Removal of restrictions following primary THA with posterolateral approach does not increase the risk of early dislocation

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Background and purpose — Patient education and mobilization restrictions are often used in an attempt to reduce the risk of dislocation following primary THA. To date, there have been no studies investigating the safety of removal of mobilization restrictions following THA performed using a posterolateral approach. In this retrospective non-inferiority study, we investigated the rate of early dislocation following primary THA in an unselected patient cohort before and after removal of postoperative mobilization restrictions.

Patients and methods — From the Danish National Health Registry, we identified patients with early dislocation in 2 consecutive and unselected cohorts of patients who received primary THA at our institution from 2004 through 2008 (n = 946) and from 2010 through 2014 (n = 1,329). Patients in the first cohort were mobilized with functional restrictions following primary THA whereas patients in the second cohort were allowed unrestricted mobilization. Risk of early dislocation (within 90 days) was compared in the 2 groups and odds ratio (OR)—adjusted for possible confounders—was calculated. Reasons for early dislocation in the 2 groups were identified.

Results — When we adjusted for potential confounders, we found no increased risk of early dislocation within 90 days in patients who were mobilized without restrictions. Risk of dislocation within 90 days was lower (3.4% vs 2.8%), risk of dislocation within 30 days was lower (2.1% vs 2.0%), and risk of multiple dislocations (1.8% vs 1.1%) was lower in patients who were mobilized without restrictions, but not statistically significantly so. Increasing age was an independent risk factor for dislocation.

Interpretation — Removal of mobilization restrictions from the mobilization protocol following primary THA performed with a posterolateral approach did not lead to an increased risk of dislocation within 90 days.

Dislocation of the hip is one of the most common complications following total hip arthroplasty (THA), with reported incidence rates ranging from less than 1% to over 15%, and higher risk of dislocation after revision arthroplasty than after primary THA (Woo and Morrey 1982, Phillips et al. 2003, Khatod et al. 2006, Patel et al. 2007). Several patient-related and surgery-related parameters, such as age (Ali Khan et al. 1981), cognitive function (Fackler and Poss 1980, Jolles et al. 2002), component malposition (Lewinnek et al. 1978, Jolles et al. 2002, Nishii et al. 2004), surgical approach (Masonis and Bourne 2002) and soft-tissue related factors (White et al. 2001) contribute to the risk of dislocation. In the past, many surgeons have used patient education and postoperative mobilization restrictions in an attempt to reduce this risk (Woo and Morrey 1982, Morrey 1992, 1997). However, in recent years some authors have questioned the benefit of such restrictions (Peak et al. 2005, Restrepo et al. 2011) and no published studies have ever confirmed a reduction in dislocation using restrictions, making some authors question the value of postoperative restrictions (Husted et al. 2014).

A possible limitation of these studies was that they all investigated primary THA performed using the anterolateral approach, which is probably associated with a lower rate of dislocation than primary THA using the posterior approach (Masonis and Bourne 2002). One recent study investigated a reduction in movement restrictions following primary THA with the posterolateral approach and found that fewer movement restrictions did not affect the patient-reported outcomes after 6 weeks, and led to earlier return to work. However, no recommendations on safety issues could be made due to the low number of patients (Mikkelsen et al. 2014).

The main aim of this retrospective, non-inferiority study was to investigate the rate of early dislocation (within 90 days) following primary THA in an unselected patient cohort before and after removal of postoperative mobilization restrictions. We also investigated the reasons for dislocation in patients who were mobilized with and without restrictions.

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Methods

Patient data

In a previous paper, based on the Danish National Health Registry (DNPR), we identified re-admissions due to early dislocation (within 90 days of index surgery) for 946 patients with primary THA performed at our institution between 2004 and 2008 (Husted et al. 2010). After removal of postoperative mobilization restrictions, we identified a second group of 1,329 patients with re-admissions due to early dislocation following index surgery (primary THA) performed at our institution between September 2010 and June 2014. All the patients were consecutive and unselected, and all the surgeries were performed in a standardized fast-track setup (Husted 2012). All THAs were performed by experienced surgeons specialized in hip arthroplasty surgery using a standard posterolateral approach (Barrett et al. 2013) with simple posterior soft-tissue repair (Browne and Pagnano 2012). Patients were discharged after fulfilling the same set of functional discharge criteria throughout the study period, and all the patients were discharged to their own homes, as there are no inpatient rehabilitation facilities in Denmark. Patient demographics and femoral head size were recorded.

All records for patients with early dislocation were scrutinized to confirm the reason for re-admission and to identify the mechanism of dislocation as stated in the patient chart. Dislocations were divided into "avoidable" and "unavoidable". "Unavoidable" dislocations were defined as dislocations due to falls, direct trauma, and unexpected movements as well as dislocations from unknown causes. All other causes of dislocations were considered to be "avoidable"; these included bending over to tie shoelaces, sitting down on a toilet or in a chair without elevation, or crossing the legs. If the reason for dislocation was not specified, the mechanism was considered to be "unknown". The primary endpoint was rate of early dislocation (within 90 days), dislocation within 30 days, multiple dislocation, and revision due to dislocation. The secondary endpoint was rate of "avoidable" dislocations.

Change in the postoperative restriction protocol

All the patients who underwent primary THA at our institution before August 2010 were mobilized postoperatively with functional restrictions. While admitted, all the patients received daily care from physiotherapists who were experienced in working with THA patients. Following discharge from hospital, all of them were offered continued physiotherapy training as outpatients. Patients mobilized with postoperative restrictions were told to refrain from hip adduction over midline, hip flexion > 90%, and internal rotation. They were told to place a pillow between the legs when lying in bed on the unoperated side. Elevated chairs and toilet seats were used while the patients were in hospital, and they were also provided for home use following discharge. The mobilization restrictions were followed for 3 months postoperatively.

Postoperative mobilization restrictions were abandoned on August 1, 2010. After that date, all patients who underwent primary THA received the same postoperative care and training from the nursing staff and physiotherapists, but they were mobilized without restrictions, allowing free range of motion. They were specifically told that no restrictions applied for them, which was reinforced in writing. During the entire study period, patients were offered a revision if they had dislocation more than 3 times.

Data sources

The DNPR was established in 1977. It holds information on all admissions and discharges, and up to 20 diagnoses for every discharge from public somatic hospitals in Denmark (Andersen et al. 1999). Diagnoses are classified according to the Danish version of the International Classification of Diseases (ICD-10) and are assigned by the discharging physician.

The Civil Registration System (CRS) holds information on the vital status of all Danish citizens, including changes of address, date of emigration, and date of death. Since 1968, all Danish citizens have been assigned a unique 10-digit personal identification number (CPR) at birth, encoding age, sex, and date of birth (Frank 2000). The use of CPR numbers enables unambiguous linkage between all Danish administrative registries and it allows tracking of patients who have died, have emigrated, or have been treated at other departments or admitted to hospitals other than the hospital of primary treatment.

Statistics

Results of comparison between dislocations in the 2 groups are reported as relative risk (RR) estimates with 95% confidence intervals (CIs) and p-values from Pearson's chi-square test or Fisher's exact test, as appropiate. Logistical regression analysis was used to calculate an OR for dislocation in patients mobilized without restrictions, adjusted for the potential confounders age (continuous), sex, and femoral head size. Age squared was entered to achieve a satisfactory model fit. A non-inferiority test based on the absolute risk difference was performed, applying a 1% non-inferiority margin (Vavken 2011). In this case, the null hypothesis was an absolute increase in risk of 1% or more in the regime without restrictions. Statistical significance, defined as a p-value < 0.05, was considered to be evidence of non-inferiority, meaning an increase in absolute risk difference of less than 1% when moving to the regime without restrictions. Finally, we calculated the upper 90% confidence interval for the OR of early luxation in the period without restrictions as compared to the period with restrictions.

The 1% limit was chosen based on consensus between several authors for a maximum acceptable increase in dislocation rate, while allowing for faster mobilization, quicker rehabilitation, and possible earlier return to work for patients after primary THA (Peak et al. 2005, Ververeli et al. 2009, Mikkelsen et al. 2014).

Table 1. Patient demographics

	With restrictions	Without restrictions	p-value
Age, median (range)	67 (20–99)	69 (15–104)	0.006 [a]
Sex			
Male	424 (45%)	513 (39%)	0.003 [b]
Female	522 (55%)	816 (61%)	
Femoral head size, mm			
28	946 (100%)	33 (3%)	< 0.001 [c]
32	0	403 (30%)	
36	0	890 (67%)	
Total	946	1,329	

[a] Pearson's chi-square test.
[b] Wilcoxon's rank-sum test.
[c] Fisher's exact test.

Table 3. Logistic regression analysis: odds ratio (OR) for dislocation

Risk factor	OR (95% CI)	p-value
Mobilization without functional restriction	0.32 (0.07–1.38)	0.1
Male sex	1.17 (0.70–1.95)	0.6
Age	1.52 (1.05–2.19)	0.03
Age ^{2} [a]	1.00 (0.99–1.00)	0.06
Femoral head size [b]	1.13 (0.93–1.38)	0.2

[a] Age and age squared included as continuous variables.
[b] Femoral head size included as a continuous variable.

Results

All 946 patients in the group mobilized with restrictions received a size 28 femoral head, while most patients (890 of 1,329) who were mobilized without restrictions received a size 36 femoral head (Table 1). 3.4% (32 of 946) of the patients in the restriction group had an early dislocation (within 90 days), as compared to 2.8% (37 of 1,329) in the unrestricted group. Patients who were mobilized without restrictions had a lower risk of dislocation within 30 days, of multiple dislocations, and of revision due to dislocation than patients mobilized with restrictions. None of the differences in risk were statistically significant (Table 2). The hypothesis of inferiority by a minimum of 1% increase in absolute risk of early dislocation, dislocation within 30 days, multiple dislocations, and revision due to dislocation could be discarded (Table 2). When adjusting for possible confounders, we did not find an increased risk of early dislocation in patients who were mobilized without restrictions (Table 3). Age was an independent risk factor for dislocations, with a 7% increase in OR per year (Table 3). The upper 90% confidence interval of the OR for luxation in the period with no restrictions relative to the period with restrictions was 0.99. This supports the conclusion regarding non-inferiority in the univariate analyses above.

The risk of dislocation categorized as "avoidable" was similar in both groups. The hypothesis of inferiority by a minimum of 1% increase in absolute risk of "avoidable" dislocations could also be discarded. Risk of revision for dislocation was reduced in patients who were mobilized without functional restrictions (Table 2).

When we analyzed reasons for dislocation in patients mobilized with restrictions, 4 of 32 dislocations were classified as "avoidable" (Table 4). 2 of these dislocations occurred when the patients were bending over excessively to tie shoelaces or to reach the floor and 2 occurred when the patients crossed their legs. Close to one-third of all dislocations occurred due to falls. 6 of 37 dislocations in patients who were mobilized without restrictions were classified as "avoidable" (Table 4). 4 of these dislocations occurred when the patients were bending over excessively to tie shoelaces or reach the floor and 2 occurred at toilet visits when the patients were not using an elevation seat for the toilet. About one-quarter of all dislocations occurred due to falls and one-fifth occurred due to an unexpected twist without falling.

Table 2. Dislocations in patients mobilized with and without functional restrictions following primary THA

	Dislocations with restrictions, n/N (%)	Dislocations without restrictions, n/N (%)	Risk of dislocation, RR (95% CI)	Test for difference, p-value [a]	Non-inferiority test, p-value [b]
Total	32/946 (3.4%)	37/1,329 (2.8%)	0.8 (0.5–1.3)	0.5	0.02
Within 30 days	20/946 (2.1%)	26/1,329 (2.0%)	0.9 (0.5–1.7)	0.9	0.03
> 1 dislocation	17/946 (1.8%)	14/1,329 (1.1%)	0.6 (0.3–1.2)	0.2	< 0.001
Revised due to dislocation	16/946 (1.7%)	8/1,329 (0.6%)	0.3 (0.2–0.8)	0.02	< 0.001
Avoidable dislocation	4/946 (0.4%)	6/1,329 (0.5%)	1.1 (0.3–3.8)	1.0	< 0.001

[a] Pearson's chi-square test.
[b] p-values for non-inferiority test, with null hypothesis for absolute increase in risk of 1% or more. Any p-values less than 0.05 were considered significant for rejection of the null hypothesis.

Table 4. Reasons for dislocation in patients who were mobilized with functional restrictions following primary THA

Reason for dislocation	Dislocations with restrictions, n = 32	Dislocations without restrictions, n = 37
Avoidable		
Excessive bending over [a]	2	4
Crossing the legs	2	0
Sitting on a toilet [b]	0	2
Unavoidable		
Fall	10	8
Twist [c]	5	7
Getting up from a chair	6	5
Unknown mechanism [d]	5	6
Other [e]	2	5

[a] Excessive bending over to tie shoelaces or to reach the floor.
[b] Sitting on a toilet without elevation seat.
[c] Unexpected twist in the leg/legs, without falling.
[d] Patients were unable to specify how the dislocation had occurred.
[e] Other: getting dressed, moving in bed, getting out of a car, lifting a leg.

Discussion

We found a similar risk of early dislocation within 90 days in patients who were mobilized with or without functional restrictions. Non-inferiority analysis rejected the hypothesis of a minimum of 1% increase in absolute risk of early dislocation. Further on, we did not find an increase in OR for early dislocations within 90 days in patients who were mobilized without functional restrictions, when we adjusted for possible confounders such as age, sex, and femoral head size.

The risk of dislocations that could possibly have been avoided if mobilization restrictions had been observed was similar in both groups, indicating that dislocations due to undesirable movement do occur despite having restrictions. Also, patient compliance with restrictions may be flawed; patients can forget them or choose to ignore them. This is supported by a study by Peak et al. (2005), who found a 74% compliance rate for restrictions following primary THA. In our study, almost half of all dislocations in both the restricted and the unrestricted groups occurred due to falling or an unexpected twist, something that cannot be avoided with mobilization restrictions or additional aid, and which may occur regardless of the length of hospital stay (Jørgensen and Kehlet 2013). These findings support our hypothesis that a no-restriction protocol does not lead to an increased rate of early dislocations, as total compliance to a restriction protocol cannot be expected and many dislocations occur due to unavoidable events.

There are several arguments for removal of mobilization restrictions following primary THA, provided it is safe. Peak et al. (2005) reported increased patient satisfaction at 6-month follow-up regarding the return of daily activities to preoperative levels in patients who were mobilized without restrictions. Ververeli et al. (2009) found a faster pace of recovery in patients who were mobilized with reduced restrictions than in those with more comprehensive restrictions. Mobilization restrictions can be associated with a substantial economic burden due to the cost of additional patient aids such as abduction pillows, elevated seats, etc. (Peak et al. 2005, Restrepo et al. 2011).

We included dislocations that occurred within 90 days of the index surgery. Although some dislocations occur later, several studies have shown that the risk of dislocation is greatest during the first 3 months (Ali Khan et al. 1981, Woo and Morrey 1982, Khatod et al. 2006). Also, mobilization restrictions are rarely extended beyond 6 weeks and never beyond 3 months (Restrepo et al. 2011, Mikkelsen et al. 2014), therefore making it unlikely that restrictions would affect the risk of first-time dislocation that occurs later than 3 months postoperatively.

Our finding that removal of mobilization restrictions following primary THA does not lead to an increased risk of dislocation is in agreement with previous reports using other approaches (Talbot et al. 2002, Peak et al. 2005, Restrepo et al. 2011). Contrary to these studies, Lübbeke et al. (2009) suggested that preoperative patient education, including information on mobilization restriction, reduces the risk of dislocation following primary THA. A weakness of that study was that participation in a preoperative education seminar does not guarantee that patients would actually follow a restriction protocol. It is also not possible to determine which part of the preoperative education was most useful in reducing the risk of dislocation. To our knowledge, only 1 previous study has looked at mobilization restrictions following THA with a posterolateral approach, and it found dislocation rates of 1.4% and 2.7% in patients mobilized with and without restrictions, respectively (Mikkelsen et al. 2014). Mikkelsen et al. included dislocations within 42 days of the index surgery, whereas our study included dislocations within 90 days, which at least partly explains the slightly higher dislocation rate found in our study. Also, we included dislocations that were reduced at other orthopedic departments in Denmark, ensuring the best possible degree of completeness, as all procedures requiring admission were registered. This will lead to a higher number of registered dislocations than in single-center studies that include only dislocations that have been reduced at the same center as the one that performed the index THA (Masonis and Bourne 2002).

Femoral head size was not an independent risk factor for early dislocation in our study. This contradicts recent registry studies that have found that increased femoral head size reduces the risk of dislocation (Hailer et al. 2012, Kostensalo et al. 2013), and also level-1 studies that have also shown a reduced risk of dislocation with larger femoral heads (Garbuz et al. 2012, Howie et al. 2012). One possible explanation for this is our study design. As we compared 2 historical retrospective cohorts, the distribution of femoral head size differed greatly as expected, as only size 28 femoral heads were used in patients who were mobilized with functional restrictions, while mostly size 32–36 femoral heads were used in patients who were mobilized without functional restrictions. Possible differences between these 2 cohorts that we did not adjust for could provide residual confounding, and limit the effect of femoral head size on early dislocation. We found that the risk of revision due to dislocation was reduced in patients who were mobilized without functional restrictions. The general consensus among surgeons was to offer a patient revision if more than 3 dislocation had occurred, but individual decisions were made in each case, based on age, cognitive status, and comorbidities. Slightly higher age, together with other residual confounders, could possibly explain this finding.

Our study had several limitations. Firstly, even though the same posterolateral approach was used at our institution throughout the study period, subtle changes to the surgical technique could have occurred, affecting the dislocation rate. However, this seems unlikely as the surgeons were experienced far beyond possible learning curves. Secondly, as this was an unselected consecutive patient cohort, we did not adjust for primary diagnosis, ASA score, cognitive function, or component malposition—which are also recognized risk factors for dislocation (Lewinnek et al. 1978, Fackler and Poss 1980, Jolles et al. 2002, Nishii et al. 2004, Hailer et al. 2012, Ravi et al. 2014). However, as we investigated consecutive unselected patients, confounding from those factors would be expected to be minimal. Thirdly, our non-inferiority margin of 1% can be questioned. However, we believe that this number is reasonable and clinically acceptable considering the different dislocation rates, ranging from less than 1% to over 15%, reported by several authors (Phillips et al. 2003, Khatod et al. 2006, Patel et al. 2007, Woo and Morrey 1982). Finally, we only investigated the prevalence of dislocations and subsequent revisions due to dislocation, and no patient-reported outcome measures were included.

In summary, we found that removal of mobilization restrictions from the postoperative mobilization protocol following primary THA performed with a posterolateral approach did not lead to an increased risk of dislocation.

KG, AT, and HH wrote the protocol and all the authors revised it. KG, KSO, and TØ undertook all data gathering; KG, AT, SL, and HH performed and evaluated all the statistical analyses. KG wrote the first draft of the manuscript and HH revised it; all the authors revised the draft and approved the final version. All the authors had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analyses.

No competing interests declared.

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