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Determinants of outcome prior to and after total hip and knee arthroplasty

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Chapter V.

Self-reported knee instability associated with pain, activity limitations, and poorer quality of life before and 1 year after total knee arthroplasty in patients with knee osteoarthritis.

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Abstract

Information on the association of self-reported knee instability with clinical outcomes after Total Knee Arthroplasty (TKA) and one year follow-up is scarce. The aims were to determine (i) the course and prevalence of self-reported knee instability before and one year after TKA and (ii) the associations of preoperative, postoperative, and retained self-reported knee instability with pain, activity limitations, and quality of life (QoL) in patients with knee osteoarthritis. Patients undergoing primary TKA, selected from the Longitudinal Leiden Orthopaedics and Outcomes of OsteoArthritis Study, had their knee instability measured using a questionnaire. The Knee injury and Osteoarthritis Outcome Score pain, activity limitations, and QoL subscales were administered before and one year after surgery. Multivariable regression analyses were performed to examine associations between knee instability, pain, activity limitations, and QoL, adjusted for covariates (age, gender, comorbidities, and radiographic severity). Of the 908 included patients, 649 (71%) and 187 (21%) reported knee instability before and following TKA, respectively. Of the patients with preoperative knee instability, this perception was retained in 165 (25%) cases. Knee instability was preoperatively associated with pain (B -9.6; 95%CI: -12.4 to -6.7), activity limitations (B -7.5; 95%CI: -10.2 to -4.8), and QoL (B -4.7; 95%CI: -7.0 to -2.4) and postoperatively with pain (B -15.0; 95%CI: -18.5 to -11.6), activity limitations (B -15.1; 95%CI: -18.4 to -11.8), and QoL (B -18.7; 95%CI: -22.3 to -15.3). Retained knee instability was associated with postoperative pain (B -15.1; 95%CI: -18.9 to -11.2), activity limitations (B -14.1; 95%CI: -17.8 to -10.4), and QoL (B -18.0; 95%CI: -21.7 to -14.3). In conclusion, in clinical care, self-reported knee instability is retained postoperatively in 25% of the patients. Retained knee instability is associated with more pain, activity limitations, and poorer QoL postoperatively.

Introduction

Total knee arthroplasty (TKA) is carried out to reduce pain and limitations in daily activities in patients with severe knee osteoarthritis (OA). Overall, TKA is a highly effective treatment (1, 2). Nevertheless, persisting pain and activity limitations 6-36 months after surgery are reported by 10-30% of the patients (3-7). Older age, female gender, overweight, comorbidities, and radiographic severity have been suggested to be associated with persisting pain and activity limitations (8-11). Recently, an association was reported between, on the one hand, postoperative pain and activity limitations and, on the other hand, postoperative knee instability (12).

Previous research concluded that the majority (60-80%) of patients with knee OA report knee instability (12-16). Self-reported knee instability is the sensation of buckling, shifting, or giving way of the knee (13), and is associated with pain and activity limitations prior to TKA (14-16). It is to be expected that after TKA, self-reported knee instability reduces due to the decrease in postoperative pain, and due to the damaged, uneven articulated joint surface of the tibia and femur having been replaced by a smooth implant surface. Nevertheless, a previous randomized controlled trial demonstrated that, six months after TKA, a third of the included patients (32%) retained self-reported knee instability (12). Moreover, retained self-reported knee instability was associated with pain and activity limitations six-month postoperatively in a randomized controlled study (12).

In the long run and in clinical care it is unknown whether patients with retained knee instability represent a population with poor clinical outcomes (i.e., persistent pain and activity limitations) after TKA. It is to be expected that retained postoperative knee instability patients can be characterized by having worse pain, more activity limitations, and accordingly, poor quality of life (QoL) compared with patients who postoperatively no longer report knee instability.

The aims of the study were to determine (i) the prevalence of self-reported knee instability before and at one year after TKA. Along with, the clinical course of knee instability within individual patients; and (ii) the associations of preoperative, postoperative, and retained self-reported knee instability with pain, activity limitations, and QoL.

Methods

Study Design

The present study analyzed a subset of data from the Longitudinal Leiden Orthopeadics Outcomes of Osteo-Arthritis study (LOAS), which is an ongoing, multi-center, longitudinal prospective cohort study designed to determine long-term outcomes of Total Hip Arthroplasty (THA) and TKA (Level of Evidence II). The LOAS study (Trial ID NTR3348) started in June 2012 and has preoperative and postoperative data until June 2015 on 1220 patients undergoing TKA.

Study Population

The patients involved underwent primary TKA in one of the six participating hospitals (Leiden University Medical Center, Leiden; Alrijne Hospital [former Diaconessenhuis and Rijnland Hospital], Leiden and Leiderdorp; Groene Hart Hospital, Gouda; Reinier de Graaf Hospital, Delft; LangeLand Hospital, Zoetermeer; Waterland Hospital, Purmerend). The inclusion criteria of the LOAS study were being enlisted to undergo THA or TKA, being able to complete questionnaires in Dutch and being aged 18 years or older. Excluded were patients who did not provide informed consent or who had a physical or mental status not allowing participation. Recruitment of patients in the LOAS has previously been described (17). Eligible patients were informed about the study through written and oral information by their treating medical specialist. Additional written information about the study was provided by regular mail, as well as a consent form, a questionnaire, and a stamped return envelope. Patients were included once written informed consent was obtained according to the Declaration of Helsinki. Postoperative questionnaires were sent by regular mail 6, 12, and 24 months after surgery, and every

2 years thereafter. Solely the preoperative and 12-month postoperative questionnaires included a questionnaire on self-reported knee instability.

Only data from patients undergoing primary TKA who reported on knee instability both preoperatively as well as one year postoperatively were analysed. Ethical approval was obtained by the Medial Ethics Committee of the Leiden University Medical Center (registration number P12.047) and funding was received from the Dutch Arthritis Foundation (LLP13).

Assessments

Self-Reported Knee Instability

Self-reported knee instability was assessed by means of a Dutch version of the knee instability questionnaires used in previous studies (13, 18). The item on the presence of knee instability can be translated into English as follows: "the sensation of buckling, shifting, or giving way of the knee in the previous 3 months", with the following answering options: 1 never (0 episodes); 2 seldom (1-2 episodes); 3 regularly (3-5 episodes); 4 very often (more than five episodes). These options were dichotomized into "no episodes of knee instability" or "one or more episodes of knee instability".

Pain, Activity Limitations, and QoL

Pain, activity limitations, and QoL were assessed using three of the subscales from the Knee Injury and Osteoarthritis Outcome Score (KOOS). The KOOS comprises 42 items in five subscales, including the subscales Pain (9 items), Activity in Daily Living (17 items), and Knee Related QoL (4 items). The Activity in Daily Living subscale was used to assess activity limitations. Standardized answer options are given on a 5-point Likert scale resulting in a score from 0 to 4. A normalized score (100 representing the best outcome and 0 indicating the worst outcome) is calculated for each subscale (19, 20).

Patient Characteristics and Comorbidities

Patient characteristics included age, gender, mass (kg), and height (m) to calculate Body Mass Index (BMI).

Information on comorbidities was gathered using a questionnaire developed by the Dutch Central Bureau of Statistics (CBS) (21), in which the presence or absence of comorbidities in the previous year was determined. These comorbidities were classified in two domains: Musculoskeletal comorbidities (severe elbow, wrist, hand or back pain; other rheumatic diseases) and non-musculoskeletal comorbidities (chronic lung, cardiac, or coronary disease; arteriosclerosis; hypertension; [consequences of] stroke; severe bowel disorder; diabetes mellitus; migraine; psoriasis; chronic eczema; cancer; urine incontinence; hearing or vision impairments; dizziness in combination with falling). In analysis, comorbidities were categorized into absent, musculoskeletal, non-musculoskeletal, or both musculoskeletal and non-musculoskeletal.

Preoperative Radiographic Severity of OA

Preoperative weight bearing anteroposterior and lateral radiographs of the knees were assessed by an experienced musculoskeletal radiologist (HMK), who was shielded for patient characteristics. The Kellgren and Lawrence (KL) grading system was used to classify the severity of OA (22). In addition, 10% of the radiographs were scored twice to establish intra-reader reliability (Intra-Class Correlation 98% [95% CI: 97-99%]). Discrepancies between the first and second readings were solved by consensus.

Statistical Analysis

Patients' characteristics, pain, activity limitations, and QoL were calculated as means (SD) or medians (range). For categorical or nominal level variables (self-reported knee instability, gender, comorbidities, radiographic severity of OA) frequencies and percentages were calculated. Differences in age, gender, BMI, comorbidities, radiographic severity, and outcome variables between patients reporting knee instability and patients reporting no knee instability pre- or postoperatively were analyzed by means of Chi Square, Independent T-test, or Mann-Whitney U test, as appropriate. In patients reporting instability prior to TKA, the course of instability over a one-year period was determined. Additionally, among patients reporting no instability prior to TKA, the incidence of instability was determined. Subsequently, differences in

age, gender, BMI, comorbidities, radiographic severity, and outcome variables between patients with retained knee instability and patients with resolved knee instability were analyzed by means of Chi Square, Independent T-test, or Mann-Whitney U test, as appropriate. Linear regression analyses were used to calculate the associations between self-reported knee instability (independent variable), pain, activity limitations, and QoL (dependent variables), controlled for age, gender, BMI, comorbidities, and radiographic severity first prior to TKA and then one year after TKA. Finally, linear regression analyses were performed to study the associations between retained knee instability, pain, activity limitations, and QoL, adjusted for baseline scores, age, gender, BMI, comorbidities, and radiographic severity. All analyses were performed using SPSS software, version 23.0 (Chicago, IL).

Results

Of the 1220 patients undergoing TKA between June 2012 and July 2015 who completed the preoperative assessment, 261 (26%) patients were lost to follow-up and 51 patients did not report any information regarding their perception of knee instability in one of the questionnaires, resulting in 908 (74%) patients included in the present study (Fig. 1).

Prevalence of Self-Reported Knee Instability Before and one Year After TKA

Of the 908 patients, 649 (72%) reported preoperative knee instability and 187 (21%) reported knee instability one year after surgery (Table 1). In patients reporting preoperative knee instability, preoperative pain, activity limitations, and QoL scores were worse than corresponding outcomes for patients reporting no preoperative knee instability ($p<0.001$). Patients reporting preoperative knee instability were also more often female ($p<0.05$). Postoperative pain, activity limitations, and QoL subscale scores were lower (i.e., more pain and activity limitations, and poorer QoL) in patients reporting postoperative knee instability compared with patients reporting no postoperative knee instability ($p<0.001$). In addition, reporting postoperative knee instability was associated with a younger age ($p=0.012$).

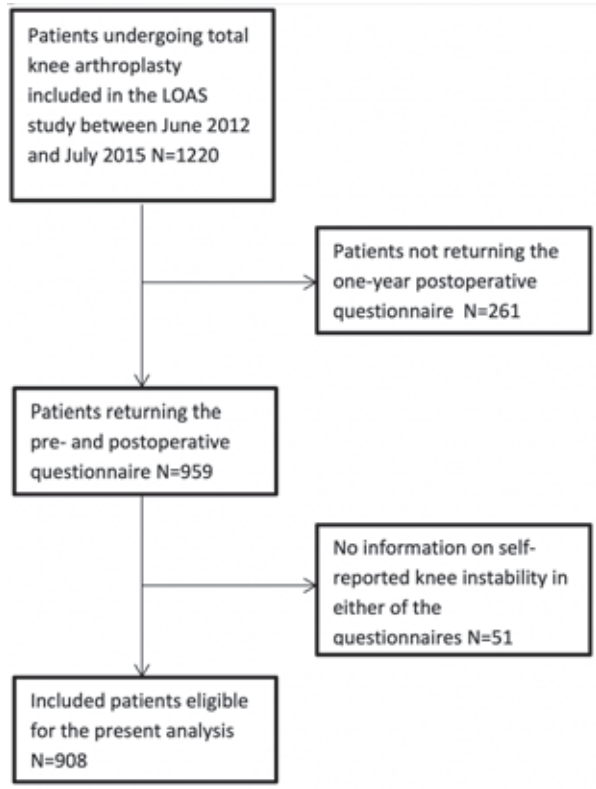

Figure 1. Flowchart of patients included in the Longitudinal Leiden Orthopaedics and Outcomes of Osteo-Arthritis Study (LOAS) between June 2012 and July 2015 undergoing Total Knee Arthroplasty. From a total of 1200 patients, 908 patients were eligible for the present study.

Association of Knee Instability with Pain, Activity Limitations and QoL before and one year after TKA

Cross-sectional analyses adjusted for covariates showed that preoperative knee instability was statistically significantly associated with pain (B -9.6; 95% CI: -12.4 to -6.7), activity limitations (B 7.5; 95% CI: -10.2 to -4.8), and QoL (B -4.7; 95% CI: -7.0 to -2.4). Postoperative knee instability was also associated with more postoperative pain (B -15.0; 95% CI: -18.5 to -11.6), activity limitations (B -15.1; 95% CI: -18.4 to -11.8), and poorer QoL (B -18.8; 95% CI: 22.3 to - 15.3) (Table 2).

Table 1. Patients characteristics, Self-Reported Knee Instability and Self-Reported Pain, Function and Quality of Life of the study population preoperatively (T0) and one year postoperatively (T1) separated into patients with and without self-reported knee joint instability.

	Knee-instability T0 N=649 (72%)	No knee-instability T0 N=259 (28%)	P-value	Knee-instability T1 N=187 (21%)	No knee-instability T1 N=721 (79%)	P-value
Age, mean (SD)	67.3 (8.6)	68.3 (8.5)	0.117	67.2 (9.2)	69.0 (8.4)	0.012*
Female, n (%)	453 (70%)	154 (60%)	0.003*	131 (70%)	476 (66%)	0.338
Body Mass Index, mean (SD)	(n=640) 29.1 (4.7)	(n=255) 29.1 (4.5)	0.928	(n=183) 29.7 (4.5)	(n=712) 29.0 (4.6)	0.051
Comorbidity, n (%)	(n=589)	(n=238)				
None	114 (19%)	51 (21%)	0.082	-	-	-
Musculoskeletal	80 (14%)	27 (11%)		-	-	-
Non-musculoskeletal	247 (42%)	117 (49%)				
Both	148 (25%)	43 (18%)				
Kellgren&Lawrence grade indexknee, n (%)	(n=500)	(n=197)	0.227			
0-1	62 (12%)	22 (11%)		-	-	-
2	90 (18%)	25 (13%)		-	-	
3	280 (56%)	126 (64%)		-	-	
4	68 (14%)	24 (12%)				
KOOS Pain, median (range)	(n=578) 36.2 (0-91)	(n=230) 44.4 (0-100)	0.000*	(n=186) 78.2 (0-100)	(n=705) 94.4 (17-100)	0.000*
KOOS Function, median (range)	(n=582) 42.6 (0-99)	(n=236) 50.0 (4-100)	0.000*	(n=185) 76.5 (0-100)	(n=713) 92.6 (6-100)	0.000*
KOOS Quality of Life, median (range)	(n=642) 31.3 (0-81)	(n=257) 31.3 (6-88)	0.989	(n=186) 43.8 (6-81)	(n=674) 57.8 (17-68)	0.000*

*Comparison of patients with knee stability and patients without knee instability by means of Chi Square, Independent T-test or Mann-Whitney U test where appropriate. Significance level <0.05
SD = Standard Deviation
n = number of patients
KOOS = Knee injury and Osteoarthritis Outcome Score

Table 2. Uni- and Multivariable Regression Analyses of Knee Instability on Pain, Activity Limitations and Quality of Life Preoperatively and one Year After Total Knee Arthroplasty, Adjusted for Covariates

	Preoperative pain				**Preoperative activity limitations**				**Preoperative quality of life**			
	Beta	SE	P-value	95% CI	Beta	SE	P-value	95% CI	Beta	SE	P-value	95% CI
Knee Joint Instability T0	-9.6	1.4	0.000	-12.4 - -6.7	-7.5	1.4	0.000	-10.2 - -4.8	-0.43	0.84	0.610	-2.1 – 1.2
Age	-9.1	1.4	0.000	-11.9 - -6.3	-7.3	1.4	0.000	-10.0 - -4.5	-0.28	0.83	0.734	-1.9 – 1.4
Gender	-8.8	1.4	0.000	-11.6 - -6.0	-6.8	1.4	0.000	-9.5 - -4.2	-0.18	0.82	0.831	-1.8 – 1.4
BMI	-9.4	1.4	0.000	-12.2 - -6.6	-7.4	1.4	0.000	-10.1 - -4.7	-0.46	0.84	0.581	-2.1 – 0.3
Comorbidities	-9.5	1.5	0.000	-12.4 - -6.6	-6.5	1.4	0.000	-9.4 - -3.7	-0.09	0.85	0.912	-1.8 – 1.6
Radiographic Severity	-9.8	2.1	0.000	-13.8 - -5.8	-6.5	2.0	0.001	-10.3 - -2.6	0.91	1.1	0.410	-1.3 – 3.1
	Postoperative pain				**Postoperative activity limitations**				**Postoperative quality of life**			
	Beta	SE	P-value	95% CI	Beta	SE	P-value	95% CI	Beta	T	P-value	95% CI
Knee Joint Instability T1	-15.0	1.8	0.000	-18.5 - -11.6	-15.1	1.7	0.000	-18.4 - -11.8	-11.0	1.3	0.000	-13.4 - -8.5
Age	-14.7	1.7	0.000	-18.1 - -11.3	-15.1	1.7	0.000	-18.4 - -11.9	-10.3	1.3	0.000	-12.8 - -7.9
Gender	-14.9	1.8	0.000	-18.4 - -11.5	-14.9	1.7	0.000	-18.2 - -11.6	-10.7	1.3	0.000	-13.2 - -8.2
BMI	-15.3	1.8	0.000	-18.8 - -11.7	-15.1	1.7	0.000	-18.5 - -11.7	-10.9	1.3	0.000	-13.4 - -8.5
Comorbidities	-14.8	1.9	0.000	-18.4 - -11.2	-14.6	1.7	0.000	-18.0 - -11.2	-10.8	1.3	0.000	-13.3 - -8.2

T0 = Preoperatively, T1 = one year postoperatively
SE = Standard Error

Course of Instability over one Year

Among the 649 patients with preoperative self-reported knee instability, 165 patients (25%) retained knee instability whereas 484 patients' knee instability resolved (75%). The patients with retained knee instability were younger and had more preoperative pain and more activity limitations compared with the patients with resolved knee instability ($p<0.05$) (Table 3). Moreover, the median of one-year postoperative pain, activity limitations, and QoL outcomes was 77.8 (Interquartile Range [IQR] 35.4), 76.5 (IQR 32.4) and 50.0 (IQR 25.0) for patients with retained instability and 94.4 (IQR 16.7), 92.2 (IQR 16.2) and 75.0 (IQR 31.3) for patients with resolved instability, respectively. All outcomes were statistically significantly worse for patients with retained instability as compared with those with resolved instability ($p<0.001$).

Among the 259 patients with no preoperative self-reported knee instability, 22 patients (8%) reported knee instability one year after surgery. The analysis of the 22 patients who developed knee instability showed, compared to the patients with no, retained or resolved instability, no significant differences on preoperative pain, activity limitations or QoL (p-value's 0.063, 0.265 and 0.309, respectively), or on postoperative pain or activity limitations (p-value's 0.268 and 0.077, respectively), only on postoperative QoL (p-value 0.014).

Association of Retained Knee Instability with Pain, Activity Limitations, and QoL

Statistically significant associations were found between retained knee instability and postoperative pain (B -15.1; 95%CI: -18.9 to -11.2), activity limitations (B -14.1; 95% CI: -17.8 to -10.4), and QoL (B-18.0; 95%CI: -21.7 to -14.3), adjusted for baseline scores and covariates. Patients with retained self-reported knee instability had worse postoperative pain, more activity limitations, and poorer QoL compared with the patients with no instability and those whose instability resolved.

Table 3. Patients Characteristics and Self-Reported Preoperative Pain, Activity Limitations and Quality of Life of patients with a retained versus resolved perception of knee instability

	Retained knee instability N=165	Resolved knee instability N=484	P-value
Age, mean (SD)	66 (9.3)	68 (8.4)	0.039*
Female, n (%)	117 (71%)	336 (69%)	0.179
Body Mass Index, mean (SD)	30 (4.7)	29 (4.7)	0.101
Comorbidity, n (%)	(n=148)	(n=441)	
None	30 (20%)	84 (19%)	0.748
Non-musculoskeletal	23 (15%)	57 (13%)	
Musculoskeletal	57 (39%)	190 (43%)	
Both	38 (26%)	110 (25%)	
Kellgren&Lawrence grade indexknee, n (%)			
0-1	18 (22%)	28 (12%)	0.245
2	15 (18%)	40 (18%)	
3	40 (49%)	132 (58%)	
4	9 (11%)	28 (12%)	
KOOS Pain, median (range)	33 (16.4)	37 (17.0)	0.005*
KOOS Function, median (range)	39 (16.6)	45 (18.0)	0.000*
KOOS Quality of life, median (range)	33 (9.0)	34 (10.2)	0.410

*Comparison of patients with knee stability and patients with knee instability by means of Chi Square, Independent T-test or Mann-Whitney U test where appropriate. Significance level <0.05
SD = Standard Deviation
n = number of patients
KOOS = Knee injury and Osteoarthritis Outcome Score

Discussion

Before and one year after TKA, respectively 72% and 21% of the patients reported knee instability. Twenty-five percent of the patients with preoperative knee instability retained this one year after TKA. Patients with retained knee instability reported clinically significant more pain, more activity limitations, and poorer QoL than patients with no perception of knee instability or with resolved knee instability. These results suggest that a substantial number of the patients who undergo TKA retain knee instability and that these patients suffer from more pain, more activity limitations, and poorer QoL compared to patients who no longer reported knee instability.

The percentages of patients reporting knee joint instability pre- and postoperatively, as well as the percentage of patients with retained

knee instability were in accordance with previous studies (12-14, 16). Preoperatively, patients with knee instability had more pain and more activity limitations as compared with those with no instability, which corresponds to previous studies (12-14, 16). Our study found similar results for patients reporting knee instability one year postoperatively. The differences in postoperative pain and activity limitations between those with and without knee joint instability exceeded the minimal clinically important difference (range between 8 and 10 for both subscales) and are therefore clinically significant (19, 23). These results are in line with the study of Fleeton et al., a randomized controlled trial where a selected patient population was used that excluded the worst patients (e.g., patients aged 75 and over, those who had previously undergone lower limb surgery, or those with severe comorbidities) (12). In addition, one group of patients received an intensive postoperative exercise programme that potentially influenced the perception of knee joint instability (12, 24). This is different from our study, in which both young and old patients could have undergone uncontrolled interventions: A situation typical of clinical care. Our results emphasize that associations found earlier between self-reported knee instability and pain and activity limitations are also present in clinical care and persist up to one year after surgery. Moreover, patients with retained knee joint instability reported more preoperative pain and worse preoperative function compared with patients who no longer reported knee instability. Future research in clinical care should identify whether preoperative pain and function predict retained instability.

In addition to patients' perspectives on pain and activity limitations, QoL was assessed to include aspects of psychosocial function and emotional-social dimensions (25, 26). QoL as a generic outcome plays an important and complementary role in evaluating outcomes of lower limb arthroplasty surgery (7). Our results demonstrated that patients with self-reported knee instability reported worse pre- and postoperative QoL. A possible explanation for poor QoL is the combination of pain and a decline in physical function resulting in loss of functionality. Variables influenced by emotions, such as depression and the perception of knee instability can be seen as indicators of poor QoL. Studies are needed

to understand the underlying mechanisms of poor QoL in patients with retained knee instability.

For the associations found between self-reported instability, pain, activity limitations, and QoL, no causal conclusions can be drawn despite the longitudinal study design. However, one can speculate about possible underlying mechanisms that might explain or clarify the results found. Potential underlying mechanisms include muscle strength and pain catastrophizing (15, 27-29). Muscle weakness may thus contribute to a delayed response of muscles to sudden forces that results in excessive movements of the knee joint and the perception of knee joint instability (15). In addition, knee pain itself was found to impair quadriceps control, likely provoking knee instability (27). This suggests that improving muscle strength, and in particular quadriceps strength, could be a target for intervention. A previous study showed that the perception of knee instability could be improved through exercise therapy and additional knee stabilization training (24). Future studies should determine if patients with retained knee joint instability benefit from exercise therapy and/or knee stabilization training. Furthermore, pain catastrophizing appeared to be related to experienced pain and activity limitations (28, 30). Pain catastrophizing is a method of cognitively coping with pain, characterized by negative self-statements and overly negative thoughts and ideas about the future (29, 31). Knee instability is also a perception and could therefore be closely related to pain catastrophizing. Future studies should determine the associations between pain catastrophizing and self-reported knee instability.

From a clinical perspective, knee instability might help orthopaedic surgeons to evaluate outcome after TKA. Differences between orthopaedic surgeon derived outcome scores and patient reported outcomes have been shown (32-34). In estimating outcomes, surgeons focus on pain, range of motion, alignment, joint laxity, and walkability, whereas patients focus on pain and limitations in daily activities (32-34). This discrepancy in scoring outcome (i.e., physician based and patient based) contributes to a disparity in postoperative results with possible overestimation of positive results by orthopaedic surgeons (26, 27). Due to the associations

with clinical outcomes, retained knee joint instability could be an easily identifiable alarm symptom for poor clinical outcomes. When retained knee joint instability is present, orthopaedic surgeons could be aware of a higher risk for poor clinical outcomes. This implies that retained knee joint instability could be acknowledged as an important surrogate outcome. A surrogate outcome is defined as ''a laboratory measurement or physical sign used as a substitute for a clinically meaningful endpoint that measures directly how a patient feels, functions or survives'' (35). Although there are disadvantages to the use of surrogate outcomes, surrogate outcomes have been accepted as proxy measures of patient-important outcomes, being often easier and quicker to measure, making surrogate outcomes suitable for usage in clinical care (35). It is therefore recommendable to use simple questions on self-reported knee instability in clinical care, for example as new patient reported outcome measure (PROM). Currently, PROMs are not only used for the measurement of surgery outcomes from the patients' perspective, but also included in national joint registries worldwide and considered as important quality marker after surgery (36).

Several strengths and limitations of the study should be acknowledged. Strengths of our study included the use of a large, unselected clinical cohort of patients of different ages, and postoperative analyses that contained one-year postoperative measurements. However, our study equally demonstrated some limitations. First, the measurement of objective instability was not included due to the clinical character of the study. Measuring objective dynamic instability requires an advanced measuring system that is currently only available with highly qualified gait analysis laboratories. Second, 26% of the patients did not return the postoperative questionnaire or did not complete information regarding knee instability, which resulted in substantial missing data and a potential risk of selection bias. We determined the distribution of gender and age and found no differences between the patients included in the analysis and the patients not included in the analysis (data not shown). Therefore, we believe that our patient population represents a general patient population in clinical care.

In conclusion, in 25% of the patients self-reported knee joint instability is prevalent preoperatively and retained at one year. The retained knee instability by patients is associated with more pain, activity limitations, and poor QoL postoperatively.

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