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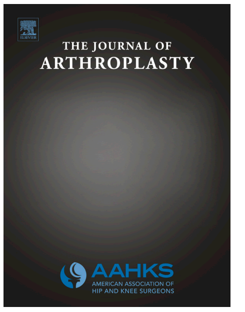

Is outcome of total hip arthroplasty for hip fracture inferior to that of arthritis in a contemporary arthroplasty practice?

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Title page

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Is outcome of total hip arthroplasty for hip fracture inferior to that of arthritis in a contemporary arthroplasty practice?

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Is outcome of total hip arthroplasty for hip fracture inferior to that of arthritis in a contemporary arthroplasty practice?

Abstract

Introduction

Outcome of total hip arthroplasty (THA) for femoral neck fractures (FNF) has been associated with higher complication rates. However, THA for FNF is not always performed by arthroplasty-surgeons. This study aimed to compare THA outcomes for FNF to osteoarthritis (OA). In doing so, we described contemporary THA failure modes for FNF performed by arthroplasty surgeons.

Methods

This was a retrospective, multi-surgeon study from an academic center. Of FNF treated between 2010 and 2020, 177 received THA by an arthroplasty-surgeon [mean age 67 years (range, 42 to 97), sex: 64.4% women]. These were matched (1:2) for age and sex with 354 THAs performed for hip OA, by the same surgeons. No dual-mobilities were used. Outcomes included radiologic measurements (inclination/anteversion and leg-length), mortality, complications, reoperation rates and patient-reported outcomes including Oxford Hip Score (OHS).

Results

Post-operative mean leg-length difference was 0 millimeters (mm) (range, -10 to -10 mm), with a mean cup inclination and anteversion of 41 and 26° respectively. There was no difference in radiological measurements between FNF and OA patients (p=0.3). At 5 years follow-up, mortality rate was significantly higher in the FNF-THA compared to the OA-THA group (15.3 vs. 1.1%; p<0.001). There was no difference in complications (7.3 vs. 4.2%; p=0.098) or reoperation rates (5.1 vs. 2.9%; p=0.142) between groups. Dislocation rate was 1.7%. OHS at final follow-up was similar [43.7 points (range, 10 to 48) vs. 43.6 points (range, 10 to 48); p=0.030].

Conclusion

Total hip arthroplasty for the treatment of FNF is a reliable option and is associated with satisfactory outcomes. Instability was not a common reason of failure, despite not using dual-mobility articulations in this at-risk population. This is likely due to THAs being performed by the arthroplasty staff. When patients live beyond 2-years, similar clinical and radiographic outcomes with low rates of revision can be expected, comparable to elective THA for OA.

Level of evidence: III, case-control study

Key words: Total hip arthroplasty, anterior approach, femoral neck fracture, outcome, complications

Introduction

Hip fractures are a leading cause of death and disability worldwide [1]. With demographic projections estimating annual global incidence of hip fractures to increase from 1.26 million in 1990 to 4.5 million by 2050 [2, 3], this will impose major demands on healthcare systems worldwide. Therefore, optimizing Hip Fracture Care pathways to improve outcome and reduce reoperation and revision rates is a topic of great importance.

The mainstay treatment of displaced femoral neck fractures (FNF) is hip arthroplasty. The Clinical Practice Guidelines (CPG) of the American Academy of Orthopaedic Surgeons (AAOS) indicated moderate evidence to support total hip arthroplasty (THA) over hemiarthroplasty (HA) in higher functioning, physiologically younger patients who have FNF [4]. With studies emphasizing the functional advantages of THA over HA [5, 6] and the fact that conversion of HA to THA in patients who develop a painful HA is associated with increased risk of subsequent complications [7, 8], there has been a growing trend in the use of THA for the initial treatment of FNF in higher demand patients [9].

Outcome of THA for FNF has traditionally been considered inferior to outcome following elective THA for degenerative conditions, using registry-data [10-12]. However, THA for FNF is not always performed by arthroplasty surgeons, which may, in-part, explain these inferior outcomes. To-date, no studies have assessed for differences in outcome between THA for FNF and THA performed for non-traumatic arthritis in contemporary arthroplasty practice.

This study aimed to compare clinical and patient-reported outcome of THA for FNF **at a mean of 5 years follow-up,** to that of THA performed for hip osteoarthritis (OA), based on radiographic outcome, complication, and reoperation rates, as well as patient-reported outcome measures. In doing so, we described contemporary failure modes of THAs for hip fracture performed by arthroplasty surgeons.

Methods

Study design

This was a retrospective, multi-surgeon, case-matched cohort study at a single academic tertiary referral center. The study was approved by the Institutional Review Board.

An *a priori* sample size calculation was performed in SPSS Statistics version 28 (IBM Corp, New York, United States). Based on a dislocation risk of 0.5% among THA for hip OA [13] versus 5.0% among THA for FNF [14], with an enrolment ratio 1:2, a minimum of 168 cases in the FNF group and 336 in the OA group was needed to achieve sufficient power ($1\text{-}\beta=0.80$, $\alpha=0.05$).

Study population

We enquired the institute's hip fracture database to identify consecutive patients who were treated with primary THA between January 1, 2010 and August 31, 2020 by using procedural codes for an isolated displaced FNF (Garden III and IV). Of 197 THAs for hip fracture, 20 were excluded as they were not operated by a fellowship-trained arthroplasty surgeon, leaving 177 THAs for inclusion with a minimum follow-up of 2 years.

To compare outcome between THA FNF and OA, we retrieved prospectively collected data from our institutional arthroplasty database of patients who underwent primary, elective THA between January 1, 2018 and October 31, 2020 (n=901). Patients who had an indication other than OA (n=31), who underwent THA following failure of previous hip surgery (n=8), or received a THA from a non-fellowship trained arthroplasty surgeon (n=17) were excluded for the purpose of the study.

To minimize variability and balance cohorts with respect to baseline characteristics, the 177 THA (160 patients) for FNF were matched for age and sex in a 1:2 fashion with 354 THA (351 patients) performed for OA (Figure 1).

The mean age of the cohort was 67 years (range, 42 to 97 years). There were 342 women (64.4%) and 189 men (35.6%), who had a mean BMI of 28 (range, 18 to 52) (Table 1).

Surgical Procedures

Patients who had FNF were on average, treated within 2 days of admission (range**,** 1 **to** 9 days). All patients received preoperative antibiotics and 1 gram of intravenous tranexamic acid. Decision to use a general or spinal anesthetic reflected the anesthesiologist judgment on patient suitability for a spinal.

Most of the THAs were conducted through anterior approach (n=395; 74%), the remaining were performed with the posterior approach (n=107; 20%), and a small minority through the lateral approach (n=29; 6%). All surgeons were fellowship-trained and/or had a minimum of 10-years experience with the anterior approach [15]. Anterior approach was performed with the patient in the supine position on a standard operating table (n=166) or using a positioning table (n=221); through a horizontal 'bikini' incision (n=66), or a longitudinal incision (n=321) [16, 17].

Most commonly used acetabular implants were G7® cup (Zimmer-Biomet, Warsaw, Indiana, United States) in 476 cases and Trident® cup (Stryker, Kalamazoo, Michigan, United States) in 22 cases. Most used femoral stems were Taperloc Microplasty® (Zimmer-Biomet) (n=344), Taperloc Complete® (Zimmer-Biomet) (n=79), and Sirius® (Zimmer-Biomet) (n=52). There were 67 stems (13%) cemented and 464 stems (87%) uncemented. There was no difference in use of cemented implants between cohorts (p=0.065). The majority were 32-millimeter (mm) (38%) and 36-mm

(57%) heads, with no difference between cohorts (*p*=0.145). No dual-mobility components were used.

A standardized postoperative protocol was followed in all patients, allowing immediate full weight bearing. All patients were assessed by physiotherapy before hospital discharge. Routine, 30-day deep venous thrombosis prophylaxis was used in all cases. Patients were reviewed clinically at 2-weeks, 6-weeks, 6-months, 12-months, and annually thereafter.

Radiographic measurements

Radiographic assessments were done based on an antero-posterior (AP) pelvic radiographs at 1 year postoperatively. Radiographic measurements were performed by two fellowship-trained arthroplasty surgeons (JV and GG) using Picture Archiving Communication System (PACS) (Change Healthcare, Nashville, United States) and Ein-Bild-Röntgen-Analyse (EBRA-cup®) (University of Innsbruck, Innsbruck, Austria). Leg length discrepancy (LLD) [18], acetabular cup inclination and anteversion [19] were measured. The optimum cup orientation was defined as 40±10° inclination and 20±10° anteversion [20]. Average-measure correlation coefficients with a two-way random effects model for absolute agreement were calculated, showing excellent intra- and inter-observer reliabilities for radiographic measurements [range, 0.901 (95% Confidence Interval (CI); 0.705–0.969) to 0.932 (95 % CI; 0.796–0.979)].

Clinical outcome measurements

Outcome measures included surgical-related intraoperative and postoperative complications, and reoperations. The Clavien-Dindo classification was used to grade complications [21]. Grade 1 complications needed no treatment. Grade 2 complications required pharmacologic treatment, including superficial wound infections treated with antibiotics. Grade 3 complications resulted in reoperation, including dislocation, instability, infection, fracture or aseptic loosening. Grade 4 complication were potentially life-threatening complications, and grade 5 complications resulted in death.

Length of follow-up was determined from the date of surgery to the last clinical review or time of revision or death [22].

Patient-reported outcome measures (PROMs) were obtained preoperatively (for OA patients only) and at minimum 12 months postoperatively for all patients. These included Oxford Hip Score (OHS) [23] (0-48 points; worse to best) and EuroQoL Five Dimensions Questionnaire [24] (-0.594 to 1.000 points; worse to best). The difference between latest follow-up and pre-operative values was defined as change; the meaningful clinically important difference (MCID) of OHS is 5 points [25].

Among alive patients by follow-up, PROM scores could be obtained for 89% of patients treated for OA (311 of 350), compared to 56% of patients treated for FNF (84 of 150) (*p*<0.001).

Data analyses

Statistical analyses were performed using SPSS v28 (**IBM Corp, New York, United States**). Normal distribution of data was tested with Kolmogorov-Smirnov tests and Q-Q plots, showing no normal distribution of data. Mann Whitney-*U* or Kruskal-Wallis tests were used to compare continuous variables, and *Chi* Square tests to compare categorical variables. Survival data were obtained by Kaplan-Meier analyses[26]. A *p*-value of <0.05 was considered to indicate statistical significance.

Results

Radiographic assessment

Mean post-operative leg-length difference was 0 mm (range, -10 to 10) with a mean cup inclination of 41° (range, 14 to 58°) and anteversion of 26° (range, 3 to 60°), and 57% of cups were optimally positioned (Table 2). There was no difference in cup orientation between groups [inclination: 42° (range, 14 to 58°) vs. 41° (range, 21 to 58°); p=0.330 and anteversion: 26° (range, 3 to 60°) vs. 26° (range, 7 to 42°); p=0.337], nor in chances of being within orientation target (52 vs. 62%; p=0.084) (Figure 2).

Complications and reoperations

The 1-year mortality rate was 4.0% in the FNF-THA group and 0% in the OA-THA group (p<0.001). The 5-year mortality rate was 15.3% in the FNF-THA group and 1.1% in the OA-THA group (p<0.001) (Figure 3).

A higher rate of intra-operative fractures was seen in the FNF-THA group (1.7 vs. 0.0%; p<0.001). All fractures occurred with uncemented femoral implants.

At a mean follow-up of 4.6 years (range, 2 to 14 years), the overall rate of any complication was 5.3% (28 of 531). Clavien-Dindo grade 3 complications were seen in 3.6% (1 of /531), and 3.2% implants were revised (17 of 531). Indications for revision included peri-prosthetic fracture (8 of 531; 1.5%), instability (4 of 531; 0.8%) and peri-prosthetic joint infection (PJI) (5 of 531; 0.9%) (Table 3). There was no difference in complication- (7.3 vs. 4.2%; p=0.098) or reoperation rates (5.1 vs. 2.9%; p=0.142) between THA for FNF or OA, nor was there a difference in complication- or reoperation rates per surgical approach (Table 4).

For endpoint implant revision, a survival of 98% among OA-THA vs. 97% among FNF-THA was found at 5-year follow-up using Kaplan-Meier (log rank *p*=0.86) (Figure 3).

Patient-reported outcome measures

PROMs were similar between groups (Table 5). The mean EQ5D was 0.805 points (range, -0.331 to 1.000) in FNF-THA patients and 0.804 points (range, -0.358 to 1.000) for OA-THA patients (*p*=0.151). OHS was FNF patients was 43.7 points (range, 10.0 to 48.0) for FNF-THA patients and 43.6 points (range, 10.0 to 48.0) for OA-THA patients (*p*=0.030). Among patients treated for OA, the mean change in OHS was 24.0 points (range, -2.0 to 44.0), with 96.5% of patients reaching a MCID compared to pre-operatively (Table 5). There was no difference in OHS between anterior and posterior approach in the FNF-THA group [44.5 points (range, 15.0 to 48.0) vs. 44.4 points (range, 10.0 to 48.0); *p*=0.485] or OA [43.7 points (range, 10.0 to 48.0) vs. 43.0 points (range, 30.0 to 48.0); *p*=0.135). Patients who underwent THA for FNF treated through a lateral approach had the worst OHS scores at final follow-up [mean 36.3 points (range, 22.0 to 48.0)] (*p*=0.014) (Table 4 and Figure 4).

Discussion

This case-control study showed that THA for femoral neck fracture (FNF) is safe and effective when conducted by arthroplasty surgeons, with surgical outcomes comparable to those of patients treated with THA for hip osteoarthritis (OA). However, mortality among patients who had FNF remains high, despite being operated by arthroplasty surgeons, with 15% mortality at 5-years follow-up, reflecting FNF patients' lower physiological reserve [27-30]. Among FNF patients, complication- and reoperation- rates were 7.3 and 5.1% respectively. Complication- and reoperation-rates were similar to a matched group of OA patients treated with THA, except for intra-operative femoral calcar or greater trochanter fractures, which were more common among patients with FNF (2.8%), as fractures were associated with the use of uncemented femoral implants. They are likely preventable with change of implant fixation of choice in line with national recommendations [31]. Instability was uncommon (1.7%) and compared favourably to the literature [14] despite not using dual-mobility articulations. PROM scores at final follow-up were similar in both groups, further illustrating the efficacy of THA for FNF patients. The lateral approach was associated with significantly worse outcome, compared to other approaches and thus national recommendations might not be applicable for THA by arthroplasty surgeons, who are likely to achieve better results utilizing the approach they are most comfortable with.

Previously, large registry databases such as the National Surgical Quality Improvement Program (NSQIP) [10, 12, 32] and the National Hospital Discharge Survey [33] have shown significantly higher rates of 30-day mortality (1.8 vs. 0.3%), re-admission (7.3 vs. 5.5%), complication (24.2 vs. 19.0%), and reoperation (3.7 vs. 2.7%) rates among patients treated with THA for FNF [10]. However, other prospective case-control studies using PROM scores have showed comparable functional outcomes and satisfaction between FNF and OA patients treated with THA [34, 35]. Mortality at 1- and 5-year follow-up was higher among patients who had FNF (4.0 and 15.3%), reflecting the frailty of the patient population with significantly higher ASA grades. A higher incidence of peri-prosthetic fractures was seen in the FNF-THA group. This is likely to be associated with the use of uncemented implants, which has been shown to be associated with increased peri-prosthetic fracture risk, compared to cemented fixation in this group of patients, even among arthroplasty surgeons [36-40]. In recent years, a change in practice has occurred in our center in accordance with national and international guidelines, which should reduce the incidence of peri-prosthetic fractures reported in this cohort. Whereas, surgeon volume and experience is not associated with early outcome and complication rates following hip hemiarthroplasty [41], surgeon volume does impact outcome and complication rates in THA [42, 43]. Trauma surgeons were found to have a higher rate of major complications (e.g., dislocation, deep infection, loosening, fracture) compared to arthroplasty surgeons, and decreased accuracy of THA component positioning [44].

Outcome of THA for the treatment of FNF has been associated with increased instability and revision risk compared to other indications [10-12]. Although no statistical differences were identified, similar trends were seen in this cohort, with a higher rate of dislocation (1.7 vs. 0.3%) compared to the controls. Our dislocation rate of 1.7% compared well to those described in the literature (1.4 to 4.7%) [14, 45-48], despite not using dual-mobility articulations. The high dislocation risk among FNF patients, has led to a growing interest for dual-mobility THA as an alternative to conventional, single-bearing THA, with some studies suggesting improved stability and decreased risk of dislocation [45, 49, 50]. In a recent meta-analysis using data from six registries, no difference was found in revision risk between dual-mobility and conventional THA for FNF at 5-years. While a lower proportion of dual-mobility THA were revised for dislocation (0.9 versus 1.4%), a higher proportion were revised for infection (1.2 versus 0.8%) [51]. Other potential disadvantages include possibility of increased polyethylene wear as well as intra-prosthetic dislocation [52, 53]. In addition, dual-mobility components come at an increase cost, although a recent study showed that dual-mobility THA for FNF may be cost-effective compared to single-bearing THA in patients aged under 80 years [54]. Until the results from the DISTINCT [55] and DUALITY [56] trials are published, it remains unclear if routine use of dual-mobility THA is justified.

Most guidelines recommend a lateral approach for all types of hip arthroplasty following FNF, instead of the posterior approach, to decrease the risk of dislocation [31]. However, in this study, the lateral approach was associated with a higher risk of intra-operative fractures, post-operative complications and reoperations, as well as worse PROM scores. No difference in outcome was found between anterior and posterior approaches in the FNF-THA group. The anterior approach has been criticized because of its technical difficulty and associated learning curve, inducing risk of complications [57]. But if conducted by arthroplasty fellowship-trained surgeons, the anterior approach may yield certain advantages, including minimal muscle damage and faster recovery [58, 59] and a lower risk of dislocations [60], which may be of particular value in FNF patients. Prospective, randomized controlled trials are necessary to confirm these findings.

This study was not without potential limitations. This was a retrospective, multi-surgeon, study and thus suffers from associated biases. Thus, no standardized criteria for choosing which patients should receive a THA, other than the recommended guidelines set forth by the AAOS were used – which might have lead to selection bias [4]. Also, although sufficiently powered as per available literature, with contemporary techniques, the incidence of complications has reduced and thus a larger cohort might have led to statistical significance in the trends identified and explored above. However, although the study population was relatively small, this study is the largest series to date to compare clinical and patient reported outcomes of THA for FNF to elective THA for OA **at a mean of 5 years follow-up**. Moreover, difference existed between cohorts in terms of approach and ASA which might have also contributed to selection bias. However, the AA has not been shown to be superior to other approaches in elective THA, nor in the setting of FNF [61, 62].

Conclusion

Despite high-volume arthroplasty surgeons treating FNF patients, a higher rate of mortality and intra-operative fractures occurred. When patients live beyond 2-years, similar clinical and radiographic outcomes with low rates of revision can be expected, comparable to elective THA for OA. Instability was not a common reason of failure and the risk was low despite not using dual-mobility articulations. Future prospective studies are necessary to determine the cost-effectiveness of streamlining THA for FNF to arthroplasty surgeons compared to less experienced surgeons.

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Legend of figures

Figure 1. Flowchart of the inclusion process of the study

Figure 2. Acetabular cup positioning in patients treated with total hip arthroplasty (THA) for osteoarthritis (blue) or femoral neck fracture (red)

Figure 3. Kaplan-Meier survival analysis (blue: THA for osteoarthritis; red: THA for femoral neck fracture)

Figure 4. Boxplot comparing Oxford Hip Score (OHS) at final follow-up between different approaches for patients treated with Total Hip Arthroplasty for Femoral Neck Fracture (FNF) and Osteoarthritis (OA)

Table 1. Demographics of the cohort

Parameter	Whole cohort (n=531)	Study group (n=177) THA for FNF[a]	Control group (n=354) THA for OA[b]	*p*-value
Age (years) [mean (range)]	67 (42-97)	67 (43-97)	67 (42-96)	0.771†
Sex				1.000‡
Women (n, %)	342 (64.4)	114 (64.4)	228 (64.4)	
Men (n, %)	189 (35.6)	63 (35.6)	126 (35.6)	
BMI[c] (kg/m^2) [mean (range)]	28 (18-52)	28 (18-52)	26 (19-42)	0.042†*
Follow-up (years) [mean (range)]	4.6 (2.3-14.1)	5.2 (2.3-14.1)	4.4 (3.1-5.9)	0.405†
ASA-score[d]				<0.001‡*
ASA I (n, %)	22 (4.1)	9 (5.1)	13 (3.7)	
ASA II (n, %)	227 (42.7)	51 (28.8)	176 (49.7)	
ASA III (n, %)	234 (49.7)	107 (60.5)	157 (44.4)	
ASA IV (n, %)	18 (3.4)	10 (5.6)	8 (2.3)	
Approach				<0.001‡*
Anterior (n, %)	395 (74.4)	88 (49.7)	307 (86.7)	
Lateral (n, %)	29 (5.5)	29 (16.4)	0 (0.0)	
Posterior (n, %)	107 (20.2)	60 (33.9)	47 (13.3)	
Cement implants				0.065‡
Cemented (n, %)	67 (12.6)	29 (16.4)	38 (10.7)	
Cementless (n, %)	464 (87.4)	148 (83.6)	316 (89.3)	

[a] THA for FNF: Total Hip Arthroplasty for Femoral Neck Fracture
[b] THA for OA: Total Hip Arthroplasty for Osteoarthritis
[c] BMI: Body Mass Index
[d] ASA: American Society Anaesthesiologists score
† Mann Whitney *U* test
‡ *Chi*-Square test
* Statistically significant (*p*-value<0.05)

Table 2. Radiographic measurements among patients treated with total hip arthroplasty (THA) for femoral neck fracture (FNF) or osteoarthritis (OA)

Parameter	Whole cohort (n=531)	Study group (n=177) THA for FNF	Control group (n=354) THA for OA	*p*-value
Leg Length difference (mm) [mean (range)]	0 (-10-10)	0 (-10-10)	0 (-10-8)	0.141†
Cup inclination (°) [mean (range)]	41 (14-58)	42 (14-58)	41 (21-58)	0.330†
Cup anteversion (°) [mean (range)]	26 (3-60)	26 (3-60)	26 (7-42)	0.337†
Cup within target zone (%)	57	52	62	0.084‡

† Mann Whitney *U* test

‡ *Chi*-Square test

* Statistically significant (*p*-value<0.05)

Table 3. Complication and reoperation rate among patients treated with total hip arthroplasty (THA) for femoral neck fracture (FNF) or osteoarthritis (OA)

Complication type	Whole cohort (n=531)	Study group (n=177) THA for FNF	Control group (n=354) THA for OA	*p*-value
Intraoperative fractures	**9 (1.7)**	**9 (1.7)**	**0 (0.0)**	**<0.001**‡*
Calcar	6 (1.1)	6 (1.1)	0 (0.0)	0.037‡*
Greater trochanter	3 (0.6)	3 (0.6)	0 (0.0)	0.001‡*
Grade 1	**4 (0.8)**	**1 (0.6)**	**3 (0.8)**	**0.593**‡
Hematoma	4 (0.8)	1 (0.6)	3 (0.8)	0.593‡
Grade 2	**5 (0.9)**	**3 (1.7)**	**2 (0.6)**	**0.209**‡
Periprosthetic fracture (conservative)	1 (0.2)	1 (0.6)	0 (0.0)	0.333‡
Persistent wound leakage (antibiotics)	4 (0.8)	2 (1.1)	2 (0.6)	0.407‡
Grade 3 (reoperation)	**2 (0.4)**	**0 (0.0)**	**2 (0.6)**	**0.444**‡
Persistent wound leakage (debridement)	1 (0.2)	0 (0.0)	1 (0.3)	0.667‡
Psoas tendinopathy (psoas release)	1 (0.2)	0 (0.0)	1 (0.3)	0.667‡
Grade 3 (revision)	**17 (3.2)**	**9 (5.1)**	**8 (2.3)**	**0.081**†
Instability	4 (0.8)	3 (1.7)	1 (0.3)	0.110‡
Periprosthetic fracture (revision)	8 (1.5)	5 (2.8)	3 (0.8)	0.086‡
Periprosthetic joint infection	5 (0.9)	1 (0.6)	4 (1.1)	0.460‡

† *Chi*-Square test

‡ Fisher's exact test

* Statistically significant (*p*-value<0.05)

Table 4. Complication and reoperation rate per approach for total hip arthroplasty (THA) for femoral neck fracture (FNF) or osteoarthritis (OA)

	THA for FNF				**THA for OA**			
	Anterior	**Lateral**	**Posterior**	***p*-value**	**Anterior**	**Lateral**	**Posterior**	***p*-value**
Overall complication rate (n, %)	6 (6.8)	4 (13.8)	3 (5.0)	0.318†	13 (4.2)	-	2 (4.3)	0.616†
Overall reoperation rate (n, %)	4 (4.5)	4 (13.8)	1 (1.7)	0.048†*	8 (2.6)	-	2 (4.3)	0.392†
Intra-operative fracture (n, %)	3 (3.4)	2 (6.9)	1 (1.7)	0.442†	0 (0.0)	-	0 (0.0)	-
Dislocation (n, %)	1 (1.1)	2 (6.9)	1 (1.7)	0.705†	0 (0.0)	-	1 (2.1)	0.010†*
Peri-prosthetic fracture (n, %)	3 (3.4)	1 (3.4)	0 (0.0)	0.442†	3 (1.0)	-	0 (0.0)	0.496†
Infection (n, %)	0 (0.0)	1 (3.4)	0 (0.0)	0.077†	3 (1.0)	-	1 (2.1)	0.487†
Oxford Hip Score at final follow-up [mean (range)]	44.5 (15.0-48.0)	36.3 (22.0-48.0)	44.4 (10.0-48.0)	0.014‡*	43.7 (10.0-48.0)	-	43.0 (30.0-48.0)	0.135††

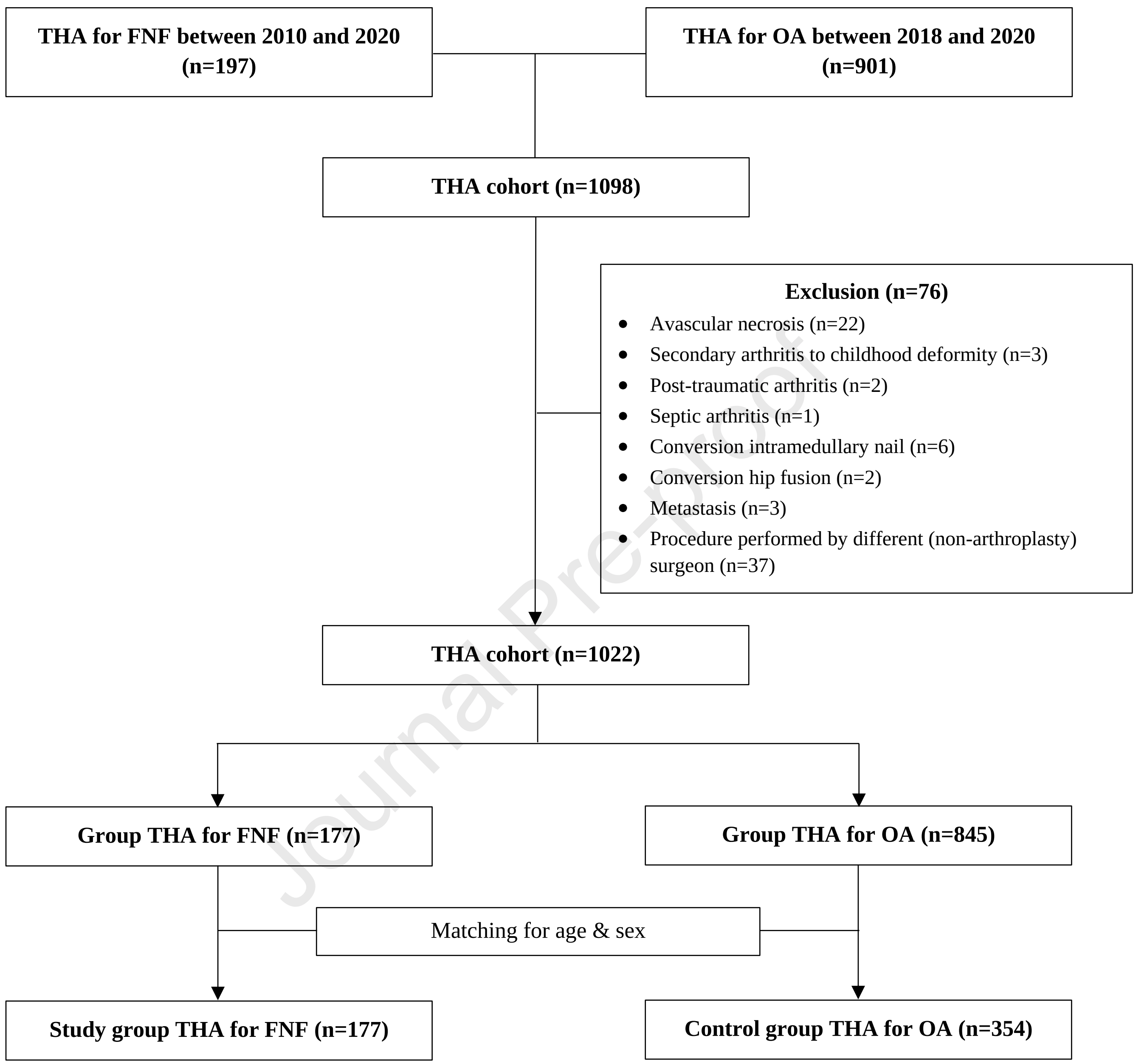
† *Chi*-Square test
‡ Kruskall wallis test
†† Mann Whitney U test
* Statistically significant (*p*-value<0.05)

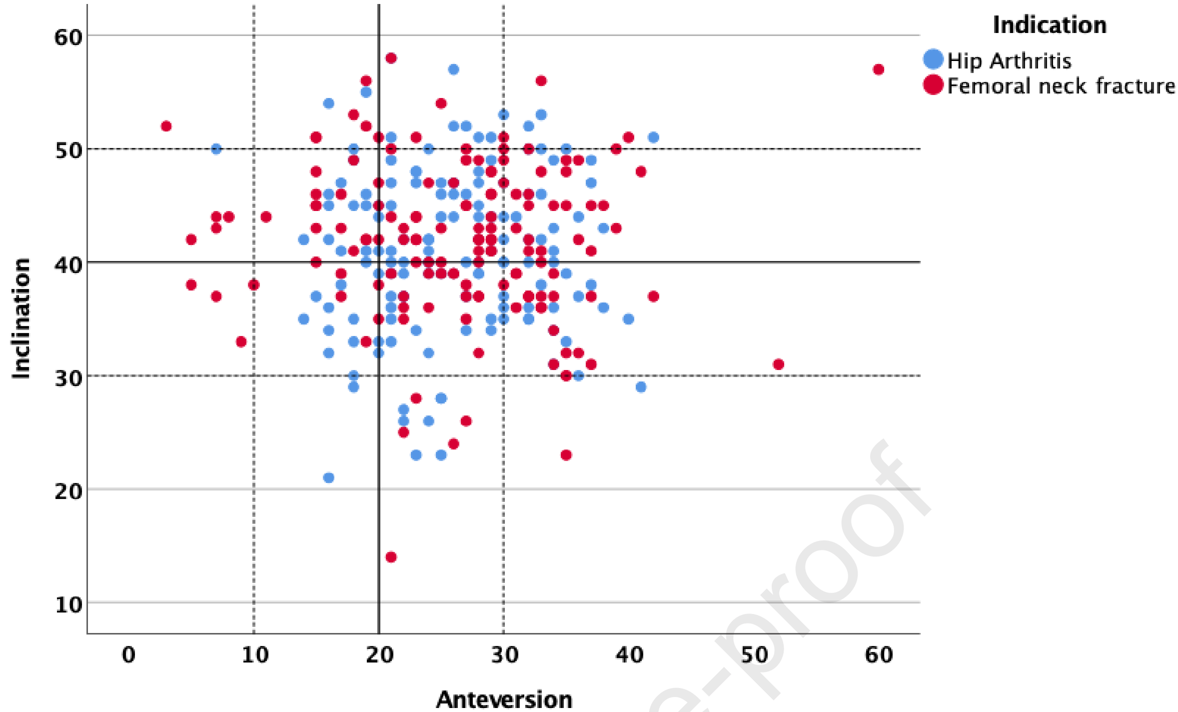
Table 5. Patient-reported outcome measures of patients treated with total hip arthroplasty (THA) for femoral neck fracture (FNF) or osteoarthritis (OA)

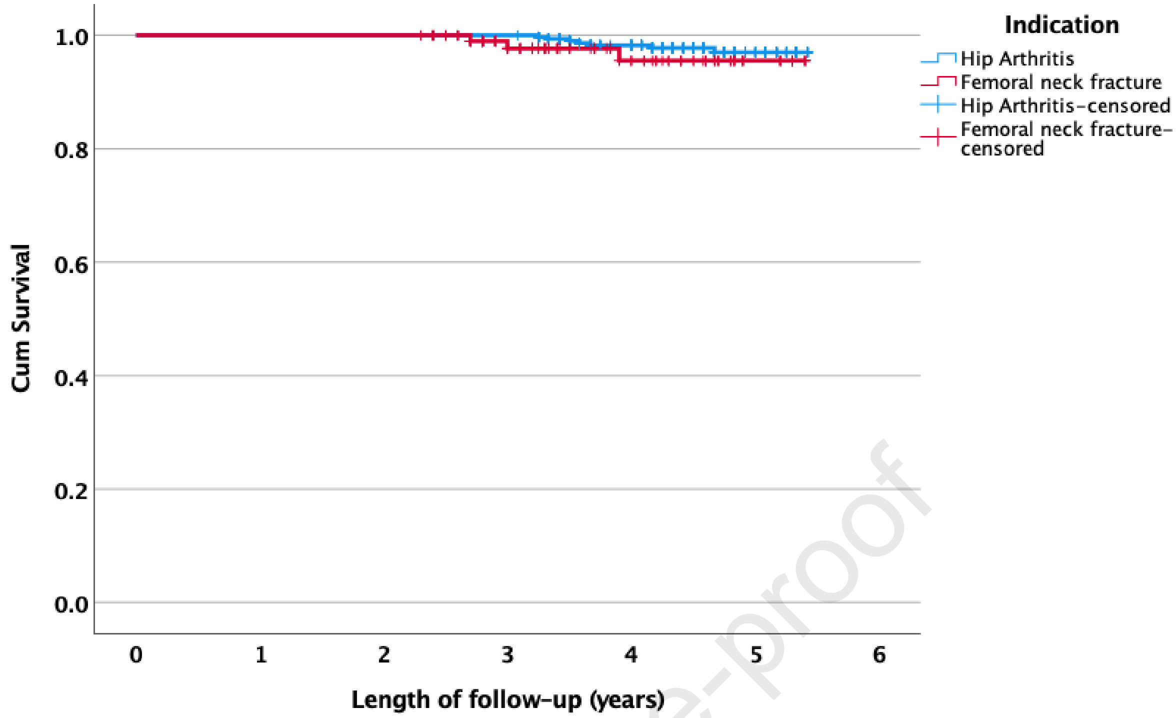
Score	Timing	Study group (n=177) THA for FNF	Control group (n=354) THA for OA	*p*-value
EQ5D [mean (range)]	Pre-operative	-	0.386 (-0.510-0.796)	-
	At final follow-up	0.805 (-0.331-1.000)	0.804 (-0.358-1.000)	0.151†
	Difference between pre-operative score and score at final follow-up	-	0.417 (-0.162-1.324)	-
OHS [mean (range)]	Pre-operative	-	19.5 (1.0-45.0)	-
	At final follow-up	43.7 (10.0-48.0)	43.6 (10.0-48.0)	0.030†*
	Difference between pre-operative score and score at final follow-up	-	24.0 (-2.0-44.0)	-
	Minimal clinical important difference (ΔOHS≥10)	-	96.5%	-

† *Chi*-Square test

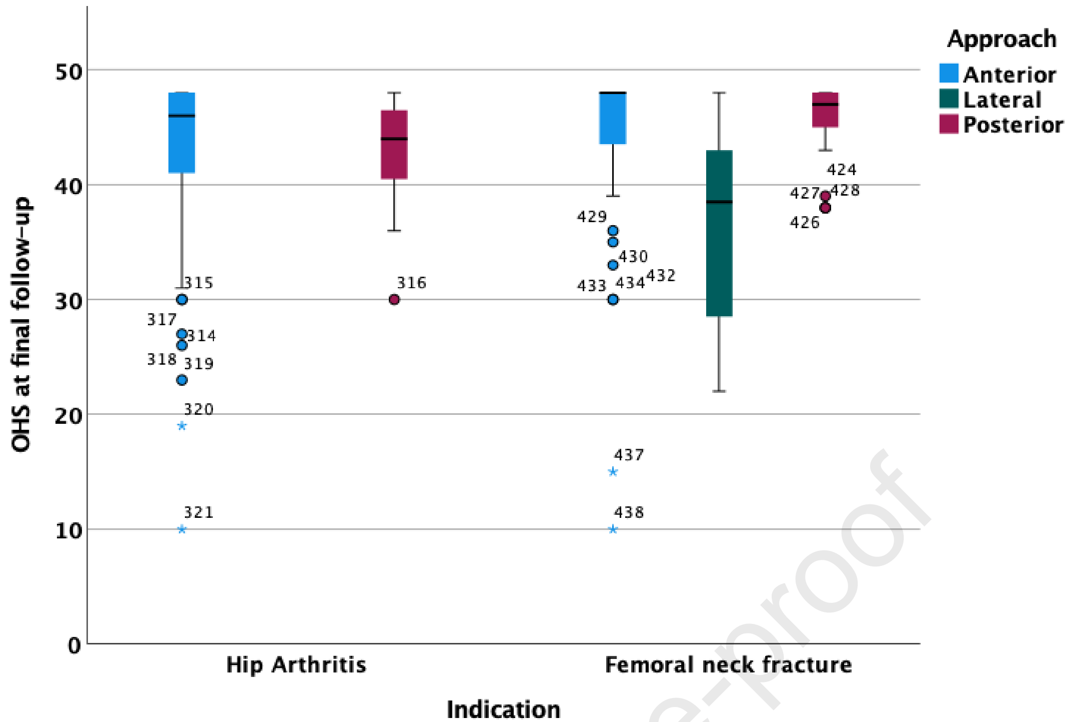
* Statistically significant (*p*-value<0.05)


THA for FNF between 2010 and 2020 (n=197)
THA for OA between 2018 and 2020 (n=901)
THA cohort (n=1098)
Exclusion (n=76)
Avascular necrosis (n=22)
Secondary arthritis to childhood deformity (n=3)
Post-traumatic arthritis (n=2)
Septic arthritis (n=1)
Conversion intramedullary nail (n=6)
Conversion hip fusion (n=2)
Metastasis (n=3)
Procedure performed by different (non-arthroplasty) surgeon (n=37)
THA cohort (n=1022)
Group THA for FNF (n=177)
Group THA for OA (n=845)
Matching for age & sex
Study group THA for FNF (n=177)
Control group THA for OA (n=354)


Indication
Hip Arthritis
Femoral neck fracture
Inclination
60
50
40
30
20
10
0
10
20
30
40
50
60
Anteversion



Indication
Hip Arthritis
Femoral neck fracture
Hip Arthritis-censored
Femoral neck fracture-censored
Cum Survival
1.0
0.8
0.6
0.4
0.2
0.0
0
1
2
3
4
5
6
Length of follow-up (years)


Approach
Anterior
Lateral
Posterior
OHS at final follow-up
0
10
20
30
40
50
315
317
314
318
319
320
321
316
429
430
433
434
432
437
438
424
427
428
426
Hip Arthritis
Femoral neck fracture
Indication