Original Article

"Pain without loosening"-revisions of knee arthroplasties in the Danish Knee Arthroplasty Register

Kristine Bollerup Arndt[1, 2, 3], Henrik Morville Schrøder[4], Anders Troelsen[5], Mikkel Rathsach Andersen[6], Lasse Enkebølle Rasmussen[3] & Martin Lindberg-Larsen[1, 2]

1) Department of Orthopaedic Surgery and Traumatology, Odense University Hospital, 2) Department of Clinical Research, University of Southern Denmark, Odense, 3) Department of Orthopaedic Surgery, Lillebaelt Hospital, Vejle, 4) Department of Orthopaedic Surgery, Naestved Hospital, 5) Department of Orthopaedic Surgery, Clinical Orthopaedic Research Hvidovre, Copenhagen University Hospital – Hvidovre Hospital, 6) Department of Orthopaedics, Copenhagen University Hospital – Herlev-Gentofte Hospital, Denmark

ABSTRACT

INTRODUCTION. We aimed to investigate "pain without loosening" as an indication for knee arthroplasty revisions and to screen for other indications potentially hidden in this category to improve future registration and enhance data quality in the Danish Knee Arthroplasty Register.

METHODS. We included 104 patients undergoing revision knee arthroplasty for the indication "pain without loosening" from 1 January 2016 to 31 December 2018 at five Danish centres. Medical records, radiographs and computed tomographies were reviewed.

RESULTS. In 103 of 104 cases, we confirmed "pain without loosening" as an indication for revision. We found hidden indications in 44 cases; malposition of components (n = 19), stiffness (n = 13), progression of arthrosis (n = 6), instability (n = 3), liner dislocation (n = 1), residual cement (n = 1) and aseptic loosening (n = 1). The Kellgren-Lawrence arthrosis grades prior to primary knee arthroplasty were 1-2 (31%) and 3-4 (69%).

CONCLUSIONS. The indication "pain without loosening" covered patients revised due to pain, but other hidden indications were also present. Stiffness and malposition of components were hidden indications and these are not provided as indication options in the DKR and other registers. The relatively high frequency of arthrosis grade 1-2 prior to primary knee arthroplasty is concerning and may explain the occurrence of knee pain without any other pathology present.

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TRIAL REGISTRATION. Not relevant.

Nationwide arthroplasty registers provide valuable information enabling high-quality research. The quality depends on the validity of the register in terms of coverage, completeness and accuracy of variables [1]. Several countries have well-established knee arthroplasty registers. The validity of the Danish Knee Arthroplasty Register (DKR) is high, but some variables need further examination including indications for revisions [2]. To

our knowledge, indications for revisions have not previously been investigated in any national register.

Revision of knee arthroplasties because of pain with no obvious knee pathology present is generally not recommended and may not result in pain relief [3]. Nevertheless, pain revisions are still performed according to the registers [2]. Pain indication is not available in all nationwide registers. It exists as indication in knee arthroplasty registers from Denmark, Norway, Australia, the UK and Finland, but not in registers from Sweden and the Netherlands. Pain revisions account for 13% of all revisions in Denmark, 22% in Norway, 11% in Australia, 10% in UK and 10% in Finland [2]. However, the distribution of revision indications has changed over time, and a decrease in pain revisions has been shown [4]. The range of revision indications in the registers varies considerably. This variation begs the question of how well the indications in the registers reflect the true reasons for revision. Though "other" is present in most registers to group any unlisted indications, "pain" may also be used as the best fit when available. It remains uncertain if the indication "pain without loosening" covers other unknown indications. Therefore, the aim of this study was to investigate the indication "pain without loosening" in the DKR, and screen for other possible indications hidden within this category to improve future registration and data quality.
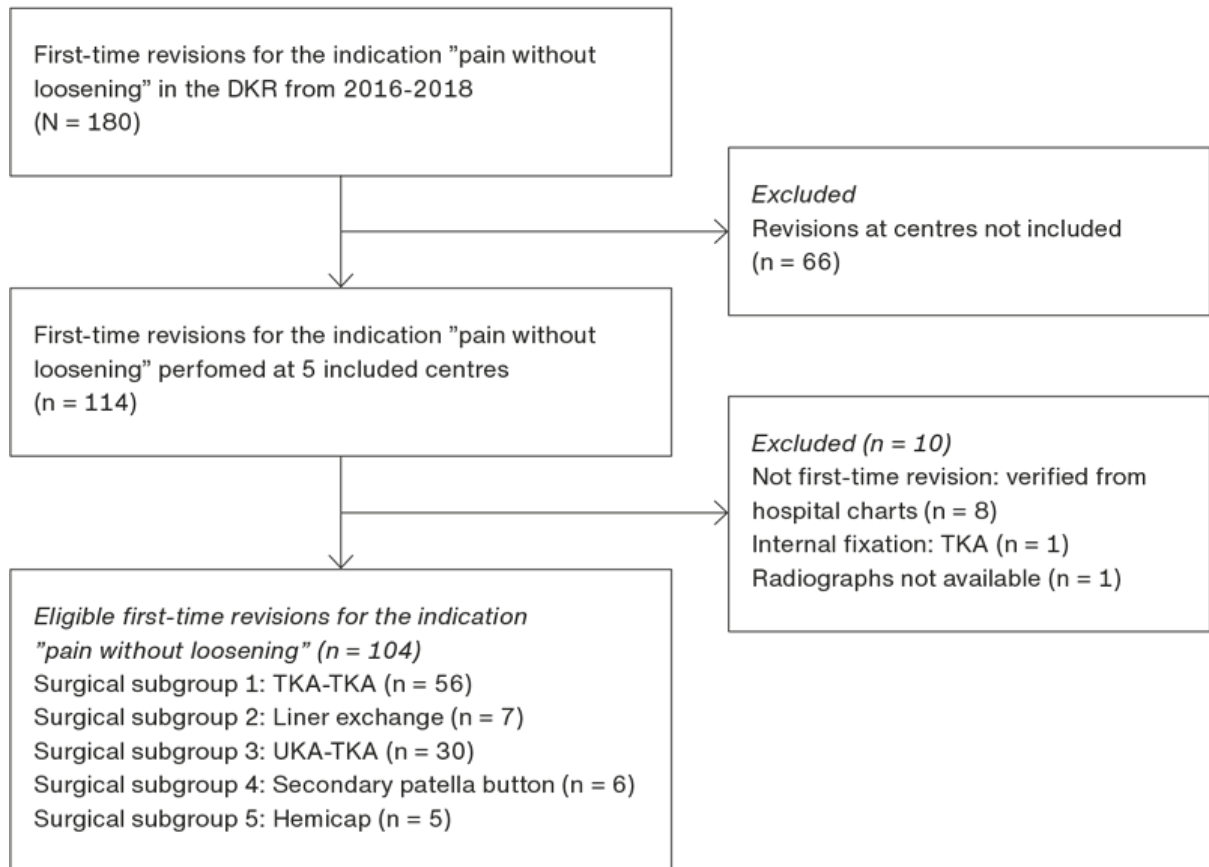
METHODS

This was a study of prospectively collected data from the DKR, medical records and radiographs.

Patients and data sources

We identified patients undergoing first-time knee arthroplasty revision for the indication "pain without loosening" in the period from 1 January 2016 to 31 December 2018 at five centres from the DKR. The DKR is a clinical quality control database that prospectively collects data on all primary and revision knee arthroplasties performed in Denmark as from 1997. In the study period, the completeness of the register was 94% for revision knee arthroplasties and 97% for primary knee arthroplasties [2].

A total of 104 patients were included in the study (**Figure 1**). The primary arthroplasties were 68 total knee arthroplasties (TKA), 28 medial unicompartmental knee arthroplasties (mUKA), three patellofemoral prostheses and five hemicaps. We defined surgical subgroups by the type of prosthesis removed and type of prosthesis inserted at the revision (Figure 1).

FIGURE 1 Flow chart of included patients.

First-time revisions for the indication "pain without loosening" in the DKR from 2016-2018 (N = 180)

Excluded
Revisions at centres not included (n = 66)

First-time revisions for the indication "pain without loosening" perfomed at 5 included centres (n = 114)

Excluded (n = 10)
Not first-time revision: verified from hospital charts (n = 8)
Internal fixation: TKA (n = 1)
Radiographs not available (n = 1)

Eligible first-time revisions for the indication "pain without loosening" (n = 104)
Surgical subgroup 1: TKA-TKA (n = 56)
Surgical subgroup 2: Liner exchange (n = 7)
Surgical subgroup 3: UKA-TKA (n = 30)
Surgical subgroup 4: Secondary patella button (n = 6)
Surgical subgroup 5: Hemicap (n = 5)

DKR = Danish Knee Arthroplasty Register; TKA = total knee arthroplasty;
UKA = unicompartmental knee arthroplasty.

Data collection

A single observer (KBA) reviewed the medical charts. Study data were collected and managed using REDCap electronic data capture tools hosted at Odense Explorative Patient data Network (OPEN). Data were collected on the following variables; indication for revision, the surgeon's description of radiographs and CT, age, sex, previous knee surgeries, type of arthrosis (primary/secondary), American Society of Anesthesiologists (ASA) score, medically treated psychiatric disorder at the time of revision, other treatment strategy prior to revision; cast, physiotherapy, weight loss, analgesics, manipulation under anaesthesia, steroid injection and other (**Table 1**).

TABLE 1 Characteristics of included patients (N = 104) and radiographic evaluation prior to primary knee arthroplasty (N = 82[a]).

Characteristics	
Females, n (%)	61 (59)
Age, median (range), yrs:	
At primary surgery	60 (25-86)
At revision	65 (29-88)
Time from primary surgery to revision, mean (95% CI), yrs	4.3 (3.3-5.1)
Previous knee surgeries, n (%):	
None	24 (23)
Arthroscopy	37 (36)
Other	5 (5)
Unknown	38 (36)
Type of arthrosis, n (%):	
Primary	54 (52)
Secondary	16 (15)
Unknown	34 (33)
ASA score at time of revision, n (%):	
1	26 (25)
2	65 (63)
3	13 (12)
Medically treated psychiatric disorder at time of revision, n (%)	5 (5)
Other treatment strategy prior to revision, n (%):	
Cast/bandage	1 (1)
Physiotherapy	10 (10)
Analgesics	8 (8)
Manipulation under anesthesia	9 (9)
Steroid injection	6 (7)
Radiographic evaluation prior to primary knee arthroplasty, n (%)	
Knee compartments affected from arthrosis before primary surgery:	
Patellofemoral	2 (2)
Medial	33 (41)
Lateral	2 (2)
Medial and patellofemoral	10 (12)
Medial and lateral	5 (6)
3 compartments	30 (37)
Kellgren-Lawrence grade of arthrosis before primary surgery:[b]	
1: doubtful narrowing of joint space and possible osteophytic lipping	3 (4)
2: definite osteophytes and possible narrowing of joint space	22 (27)
3: moderate osteophytes, definite narrowing of joint space, possible deformity of bone	40 (49)
4: large osteophytes, marked narrowing of joint space, sclerosis and deformity of bone	17 (20)

ASA = American Society of Anesthesiologists; CI = confidence interval.
a) Missing radiographs (n = 22).
b) Worst affected chamber.

Radiographic evaluation

Radiographs prior to revision were available for all included patients and prior to primary arthroplasty for 79% of the patients. A single observer reviewed all radiographs (KBA). In cases of doubt, a second observer (MLL) also assessed the radiographs. Pre-revision CTs were reviewed for patients who had CT performed (28% of cases) by two observers (KBA and MLL). Radiographic evaluation of TKA followed the criteria by Gromov et al. [5]. Rotation of femoral components was assessed from CTs using the surgical transepicondylar axis method. Tibial tubercle axis; 18° of internal tibial implant rotation in relation to the tibial tuberosity was considered neutral.

Radiographic evaluation of mUKA followed the criteria used by Hurst et al. [6]. Position of patellofemoral

prostheses was evaluated as proposed by Lustig [7].

Arthrosis grade of the worst affected compartment was estimated by the Kellgren-Lawrence classification on radiographs prior to the primary procedure and in lateral compartments of knees with a mUKA prior to revision [8].

The intra-observer level of agreement for the radiographic examinations was estimated by Cohen's kappa and by double examination of 20 randomly selected radiographs included in the study. The Cohen's kappa was 0.95.

Statistics

Categorical data were presented as counts and proportions. Continuous data were inspected for normal distribution with Q-Q plots and presented with median and range or mean and 95% confidence interval (CI). For all analyses, we used Stata Statistical Software: Release 17. College Station, TX: StataCorp LLC.

Ethical considerations

R. no. 19/14416). Approval to access medical records and radiographs was obtained from the Danish Patient Safety Authority (R. no. 31-1521-249). The authors had no conflicts of interest to declare.

Trial registration: not relevant.

RESULTS

A total of 103 (99%) of 104 patients were revised due to "pain without loosening", whereas one patient was revised due to "aseptic loosening". The observers found an additional indication in 44 (42%) of the cases (**Table 2**). The majority of the additional indications was stiffness (n = 13), patella maltracking (n = 13) and malposition of components (n = 6). Most revisions for patella maltracking were TKA revisions. The maltracking of the patella was identified from patellar skyline views. In five (38%) of these cases, malrotation of the components was found. The remaining eight cases were not CT scanned. The surgeons found malrotation in 14 cases in which we could not recover radiographic deviations from standard CT recommendations.

TABLE 2 Hidden indications assessed from medical charts. The values are n (N = 104).

	Total (n = 44 (42%))	TKA (n = 27 (26%))	mUKA (n = 14 (13%))	Hemicap (n = 3 (3%))
Stiffness	13	12	1	-
Patella maltracking[a]	13	12	1	-
Malposition of components[a]	6	-	6	-
Dislocated bearing	1		1	-
Instability[b]	3	2	1	-
Progression of arthrosis	6	-	3	3
Aseptic loosening	1	1	-	-
Residual cement	1	-	1	-

mUKA = medial unicompartmental knee arthroplasty; TKA = total knee arthroplasty.
a) Verified from radiographs.
b) Medial ligaments.

The extension deficit of patients revised due to stiffness was 16° (95% confidence interval (CI): 9-22°) and flexion ability was 92° (95% CI: 81-103°).

All radiographic measurements of TKAs and UKAs prior to revision are presented in Supplementary figures A-D (https://content.ugeskriftet.dk/sites/default/files/2023-11/a04230242-supplementary.pdf). Deviations from optimal component placement were present in 60% of all the cases; 47% of the cases revised for pain without other hidden indications and 68% of the cases in which another indication was present (mean 71.7°; standard deviation (SD) ± 26.7°).

The distribution of Kellgren-Lawrence arthrosis grade up to the primary knee arthroplasty was grade 1 (4%), grade 2 (27%), grade 3 (49%) and grade 4 (20%). The distribution of Kellgren-Lawrence grades and the presence of hidden indications are presented in **Table 3**.

TABLE 3 Presence of other hidden indications and Kellgren-Lawrence grades prior to the primary knee arthroplasty (N = 82[a]).

Verification of the indication "pain without loosening"	n	Kellgren-Lawrence grade, n (%)	
		1-2	3-4
No other indications present	35	13 (37)	22 (63)
Other indications for revision were present	47	12 (26)	35 (74)
Total	82	25 (30)	57 (70)

a) Missing radiographs (n = 22).

Supplementary figures A-D showed histograms of some of the most important measurements (coronal angle of femoral component in TKA; coronal angle of tibial component in TKA; coronal angle of tibial component in UKA; tibial component medial fit in UKA). The presence of radiographic deviations in groups with the presence or absence of other indications is presented in Supplementary Table A.

DISCUSSION

Hidden indications

Our study demonstrated hidden indications in addition to the registered indication "pain without loosening" in the DKR. Some of the additional indications found already existed in the DKR (instability, progression of arthrosis, aseptic loosening).

A total of 13% of the revisions in our study were performed due to stiffness in addition to pain. Stiffness is a controversial indication that is not infrequently used. It does not exist in the DKR, but it is available in other national arthroplasty registers.

Malalignment is implemented in other national registers and our data confirmed a need for an indication for revision of an incorrectly inserted prosthesis in the DKR. We could recover patella maltracking in 13 cases (13%) and malrotation was evident in five of these cases. No consensus exists on the cut-off point for malrotation or CT assessment of surgical landmarks, which makes interpretation of malrotation debatable [9]. Internal rotation of the femoral component above 3-6° was found to be associated with poorer outcomes in some studies, whereas others found no correlation [10]. Internal rotation of the tibial component > 10° has been associated with inferior outcomes, pain and stiffness [9]. External rotation of the femoral and tibial component does not correlate with inferior outcomes [10]. Some studies have suggested a correlation between rotational malalignment and patella maltracking though the evidence is not consistent [11]. Rotational malalignment was verified in five of the cases revised for patella maltracking. CTs were not present for all patients revised for patella maltracking. We cannot estimate any association based on the data from the present study.

We found six (6%) cases of revisions performed due to malposition of components. They were not noticeably displaced compared with the other prostheses in this study, of which 60% deviated from the optimal recommendations. Malalignment is difficult to estimate because of differences in radiographic measurements and shortcomings of available radiographic material. Furthermore, rather large variations in placements of component seems to result in acceptable outcomes [12]. For example, kinematic versus mechanical alignment approaches lead to different positions of components without any of the methods being obviously superior to the other [13]. Therefore, the amount of prostheses with radiographic measurement deviations in this study was not an unexpected finding.

Radiographic assessment

Although radiographic deviations from standard recommendations for optimal prosthesis component placement were present in 60% of all cases, the components were not excessively displaced compared with TKAs reported in other investigations [14, 15]. Ritter et al. found a mean femoral alignment of TKAs of 3.7° ± SD 3.3° and a mean tibial alignment of 90.4° ± SD 2.4° [15]. Nielsen et al. observed 18% with medial overhang, 32.2% with lateral overhang and 5.8% with anterior overhang of the tibial component in a cohort of 323 TKA patients. In their study, overhang was defined as any measurement above 0 mm [14]. Deviations from optimal component placement may be expected in standard series of TKAs, which does not necessarily cause clinical symptoms leading to a revision need. Achievement of optimal femoral and tibial component alignment is important to long-term TKA survival [15]. Overall, the femoral components in our study were well placed, but 30% of the tibial components were placed in varus position, which is associated with increased failure rates [15].

Arthrosis grade prior to primary surgery

It is well established that preoperative radiographic severity of knee arthrosis is correlated with higher post-operative levels of satisfaction and improved pain scores after TKA [16]. Preoperative Kellgren-Lawrence arthrosis grades > 3 are associated with better pain scores after TKA than grades ≤ 2, where a larger portion of pain may potentially not emanate from arthrosis but rather from the periarticular soft tissues. Patients with preoperative Kellgren-Lawrence grades ≥ 3 were more satisfied after TKA [16]. In our study, 31% of the patients had a Kellgren-Lawrence grade ≤ 2. This is a larger portion than reported from three previous single-centre studies where the share of grades 0-2 was 3-13% in consecutive series of osteoarthritis patients receiving TKA [17, 18]. This supports the correlation between severity of arthrosis and improved pain scores after TKA. Possibly, some of the patients included in our study received their primary knee arthroplasty at a too early stage.

Strengths and limitations

This was the first study to validate pain as an indication for knee arthroplasty revision in a nationwide register. Medical records were thoroughly investigated, but we can only account for data entered into the records and might be missing some unrecorded observations. Furthermore, data might be entered differently by the surgeons, e.g., estimation of range of motion (ROM), instability, etc., making comparisons inaccurate. Furthermore, the radiographic assessment had limitations; long radiographs and calibration ball were missing in most cases, which limits the precision of radiographic measurements. However, estimations from short radiographs have been proven acceptable [19]. It is a limitation that the Kellgren-Lawrence classification does not take patellofemoral osteoarthritis into account. Therefore, we cannot be certain that some patients with low degrees of osteoarthritis on anteroposterior radiographs did not have excessive patellofemoral osteoarthritis. However, we examined the available radiographs, which also included lateral projections and, in some cases, the skyline patella view. We did not identify cases with Kellgren-Lawrence grades of one or two that were suspicious of patellofemoral osteoarthritis. CTs had been performed only for a limited number of the patients, and the reliability for measurements is well known to be low concerning rotation of components estimations. Therefore,

the precision was improved by ensuring agreement between two observers.

CONCLUSIONS

The indication "pain without loosening" covered patients revised due to pain, but other hidden indications were present. Stiffness and malposition of components were hidden indications that are not available as indication options in the DKR and other registers.

The relatively high frequency of arthrosis grade 1-2 prior to primary knee arthroplasty is concerning and may explain the occurrence of knee pain without any other pathology present.

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