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Dislocation rates following total hip arthroplasty via the direct anterior approach in a consecutive, non-selective cohort

J. V. Horberg,
B. R. Coobs,
A. K. Jiwanlal,
C. J. Betzle,
S. G. Capps,
J. T. Moskal

From Carilion Roanoke Memorial Hospital, Roanoke, Virginia, USA

Aims

Use of the direct anterior approach (DAA) for total hip arthroplasty (THA) has increased in recent years due to proposed benefits, including a lower risk of dislocation and improved early functional recovery. This study investigates the dislocation rate in a non-selective, consecutive cohort undergoing THA via the DAA without any exclusion or bias in patient selection based on habitus, deformity, age, sex, or fixation method.

Methods

We retrospectively reviewed all patients undergoing THA via the DAA between 2011 and 2017 at our institution. Primary outcome was dislocation at minimum two-year follow-up. Patients were stratified by demographic details and risk factors for dislocation, and an in-depth analysis of dislocations was performed.

Results

A total of 2,831 hips in 2,205 patients were included. Mean age was 64.9 years (24 to 96), mean BMI was 29.2 kg/m^2 (15.1 to 53.8), and 1,595 (56.3%) were female. There were 11 dislocations within one year (0.38%) and 13 total dislocations at terminal follow-up (0.46%). Five dislocations required revision. The dislocation rate for surgeons who had completed their learning curve was 0.15% compared to 1.14% in those who had not. The cumulative periprosthetic infection and fracture rates were 0.53% and 0.67% respectively.

Conclusion

In a non-selective, consecutive cohort of patients undergoing THA via the DAA, the risk of dislocation is low, even among patients with risk factors for instability. Our data further suggest that the DAA can be safely used in all hip arthroplasty patients without an increased risk of wound complications, fracture, infection, or revision. The inclusion of seven surgeons increases the generalizability of these results.

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Introduction

In recent years there has been an increased adoption of the direct anterior approach (DAA) for total hip arthroplasty (THA).[1] This has been reflected in the literature as the number of studies evaluating the DAA has risen dramatically, generating debate about the merits of the approach. This increasing interest stems primarily from the purported benefits of the DAA relative to other approaches. Advocates for the DAA describe the approach as a muscle-sparing which follows an internervous plane, in contrast to more conventional techniques.[1-4] This contention is supported by studies demonstrating faster mobilization, less postoperative pain, and decreased narcotic use in patients who undergo THA via the DAA.[5-7]

Several authors have also described technical benefits when performing THA through an anterior approach.[8,9] The procedure is typically performed supine which facilitates the use of intraoperative imaging. This has been shown to improve the accuracy of acetabular component positioning and anatomically restore leg length and offset.[10] Even without enabling technologies, supine positioning is associated with less variability in the position of the pelvis within the soft tissue envelope. This, combined with excellent visualization of the acetabulum, promotes more accurate acetabular

Correspondence should be sent to J. T. Moskal; email: JTMoskal@carilionclinic.org

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Table I. Patient demographic details.

Characteristic	Population (n = 2,831)	Male hips (n = 1,236)	Female hips (n = 1,595)
Mean age, yrs (range)	64.90 (24 to 96)	63.09 (24 to 92)	66.31 (25 to 96)
Mean BMI, kg/m^2 (range)	29.18 (15.1 to 53.76)	29.56 (15.1 to 46.8)	28.90 (16.64 to 53.76)
Mean follow-up, mths (range)	61.40 (24.11 to 108.03)	61.23 (24.11 to 108.3)	61.54 (24.11 to 108.3)
ASA grade, n (%)			
I	96 (3.39)	38 (3.07)	58 (3.64)
II	1,728 (61.04)	712 (57.61)	1,016 (63.70)
III	968 (34.19)	462 (37.38)	506 (31.72)
IV	38 (1.34)	24 (1.94)	14 (0.88)
V	1 (0.04)	0 (0)	1 (0.06)

ASA, American Society of Anesthesiologists; CI, confidence interval; SD, standard deviation

component positioning with fewer outliers than laterally positioned approaches.

Although there exists some debate in the literature,[11,12] it is has been widely reported that the DAA is associated with a lower rate of dislocation than the direct posterior (DP), anterior lateral (AL), or direct lateral (DL) approaches.[5,13] Wyles et al presented a series of over 7,000 THAs demonstrating a one- and five-year dislocation rate for the DAA, DP, and DL approaches of 0.4% to 0.4%, 2.1% to 3.0%, and 0.7% to 0.7%, respectively.[14] This would indicate that not only does the DAA have a five- to seven-fold lower rate of dislocation than the DP approach, but also that the cumulative risk of dislocation and reoperation continues to rise with the DP approach but remains stable with the DAA. These findings echo a previous study that demonstrated increasing rates of instability with longer-term follow-up for THA performed through the DP approach.[15] Likewise, multiple large-scale single centre, multicentre, and database studies have demonstrated lower rates of instability following THA via the DAA.[5,12,14–16] However, many of these studies are confounded by selection bias, bringing their applicability to the overall hip arthroplasty population into question.[17]

Despite the benefits, there have been several important concerns raised in the literature about the anterior approach. It has been widely reported that there is a steep learning curve for surgeons transitioning from other approaches which can increase the rate of periprosthetic fractures and other complications.[18–20] Even among surgeons beyond their learning curve, a higher incidence of periprosthetic fractures has been reported.[16] It is also important to note that this learning curve phenomenon may not hold true for surgeons beginning practice after learning the DAA in their formal training.[19,21]

Recently the relationship between the kinematics of the hip and spine as well as their effect on prosthetic hip stability has received a great deal of attention. Postural changes affect the position of the pelvis and, therefore, the acetabulum.[22] Decreased motion in the spinopelvic complex, whether due to chronic biological degeneration or secondary to surgical instrumentation, alters the normal dynamic relationship between the acetabulum and proximal femur and has been shown to increase the incidence of prosthetic hip instability.[23–27] While it has become widely accepted that spinopelvic stiffness is a major risk factor for prosthetic hip dislocation, the question of how to best manage these patients remains controversial. Several authors have described imaging protocols and preparatory algorithms for addressing the hip-spine patient.[28–31] This has led some surgeons to advocate acetabular component placement outside the traditional Lewinnek safe zone based on the dynamic position of the pelvis.[28,31,32] Some authors have also advocated the use of dual mobility constructs as a means of mitigating the risk of dislocation in patients with spinopelvic stiffness, although the long-term durability of these constructs is unknown.[28,29,33] To date, it remains unclear what role approach selection may play in mitigating instability in this setting.

At our institution, the DAA has become the principal exposure used for THA since 2009. Furthermore, this approach has been implemented in a non-selective way such that patients with variations in body habitus, extensive deformity, and associated spinopelvic pathology have all been managed through the aDAA. The aim of this study is to evaluate the dislocation rate in a large, non-selective cohort of patients undergoing THA via the DAA. The dislocation rate was stratified by patient characteristics and risk factors as well as surgeon factors. Secondarily, we reviewed the overall complication, reoperation, and revision rate. We hypothesized that the dislocation rate following THA performed via the DAA would remain low, despite the inclusion of patients with potential risk factors for instability, and that there would be no increased risk in adverse events.

Methods

This study is a non-controlled, retrospective cohort study using a prospectively maintained, single institution database evaluating patients undergoing THA at an academic regional tertiary referral centre. Prior to collecting data, we were issued an exemption by our local institutional review board due to the retrospective nature of this study. All patients over 18 years of age undergoing primary THA via the DAA from 1 January 2011 through 31 December 2017 were identified based on current procedural terminology (CPT) code and included for review. 1 January 2011 was used as the start date for data collection, as this was when our institution implemented an electronic medical record system allowing for more accurate and complete data recording. All operations were performed by one of seven fellowship-trained orthopaedic surgeons, two in orthopaedic traumatology with extensive hip arthroplasty experience and five in adult reconstruction. Only two of the seven were formally trained in the DAA during their fellowship, while the remaining five surgeons adopted the approach after being in practice for a mean of 14.9 years (2.7 to 22.3). Three of those five providers had transitioned to the DAA prior to 1 January 2011 and were felt to be out of their learning curve,

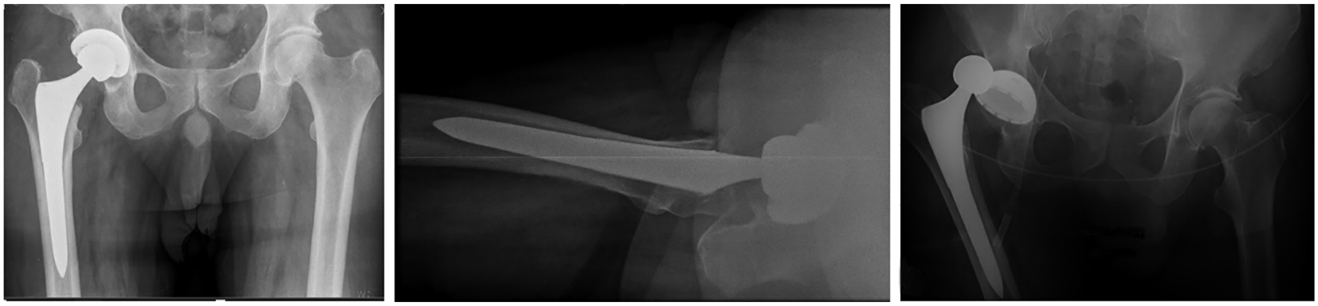

Fig. 1

Previously well-functioning right total hip arthroplasty (THA) in a 46-year-old male. The first two radiographs were taken on postoperative day 0. The third radiograph shows sustained posterior dislocation in a high-speed motor vehicle collision with concomitant open tibial shaft fracture, contralateral traumatic below knee amputation, open pneumothoracies bilaterally requiring surgical management, and multiple other nonoperative fractures, 1,556 days after THA. His hip dislocation was managed with a single closed reduction.

Table II. Dislocations by patient age and sex.

Variable, n (%)	Total	< 50 yrs	50 to 59 yrs	60 to 69 yrs	70 to 74 yrs	≥ 75 yrs
THA	2,831	242 (8.55)	647 (22.85)	933 (32.96)	424 (14.98)	585 (20.66)
Dislocation rate	13 (0.46)	4 (1.65)	4 (0.62)	4 (0.43)	0 (0)	1 (0.17)
Total dislocations	13	4 (30.77)	4 (30.77)	4 (30.77)	0 (0)	1 (7.69)
Male dislocation rate	3/1,236 (0.24)	1/162 (0.62)	1/313 (0.32)	1/371 (0.27)	0/160 (0)	0/230 (0)
Female dislocation rate	10/1,595 (0.63)	3/80 (3.75)	3/334 (0.90)	3/562 (0.53)	0/264 (0)	1/355 (0.28)

THA, total hip arthroplasty.

Table III. Statistical significance by subgroup.

Risk factor	Significant	p-value*
Sex	Yes	0.016
Age group	Yes	0.027
Age group by sex	Yes	0.012
BMI	No	0.513†
ASA grade	No	0.952†
Preop diagnosis	No	0.144†
Femoral head size	No	0.497†
Operating surgeon	Yes	0.007†
Spinal diagnosis/surgery	No	0.404†

*Chi-squared test.
†20% of cells have an expected count less than 5; chi-squared test in this situation is therefore suspect.
ASA, American Society of Anesthesiologists.

while the last two adopted the approach during the study period. Thus, only two of the seven surgeons had procedures from their learning curve included in the study. There were no exclusions for comorbidities or patient factors that are known risk factors for instability. Patients undergoing non-primary arthroplasty or with less than two years' follow-up at the time of data collection were excluded.

The primary outcome was prosthetic hip dislocation at minimum two-year follow-up. The secondary outcome was prosthetic hip dislocation in a subset of patients with spinopelvic pathology classified as "high risk" for postoperative instability. Patients with previously diagnosed spinal disease based on International Classification of Diseases of the World Health Organization (ICD)-9, ICD-10, and CPT code enquiries were deemed high-risk. Spinal disease was defined as a history of previous lumbar or lumbosacral fusion or a diagnosis of degenerative disk disease, spinal stenosis, lumbar/sacral spondylosis or spondylolisthesis.

Patients who dislocated were evaluated for BMI, time to dislocation, direction of dislocation, acetabular component position, and subsequent need for revision surgery. Patients were classified as either early or late dislocations based on a one-year threshold. Component position was evaluated based on the most recent anteroposterior (AP) pelvic plain film prior to the dislocation event. Acetabular anteversion was measured as described by Bacchal et al,[34] and inclination was measured by the method described by Murray.[35] Component position was judged relative to the safe zones described by Lewinnek et al.[32]

We identified 2,831 hips in 2,205 patients who underwent primary THA via the DAA during the study period. The mean age was 64.9 years (24 to 96) with 1,595 females (56%) and 1,236 males (44%). Mean BMI was 29.2 k g/m^2 (15.1 to 53.8). American Society of Anesthesiologists (ASA)[36] rating was I in 96 hips (3.4%), II in 1,728 (61.0%), III in 968 (34.2%), IV in 38 (1.3%), and V in one hip (0.04%). Mean follow-up was 61.4 months (24.1 to 108.0). All patients received hemispherical acetabular components with hard on soft bearings with no face changing, lipped or constrained liners, and no dual mobility constructs (Table I). A 28 mm head was used in 43 hips (1.5%), a 32 mm head in 590 (20.8%), 36 mm in 1,909 (67.4%), 40 mm in 288 (10.12%), and a 44 mm in one (0.04%).

Statistical analysis. Independent statistical analysis was performed by Susan G. Capps, PhD using JMP15.0.0 software (SAS, USA). Descriptive statistics were reported with mean (range) or number/total (percentage) where appropriate. Statistical significance is given as Pearson chi-squared values for categorical variables using a cutoff of $p < 0.05$. Due to the

Table IV. Patient details for dislocations

n	Age, yrs	Sex	BMI, kg/m²	Days to dislocation	Follow-up after dislocation, days	Direction	Head size, mm	Acetabular component abd, °	Acetabular component version, °	Spinal disease	Management
1	58	M	30.7	0	3,200	N/A	36	45	17.8		Femoral revision
2	46	M	28.4	1,556	1,278	Post	36	30	25		Closed reduction
3	53	F	31.47	38	2,235	Ant	40	50	12	Lumbosacral spondylosis L4-S1 fusion	Closed reduction
4	67	F	28.16	227	1,872	Ant	36	45	12		Closed reduction
5	57	F	32.8	67	1,950	Ant	36	55	10.1		Increased neck length, lateralized liner
6	42	F	26.36	32	1,933	Ant	32	48	7.2		Femoral revision
7	49	F	22.64	51	1,447	Post	32	45	8.4		Constrained liner
8	59	F	26.88	902	590	Post	32	48	13		Closed reduction
9	69	F	34.76	241	1,187	Post	36	41	7.5		Closed reduction
10	66	M	40.94	56	1,286	Ant	40	36	9.9		Closed reduction
11	46	F	31.77	29	1,274	Ant	32	54	13.6		Closed reduction
12	63	F	30	26	2,334	Ant	36	35	16	Lumbosacral spondylosis	Closed reduction
13	79	F	22.14	18	775	Ant	32	34	19.8		Constrained liner

abd, abduction; ant, anterior; N/A, not available; post, posterior

low overall number of dislocations, statistical significance must be carefully scrutinized. Results will note when 20% of cells have an expected count less than 5, as chi-squared test in that situation is suspect.

Results

There were 13 dislocation events in 13 patients yielding an overall dislocation rate of 0.46%. In all, 11 of the dislocations occurred within the first year after surgery at a mean of 71 days (0 to 1,556) and were classified as early yielding a dislocation rate of 0.38% at one year. The two late dislocations occurred at 902 and 1,556 days after index surgery, and were both traumatic in nature (Figure 1). When stratified by age, patients under 50 years of age had a dislocation rate of 1.65%, patients between 50 and 59 of 0.62%, between 60 and 69 of 0.43%, between 70 and 74 had no dislocations, and patients aged 75 and over had a rate of 0.17% ($p = 0.027$). Dislocation was more common in females (0.63%) than in males (0.24%, $p = 0.016$). When stratified by age and sex, most dislocations occurred in younger females and this sex discrepancy in dislocation rate was most substantial in the younger (< 50 years) cohorts ($p = 0.012$) (Table II and Table III).

Among the patients who dislocated, 5/13 (38.5%) had undergone THA for osteoarthritis, 6/13 (46.2%) for avascular necrosis, 1/13 (7.7%) for post-traumatic arthritis, and 1/13 (7.7%) for rheumatoid arthritis. Only 5/13 (38.5%) patients who dislocated required a revision for recurrent instability; one was managed with an elevated lipped liner, two were converted to a constrained liner, and two with femoral component revision. Both hips requiring femoral component revision were found to have undersized femoral stems and attributed to surgical technique failures. One dislocated in the post-anaesthesia care unit and was immediately revised to an appropriately sized stem, the second dislocated recurrently following postoperative stem subsidence likewise requiring revision to a larger stem. The remaining 8/13 (61.5%) were managed with a single closed reduction and have had no subsequent dislocation (Table IV).

In all patients who dislocated, the acetabular components were placed within the Lewinnek safe zone for anteversion while 2/13 (15.4%) had excessively vertical acetabular components measuring 55° and 54° of abduction. The mean acetabular component inclination was 42.4° (30° to 55°) and the mean anteversion was 13.25° (7.5° to 25°). A 32 mm head was used in five of the dislocated hips, a 36 mm in six hips, and a 40 mm in two hips. (Table IV)

Within the study population we identified 666 hips in patients with either surgically or biologically stiff spines, two of which dislocated (2/666; 0.30%). This included 627 hips in patients with a prior diagnosis of degenerative lumbosacral pathology, two of which dislocated (2/627; 0.32%). One of these dislocations was among 104 patients who underwent spinal fusion prior to THA (1/104; 0.96%). The difference in dislocation rate between those patients with spinopelvic pathology and those without was not significant ($p = 0.404$). Both of these dislocations were managed closed and required no further treatment. Previous authors have suggested that a large proportion of patients over the age of 75 years have stiff spines due to degenerative disease. Among these 585 hips in our study, 145 (24.8%) had diagnosed spinopelvic pathology and 34 (5.8%) had prior spinal fusion. There were no dislocations in the elderly cohort with concomitant spinopelvic pathology.

Five of the seven participating surgeons were fellowship-trained in adult reconstruction and performed 2,666/2,831 (94.17%) of the hip arthroplasties in our cohort. (Table V) Two surgeons learned the DAA during their fellowship and performed 257/2,831 (9.08%) hips. An additional 1,694 hips (59.84%) were performed by surgeons who had completed their learning curve in the DAA and 880 hips (31.08%) by surgeons who were in their learning curve during the study. Out of 13 dislocations, ten (76.92%) occurred during the learning curve and eight (61.54%) were from a single surgeon. The dislocation rate was 1.14% for surgeons in their learning curve, 0.15% for surgeons out of their learning curve, and 1.11% for the surgeon

Table V. Dislocations by surgeon.

Experience	Status	Speciality	Total, n (%)	Dislocation rate, n (%)	Cumulative, n (%)
Learning curve	Transitioning	Recon	715 (46.27)	8/715 (1.11)	10/880 (1.14)
	Transitioning	Trauma	105 (3.7)	2/105 (1.9)	
	Transitioning	Trauma	60 (2.11)	0/60 (0.0)	
Experienced	Fellowship	Recon	101 (3.46)	1/101 (0.99)	3/1,951 (0.15)
	Fellowship	Recon	156 (5.51)	0/156 (0.0)	
	Transitioned	Recon	384 (13.56)	0/384 (0.0)	
	Transitioned	Recon	1310/2,831 (46.27)	2/1,310 (0.15)	

Table VI. Complications, revisions, and reoperations in our series.

Complications, n (%)	30 days	90 days	Overall
Superficial wound breakdown	4 (0.14)	10 (0.35)	12 (0.42)
PJI	1 (0.04)	5 (0.18)	15 (0.53)
Fracture	7 (0.25)	14 (0.49)	19 (0.67)
Vancouver A-GT[37]	1 (0.04)	1 (0.04)	1 (0.04)
Vancouver B1	0 (0.0)	4 (0.14)	4 (0.14)
Vancouver B2/B3	6 (0.21)	7 (0.25)	12 (0.42)
Vancouver C	0 (0.0)	2 (0.07)	2 (0.07)
Other, n (%)			
Femoral nerve palsy	2 (0.07)	2 (0.07)	2 (0.07)
Symptomatic screw	0 (0.0)	0 (0.0)	1 (0.04)
Heterotopic ossification	0 (0.0)	0 (0.0)	1 (0.04)
Pseudotumour	0 (0.0)	0 (0.0)	1 (0.04)
Acetabular component loosening	0 (0.0)	0 (0.0)	1 (0.04)
Revisions and reoperations, n (%)			
One-stage revision	0 (0.0)	1 (0.04)	4 (0.14)
Two-stage revision	1 (0.04)	1 (0.04)	8 (0.28)
Revision for infection	1 (0.04)	2 (0.07)	12 (0.42)
Aseptic revision femur	7 (0.25)	14 (0.49)	15 (0.53)
Aseptic revision acetabulum	0 (0.0)	0 (0.0)	2 (0.07)
Revision all cause	8 (0.28)	16 (0.57)	29 (1.02)
Wound debridement	4 (0.14)	10 (0.35)	12 (0.42)
I&D bearing change	0 (0.0)	3 (0.11)	3 (0.11)
ORIF	1 (0.04)	2 (0.07)	6 (0.21)
Screw removal	0 (0.0)	0 (0.0)	1 (0.04)
Excision of HO	0 (0.0)	0 (0.0)	1 (0.04)
Aseptic bearing exchange	0 (0.0)	1 (0.04)	3 (0.11)
RTOR all cause	13 (0.46)	32 (0.99)	55 (1.94)

HO, heterotopic ossification; I&D, irrigation and debridement; ORIF, open reduction internal fixation; PJI, periprosthetic joint infection; RTOR, return to the operating room.

who contributed 8/13 dislocations. The difference in dislocation rates between surgeons was significant (p = 0.007).

Additionally, there were 19 periprosthetic femur fractures in this series (0.67%) of which seven occurred within 30 days (0.28%) and 14 occurred within 90 days (0.49%) of index operation. While 728/2,831 (25.7%) of hips in our series were cemented, all but one (94.7%) of the periprosthetic fractures occurred in press-fit hips yielding fracture rates of 0.86% in non-cemented versus 0.14% in cemented constructs (p = 0.026). A total of 12 hips in 12 patients had superficial wound breakdown (0.42%) requiring surgical debridement and antibiotics. There were 15 total periprosthetic joint infections in our series (0.53%): one within the first 30 days (0.04%) and five within 90 days (0.18%). Three were successfully managed with debridement and bearing change while 12 went on to either one-stage or two-stage revision. All-cause return to the operating theatre at 30 days, 90 days, and final follow-up was 0.46%, 1.13%, and 1.94% respectively. Implants were retained in most hips with survivorship of 99.76%, 99.43%, and 98.98% at 30 days, 90 days, and final follow-up. (Table VI)

Discussion

At our institution the DAA has become the preferred approach for primary and revision THA over the past ten years and has been used almost exclusively during that time. This has provided us with a non-selective cohort of consecutive patients to review without exclusion or biases in patient selection that often confound outcome studies for the DAA. Even in this non-selective cohort, the results of this study demonstrate a low rate of early (0.38%) and cumulative (0.46%) dislocation following THA via the DAA. When addressing the 562 patients with documented degenerative lumbosacral pathology, the dislocation rate was quite low (0.18%). Furthermore, of the 104 patients with instrumented lumbar and sacral fusions, we noted a dislocation rate of 0.96% which is substantially lower than reported elsewhere in the literature.[30,31,33,38,39] The differences in dislocation rate between the spinopelvic pathology subgroup and the remainder of the cohort were not statistically significant (p = 0.404).

When evaluating the data in this study, we noted several trends. First, although 2,666 (94.17%) of the hip arthroplasties in our cohort were performed by surgeons with fellowship training in adult reconstruction, only 257 hips (9.08%) were performed by the two surgeons (BRC, Phillip J. Patterson) who learned the DAA during formal fellowship training. Nevertheless, most hips (68.92%) were performed by surgeons who had completed their learning curve prior to the study. The learning curve phenomenon for those who have already completed their formal training and then transitioning to the DAA has been well described in the literature, with more complications occurring early in a surgeon's transition.[19,21,35] Consistent with these prior findings, 10/13 (76.92%) dislocations occurred in patients operated on by surgeons in their learning curve and 8/13 (61.54%) by a single surgeon who transitioned to the DAA after being in practice 15 years. The dislocation rate among these surgeons (1.14%) was significantly higher than for those surgeons who had completed their learning curve (0.15%, p = 0.007). Furthermore, the fact that our data spanned seven different surgeons, including those transitioning to the DAA, suggests that these results are generalizable and not confounded by a single surgeon's outcomes.

In keeping with previously reported data, most of our dislocations (11/13, 84.61%) occurred early, within the first year following surgery. The two late dislocations occurred as a result of traumatic injuries: one sustained in a motor vehicle accident at 1,556 days following index surgery, and one after the patient caught her foot while moving furniture, falling onto the involved hip at 902 days. It would be difficult to attribute these traumatic dislocations in otherwise well-functioning hips to the surgical approach. Although our cumulative risk changed little from one year (11/2,831; 0.38%) to five years (13/2,831; 0.45%) postoperatively, with the exclusion of these two traumatic dislocations our findings are similar to those of Wyles et al[14] which demonstrated no further dislocations beyond one year in patients undergoing THA via the DAA.

We found a trend towards a higher rate of dislocation in younger patients and females (Table II). When stratified by age, 12/13 (92.3%) of our dislocations occurred in patients under the age of 70 years. When stratified by decade, the overall dislocation rate decreased with age; patients under 50 years dislocated at a rate of 1.65%, between 50 to 59 at 0.62%, between 60 to 69 at 0.43%, and in patients over 70 at 0.10% ($p = 0.013$). Females dislocated at an overall rate of 0.63% relative to males at 0.24% ($p = 0.016$). This difference is more marked in the younger cohort as well with males under 50 years of age, dislocating at a rate of 0.62% relative to females at 3.75% ($p = 0.009$) (Table III). We suspect that younger patients and females are more flexible as a population and may be more prone to reach a point of impingement resulting in a dislocation than their older or male counterparts. Further study will be needed to explain these findings.

As our understanding of the relationship between the hip and spine increases, it is becoming clear that spinopelvic stiffness is a major contributor to prosthetic hip instability.[29–31,33] How to best mitigate this problem remains a considerable area of debate. In these patients the traditional Lewinnek safe zone is not always a reliable guide for stable acetabular component position.[30–32] While some authors advocate for acetabular component positioning tailored to the patient's specific deformity, others suggest that dual mobility or constrained constructs may confer increased stability in patients with limited spinopelvic motion, hypermobility, or other confounding risk factors.[1,33,40] This may account for the trend in the USA toward increasing usage of dual mobility bearings even in the primary setting.[1] Such an increase has raised concern about long-term risks of mechanical failure of such devices.[41–48] In light of these data, it is not clear to us that dual mobility constructs offer a completely safe and effective solution to the spinopelvic problem when using the DAA.

In recent years, several authors have reported on infection and wound complication rates following THA via the DAA. Ilchmann et al[49] reported a deep perirosthetic joint infection (PJI) rate of 2.3% for the DAA compared to 1.7% for the DL but the difference was not found to be statistically significant. Similarly, Aggarwal et al[50] reported a 2.2 × higher rate of infection in their DAA cohort (1.2%) when compared to a non-DAA cohort (0.63%). While some studies have failed to show this difference in infection rate,[51,52] several other studies have reported a higher wound complication rate in DAA hips than other approaches.[51,53] We identified 12 hips with wound complications requiring intervention (0.42%) and 15 hips with PJI (0.53%), of which 12 went on to require removal of hardware and revision. In this series, unlike some prior studies,[17,49–54] there was no selection bias towards lower BMI patients as all patients were managed with the DAA regardless of body habitus.

The periprosthetic fracture rate in our cohort was 0.67% which is lower than has been reported in other studies. We attribute this to the selective use of cemented fixation at our institution for older patients and those with poor bone stock. Nearly all (18/19, 94.7%) fractures occurred in cementless constructs, yielding a fracture rate that was six times higher than in cemented hips (0.86% vs 0.14%, $p = 0.026$). This underscores the need to take patient age, sex, and bone health into consideration when planning preoperatively. At final follow-up, our all-cause reoperation rate was 1.94% with implant survivorship of 98.98%.

There are several limitations to this study. As this is a retrospective review of a prospectively collected institutional database, there is concern that patients may present remotely with dislocation events and not be documented on our system. As the regional tertiary referral centre for a large catchment area with multiple points of entry for our patients extending over a broad geographical region, this likely represents a very small number of patients and is unlikely to significantly change our results. Due to limitations of our electronic medical record, which was instituted in 2011, we were unable to survey patients who underwent THA prior to that year. This limits access to a historical control cohort for comparison of other approaches, as nearly all hip arthroplasty is currently performed via the DAA at our institution. Although we identified patients at high risk for rigid spinopelvic deformity based on the presence of degenerative spinal disease and prior instrumentation in the lumbar and sacral regions, we did not have standardized spinopelvic images such as seated and standing lateral films of the pelvis to confirm the presence of limited spinopelvic motion in this cohort. In order to explore more accurately the relationship between approach and instability in patients with spinopelvic pathology, routine, standardized seated and standing radiographs will be necessary. Finally, the addition of patient-reported outcome measures into our database is a relatively recent development so we do not have access to this data which should be a consideration when selecting a surgical approach.

In conclusion, the data from this study demonstrate a very low rate of dislocation following THA via the DAA in a non-selective, consecutive cohort of patients. Nearly all dislocations occurred within the first 60 days after the index operation and, excluding two traumatic dislocations, there were no subsequent dislocations after one year. As our dataset included seven surgeons, these results can be considered generalizable and not the result of a single surgeon's experience. Our data also re-demonstrate the learning curve phenomenon previously described by other authors. Among the subset of patients with documented lumbosacral pathology or instrumentation, we found no change in the dislocation rate. Further study with radiographs confirming the presence of spinopelvic stiffness is needed to determine whether the DAA could be considered protective in this subset of patients. In addition to a low dislocation rate, our data suggest a lower overall fracture, PJI, wound complication, revision, and reoperation rate than has been previously reported for the DAA. These data were obtained without bias in patient selection, indicating that the DAA can be safely used in all hip arthroplasty patients with reproducibly good outcomes.

Take home message

- The rate of dislocation following total hip arthroplasty via the direct anterior approach is low.
- This approach can be used non-selectively regardless of age, sex, habitus, deformity, or concomitant spinoplevic pathology with a low dislocation rate.
- The rate of periprosthetic fracture or infection and overall complication rate is similar to that described in the literature for other approaches.

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Author information:
J. V. Horberg, MD, Adult Reconstruction Fellow, Department of Orthopaedic Surgery, Virginia Tech Carilion School of Medicine Carilion Clinic Institute of Orthopaedics and Neurosciences, Roanoke, Virginia, USA; Orthopedic Center of Illinois, Springfield, Illinois, USA.

B. R. Coobs, MD, Assistant Program Director Adult Reconstruction Fellowship
A. K. Jiwanlal, MD, Adult Reconstruction Fellow
C. J. Betzle, MD, Adult Reconstruction Fellow
J. T. Moskal, MD, FACS, Chairman of Orthopaedics
Department of Orthopaedic Surgery, Virginia Tech Carilion School of Medicine Carilion Clinic Institute of Orthopaedics and Neurosciences, Roanoke, Virginia, USA.

S. G. Capps, PhD, Statistician

Author contributions:
J. V. Horberg: Wrote and edited the manuscript, Collected the data.
B. R. Coobs: Wrote, edited, and oversaw the manuscript.
A. K. Jiwanlal: Handled the IRB application, Collected the data.
C. J. Betzle: Collected the data, Edited the manuscript.
S. G. Capps: Conducted the statistical analysis, Edited the manuscript.
J. T. Moskal: Wrote, edited, and oversaw the manuscript.

J. V. Horberg and J. T. Moskal are joint senior authors.

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