



# Persistent morbidity after Medial Patellofemoral Ligament Reconstruction – A registry study with an eight-year follow-up on a nationwide cohort from 1996 to 2014



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## ABSTRACT

**Background:** To evaluate the trends in treatment of patellar dislocation in the Danish population as a whole from 1996 to 2014 and evaluate the incidence of persistent morbidity after Medial Patellofemoral Ligament Reconstruction (MPFL-R).

**Methods:** This epidemiological study was performed by retrospectively searching the Danish National Patients Registry from 1996 to 2014. The study investigated the trends in surgery performed on patients with patellar dislocations and the risk of persistent patellar morbidity (PPM) with an eight-year follow-up. PPM was defined as a new patella-related contact to the healthcare system more than a year after surgery.

**Results:** From 1996 to 2014, a total of 1956 MPFL-R were performed in Denmark. In 2014, MPFL-R constituted 75% of all patella-stabilizing surgery and was performed on almost 10% of patients with patellar dislocation. The mean risk of PPM eight years after surgery was 20.9% (18.3–23.4%), and young patients aged 10–17 showed the highest risk of 28.9% (23.7–33.7%).

The risk of PPM over time was significantly higher for other patella-stabilizing surgery (33.8%) and patients receiving conservative treatment (29.4%) compared to MPFL-R.

**Conclusions:** A rapid rise in the use of MPFL-R was found from 2005 to 2014, constituting 75% of all patella-stabilizing surgery in 2014. The overall risk of persistent patellar morbidity within eight years after MPFL-R was 21%. MPFL-R was found to give a significantly lower risk of PPM over time as compared to other patella-stabilizing surgery and conservative treatment.

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## 1. Introduction

Primary patellar dislocation constitutes approx. three percent of all knee injuries. The incidence has been found to be 42 per 100,000 person years at risk (PYRS) in general and 108 per 100,000 PYRS among young female patients [1]. Generally, patients suffering first-time acute patellar dislocation are treated conservatively, except patients with associated significant osteochondral

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injury and patients, who do not improve with normal rehabilitation [2,3]. Recurrent patellar dislocation is associated with patellofemoral osteoarthritis and reduced physical activity and quality of life [4–6]. Predisposing factors for recurrent instability and dislocation such as trochlear dysplasia, patella alta, femoral antetorsion and an increased tibial tubercle-trochlear groove distance have been identified, and today, it is commonly accepted that each patient should be treated individually in order to address the present predisposing factors [7–12].

Over the past decades, the surgical treatment options for patella stabilization have increased, and there has been a rise in surgery rates in the United States [13]. During this period, the Medial Patellofemoral Ligament Reconstruction (MPFL-R) has gained popularity. The MPFL is the most important soft-tissue structure, which provides a medial restraining force that protects against lateral patellar dislocation [14], and studies have shown that ligament was torn in up to 100% of the primary patellar dislocations [15]. MPFL-R has shown promising results; yet there is a risk of bias as studies were conducted among homogeneous patient groups and lacked consistency in reporting complications. This makes it difficult to compare the results [16–18]. Other studies have shown less promising results, pointing out that many patients suffer from persistent morbidity after surgery, especially patients with trochlear dysplasia [19–21].

This nationwide retrospective registry study aims to investigate the trends in surgery performed on patients with patellar dislocations from 1996 to 2014 and the risk of persistent patellar morbidity (PPM) with an eight-year follow-up after surgery. Hopefully, this will assist the clinician in choosing the right treatment for the right patient.

## 2. Methods

The 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 who seek 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 either they are discharged from the hospital or their course as an outpatient is closed. Data in DNPR include age, gender, municipality, date of injury, type of injury, surgical intervention, date of discharge and the site of injury. Injuries are registered according to the tenth revision of International Classification of Diseases (ICD-10) classification system, which was implemented in Denmark in 1994. Since 1996, surgical interventions in Denmark have been registered according to the Nordic Medico-Statistical Committees Classification of Surgical Procedures (NOMESCO).

A search was made in The Danish National Patient Registry, covering the period 1 January 1996 to 31 December 2014 for patients registered under the ICD-10 code for either Patellar Dislocation (DS83.0) or Recurrent Patellar Dislocation (DM22.0). Data on surgical treatment was obtained from 1 January 1996 to 31 December 2014. NOMESCO codes are linked to a specific diagnosis code. In this study, only the specific surgical interventions linked with DS83.0 and DM22.0 were investigated.

The NOMESCO surgical codes linked to both DS83.0 and DM22.0 were used to evaluate trends in surgical treatment from 1996 to 2014. Patients were categorized into three groups: patients, who received MPFL-R, patients, who received other patella-stabilizing surgery and patients, who received conservative treatment. MPFL-R was defined as a patient receiving the NOMESCO code KNGH72a–d. Other patella-stabilizing surgery was defined as Trochleoplasty, Medial Duplication, Tibial Tubercle osteotomy, Lateral Release and treatment of cartilage injury (Table 1). As surgical treatment is largely reserved for patients with recurrent patellar dislocation, and in order to increase its comparability, the group receiving conservative treatment was defined as patients, who have been registered at least twice with the DS83.0 code or the DM22.0 code, but with no code for surgical intervention. If a patient receives surgery, they are then moved to the respective group of surgery.

Due to the register-based study design, it was not possible to establish whether the use of a new diagnosis code was due to re-dislocation or whether it was due to another condition regarding the patellar instability, which had made the patient seek medical help. A normal treatment course for patellar dislocation was considered to last up to 365 days including follow-up visits. After this period, a new registration for either Patellar Dislocation (DS83.0) or Recurrent Patellar Dislocation (DM22.0) was considered to be proof of persistent patellar morbidity as the patient had to seek medical help for a patellar problem. In the present study, the term PPM was defined as a new contact to the healthcare system more than a year after surgery. Therefore, the risk time was set to start 365 days after surgery.

**Table 1**

The table shows the surgical codes (NOMESCO code) with their individual procedure name, code and date of introduction.

Procedure	Code	Introduction
Trochleoplasty	KNGG29a	2005
	KNGG29b	2009
Medial Patellofemoral Ligament Reconstruction	NGH72	1996
	KNGH72a–d	2005
	KNGH71	1996
Medial Duplication	KNGH71	1996
Elmslie–Trillat	KNGK59, 79, 99	1996
Lateral Release	KNGL09, 99	1996
Treatment of cartilage injury	KNGF21	1996
	KNGF31	1996

All patients were evaluated for the risk of receiving a new diagnosis code more than 365 days after the primary surgery using the Kaplan–Meier estimator with a yes/no to a recurrent contact to the healthcare system as outcome, stratified on sex, age and treatment groups. Differences within strata levels were evaluated by log-rank test. Additionally, a cumulative incidence plot with treatment groups was performed.

Association between treatment groups and risk of PPM over time was analyzed by Cox proportional hazard regression, adjusted for age and sex.

Statistical data concerning age and gender of the background population from 1996 to 2013 was obtained from Statistics Denmark's Statbank (available for free at [www.statistikbanken.dk](http://www.statistikbanken.dk)).

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

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

### 3. Results

#### 3.1. Surgical treatment

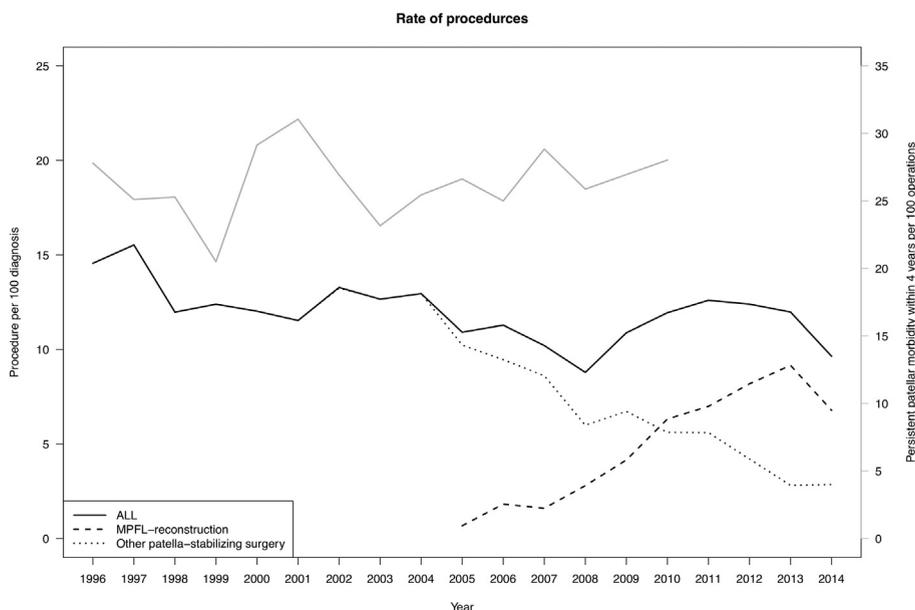
From 1996 until 2013, the number of patella-stabilizing surgical procedures was stable, but the types of procedures performed changed with a rise in MPFL-R from 2005 (Figure 1). From 2005 until 2014, 1770 patients received 1956 MPFL-R. In 2014, MPFL-R constituted 75% of all patella-stabilizing surgical procedures and was performed on almost 10% of patients with patellar dislocation. After the introduction of the MPFL-R in 2005, the four-year risk of persistent patellar morbidity remained stable until 2010 (Figure 1).

#### 3.2. Risk of persistent patellar morbidity after MPFL-R

The total risk of PPM after MPFL-R was 21% when investigating 1956 MPFL-R performed in the study period (Table 2). The highest risk was found in the age group nine to 17, who had an eight-year risk of 28.9% (p-value < 0.001). A higher risk was also found for women, with risk at eight years of 22.4% (p-value = 0.029).

#### 3.3. Comparison of different types of treatment

Figure 2 shows the risk of PPM for MPFL-R patients, patients treated with other patella-stabilizing surgery and patients, who received conservative treatment. After eight years of follow-up, the risk for MPFL-R patients was 21%, the risk for patients, who had had other patella-stabilizing surgery, was 33.8% and risk for patients, who had received conservative treatment was 29.4%.



**Figure 1.** The figure shows the total number of surgical procedures connected to the diagnosis codes for patellar dislocation. The x-axis shows the year. The y-axis (left) shows the number of patients being diagnosed with DS83.0 or DM22.0, who received a surgical procedure per 100 diagnoses. The z-axis (right) shows the rate of persistent patellar morbidity (PPM), resulting in a new patella-related contact to the healthcare system, one year or later after Medial Patellofemoral Ligament Reconstruction with four years of follow-up. The light gray solid line represents PPM.

**Table 2**

The table shows the risk of persistent patellar morbidity one, five and eight years after Medial Patellofemoral Ligament Reconstruction. Persistent patellar morbidity was defined as a new contact to the healthcare system more than a year after surgery.

	1-year incidence (95% CI-interval)	5-year incidence (95% CI-interval)	8-year incidence (95% CI-interval)
Combined	10.7 (9.3–12.0)	19.8 (17.7–21.9)	20.9 (18.3–23.4)
Men	8.5 (6.2–10.7)	17.3 (13.5–21.0)	17.3 (13.5–21.0)
Women	11.6 (9.9–13.3)	21.0 (18.4–23.5)	22.4 (19.1–25.5)
Age 10–17	14.5 (11.8–17.2)	27.5 (23.1–31.6)	28.9 (23.7–33.7)
Age 18–25	9.2 (7.1–11.2)	18.6 (15.2–22.0)	20.8 (15.3–25.9)
Age 26–31	8.8 (5.2–12.3)	15.1 (9.7–20.1)	15.1 (9.7–20.1)
Age >31	7.7 (4.5–10.7)	10.6 (6.6–14.3)	10.6 (6.6–14.3)

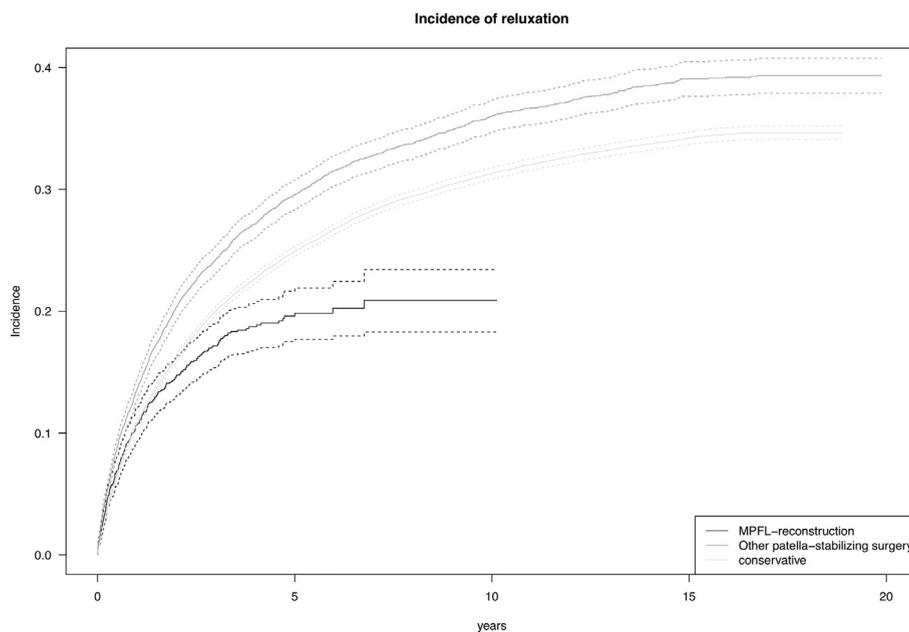
The risk of persistent patellar morbidity over time was significantly larger for other patellar stabilizing surgery (Hazard Ratio = 1.6, CI = 1.4–1.8,  $p < 0.001$ ) and conservatively treated patients (HR = 1.3, CI = 1.2–1.4,  $p < 0.001$ ) compared to MPFL-R.

#### 4. Discussion

The most important finding in the present study was a 21% risk of PPM within the first eight years after MPFL-R, following an investigating of 1956 procedures. This finding can be interpreted in two ways: On the one hand, it must be perceived as being positive that 79% of patients had no contact with the healthcare system regarding their knees with a diagnosis of recurrent patellar instability or acute patellar dislocation. This is in support of the literature, which presents MPFL-R as an operation with good results and low comorbidity. Schneider et al. and Tompkins et al. have, in systematic reviews, found good outcomes for patellar stability with a risk of recurrent patellar dislocation after MPFL-R of one percent. However, it must be borne in mind that most of the included studies presented small patient cohorts, who had been subjected to a range of surgical techniques.

On the other hand, it is worth noting that 21% of the patients did contact the healthcare system regarding their operated knees. This could be due to persistent subluxations as described by Enderlein et al. in a large single-clinic study on MPFL-R. They found a relatively low rate of recurrent patellar dislocation after surgery of 4.5%, but a high risk of subluxations. Eleven percent of the patients experienced longer periods of subluxation sensation, while 39% experienced the sensation of a subluxation. As the authors pointed out, this could be due to the fact that a high proportion of the patients with recurrent patellar disability suffer from various degrees of patellofemoral dysplasia or other underlying biomechanical factors for patellar instability [22].

The present study-setup does not allow for speculation about whether PPM represents pain, limited function, feeling of instability, a general concern or recurrent patellar dislocation. However, when considering MPFL-R, it is important to acknowledge that even though only one to 4.5% might suffer from recurrent dislocation, 21–26% might experience persistent patellar morbidity.



**Figure 2.** The figure shows the incidence of persistent patellar morbidity (PPM) when comparing Medial Patellofemoral Ligament Reconstructed patients with patients, who had either received other patella-stabilizing surgery or conservative treatment. PPM was defined as a new contact to the healthcare system after the first year following initial surgery. The dotted lines represent the 95% confidence interval.

A recent study from Magnussen et al. found that among a group of patients, who had suffered first-time patellar dislocation and who did not experience re-dislocation, many continued to experience patellofemoral symptoms, as only 26.4% were able to return to their desired sports activities without any limitations [23].

Today's treatment principles, using an individualized treatment algorithm for surgery based on the biomechanical properties of the patello-femoral joint, as suggested by Dejour, might not have been fully understood and implemented among Danish surgeons during the study period. It is therefore likely that strict adherence to these principles would reduce the proportion of patients experiencing PPM compared to the findings of the present study [24].

Patients, who received conservative treatment, were shown to have a 30% risk of PPM. This is less than expected, as previous studies have shown that up to 40% of patients with primary dislocation would suffer recurrent patellar dislocation when receiving conservative treatment [9,25]. It should be pointed out that the 70% of patients who did not seek medical assistance might be healthy and experience no further patellar problems, or they might just have learned to cope with having an unstable knee and the subsequent limitations to their everyday lives. It is important to have in mind that PPM might be different from conservatively treated patients and surgically treated patients. Surgically treated patients could have additional problems such as post-operative pain, scar issues, and limited knee function. It would be desirable to investigate this subgroup of patients with primary and secondary patellar dislocations, as many patients, who do not seek medical assistance after patellar dislocation, could still be limited in their daily lives long after the injury [23].

In the present study, the group treated with other patella-stabilizing surgery represents the highest risk (34%) of PPM. This group is quite heterogeneous and represents a large variation of surgical procedures, including lateral release, medial impactions, tibial tubercle osteotomy; trochleoplasty and combined surgeries. It is a well-established fact that especially young patients with severe anatomical predisposing factors are at a high risk of suffering from patellar dislocation, recurrent problems and instability regardless of surgery [18,20,21].

It is worth noticing that a large number of the patients returned to hospital two years or more after their surgical procedure. This fact emphasizes the importance of long-term follow-up studies.

In future studies, it would be desirable to analyze the subgroup of patients, who returned to hospital with the code of recurrent patellar instability or acute patellar dislocation, and to analyze the symptoms that caused them to come back. Moreover, it would be interesting to correlate these findings to the underlying pathomorphology.

#### 4.1. Limitations

This study is limited by the data available in DNPR. Data from DNPR does not include medical journal, physical examination, X-rays or Magnetic Resonance Imaging (MRI). The definition of persistent patellar morbidity was based on a risk time set to start 365 days after surgery. This leaves a risk of overestimation due to planned visits, as some clinics may call in patients for routine follow-up investigations more than 365 days after surgery. As far as the authors know, only one clinic in Denmark follows this practice.

#### 4.2. Strengths

Denmark is an optimal setting for a nationwide epidemiological study. The DNPR includes patient data from the past two decades, which is available for investigation. This gives the present study strength when investigating the development in trends and the incidence of patellar dislocation.

The data collected on patellar dislocation in DNPR is considered to be complete as all patients, who are in contact with the healthcare system, are registered as a result of the mandatory reporting requirements to the DNPR under Danish health legislation.

The risk of selection bias in the present study is minimal as the study population covers the full national population. Furthermore, the patients come from a heterogeneous group due to the fact that medical care in Denmark is paid for via taxes, and thus, patients are not required to take out separate health insurance or pay for medical care up front. This ensures that patients will seek medical help when needed, irrespective of their social class, income and age group.

## 5. Conclusion

The 2005 to 2014 period saw a rapid rise in the use of MPFL-R, constituting 75% of all patella-stabilizing surgery in 2014. The overall risk of PPM within eight years after MPFL-R was 21%. MPFL-R was found to have a significantly lower risk of PPM over time as compared with other patella-stabilizing surgery and conservative treatment.

## Declaration of interest

None.

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