

# Temporal trends in length of stay and readmissions after fast-track hip and knee arthroplasty

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## ABSTRACT

**INTRODUCTION:** Implementation of fast-track protocols in total hip and knee arthroplasty (THA/TKA) has dramatically changed the perioperative care, leading to a subsequent reduction in post-operative length of stay (LOS) and morbidity. Previous investigations in Denmark have shown a reduction in LOS from about ten days in 2000 to four days in 2009. We aimed to describe temporal changes in LOS and readmissions within the context of a continuous multicentre collaboration focusing on enhancing recovery and reducing morbidity after fast-track THA and TKA.

**METHODS:** We used an observational cohort design from nine Danish orthopaedic centres. All procedures were performed from January 2010 to August 2017. Data on LOS and 90-day readmissions were obtained from The Danish National Patient Registry. Cause of readmission and possible association with surgery were investigated using discharge summaries or health records.

**RESULTS:** We included 36,608 procedures with a median age of 69 (Interquartile range (IQR): 62–75) years of whom 58% were women. LOS decreased from a median of three (IQR: 2–3) days in 2010 to one (IQR: 1–2) days in 2017. The proportion of patients with LOS > 4 days decreased from 9.6% to 4.4%. Still, 90-day readmissions remained stable throughout the period at ≈ 8%.

**CONCLUSIONS:** A reduction in both LOS and proportion of patients with prolonged LOS without an increase in readmission is possible within a multicentre collaboration aiming at enhancing recovery and reducing morbidity.

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**TRIAL REGISTRATION:** The study was registered with ClinicalTrials.gov (NCT01515670).

for Fast-Track Hip and Knee replacement (FTHK) was established to study and improve clinical outcomes of THA and TKA in a Danish collaborative multicentre research environment. However, no data on the temporal trends of LOS and readmissions from the FTHK collaboration are available.

We aimed to describe temporal changes in LOS and readmissions within the context of a continuous multicentre collaboration focusing on enhancing recovery and reducing morbidity after fast-track THA and TKA.

## METHODS

We used an observational cohort design based on procedures from the Lundbeck Foundation Centre for Fast-track Hip and Knee Replacement database (LCDB) [3]. We included consecutive primary elective THA and TKAs in Danish citizens > 18 years performed from 11 Jan 2010 to 1 Aug 2017. The exclusion criteria were patients with non-elective procedures, simultaneous bilateral procedures, additional major arthroplasty within 90 days; and surgery due to congenital disorders, infections or cancer. Additionally, patients with missing preoperative questionnaires in the LCDB were excluded from the analysis (Figure 1).

The LCDB originally consisted of six departments with an additional three departments joining in 2012, 2013, and 2014, respectively. All nine departments used similar fast-track protocols including, but not limited to, regional anaesthesia, multimodal opioid sparing analgesia, in-hospital only thromboprophylaxis if LOS ≤ 5 days, early mobilisation and discharge to own home based on functional discharge criteria [3, 4].

## Data collection

Data on LOS (number of post-operative nights in hospital, including transfers to other departments and hospitals), 90-day readmissions (≥ 1 overnight stay and potentially related to the index procedure) and mortality were obtained from the Danish National Patient Registry (DNPR) to which reporting is mandatory for all hospitals in Denmark [5]. In patients with prolonged LOS (defined as > 4 post-operative nights in hospital), readmission or mortality within 90 days, dis-

## ORIGINAL ARTICLE

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With the introduction of “enhanced recovery” or “fast-track” protocols in total hip and knee arthroplasty (THA/TKA) that embrace an evidence-based multimodal and multi-disciplinary approach to improving care and consequently patient outcomes [1], the median length of hospital stay (LOS) in Denmark decreased from about ten days in 2000 to four days in 2009 [2]. In 2009, The Lundbeck Foundation Centre

charge summaries were evaluated for causes of morbidity and possible relation to the index procedure. Only readmissions unlikely to be related to the index procedures were excluded, e.g., eye surgery, other planned elective surgical procedures and cancer treatment.

From Jan 2010 to Sep 2013, discharge summaries were primarily analysed by CCJ; and from Oct 2013 to Aug 2017, the primary investigation was conducted by PBP, supervised by CCJ. In both periods, cases of doubt were discussed with HK to obtain agreement on cause and possible relation to arthroplasty.

Primary outcomes were temporal trends of LOS, proportion with LOS > 4 days and 90-day readmission rates.

### Statistics

Data are analysed and presented as means ( $\pm$  standard deviation (SD)) for continuous data, median (interquartile range (IQR)) for nonparametric, and number (%) for categorical data. Assessment of normality was based on histograms and q-q plots. Statistical work was

carried out using SPSS v.22 (IBM Corp, Armonk, NY, USA).

### Ethics

The non-interventional nature of the study waived the need for ethical approval. However, permission to collect and store data was obtained from the Danish Patient Safety Authority (3-3013-56/2/EMJO) and the Danish Data Protection Agency (RH-2017-132), respectively. Additionally, the LCDB is registered with ClinicalTrials.gov (NCT01515670) as an ongoing registry study on post-operative morbidity and mortality following fast-track THA/TKA.

*Trial registration:* The study was registered with ClinicalTrials.gov (NCT01515670).

### RESULTS

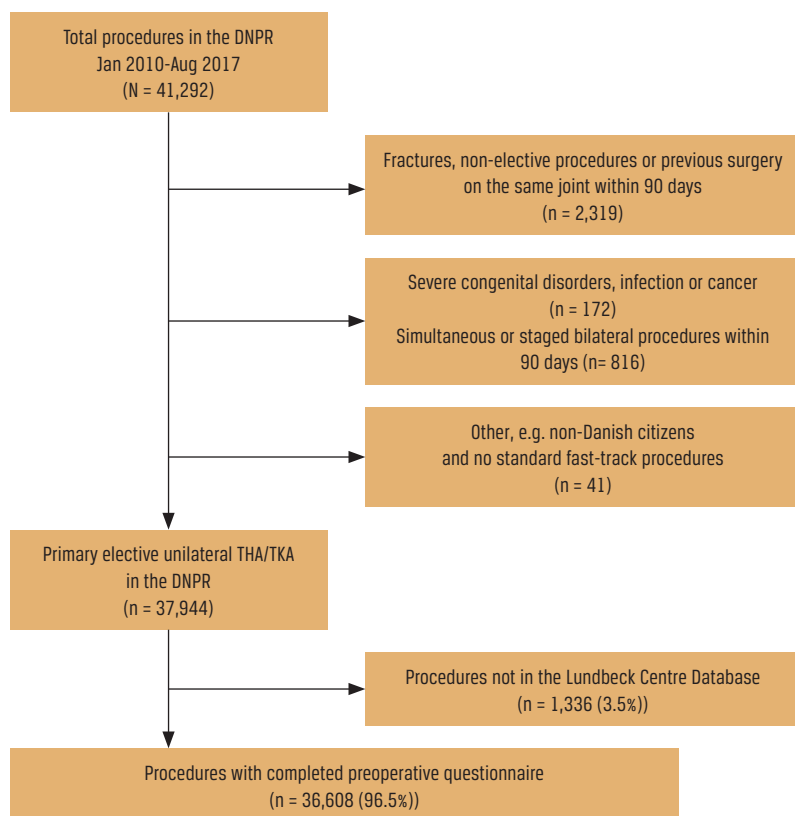
We included 36,608 procedures in 32,247 patients. Of all procedures, 16,812 (46%) were TKA and 19,791 (54%) THA. The median age was 69 (IQR: 62-75) years and 58% were women. LOS decreased from a median of three (IQR: 2-3) days in 2010 to one (IQR: 1-2) day in 2017. Mean LOS decreased from 3.0 (SD:  $\pm$  2.4) to 1.9 (SD:  $\pm$  1.6) days. Importantly, there was a decrease in the proportion of patients hospitalised > 4 days from 9.6% in 2010 to 4.4% in 2017 (**Figure 2**). The rate of 90-day readmissions with potential relation to the index procedure remained similar throughout the study period at about 8% (**Figure 3**).

### DISCUSSION

The results from this multicentre collaboration with a focus on potential continuous improvements in perioperative care of fast-track THA and TKA showed a steady decrease in LOS and fewer patients with a need for prolonged LOS. Importantly, the early perioperative improvements were not followed by an increase in 90-day readmission. The data suggest that a continued focus on improving perioperative care through multicentre collaboration with annual presentation of outcome data and discussions on the implementation of recent scientific evidence may contribute to further reductions in LOS through improved care and reduced early post-operative morbidity. It should be noted that a similar improvement has occurred in Denmark in areas not covered by the collaboration. In this context, the availability of discharge notes and health records is crucial for generating detailed clinical outcome data [6], which may provide further insights than data based solely on administrative databases and diagnostic coding. Additionally, the positive effect on LOS within well-documented and well-structured fast-track/enhanced recovery units has previously been shown in the United Kingdom [7] and Sweden [8], but not to the

**FIGURE 1**

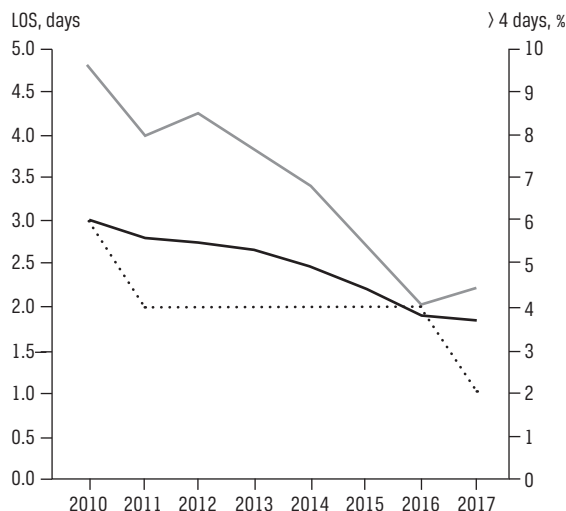
Flow of patients.



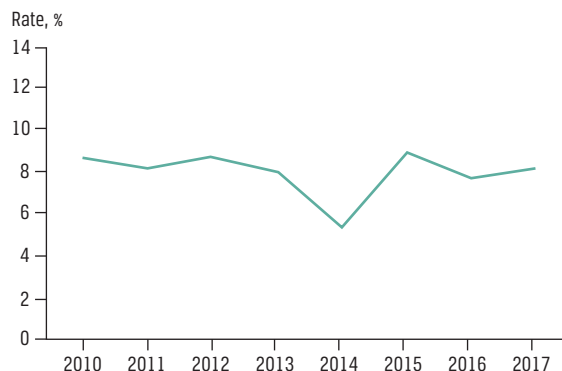
DNPR = Danish National Patient Registry THA = total hip arthroplasty; TKA = total knee arthroplasty.

**FIGURE 2**

Length of stay (LOS) (mean: —; median: ---) and percentage with LOS above four days (•), 2010-2017.

**FIGURE 3**

Ninety-day readmission rate, 2010-2017.



same extent as shown in the present study. Recent advances in perioperative optimisation of THA and TKA have questioned the need for hospitalisation at all. Consequently, in selected cases, discharge on the day of surgery has proven feasible [9]. However, the economic and safety aspects need further study [10].

The unchanged rate of readmissions of  $\approx 8\%$  in relation to the operation underlines the fact that although recovery has been enhanced and LOS markedly reduced, we have not reached the goal of a “pain- and risk-free” THA/TKA [11]. Thus, a specific focus should be placed on separation between “medical” and “surgical” complications [6]. It is our hypothesis that identification and optimisation of the individual perioperative factors influencing recovery (e.g., preoperative kidney insufficiency, preoperative psychopharmaco-

logical treatment, fall risk, perioperative anaemia, hip dislocation, intraoperative fractures, wound and deep infections, pain management, rehabilitation, etc. [12]) may lead to further improvements [11]. These improvements may be achieved by identification of those patients who may benefit from increased post-operative focus on, e.g., medical management of chronic illness and potentially at the expense of one or two more days in hospital [11].

On the other hand, it is reassuring that there was no increase in readmissions either, suggesting that the reduction in LOS has not come at the cost of increased complications after discharge.

The present study is limited by some methodological concerns. Identification of LOS and readmission from the DNPR [5], which is an administrative database, brings a risk of coding errors. However, the strength of our study was the use of discharge summaries and health records rather than diagnostic coding to identify readmissions potentially related to index procedure. Reporting of LOS to the DNPR is mandatory for receiving reimbursement. Thus, data on admission and discharge dates in the DNPR are accurate [5]. Finally, we have no data on procedures in Denmark from outside the present multicentre collaboration and that limits the possibility of nationwide statistical comparisons on LOS or readmissions with departments not participating in the FTHK.

## CONCLUSIONS

Data from a multicentre collaboration aiming to investigate and enhance post-operative recovery and consequently morbidity after THA and TKA showed a marked decrease in an already low LOS from a median of three days to a median of one day. Furthermore, fewer patients were hospitalised for more than four days. 90-day readmissions that were related to surgery remained unchanged throughout the study period at  $\approx 8\%$ .

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