 to 31 December 2013, for patients registered under the ICD-10 code for either Patellar Dislocation (DS83.0) or Recurrent Patellar Dislocation (DM22.0).

In the present study, primary patellar dislocation was defined as a patient with no previous incidents in the same knee; hence, the calculation included the ICD10 code DS 83.0, where each individual could only be included in the analysis once with each knee. The patients were divided into age groups defined as 10–17, 18–25, 26–31 and 32 and older.

The incidence rates were calculated as the number of injuries (DS83.0) divided by the person-years of risk (PYRS). PYRS was defined as the sum of years in which each person in the population was at risk of suffering an

incident. The incidence rate was then multiplied by 100,000 to achieve a unit of incidence per 100,000 person-years.

The risk of a recurring dislocation was analysed using a cox proportional hazard model, stratified according to gender and age. As patients could be coded multiple times for the same dislocation when being moved from one hospital to another or changing status from outpatient to hospitalized due to surgery, the risk time was set to start 365 days after the primary dislocation code to minimize the risk of overestimation. A recurrent dislocation was defined as a new dislocation code, either DS83.0 or DM22.0, registered more than 365 days after the primary dislocation. To interpret the risk of a recurrent patellar dislocation at two-and-a-half, five and ten years, cumulative incidences were calculated. A cumulative incidence plot was created to illustrate the overall risk over time from the first patellar dislocation. A similar incidence plot was prepared for the risk of patellar dislocation in the other knee after a primary patellar dislocation.

The study was approved by the Danish Data Protection Agency. As this study is a retrospective registry study, Danish legislation requires no approval from the IRB.

Statistical data concerning age and gender of the background population from 1994 to 2013 were obtained from Statistics Denmark's Statbank (available for free at <http://www.statbank.dk/statbank5a/default.asp?w=1600>).

Statistical analysis

Statistical significance was defined as a p value less than 0.05; all analyses and data management were performed using R 3.2.2 (R Foundation for statistical computing, Vienna, Austria).

Results

Primary patellar dislocation

A total of 24,154 primary patellar dislocations were registered from January 1994 to December 2013. Of these, 53% ($n = 12,897$) were women and 47% ($n = 11,257$) men, with a female-to-male ratio of 1:1. The mean incidence for the period was 42/100,000/year (95% CI 37–47). Female patients aged 10–17 had the highest incidence of 108/100,000/year (95% CI 101–116). Figure 1 shows the average, age-related incidence of suffering a primary patellar dislocation for the period 1994–2013. Figure 2 shows that incidence rates were rising from

Fig. 1 Incidence of primary patellar dislocation. The figure shows the average, age-related incidence of suffering a primary patellar dislocation for the period 1994–2013. A primary patellar dislocation was defined as a patient with no earlier incidents in the same knee; hence, the calculation included the ICD10 code DS 83.0, and each individual could only be included in the analysis once with each knee. Incidence rates are reported per 100,000 person-years at risk

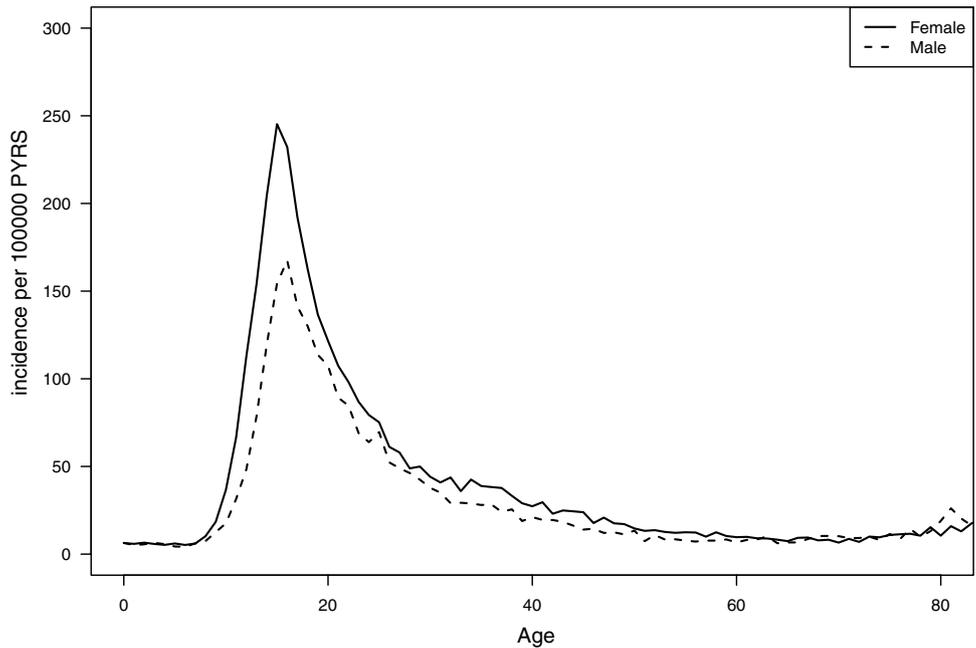
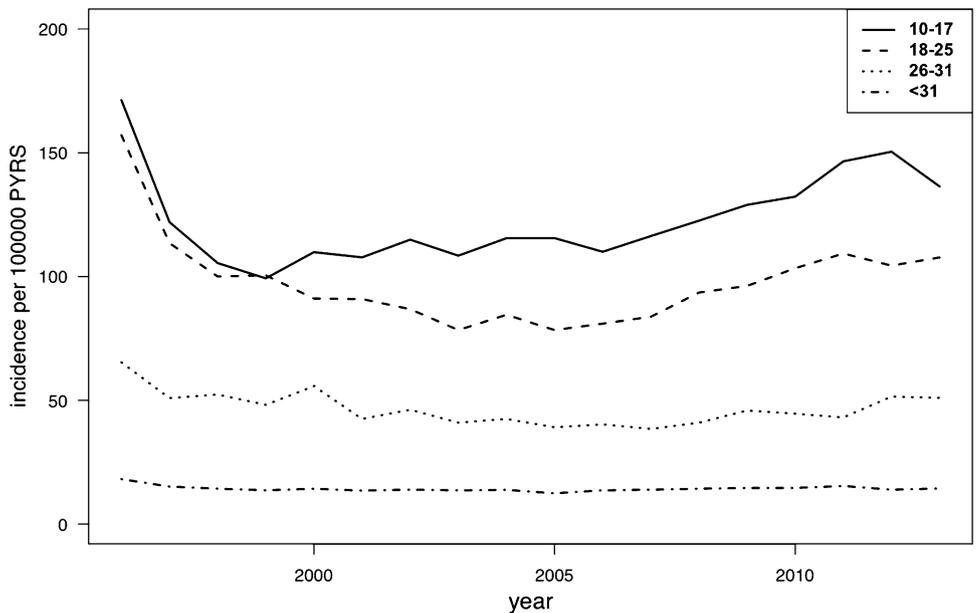


Fig. 2 Incidence rate in primary patellar dislocation from 1996 to 2013. The figure shows changes in the incidence of suffering a primary patellar dislocation from 1996 to 2013. A primary patellar dislocation was defined as a patient with no earlier incidents in the same knee; hence, the calculation included the ICD10 code DS 83.0, and each individual could only be included in the analysis once with each knee. Incidence rates are reported per 100,000 person-years at risk



1997 to 2013 for patients aged 10–17. In 1996, the incidence was significantly higher ($p < 0.01$).

Recurrent dislocation after two-and-a-half, five and ten years

Ten years after the primary patellar dislocation, the overall risk of suffering recurrent dislocation was 22.7% (95% CI 22.2–23.2). Female patients aged 10–17 were at

the highest risk of 36.8% (95% CI 35.5–38.0). Figure 3 shows the risk of recurrent dislocation with a follow-up time of 10 years.

Risk of patellar dislocation in the contralateral knee

The overall risk of suffering a patellar dislocation in the contralateral knee was 5.8 and 11.1% for patients aged 10–17 (Fig. 4).

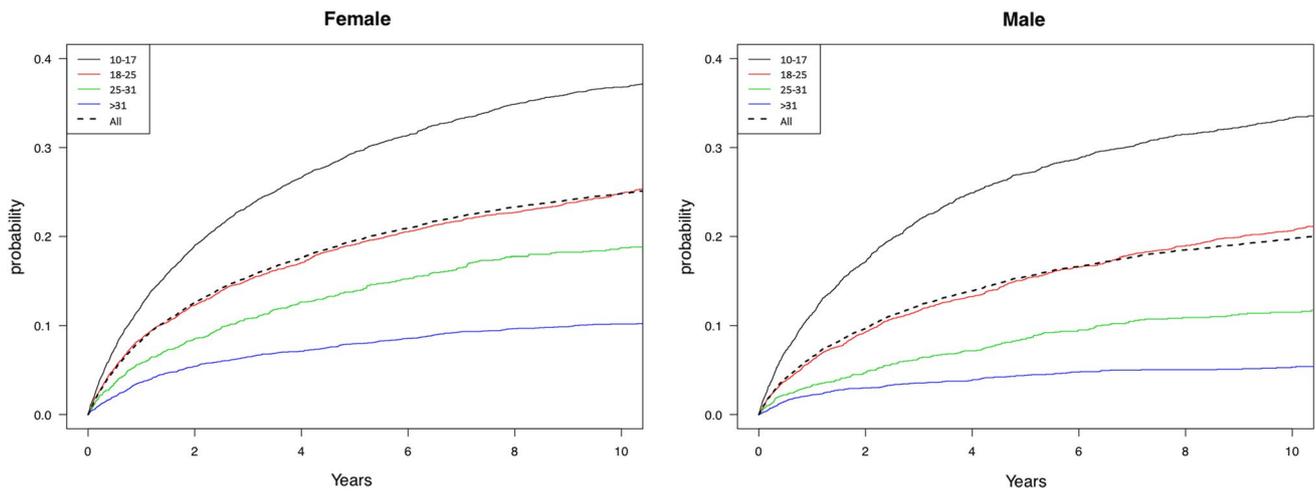


Fig. 3 Risk of suffering a recurrent dislocation. The figure shows the risk of suffering a recurrent patellar dislocation for female patients and male patients with 10 years of follow-up action during the

1996–2013 period, divided into four age groups. Incidence rates are reported as the probability of suffering a recurrent patellar dislocation after the first year following the initial diagnosis

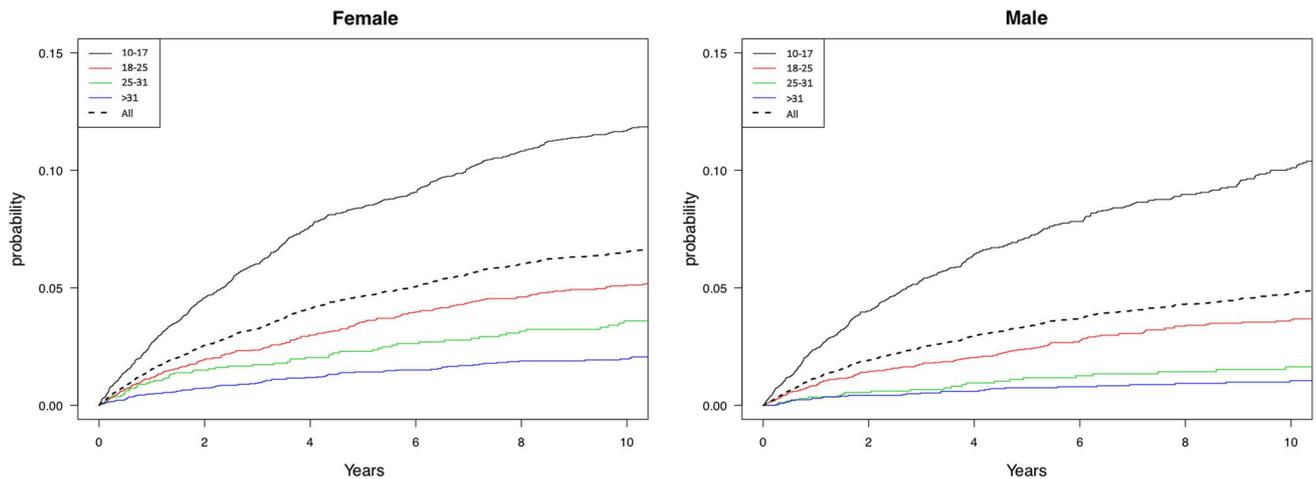


Fig. 4 Risk of patellar dislocation in the contralateral knee. The figure shows the incidence of contralateral patellar dislocations for female patients and male patients who have already suffered a patellar dislocation. The population has been divided into four age groups.

Incidence rates are reported as the probability of suffering a patellar dislocation in the opposite knee, at least 365 days after the first diagnosis code

Discussion

The key finding in the present study was a high incidence of primary patellar dislocation compared to earlier studies on civilians, 42 per 100,000 PYRS. Earlier studies have found incidences of 5.8–6.7 per 100,000 among civilians [1, 6], and 70–77 per 100,000 among military personnel [7, 21]. In these studies, the cohorts were both preselected according to social class (e.g. paid health plan) and activity level (e.g. military conscripts) and with smaller cohorts than in the present study.

From 1998 to 2013, an increase in incidence was found in patients aged 10–17. No comparable data were found in the literature. The increase could be due to an increased focus on registration.

A significantly higher incidence rate was found in 1996. In the present study, a primary patellar dislocation is defined as a patellar dislocation in a knee with no previous incidents. In 1996, a large number of the patients may have been suffering a primary dislocation, yet with no registration in the present data, which could explain the increase in the amount.

In the present study, the mean overall risk of a recurrent patellar dislocation was found to be 22.7% with a 10-year follow-up action after the primary patellar dislocation. Most studies that investigate the risk of recurrent patellar dislocation have preselected their groups with inclusion and exclusion criteria, and thus, they do not investigate the population as a whole. In a meta-analysis, Smith et al. [22] investigated clinical outcomes after conservatively treated patellar dislocation and found 22 studies that presented a mean of 33% (range 6–100%) risk of recurrent dislocation. In a population of 100 patients treated conservatively, Mäenpää and Lehto [15] found a 44% risk with a mean follow-up time of 13 years.

Studies investigating young patients found recurrence rates ranging from 34.7 to 72% for patients with both immature physes and trochlea dysplasia [8, 12, 18]. In the present study, the highest risk of recurrent patellar dislocation (35.5%) was found in the youngest age group (10–17), which corresponds with the former findings.

The risk of patellar dislocation in the contralateral knee was 11% for patients under the age of 17, under 5% in patients aged 18–25 and under 3% in patients aged 26 or older. A radiographic study performed by Dejour et al. [4] found that 93% of patients with dysplasia in one knee had a positive crossing sign in the contralateral leg. Jaquith and Parikh [8] investigated predictors of recurrent patellar dislocation in children and adolescents and found that a history of contralateral patellar dislocation was a separate risk factor, and, combined with anatomical predisposing factors, the patient were at a predicted risk of recurrence of 88%.

No difference was found between the genders when comparing the risk of primary patellar dislocation. Fithian [6] conducted a prospective study in a segment of a paid health plan, which showed that young girls were at the highest risk. By contrast, Mäenpää et al. [14] found no difference between the genders in a retrospective study that investigated young patients under the age of 18. As both studies investigate preselected groups with a short follow-up time, the data most likely represent the variability in demographics and entry criteria rather than a comparable incidence rate. In the present study, data were collected from a nationwide cohort over a period of 20 years and with more than 24,000 patients, which makes the variance in demographics and time less of an influential factor.

This study is limited by the data that are available in DNPR. Data from DNPR do not include information from medical journals, physical examinations or MRI scans, which, in earlier studies, formed the basis for patient inclusion [1, 5, 6, 21]. It was only possible to retrieve information relating to age and gender of the patient. This makes the present study vulnerable to possible confounders.

There is a risk that patients have been incorrectly diagnosed and thus incorrectly registered, and this could count

for an overestimation or underestimation of primary patellar dislocation. As demonstrated by Beasley and Vidal [3], the clinical symptoms for primary patellar dislocation might not be as straightforward as could be expected, as only 20% of the patients have a laterally placed patella when examined in the emergency room. An untrained physician might incorrectly code a patellar dislocation with a knee without a laterally placed patella as DS80.0—contusion of the knee. This specific code, DS80.0, was used 243,000 times from 1994 to 2012 and could potentially lead to an underestimation of the number of both primary and recurrent dislocations.

In the present study, several factors could lead to an underestimation of the risk of recurrent dislocation. The study was designed to ensure that the time from the primary patellar dislocation to the recurrent dislocation was at least 365 days. This method was used to prevent multiple registrations on the same patient from the same dislocation, thus minimizing the risk of overestimation. Patients in an active period of treatment can only be registered once within the registry. As a result, another dislocation within this period of time will not be registered. Finally, patients with recurrent dislocations might have learned to cope with patellar dislocations and may choose not to visit an emergency department after dislocation.

As the data from DNPR rely on the right code being used, the risk of recurrent patellar dislocation could be overestimated. A patient, who is seen in the emergency room with anterior knee pain, sub-luxation or the sensation of instability, could be incorrectly coded as a recurrent dislocation, which would lead to an overestimation.

Denmark is an optimum setting for a nationwide epidemiological study. The DNPR comprises patient data from the past two decades, which is available for investigation, and this is a compelling factor for the present study in the investigation of developments in trends and incidence of patellar dislocation.

The data collected about patellar dislocations in DNPR can be considered to be almost complete as all patients who are in contact with the health system are registered. This is due to the health legislation and because the hospitals in Denmark are being reimbursed based on their registrations. Furthermore, we expect that all patients with first or second time patellar dislocation would come to the emergency room.

Studies that examine the validity of DNPR have shown that the highest validity of the primary diagnose code is found in orthopaedic coding with a positive predictive value of 83–89% [16, 20].

The risk of selection bias in the present study is minimal, as the study population is made up by the entire national population. Furthermore, the patients come from a heterogeneous group, which is due to the fact that medical

care is free in Denmark. This ensures that patients from all strata of society, income brackets and age groups will seek medical help when needed.

Conclusion

This nationwide epidemiological study found that the incidence of primary patellar dislocation was high in the Danish population from 1994 to 2013 (42/100,000). Female patients aged 10–17 years showed the highest incidence (108/100,000), although an equally high rate of primary dislocations was found between the genders. A mean risk of recurrent dislocation was found to be 22.7%, with the 10–17-year age group showing the highest risk (35.5%). Patients under the age of 17 years were at a 11.1% risk of suffering a patellar dislocation if they had already suffered a patellar dislocation to the contralateral knee.

Authors' contribution KSG participated in the design of the study and drafted the manuscript. TK performed the statistical analysis. LB assisted with analysis and interpretation of the data and revised the manuscript. AT assisted with analysis and interpretation of the data and revised the manuscript. KB conceived the idea of the study and participated in its design and coordination and assisted in drafting the manuscript. All authors have read and approved the final manuscript.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Funding No funding were received for this study.

Ethical approval For this type of study formal consent is not required.

Informed consent As there were no human participants in this study, no informed consent was necessary.

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