acta orthopaedica belgica, 2025, 91, 453-461

doi.org/10.52628/91.4.13685

Elective total hip arthroplasty stratified by surgical approach: how does the risk of dislocation relate to bearing size, type, and implant fixation?

P. H. J. CNUDDE[1,2,3,4], J. NÅTMAN[3], O. ROLFSON[3,4], N. P. HAILER[3,5]

11Department of Orthopaedics, Hywel Dda University Healthboard, Prince Philip Hospital, Bryngwynmawr, Llanelli, SA14 8QF, UK; [2]School of Management, Swansea University, Bay Campus, Swansea, SA1 8EN, UK; [3]Swedish Arthroplasty Register, Registercentrum Västra Götaland, 413 45 Gothenburg, Sweden; [4]Department of Orthopaedics, Institute of Clinical Sciences, University of Gothenburg, Göteborgsvägen 37, 431 80, Mölndal, Sweden; [5]Orthopaedics, Department of Surgical Sciences, Uppsala University, 751 85 Uppsala, Sweden.

Correspondence at: Peter H.J. CNUDDE, M.D., PhD., Prince Philip Hospital Llanelli, Bryngwynmawr, Llanelli, SA14 8ED, UK.
Email: Peter.cnudde@icloud.com

Dislocation after total hip arthroplasty (THA) is a serious concern that is rarely reported as a complication in register studies. The aim of this population-based register study was to evaluate the true cumulative incidence of dislocation by surgical approach following THA and to assess the impact of bearing size, bearing type, and stem fixation on dislocation risk. In this longitudinal cohort study based on data from 136,810 patients with a unilateral primary elective THA were included and followed up until 1st dislocation, revision, death, second THA of bilateral THA, or until the end of the observation period. The cumulative dislocation incidence was estimated using the Kaplan-Meier method, stratified by surgical approach. Multiple Cox regression models were fitted to estimate adjusted hazard ratios (HRs) for dislocation. The 1-year cumulative dislocation incidence was 1.1% (1.0-1.2) after use of the lateral approach and 2.3% (2.2-2.4) after the posterior approach. The use of femoral heads smaller than 32mm (reference) was associated with a higher risk of dislocation for both approaches (lateral HR 1.72, 95% CI 1.43-2.07, p<0.001; posterior HR 1.34, 95% CI 1.19-1.51, p<0.001). For the posterior approach, head sizes bigger than 32mm or dual mobility cups (DMC) conferred a lower risk of dislocation (>32mm HR 0.64, 95% CI 0.9-0.83, p<0.001; DMC HR 0.21, 95%CI 0.1-0.41, p<0.001). The use of the posterior approach carried an increased risk of dislocation when compared with the lateral approach, however, this risk was mitigated when using head sizes of 36 mm and by DMC.

INTRODUCTION

Dislocation following elective THA is a complication that is dreaded by both patients and healthcare providers, and it represents the most common reason for early revision[1-3]. When it occurs, it comes at a huge cost for the patient and the health service, and frequently dislocations become reoccurring[1,2,4]. Patient- and surgery-related factors associated with an increased risk for dislocation have previously been investigated in smaller cohorts, and a meta-analysis concluded that the risk of dislocation following a primary THA has a multifactorial aetiolog[5]. Perioperative strategies such as head size and implant technology innovations have helped to reduce the incidence of dislocation[6]. Surgical approach, bearing type and size and fixation type all influence the risk of dislocation[7,8]. The higher prevalence of dislocation after use of the posterior approach is well known, and the effect of head size and bearing on the risk of dislocation has been studied[5].

Previous research on large cohorts, many derived from arthroplasty registers, has investigated the endpoint revision due to dislocation, not actual dislocations per se that are currently not reported to the large registers[9]. Thus, the investigation of cumulative dislocation rates in large cohorts has recently gained interest[10,11]. The evaluation of the true incidence of dislocation following elective THA, based on national available data, is more difficult to ascertain and relies on data that is not routinely available within arthroplasty registers. To study dislocation, arthroplasty register

Study carried out at the Swedish Arthroplasty Register, Gothenburg, Sweden.

data has to be linked with other sources of health administrative data in order to identify diagnostic or procedural codes that indicate THA dislocation[12-14]. Only recently has the NJR changed their minimal dataset to start recording the treatment of dislocations following THA (https://www.njrcentre.org.uk/healthcare-providers/update-of-njr-minimum-data-set-forms/).

The purpose of this study was to investigate the true dislocation cumulative incidence following elective THA performed through the two most commonly used surgical approaches in Sweden, and to investigate the association of bearing size and type, and of stem fixation with the risk of dislocation. The first research question was the cumulative incidence of dislocation after use of the different bearing sizes and types. The second research question was which patient- and surgery-related factors (bearing type and head size, age, sex, indication at time of primary surgery, Elixhauser comorbidity index (ECI), presence of neurological disease, presence of spinal disorder or surgical intervention and year of surgery) were associated with the risk of dislocation. The study was designed to stratify all analyse by approach since the approach per se is strongly associated with the outcome of interest[5].

MATERIALS AND METHODS

This observational, longitudinal cohort study used data from Swedish Arthroplasty Register (SAR) and the Swedish National Patient Register (NPR). We included patients operated with a unilateral elective THA from 1999 to 2014[12]. Patients were followed until 1st dislocation, revision, death, second THA of bilateral THA, or until the end of the study period (31/12/2015). The completeness for primary THA (98%) and revision THA (94%) and the full coverage has been reported in the 2014 annual report[15]. The flowchart depicting exclusion criteria is provided in Fig 1. Only patients with a lateral approach (as recorded by Gammer or Hardinge) or posterior approach were included. Missing data on approach, head size, articulation and indication for primary surgery were reasons for exclusion. Patients with a known and recorded hip arthroplasty prior to the study period were excluded from the study cohort to reduce potential issues with the undefined laterality of the dislocated THA. Patients were also censored at the time of revision or contralateral THA in the follow-up period for the same reason.

Exposure variables:

The exposure variables of interest were approach (posterior or lateral approach), and the final study cohort was stratified by approach. Subsequently the 2 cohorts were analysed using the 4 different bearing size and types (cTHA<32 = conventional THA with head size smaller than 32 mm, cTHA=32 = conventional THA with head size of 32 mm, cTHA>32 = conventional THA with head size bigger than 32 mm, DMC = dual mobility cup THA).

Outcome measures:

Dislocations using any potential diagnostic or procedural code from the NPR or the SAR, indicating

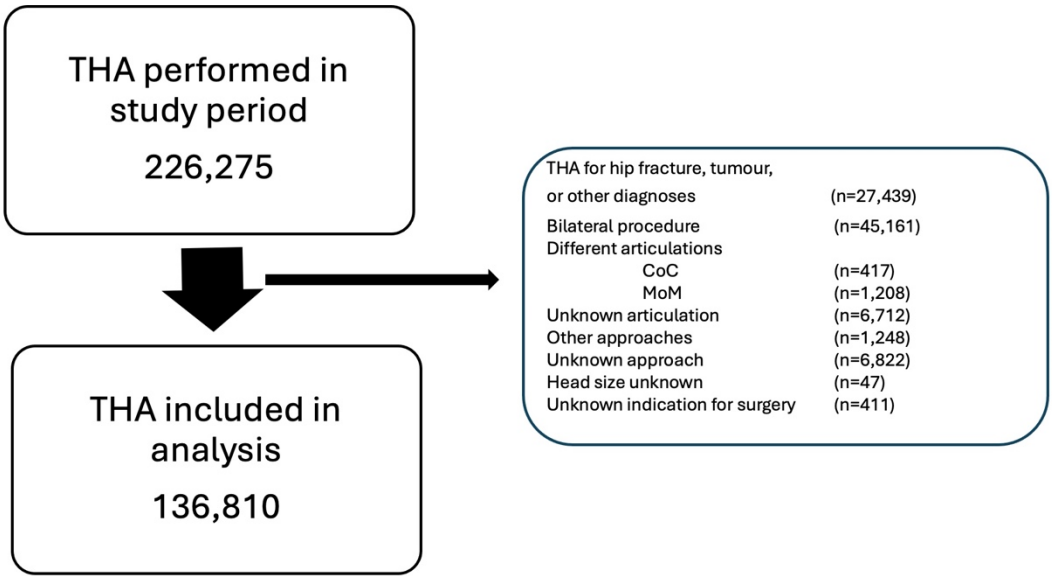

Fig. 1 — Flowchart of cases included in the final analysis. (THA =Total Hip Arthroplasty).

occurrence of a dislocation were identified. The ICD-10 codes (the International Classification of Diseases) used were M24.3-4, M24.4F, S73.0, T93.3[16]. All NFH-codes (Miscellaneous operations on the hip joint) in the NOMESCO system (Nordic Medico-Statistical Committee) indicating reduction manoeuvres of the hip (NFH00-NFH30, NFH40,NFH42, NFH70-NFH99) were used[17].

Confounders

As previous research has identified an association between dislocation and neurological disorders and spinal problems, we considered these as potential confounders[6,18-22]. Patients with preoperative neurological disorders or spinal problems were identified using procedural and diagnostic codes derived from the NPR. The Elixhauser comorbidity index (ECI) as a measure of comorbidity was calculated based on the registered diagnoses within the NPR in the year preceding the index surgery[23-27]. Additionally, age, sex, indication for primary surgery, and the mode of THA fixation were also considered confounders of interest.

Statistical analysis

The cumulative incidence of dislocations was estimated using the Kaplan-Meier method, giving the cumulative dislocation incidence at defined time points following the index procedure, following stratification by approach (posterior[28] and direct lateral approach[29,30]). Cox multivariable regression models were fitted to estimate the risk of dislocation associated with bearing type and head size, adjusting for age, sex, indication for surgery, mode of fixation, ECI, presence of neurological disease, presence of spinal disorder or surgical intervention, and year of surgery, expressed as hazard ratios (HR) with 95% confidence intervals (CI). R version 3.6.1 statistical software was used for analysis, and p values <0.05 were considered statistically significant. Log-log plots and Schoenfeld residuals were used to investigate whether the assumption of proportional hazards was fulfilled.

Ethical approval

Approval from the Regional Ethical Board in Gothenburg, Sweden (271-14 and 430-15) was received on 2014-04-09 and 2015-07-07. Patients are informed about registration in the SAR at the time of their arthroplasty procedure and have the possibility to decline participation. As the patient information also mentions that register data can be used in research, no further informed consent is necessary. The study adhered to the STROBE guidelines[31] and the Helsinki Declaration[32].

RESULTS

Of the entire study population of 136,810 patients, 77,013 (56.3%) were operated using a posterior approach. The majority of the patients received a fully cemented implant. During the study period, head sizes smaller than 32 mm were used for the majority of the cases; 89,608 (65.10%) patients had a conventional THA with head size smaller than 32 mm (cTHA<32). 40,930 (29.92%) had a conventional THA with head size of 32 mm (cTHA=32), conventional THA with head size bigger than 32 mm (cTHA>32) were used in 4,670 (3.41%) of the patients and dual mobility cup THA (DMC in 1,602 (1.17%) of the patients. The use of DMC and cTHA>32 occurred more frequently in the posterior approach group. The median follow-up was 4.70 years. Characteristics of the study population are presented in Table I.

1,042 patients in the lateral approach group suffered at least one dislocation during the study period, whilst 3,133 patients in the posterior approach group suffered one or more dislocations, giving a dislocation incidence at one year of 1.1% after use of direct lateral and of 2.3% after posterior approaches (Table II). The cumulative dislocation incidence, estimated using the Kaplan-Meier method, differed between the two approaches, with more dislocations in the posterior approach group (Figure 2).

When the cohort was stratified by approach in 2 groups (posterior and lateral group) (Figure 3,4) and a Kaplan-Meier analysis was performed giving the dislocation incidence following stratification by approach for the different bearing types and sizes (Table III).

Whilst cTHA>32 and DMC were associated with statistically significantly lower dislocation risk in the posterior approach group, this was not the case in the lateral approach group (Fig. 3 and 4). Male sex, other indications for primary THA than OA, pre-existing neurological disorder, pre-existing spinal problems and more comorbidity as per ECI were all associated with an increased risk of dislocation (Table IV).

DISCUSSION

This paper, based on register data, distinguished itself from previous register-based research, studying dislocations rather than revisions due to dislocation.

Table I. — Characteristics of the study population.

		Lateral	Posterior
Study group		59,797	77,013
Indication for primary surgery	Primary OA	53,549 (89.6)	69,202 (89.9)
	Secondary OA (unspecified)	1,878 (3.1)	3261 (4.2)
	Sequelae from childhood hip disorders	1,701 (2.8)	1,504 (2.0)
	Avascular necrosis femoral head	1,311 (2.2)	1,566 (2.0)
	Inflammatory joint disease	1,358 (2.3)	1,480 (1.9)
Sex	female	34,571 (57.8)	43,073 (55.9)
	male	25,226 (42.2)	33,940 (44.1)
Fixation	Cemented	42,523 (71.1)	60,136 (78.1)
	Hybrid	1,956 (3.3)	3,030 (3.9)
	Reverse hybrid	6,346 (10.6)	6,386 (8.3)
	Uncemented	8,972 (15.0)	7,461 (9.7)
Bearing type and size	cTHA<32	40,569 (67.8)	49,039 (63.7)
	cTHA=32	18,258 (30.5)	22,672 (29.4)
	cTHA>32	726 (1.2)	3,944 (5.1)
	DMC	244 (0.4)	1358 (1.8)
Year of surgery	1999-2000	2,530 (4.2)	3,898 (5.1)
	2001-2002	5,459 (9.1)	8,894 (11.5)
	2003-2004	6,623 (11.1)	9,884 (12.8)
	2005-2006	7,386 (12.4)	10,730 (13.9)
	2007-2008	8,313 (13.9)	10,021 (13.0)
	2009-2010	9,713 (16.2)	11,130 (14.5)
	2011-2012	9,931 (16.6)	11,093 (14.4)
	2013-2014	9,842 (16.5)	11,363 (14.8)
Preoperative diagnosis of neurological disorder	Yes	1,359 (2.3)	1,654 (2.1)
	No	58,440 (97.7)	75,359(97.9)
Preoperative diagnosis of spinal disorder	Yes	5,159 (8.6)	6,414 (8.3)
	No	52,638 (91.4)	70,599 (91.7)
Elixhauser index (mean) (SD)		0.56 (0.95)	0.60 (0.96)
Elixhauser category	0	39,182 (65.5)	48,054 (62.4)
	1	12,429 (20.8)	17,375 (22.6)
	2	5,186 (8.7)	7,541 (9.8)
	3	2,018 (3.4)	2,721 (3.5)
	4+	982 (1.6)	1322 (1.7)
Age (mean) (SD)		67.66 (10.83)	68.16 (10.55)
Age category	<55	6,638 (11.1)	7,755 (10.1)
	55-69	25,767 (43.1)	32,268 (41.9)
	70-84	25,003 (41.8)	34,035 (44.2)
	85+	2,389 (4.0)	2,955 (3.8)

OA=osteoarthritis, cTHA<32 =conventional THA with head size smaller than 32 mm, cTHA=32 = conventional THA with head size of 32 mm, cTHA>32 =conventional THA with head size bigger than 32 mm, DMC = dual mobility cup THA, SD=standard deviation.

The use of the posterior approach carried an increased risk of dislocation; however, this risk could be mitigated using bigger head sizes or DMC. The use of femoral heads<32mm was associated with an increased adjusted risk of dislocation in both the lateral and the posterior approach. Uncemented fixation of the THA was found to be associated with an increased risk of dislocation, irrespective of the approach.

The true dislocation incidence is difficult to ascertain in big cohort studies because of reporting problems. Currently, only a combination of data from national registers and other datasets such as national patient registers can provide these figures[7,8,10-12,14]. Previously data on dislocation could only be reliably assessed by experimental studies and randomized controlled trials. Our reported dislocation rate is lower than previously

Table II. — Dislocation incidence at different time intervals.

Time	Lateral	Posterior	All
30 days	0.7 (0.6 - 0.7)	1.1 (1 - 1.2)	0.9 (0.9 – 1.0)
90 days	0.9 (0.9 - 1)	1.7 (1.6 - 1.7)	1.3 (1.3 - 1.4)
1 years	1.1 (1.0 - 1.2)	2.3 (2.2 - 2.4)	1.8 (1.7 - 1.8)
2 years	1.3 (1.2 - 1.4)	2.8 (2.6 - 2.9)	2.1 (2.0 - 2.2)
3 years	1.4 (1.3 - 1.5)	3.2 (3 - 3.3)	2.4 (2.3 - 2.5)
4 years	1.6 (1.5 - 1.7)	3.5 (3.4 - 3.7)	2.7 (2.6 - 2.8)
5 years	1.7 (1.6 - 1.8)	3.9 (3.7 - 4)	2.9 (2.8 – 3.0)
10 years	2.4 (2.2 - 2.6)	5.7 (5.5 - 5.9)	4.3 (4.1 - 4.4)
15 years	3.7 (3.1 - 4.3)	7.5 (7.0 – 8.0)	5.9 (5.5 - 6.3)

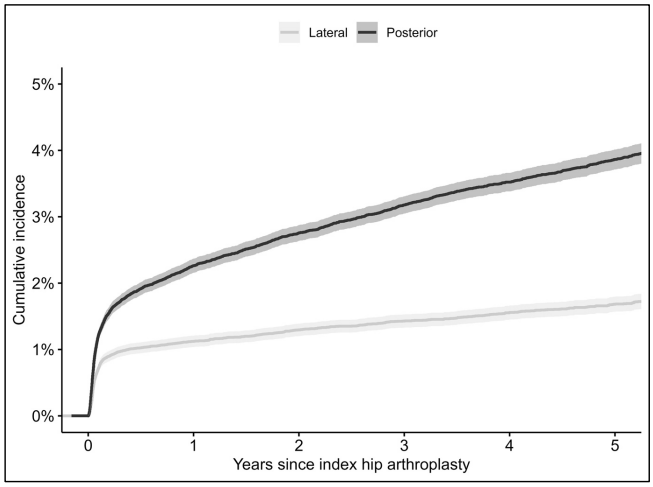

Fig. 2 — Cumulative dislocation incidence (%) using the Kaplan-Meier method with 95% confidence intervals and patients at risk for the cohort, stratified by surgical approach.

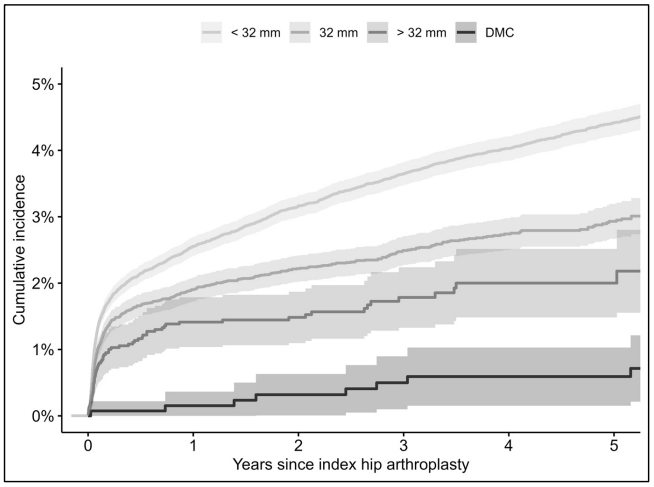

Fig. 3 — The cumulative dislocation incidence estimated by the Kaplan-Meier method, with 95% confidence intervals for the posterior approach cohort.

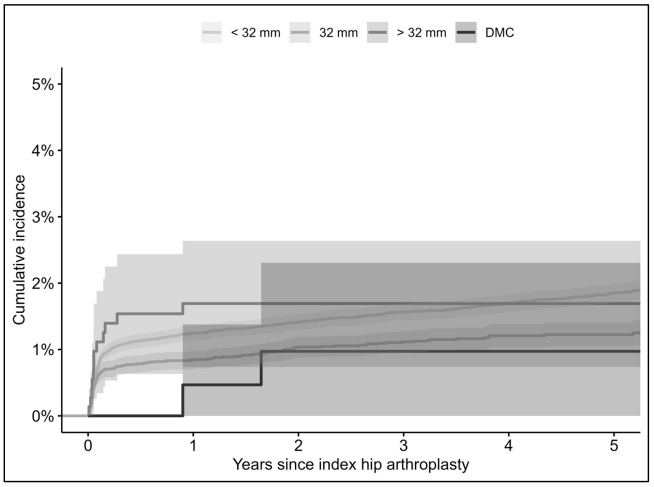

Fig. 4 — The cumulative dislocation incidence using Kaplan-Meier method with 95% confidence intervals for the lateral approach cohort.

published rates from a nationwide study and 3 large cohort studies[10,33-35]. The choice of approach might well be associated with the lower than published rates as in Denmark the preferred approach has been more predominantly posterior than in Sweden. The effect of the approach on dislocation has traditionally been in favour of the lateral approach however the capsular repair following the posterior approach has been

Table III. — Kaplan-Meier analysis providing the dislocation incidence following stratification by approach for the different bearing types and sizes.

	Posterior approach				Lateral approach			
Time	cTHA<32	cTHA=32	cTHA>32	DMC	cTHA<32	cTHA=32	cTHA=32	DMC
30 days	1.2 (1.2 - 1.3)	1 (0.8 - 1.1)	0.7 (0.4 - 1)	0.1 (0 - 0.2)	0.7 (0.6 - 0.8)	0.6 (0.5 - 0.7)	1.1 (0.3 - 1.9)	0.0 (0.0 – 0.0)
90 days	1.8 (1.7 - 2)	1.4 (1.3 - 1.6)	1 (0.7 - 1.3)	0.1 (0 - 0.2)	1.0 (0.9 - 1.1)	0.7 (0.6 - 0.8)	1.4 (0.5 - 2.3)	0.0 (0.0 – 0.0)
1 years	2.6 (2.4 - 2.7)	1.9 (1.7 - 2.1)	1.4 (1 - 1.8)	0.2 (0 - 0.4)	1.2 (1.1 - 1.3)	0.8 (0.7 – 1.0)	1.7 (0.7 - 2.6)	0.5 (0.0 - 1.4)
2 years	3.2 (3 - 3.3)	2.2 (2 - 2.4)	1.5 (1.1 - 1.9)	0.3 (0 - 0.6)	1.4 (1.3 - 1.5)	1.0 (0.9 - 1.2)	1.7 (0.7 - 2.6)	1.0 (0.0 - 2.3)
3 years	3.6 (3.5 - 3.8)	2.5 (2.3 - 2.7)	1.8 (1.3 - 2.2)	0.5 (0.1 - 0.9)	1.6 (1.4 - 1.7)	1.1 (1.0 - 1.3)	1.7 (0.7 - 2.6)	1.0 (0.0 - 2.3)
4 years	4 (3.8 - 4.2)	2.7 (2.5 - 3)	2 (1.5 - 2.5)	0.6 (0.2 - 1)	1.7 (1.6 - 1.8)	1.2 (1.0 - 1.4)	1.7 (0.7 - 2.6)	1.0 (0.0 - 2.3)
5 years	4.4 (4.2 - 4.6)	2.9 (2.7 - 3.2)	2 (1.5 - 2.5)	0.6 (0.2 - 1)	1.9 (1.7 – 2.0)	1.2 (1.0 - 1.4)	1.7 (0.7 - 2.6)	1.0 (0.0 - 2.3)

Table IV. — Cox regression, adjusted for relevant cofounders providing the hazard ratios following stratification by approach.

Unadjusted C-THA=32 (reference)	Lateral	p-value	Posterior	p-value
c-THA<32	1.45 (1.24-1.70)	<0.001	1.47 (1.34-1.61)	<0.001
c-THA>32	1.58 (0.88-2.84)	0.12	0.73 (0.57-0.94)	0.01
DMC	0.62 (0.15-2.49)	0.50	0.22 (0.12-0.42)	<0.001
Adjusted C-THA=32 (reference)	Lateral		Posterior	
c-THA<32	1.72 (1.43-2.07)	<0.001	1.34 (1.19-1.51)	<0.001
c-THA>32	1.28 (0.71-2.32)	0.41	0.64 (0.49-0.83)	<0.001
DMC	0.92 (0.22-3.88)	0.91	0.21 (0.11-0.41)	<0.001
age	1.01 (1.00-1.02)	0.03	1.02 (1.02-1.03)	<0.001
Male sex (female sex reference)	1.04 (0.92-1.18)	0.51	1.09 (1.01-1.17)	0.03
Diagnosis at primary THA (not OA) (primary OA reference)	1.46 (1.22-1.75)	<0.001	1.43 (1.29-1.6)	<0.001
Hybrid THA (cemented THA reference)	1.05 (0.74-1.51)	0.77	1.64 (1.32-2.02)	<0.001
Reverse Hybrid THA	0.96 (0.75-1.23)	0.74	0.74 (0.62-0.89)	0.001
Uncemented THA	1.59 (1.30-1.95)	<0.001	1.23 (1.04-1.46)	0.02
Pre-existing neurological disorder (no recorded pre-existing neurological disorder reference)	1.95 (1.45-2.61)	<0.001	1.85 (1.54-2.23)	<0.001
Pre-existing spinal problem (no recorded pre-existing spinal disorder reference)	1.40 (1.14-1.70)	0.001	1.70 (1.52-1.91)	<0.001
ECI=1 (ECI=0 reference)	1.37 (1.17-1.59)	<0.001	1.31 (1.21-1.43)	<0.001
ECI=2	1.58 (1.28-1.95)	<0.001	1.26 (1.11-1.42)	<0.001
ECI=3	1.98 (1.48-2.64)	<0.001	1.30 (1.08-1.57)	0.007
ECI=4 or >4	2.54 (1.77-3.64)	<0.001	1.97 (1.57-2.47)	<0.001
Year of surgery	1.01 (0.99-1.03)	0.31	0.97 (0.96-0.98)	<0.001
approach (OA=osteoarthritis, cTHA<32 =conventional THA with head size smaller than 32 mm, cTHA=32 = conventional THA with head size of 32 mm, cTHA>32 =conventional THA with head size bigger than 32 mm, DMC = dual mobility cup THA, SD=standard deviation, ECI =Elixhauser Comorbidity Index).				

associated with a reduction in risk of dislocation[36].

The effect of the head size and the effect of DMC on dislocation has been extensively described[37,38]. In our study the use of smaller heads was associated with an increased risk of dislocation in both approaches, however no clear benefit was associated with the use of DMC or head size >32mm using the lateral approach, whereas the use of bigger head sizes (>32mm) and DMC were associated with a lower risk compared to conventional cup with 32 mm head, and this is a new, previously un-described finding.

The relationship between mode of fixation and risk of dislocation has not been described previously to our knowledge. For both approaches, uncemented fixation entailed a higher dislocation risk compared to cemented. For the posterior approach, dislocation risk was higher for hybrids and lower for reverse hybrids than cemented THAs, which suggests the problem is cup-dependent. This relationship was not present

for the lateral approach. These findings do contrast the findings of Gillinov et al, who in their large US database study identified a higher risk for cemented implants[33]. However, in a Danish database study and a recent meta-analysis cemented fixation was associated with a reduced risk of dislocation[5,10].

This study has some strengths as the choice of approach might be influenced by reported and recorded confounders There has been an increased interest in the spinopelvic relationship and the association between spinal problems and dislocation[6,18]. Known preoperative spinal problems, identified by both diagnostic as well as procedural codes, were identified as an independent risk factor for dislocation in this study. An increased hazard ratio was identified, however was lower than the published data, likely because we included all back-related problems and interventions and not only fusions[18]. Further studies how to mitigate the increased risk in this group of patients is, based on these results and previous publications, warranted. There is an awareness that some patients might well have undergone spinal surgery or developed spinal problems post-surgery, and the effect of spinal surgery post THA on dislocation could not be studied using this approach. Neurological problems have previously been identified as a factor that is associated with dislocation following THA[19-22]. Our increased hazard ratio and the published higher dislocation rates in patients with neurological disorders emphasize the need for strict patient selection, shared decision-making and the use of surgical techniques that aid to reduce the instability post THA. Comorbidity as risk factor has been described by different research teams and increased comorbidity as reflected in ASA score and/or comorbidity index was associated with a higher risk of revision[5,10,33]. The indication for surgery has previously been associated with an increase in risk of dislocation, the findings of this research project support previous reported findings that the risk for dislocation is lower in patients operated for primary osteoarthritis (OA)[33]. Hermansen et al only reported the true cumulative incidence in patients with primary OA[10]. This observational cohort study is using prospectively collected data of a well-established national joint register with a high coverage and completeness and uses the well-recognised linkage process to analyse broader ranges of outcomes and an increased number of known covariables for statistical adjustment and potential more sound scientific results[12,14]. The use of both diagnostic codes (from the NPR) as well as procedural codes (from the NPR and SAR) to cover all the codes has been previously validated by a Danish research group[11].

This study has some limitations, both inherent to big database studies but also specific to this study, especially when the use of large databases within arthroplasty research is becoming more accepted for its merits and supports high-quality research, there needs to be an ongoing awareness of the pitfalls and the limitations[39-44]. Due to the absence of laterality in the NPR, bilateral procedures were excluded from the study. As 25% of the patients will have a contralateral THA within 10 years of the first procedure, quite a number of patients had to be excluded[45]. Further studies comparing dislocations in patients with a unilateral THA with bilateral THA could provide answers to the question on whether a second THA constitutes a risk for dislocation. Patient factors such as spinopelvic relationship and surgical factors such as the correction of offset, leg-length, centre of rotation implant position are important risk factors for dislocation, but unfortunately cannot be studied using register data. A previous article using data from the Swedish Hip Arthroplasty Register described a reduction if reoperation rate for dislocation, and as such could support the findings of this study that there was reduction in the number of patients with known dislocations in the later years of the study[46]. Whilst it is likely that the reason for the improvement could be multifactorial, which is certainly a positive development for both patients and healthcare providers, this would certainly benefit from some further investigation, especially as the study population consisted of patients operated between 1999 and 2014. Unfortunately, the same trend cannot be identified in the lateral approach group.

CONCLUSION

The results of this study would support the use of 32mm heads in the lateral approach and 36mm heads or dual mobility when using a posterior approach to confer a reduced risk of dislocation, however there might be a concern of a potential higher risk of all-cause revision.

REFERENCES

1. Sanchez-Sotelo J, Haidukewych GJ, Boberg CJ. Hospital Cost of Dislocation After Primary Total Hip Arthroplasty. JBJS. 2006;88(2):290-4.
2. Galvain T, Mantel J, Kakade O, Board TN. Treatment patterns and clinical and economic burden of hip dislocation following primary total hip arthroplasty in England. Bone Joint J. 2022;104-b(7):811-9.
3. Hermansen LL, Viberg B, Overgaard S. Patient-reported outcome after dislocation of primary total hip arthroplasties:

a cross-sectional study derived from the Danish Hip Arthroplasty Register. Acta Orthop. 2022;93:29-36.
4. Abdel MP, Cross MB, Yasen AT, Haddad FS. The functional and financial impact of isolated and recurrent dislocation after total hip arthroplasty. Bone Joint J. 2015;97-b(8):1046-9.
5. Kunutsor SK, Barrett MC, Beswick AD, Judge A, Blom AW, Wylde V, et al. Risk factors for dislocation after primary total hip replacement: a systematic review and meta-analysis of 125 studies involving approximately five million hip replacements. The Lancet Rheumatology. 2019;1(2):e111-e21.
6. Wright-Chisem J, Elbuluk AM, Mayman DJ, Jerabek SA, Sculco PK, Vigdorchik JM. The journey to preventing dislocation after total hip arthroplasty : how did we get here? Bone Joint J. 2022;104-b(1):8-11.
7. Cnudde PHJ, Nåtman J, Hailer NP, Rogmark C. Total, hemi, or dual-mobility arthroplasty for the treatment of femoral neck fractures in patients with neurological disease : analysis of 9,638 patients from the Swedish Hip Arthroplasty Register. Bone Joint J. 2022;104-b(1):134-41.
8. Rogmark C, Natman J, Jobory A, Hailer NP, Cnudde P. The association of surgical approach and bearing size and type with dislocation in total hip arthroplasty for acute hip fracture. Bone Joint J. 2022;104-B(7):844-51.
9. Devane PA, Wraighte PJ, Ong DC, Horne JG. Do joint registries report true rates of hip dislocation? Clin Orthop Relat Res. 2012;470(11):3003-6.
10. Hermansen LL, Viberg B, Hansen L, Overgaard S. "True" Cumulative Incidence of and Risk Factors for Hip Dislocation within 2 Years After Primary Total Hip Arthroplasty Due to Osteoarthritis: A Nationwide Population-Based Study from the Danish Hip Arthroplasty Register. The Journal of bone and joint surgery American volume. 2021;103(4):295-302.
11. Hermansen LL, Viberg B, Overgaard S. Development of a diagnostic algorithm identifying cases of dislocation after primary total hip arthroplasty-based on 31,762 patients from the Danish Hip Arthroplasty Register. Acta Orthop. 2021;92(2):137-42.
12. Cnudde P, Rolfson O, Nemes S, Karrholm J, Rehnberg C, Rogmark C, et al. Linking Swedish health data registers to establish a research database and a shared decision-making tool in hip replacement. BMC musculoskeletal disorders. 2016;17(1):414.
13. Sayers A, Ben-Shlomo Y, Blom AW, Steele F. Probabilistic record linkage. Int J Epidemiol. 2016;45(3):954-64.
14. Baker PN, Jeyapalan R, Jameson SS. The value of national arthroplasty registry data in 2023. Bone Joint J. 2023;105-B(4):356-60.
15. Swedish Hip Arthroplasty Register Annual Report 2014. Gothenburg, Sweden: Registercentrum Västra Götaland; 2015.
16. WHO. International Statistical Classification of Diseases and Related Health Problems, 10th Revision 2007 [Available from: http://www.who.int/classifications/apps/icd/icd10online/.
17. NOMESCO. NCSP – the NOMESCO Classification of Surgical Procedures 2008 [Available from: http://www.nordclass.uu.se/verksam/ncspe.htm.
18. Buckland AJ, Puvanesarajah V, Vigdorchik J, Schwarzkopf R, Jain A, Klineberg EO, et al. Dislocation of a primary total hip arthroplasty is more common in patients with a lumbar spinal fusion. Bone Joint J. 2017;99-B(5):585-91.
19. O'Driscoll CS, Hughes AJ, Davey MS, Queally JM, O'Daly BJ. Total Hip Arthroplasty in Patients With Neurological Conditions: A Systematic Review. Arthroplast Today. 2023;19:101068.
20. Queally JM, Abdulkarim a, Mulhall KJ. Total hip replacement in patients with neurological conditions. The Journal of bone and joint surgery British volume. 2009;91(10):1267-73.
21. Hernigou P, Barbier O, Chenaie P. Hip arthroplasty dislocation risk calculator: evaluation of one million primary implants and twenty-five thousand dislocations with deep learning artificial intelligence in a systematic review of reviews. Int Orthop. 2023;47(2):557-71.
22. Wyles CC, Maradit-Kremers H, Larson DR, Lewallen DG, Taunton MJ, Trousdale RT, et al. Creation of a Total Hip Arthroplasty Patient-Specific Dislocation Risk Calculator. The Journal of bone and joint surgery American volume. 2022;104(12):1068-80.
23. Mehta HB, Dimou F, Adhikari D, Tamirisa NP, Sieloff E, Williams TP, et al. Comparison of Comorbidity Scores in Predicting Surgical Outcomes. Medical care. 2016;54(2):180-7.
24. Inacio MC, Pratt NL, Roughead EE, Graves SE. Comparing co-morbidities in total joint arthroplasty patients using the RxRisk-V, Elixhauser, and Charlson Measures: a cross-sectional evaluation. BMC musculoskeletal disorders. 2015;16(1):385.
25. Sharabiani MT, Aylin P, Bottle A. Systematic review of comorbidity indices for administrative data. Medical care. 2012;50(12):1109-18.
26. Quan H, Sundararajan V, Halfon P, Fong A, Burnand B, Luthi JC, et al. Coding algorithms for defining comorbidities in ICD-9-CM and ICD-10 administrative data. Medical care. 2005;43(11):1130-9.
27. Elixhauser A, Steiner C, Harris DR, Coffey RM. Comorbidity measures for use with administrative data. Medical care. 1998;36(1):8-27.
28. Moore AT. The self-locking metal hip prosthesis. J Bone Joint Surg Am. 1957;39-A(4):811-27.
29. Hardinge K. The direct lateral approach to the hip. J Bone Joint Surg Br. 1982;64(1):17-9.
30. Gammer W. A modified lateroanterior approach in operations for hip arthroplasty. Clin Orthop Relat Res. 1985(199):169-72.
31. von Elm E, Altman DG, Egger M, Pocock SJ, Gotzsche PC, Vandenbroucke JP, et al. The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. Lancet (London, England). 2007;370(9596):1453-7.
32. World Medical Association. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. JAMA. 2013;310(20):2191-4.
33. Gillinov SM, Joo PY, Zhu JR, Moran J, Rubin LE, Grauer JN. Incidence, Timing, and Predictors of Hip Dislocation After Primary Total Hip Arthroplasty for Osteoarthritis. J Am Acad Orthop Surg. 2022;30(21):1047-53.
34. Sirignano MN, Nessler JM, Rhea EB, Ong KL, Watson HN, Yakkanti MR, et al. Incidence of Instability Following Primary Total Hip Arthroplasty Continues to Decline in the Medicare Population. The Journal of Arthroplasty. 2023;38(7, Supplement):S89-S94.e1.
35. Malkani AL, Ong KL, Lau E, Kurtz SM, Justice BJ, Manley MT. Early- and Late-Term Dislocation Risk After Primary Hip Arthroplasty in the Medicare Population. The Journal of Arthroplasty. 2010;25(6, Supplement):21-5.
36. Kwon MS, Kuskowski M, Mulhall KJ, Macaulay W, Brown TE, Saleh KJ. Does surgical approach affect total hip arthroplasty dislocation rates? Clin Orthop Relat Res. 2006;447:34-8.
37. Berry DJ, von Knoch M, Schleck CD, Harmsen WS. Effect of femoral head diameter and operative approach on risk of dislocation after primary total hip arthroplasty. The Journal of bone and joint surgery American volume. 2005;87(11):2456-63.
38. Bartz RL, Nobel PC, Kadakia NR, Tullos HS. The effect of femoral component head size on posterior dislocation of the artificial hip joint. The Journal of bone and joint surgery American volume. 2000;82(9):1300-7.
39. Browne JA, Springer B, Spindler KP. Optimizing Use of Large Databases in Joint Arthroplasty and Orthopaedics. The Journal of bone and joint surgery American volume. 2022;104(Suppl 3):28-32.

40. Troelsen A, Haddad FS. The problem is not necessarily the data, it is the interpretation. Bone Joint J. 2019;101-B(10):1177-8.
41. Konan S, Haddad FS. Joint Registries: a Ptolemaic model of data interpretation? Bone Joint J. 2013;95-B(12):1585-6.
42. Patel AA, Singh K, Nunley RM, Minhas SV. Administrative Databases in Orthopaedic Research: Pearls and Pitfalls of Big Data. J Am Acad Orthop Surg. 2016;24(3):172-9.
43. Pugely AJ, Martin CT, Harwood J, Ong KL, Bozic KJ, Callaghan JJ. Database and Registry Research in Orthopaedic Surgery: Part 2: Clinical Registry Data. The Journal of bone and joint surgery American volume. 2015;97(21):1799-808.
44. Pugely AJ, Martin CT, Harwood J, Ong KL, Bozic KJ, Callaghan JJ. Database and Registry Research in Orthopaedic Surgery: Part I: Claims-Based Data. The Journal of bone and joint surgery American volume. 2015;97(15):1278-87.
45. Cnudde PHJ, Nemes S, Bulow E, Timperley AJ, Whitehouse SL, Karrholm J, et al. Risk of further surgery on the same or opposite side and mortality after primary total hip arthroplasty: A multi-state analysis of 133,654 patients from the Swedish Hip Arthroplasty Register. Acta Orthop. 2018;89(4):386-93.
46. Skoogh O, Tsikandylakis G, Mohaddes M, Nemes S, Odin D, Grant P, et al. Contemporary posterior surgical approach in total hip replacement: still more reoperations due to dislocation compared with direct lateral approach? An observational study of the Swedish Hip Arthroplasty Register including 156,979 hips. Acta Orthop. 2019;90(5):411-6.