Arthroplasty Today 15 (2022) 167–173

Contents lists available at ScienceDirect

Arthroplasty Today

journal homepage: http://www.arthroplastytoday.org/

Original research

The Off-Table Technique Increases Operating Room Efficiency in Direct Anterior Hip Replacement

Trevor M. Owen, MD [a], John V. Horberg, MD [a,*], Kristoff Corten, MD, PhD [b], Joseph T. Moskal, MD [a]

[a] Department of Orthopaedic Surgery, Virginia Tech Carilion Clinic, Roanoke, VA, USA
[b] European Hip Clinic, Herselt, Belgium

ARTICLE INFO

Article history:
Received 19 November 2021
Received in revised form
28 March 2022
Accepted 31 March 2022
Available online 18 May 2022

Keywords:
Total hip arthroplasty
Direct anterior approach
Off table
Table free
Efficiency

ABSTRACT

Background: When performing a total hip arthroplasty via the direct anterior approach (DAA), many orthopedic surgeons utilize an orthopedic traction table. This technique requires an expensive table, time for positioning, staff to operate the table, and time-consuming transitions when preparing the femur. Some surgeons advocate for an "off-table" technique to avoid these difficulties. In this paper, we compare operating room efficiency between on-table and off-table techniques.
Material and methods: We retrospectively reviewed patients undergoing total hip arthroplasty by a single surgeon across the transition from on-table to off-table DAA technique. Three cohorts were defined; the last 40 on-table hips, the first 40 off-table hips, followed by the second 40 hips. Timestamps from the operative record were recorded to calculate setup, surgical, takedown, and total room time. Implant fixation, patient demographic data, comorbidities, and complications were recorded.
Results: From cohort 1 to 2, there was a 7-minute (14.44%, $P = .0002$) improvement in setup time but no change in total room time. From cohort 2 to 3, there was an additional 7-minute (15.47%, $P < .0001$) improvement in setup time, 32-minute (25.88%, $P < .0001$) improvement in surgical time, and 40-minute (21.96%, $P < .0001$) improvement in total room time yielding cumulative changes from cohort 1 to 3 of 15 minutes (27.68%, $P < .0001$), 28 minutes (23.11%, $P < .0001$), and 43 minutes (23.37%, $P < .0001$), respectively. There was no correlation between height, weight, or body mass index and time at any interval.
Conclusion: Conversion to an off-table DAA technique offers an improvement in operating room efficiency. This is seen in setup, operative, and total room time. Implementation could allow for an additional case each day.

Introduction

The utilization of the direct anterior approach (DAA) for total hip arthroplasty (THA) has been increasing over the past decade [1]. Although debated in the literature, advocates for the DAA describe the approach as minimally invasive with theoretical benefits including faster rehabilitation, less pain, shorter hospital stays, and lower incidence of dislocation than with other approaches [2–4]. Initially described by Carl Heuter in 1881 [5,6] and popularized in North America by Marius Smith-Petersen [7], the technique has undergone extensive modification since its inception. The Judet brothers popularized supine positioning on an orthopedic traction table [6], a technique which has been refined by Matta et al. [8]. The ability to provide traction and position the lower extremity in extremes of extension and external rotation to facilitate exposure has made the "on-table" technique the most commonly utilized variant of the DAA utilized in the United States [6].

Orthopedic traction tables, however, can be cumbersome and expensive devices restricting many surgeons from access to them. Some authors, including Keggi and Light who led the resurgence in popularity of the DAA in the United States in the 1980s, advocate for an "off-table" technique utilizing a standard operating table [6,9]. This avoids the added expense and maintenance associated with a

* Corresponding author. Virginia Tech Carilion Clinic, 1330 Churchill Road, Springfield, IL 62702, USA. Tel.: +1 309 714 0980.
E-mail address: johnvhorbergmd@gmail.com

https://doi.org/10.1016/j.artd.2022.03.026

modern orthopedic traction table and eliminates the need for additional assistants to operate it. In a time of decreasing reimbursements and bundled payments, it is necessary that arthroplasty surgeons and facilities alike scrutinize the costs such equipment and manpower requirements entail [10].

Increasing attention has also been paid to operative time associated with total joint arthroplasty [11]. Multiple studies have demonstrated increased risk of prosthetic joint infection with increased operative duration [12,13]. Similarly, increased operative time has been associated with increased blood loss and transfusion [14], rate of venous thrombosis [13], and revision surgery [11]. Improvements in operative efficiency, therefore, could translate to decreased complication and revision rates. A recent large meta-analysis comparing “on-table” vs “off-table” techniques demonstrated a mean 30-minute shorter operative time for “off-table” THA via the DAA [15]. These data, however, are confounded by inclusion of multiple surgeons at different institutions and heterogenous patient populations.

The purpose of this study is to determine whether there are any differences in operative efficiency when comparing the “on-table” and “off-table” techniques for DAA THA performed by a single surgeon. We hypothesized that the “off-table” technique would require less setup time and less operative time yielding a faster overall total room time. Next, we sought to identify and define any potential learning curve phenomenon for surgeons experienced in “on-table” DAA transitioning to the “off-table” technique. Finally, we wanted to explore the effect that patient factors and implant fixation had on operative time.

Material and methods

We performed a retrospective review utilizing a prospectively collected institutional database of 120 consecutive patients undergoing THA via the DAA by a single surgeon. Patients were divided into 3 cohorts; the last 40 hips performed utilizing an orthopedic traction table (on-table), the first 40 hips performed without an orthopedic traction table (off-table 01) and the second 40 hips performed without the traction table (off-table 02). All primary hips performed during the study period utilized a DAA and were eligible for inclusion. Revision arthroplasty, conversion procedures, cases that involved hardware removal, and bilateral procedures were excluded.

Perioperative timestamps were logged from the electronic medical record at the point the patient entered the operating room, the time of incision, the time surgery ended, and the time the patient exited the room. These were used to calculate “setup time,” “surgical time,” “takedown time,” and “total room time.” It is important to note that at our institution, administration of, preparation for, and induction of anesthesia are performed in the operating room prior to incision and are included in our setup time. Patient demographic data including age, gender, height, weight, body mass index (BMI), and medical comorbidities were recorded as well. Finally, fixation method (cemented vs uncemented) was recorded.

Surgical technique

In the “on-table” cohort, all hips were performed on a Hana traction table (Mizuho OSI, Union City, CA). Fluoroscopic imaging was used to aid in reaming, cup positioning, and assessment of length. In addition to the surgeon, a scrub tech was needed to pass instruments, a first assistant across the table held retractors, and an unsterile assistant operated the table. Fellows and residents were variably present. A powered femoral elevator was used to facilitate femoral exposure.

In the “off-table” cohort, a conventional operating table was utilized. The gripper self-retaining retractor system (Medenvision, Aarschot, Belgium) was utilized in all cases. In addition to the surgeon, only a scrub tech was needed for the procedure. Again, fellows were variably present. (Figs. 1 and 2)

Statistical analysis

Statistical analysis was performed using the JMP15.0.0 software (SAS, Cary, NC). Simple descriptive statistics were used to describe demographic and outcome data. We defined an minimum clinically important difference of 20 minutes as this would allow for the addition of an additional surgical case per day at our institution. Assuming a type-I error rate of $\alpha = 0.05$ and a type-II error rate of $\beta = 0.2$ (80% power), a minimum sample size of 25 patients per cohort was needed. Previous studies have described a learning curve for adoption of the DAA ranging from 40-100 cases [16,17]. As the primary surgeon in this series is an experienced DAA surgeon and only changing his practice from on-table to off-table, we settled on 40 cases per cohort. Chi-Square testing was used for comparing categorical variables, the students T-Test was used to compare parametric variables, whereas the Mann-Whitney U test was used for nonparametric variables. Pearson correlation coefficients and corresponding confidence intervals were used to determine if there was correlation between body habitus and operative time. Correlation coefficients were interpreted such that $R > 0.80$ represented strong correlation, 0.60-0.79 moderate correlation, 0.40-0.59 weak correlation, and <0.40 no correlation.

Results

A total of 120 consecutive primary THAs in 115 patients were included in the study and divided into 3 cohorts. The “on-table” cohort included the last 40 THAs performed prior to transitioning from an orthopedic traction table to a standard operating table. The first 40 hips after transition were labeled “off-table 01,” and the second 40 hips were labeled “off-table 02.” Cohorts were well matched in gender with no statistically significant difference in age, height, weight, or BMI between cohorts (Table 1).

After transitioning from “on-table” to “off-table 01,” there was a mean 7-minute (14.44%; $P = .0002$) improvement in setup time, 4-minute (3.74%; $P = .3639$) increase in surgery time, no difference ($P = .9051$) in takedown time, and 3-minute (1.81%; $P = .5740$) difference in total room time. When comparing “off-table 01” and “off-table 02,” setup time improved an additional 7 minutes (15.47%; $P < .0001$), surgery time was 32 minutes faster (25.88%; $P < .0001$), takedown was unchanged ($P = .9010$), and total room time was 40 minutes faster (21.96%; $P < .0001$). The cumulative improvements from the “on-table” to the “off-table 02” cohort were 15 minutes (27.68%; $P < .0001$), 28 minutes (23.11%; $P < .0001$), no change ($P = .8501$), and 43 minutes (23.37%; $P < .0001$) for setup, surgery, takedown, and total room time, respectively, (Table 2).

In the on-table cohort, the mean age was 65.9 years, height was 1.71 m, weight 91.73 kg, and BMI 31.01. The age, height, weight, and BMI were 65.4, 1.72 m, 91.39 kg, and 30.76 kg/m^2, respectively, in the off-table 01 cohort and 68.26, 1.68 m, 88.79 kg, and 31.15 kg/m^2, respectively, in the off-table 02 cohort. These values were not statistically significantly different between cohorts. Utilizing Pearson correlation coefficients, there was no correlation found between height, weight, or BMI and duration of any time interval in any of the 3 cohorts (Table 3).

In the on-table cohort, the surgical time for cemented fixation was a mean 7-minute longer (6.24%; $P = .2861$) than press-fit fixation. In the on-table 01 cohort, cemented fixation took 8 minutes longer (6.43%; $P = .3778$), and in the on-table 02 cohort, cemented

Table 1
Patient demographics in each cohort.

Patient demographics	On-table	Off-table 01	Off-table 02	*P* value
Age	65.90 (46.55-83.21)	65.41 (42.64-88.67)	68.26 (52.02-89.75)	.3995
Gender				
Male	23 (57.5%)	17 (42.5%)	21 (52.5%)	.1997
Female	17 (42.5%)	23 (57.5%)	19 (47.5%)	.2031
Body habitus				
Height (m)	1.71 (1.50-1.92)	1.72 (1.52-1.99)	1.68 (1.47-1.97)	.4272
Weight (kg)	91.37 (55.60-121.70)	91.39 (54.40-147.90)	88.79 (51.0-144.0)	.7334
BMI	31.01 (20.42-39.14)	30.76 (19.36-41.11)	31.15 (21.07-40.10)	.8298
ASA classification				
I	2 (5.0%)	0 (0.0%)	1 (2.5%)	.2004
II	27 (67.5%)	25 (62.5%)	22 (55.0%)	.4756
III	10 (25.0%)	15 (37.5%)	16 (40.0%)	.5723
IV	1 (2.5%)	0 (0.0%)	1 (2.5%)	.1837
Laterality				
Left	19 (47.5%)	16 (40.0%)	25 (62.5%)	n/a
Right	21 (52.5%)	24 (60.0%)	15 (37.5%)	n/a
Fixation				
Cemented	12 (30.0%)	15 (37.5%)	15 (37.5%)	.5639
Uncemented	28 (70.0%)	25 (62.5%)	25 (62.5%)	.6883

Cohorts were well matched in age and gender, and there was no statistically significant difference in height, weight, or BMI between groups. Similarly, there were no differences between cohorts in fixation method or American Society of Anesthesiologists (ASA) classification.

Table 2
Setup, surgery, takedown, and total room time for each cohort.

	Setup time	Surgery time	Takedown time	Total time
On-table	54 min (32-76 min)	112 min (82-233 min)	9 min (2-19 min)	186 min (129-295 min)
Off-table 01	46 min (34-64 min)	126 min (82-228 min)	9 min (1-21 min)	182 min (129-291 min)
Off-table 02	39 min (25-54 min)	94 min (65-178 min)	9 min (2-45 min)	142 min (109-236 min)
On-table to off-table 01				
Difference	Δ 7 min (14.44%)	Δ −4 min (−3.74%)	Δ 0 min (1.28%)	Δ 3 min (1.81%)
Significance	$P = .0002$	$P = .3639$	$P = .9051$	$P = .5740$
Off-table 01 to off-table 02				
Difference	Δ 7 min (15.47%)	Δ 32 min (25.88%)	Δ 0 min (1.55%)	Δ 40 min (21.96%)
Significance	$P < .0001$	$P < .0001$	$P = .9010$	$P < .0001$
On-table to off-table 02				
Difference	Δ 15 min (27.68%)	Δ 28 min (23.11%)	Δ 0 min (2.81%)	Δ 43 min (23.37%)
Significance	$P < .0001$	$P < .0001$	$P = .8501$	$P < .0001$

Time changes noted such that negative values represent an increase in time from 1 cohort to the subsequent cohort. There were statistically significant improvements in setup, surgery, and total room time from the first to the last cohorts.

Table 3
Pearson correlation coefficients and corresponding 95% confidence intervals interpreted such that R > 0.80 is strong correlation, 0.6-0.79 moderate correlation, 0.40-0.59 weak correlation, and <0.40 no correlation.

Body habitus & time	Setup time	Surgery time	Takedown time	Total time
On-table				
Height	0.36 (0.07 to 0.60)	−0.17 (−0.45 to 0.15)	0.00 (−0.31 to 0.30)	−0.04 (−0.34 to 0.26)
Weight	0.45 (0.17 to 0.66)	0.02 (−0.29 to 0.32)	−0.05 (−0.35 to 0.25)	0.14 (−0.17 to 0.42)
BMI	0.28 (−0.02 to 0.54)	0.13 (−0.18 to 0.42)	−0.08 (−0.37 to 0.23)	0.19 (−0.12 to 0.47)
Off-table 01				
Height	0.00 (−0.30 to 0.30)	0.10 (−0.21 to 0.39)	0.03 (−0.28 to 0.33)	0.09 (−0.22 to 0.39)
Weight	0.00 (−0.31 to 0.30)	−0.04 (−0.34 to 0.27)	−0.09 (−0.38 to 0.22)	−0.05 (−0.35 to 0.26)
BMI	0.03 (−0.28 to 0.33)	−0.14 (−0.43 to 0.17)	−0.09 (−0.39 to 0.22)	−0.14 (−0.42 to 0.17)
Off-table 02				
Height	0.02 (−0.28 to 0.32)	0.12 (−0.19 to 0.41)	−0.15 (−0.44 to 0.16)	0.07 (−0.24 to 0.36)
Weight	0.11 (−0.20 to 0.40)	0.17 (−0.14 to 0.45)	0.08 (−0.23 to 0.38)	0.20 (−0.11 to 0.47)
BMI	0.08 (−0.23 to 0.37)	0.13 (−0.18 to 0.42)	0.23 (−0.07 to 0.50)	0.20 (−0.11 to 0.48)

We found no correlation between height, weight, or BMI and duration of any time period in any of the 3 cohorts.

Table 4
Differences in setup, surgery, takedown, and total room time stratified by cemented vs uncemented fixation.

Cemented vs uncemented	Setup	Surgery time	Takedown time	Total time
On-table	−1 min (−3.46%) [$P = .5109$]	7 min (6.24%) [$P = .2861$]	0 min (0.0%) [$P = .9611$]	6 min (3.27%) [$P = .4731$]
Off-table 01	1 min (2.80%) [$P = .5855$]	8 min (6.43%) [$P = .3778$]	0 min (0.0%) [$P = .7574$]	9 min (4.93%) [0.3656]
Off-table 02	−1 min (−5.05%) [$P = .3222$]	−1 min (−1.72%) [$P = .8066$]	0 min (0.0%) [$P = .8634$]	−3 min (−2.24%) [$P = .6804$]

Numbers are labeled such that positive values indicate faster uncemented fixation and negative values indicate faster cemented fixation.

fixation was 1 minute faster (1.72%; $P = .8066$). None of these differences were statistically significant. Similarly, there was no significant difference in setup, takedown, or total room time when stratified by fixation in any cohort (Table 4). The mean age for cemented hips was 75.53 vs 61.67 in uncemented hips ($P < .0001$). The mean height was 1.68 m vs 1.72 m ($P = .1221$), weight was 84.90 kg vs 93.54 kg ($P = .0226$), and BMI was 29.98 vs 31.50 ($P = .1629$) in cemented vs uncemented hips, respectively. Cemented fixation was used in 29.51% of males and 40.68% of females undergoing THA, with 57.14% of all cemented hips being used in female patients (Table 5).

Discussion

The on-table DAA has become the preferred approach for primary and revision THA at our institution over the course of the last decade and is now used almost exclusively. Although debated in the literature, multiple authors have reported faster mobilization, less early postoperative pain, and a lower rate of dislocation following THA via the DAA [18–22]. Results from our institution have reflected these findings [23]. However, increased surgical volumes and competition for a limited supply of orthopedic traction tables has led some surgeons to pursue alternative options. The off-table technique provides an attractive alternative, utilizing a standard OR table without sacrificing the potential benefits of an anterior approach. The question of what effect this would have on surgeon efficiency and case-to-case workflow currently lacks answer in the literature.

Based on these data, there is a marked increase in operative efficiency for surgeons utilizing the DAA following transition from an “on-table” to an “off-table” technique. After completion of a brief learning curve, there was a 28-minute (23.11%) decrease in surgical time defined from incision to dressing application. This combined with a 15-minute (27.08%) decrease in setup time yielded an overall time savings of 43 minutes (23.37%) achieved from the time the patient entered the room until the time they left. This is sufficient to add an additional case per room per day. Although we could not accurately capture this information retrospectively, we would expect additional time savings among cases associated with switching tables on days where THAs and total knee arthroplasties are performed as well.

These improvements in operative efficiency were irrespective of body habitus. All 3 treatment cohorts were well matched in age, height, weight, and BMI. Within each cohort, there was no correlation found between these variables and operative time. It is important to note that at our institution, all primary THAs are performed via the DAA regardless of habitus or deformity, eliminating patient selection as a confounder. In addition, it should be noted that the surgeon performing all hips in this series was experienced in the DAA and had completed his learning curve before any cases included in this review were performed. These 2 factors may explain the minimal effect body habitus played in operative time in this study.

Similarly, after the learning curve period, there were no differences in operative duration noted between the fixation methods. Cemented fixation is used extensively at our institution to mitigate periprosthetic fracture risk in elderly patients, females, and patients with poor bone stock. Overall, 35% of patients in our series at a mean age of 75.53 years underwent cemented fixation compared with an age of 61.67 years in uncemented hips. Cement was used in 40.68% of women accounting for over half (57.14%) of all cemented hips implanted. Although there was no statistically significant difference in height or BMI between cemented and uncemented hips, there was a trend to lower body weight (84.90 kg vs 93.54 kg [$P = .0226$]). We believe the familiarity with cemented fixation at our institution and the selection of older, lighter patients with less

Table 5
Most (57.14%) cemented hips were performed in females, whereas most (55.13%) uncemented hips were performed in males.

Cemented vs uncemented	Male	Female	Age	Height	Weight	BMI
On-table						
Cemented	6 (50.0%)	6 (50.0%)	73.96	1.70 m	86.34 kg	29.78
Uncemented	11 (60.71%)	17 (39.29%)	62.44	1.72 m	93.53 kg	31.54
Significance			$P < .0001$	$P = .6073$	$P = .2978$	$P = .3711$
Off-table 01						
Cemented	6 (40.0%)	9 (60.0%)	73.87	1.73 m	88.19 kg	29.68
Uncemented	11 (44.0%)	14 (56.0%)	60.33	1.71 m	93.31 kg	31.40
Significance			$P < .0001$	$P = .6279$	$P = .4558$	$P = .3918$
Off-table 02						
Cemented	6 (40.0%)	9 (60.0%)	78.44	1.62 m	80.45 kg	30.44
Uncemented	15 (60.0%)	10 (40.0%)	62.16	1.72 m	93.79 kg	31.57
Significance			$P < .0001$	$P = .0063$	$P = .0448$	$P = .5453$
Overall						
Cemented	18 (42.86%)	24 (57.14%)	75.53	1.68 m	84.90 kg	29.98
Uncemented	43 (55.13%)	35 (44.87%)	61.67	1.72 m	93.54 kg	31.50
Significance			$P < .0001$	$P = .1207$	$P = .0226$	$P = .1629$

Cumulatively, patients with cemented hips were significantly older (75.53 vs 61.67; $P < .0001$) and weighed less (84.9 kg vs 93.54 kg; $P = .0226$). There was no statistically significant difference in height ($P = .1207$) or BMI ($P = .1629$) between cemented and uncemented hips.

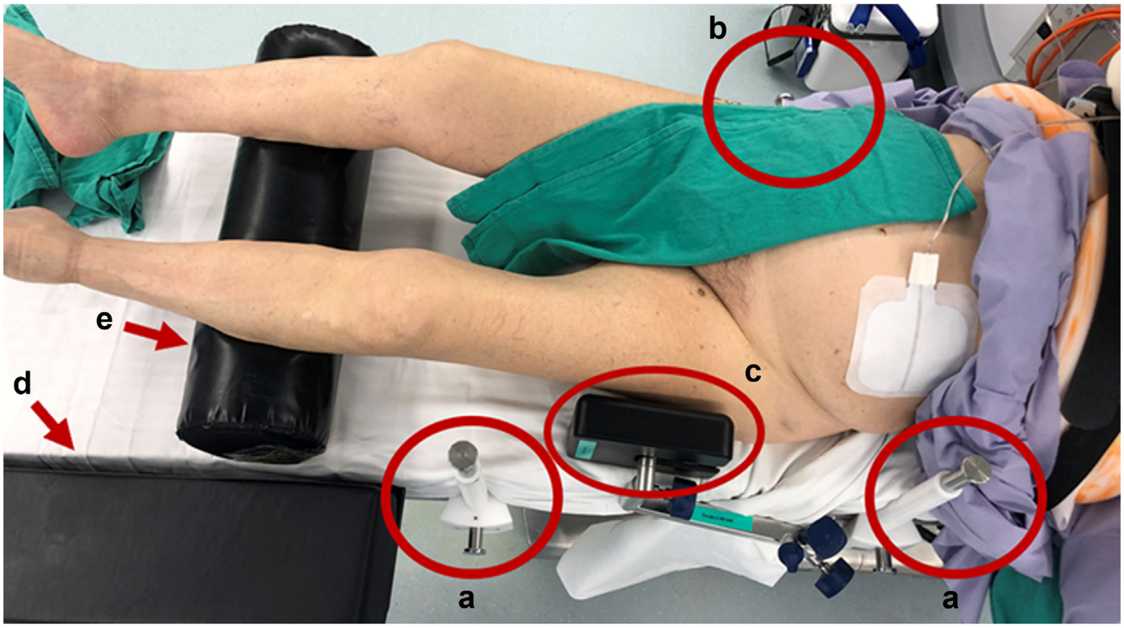

Figure 1. Patient positioning and setup of self-retaining retractors utilized for “off-table” DAA hips in this series. (a) Two tall posts for mounting self-retaining retractors were mounted on the nonoperative side; one at the superior pole of the patella and one at the inferior margin of the kidney. (b) A short post was placed on the operative side at the level of the inferior margin of the kidney. (c) A bolster was used at the nonoperative greater trochanter to prevent the patient from moving when in figure of 4 position. (d) An arm board is placed at the foot of the bed on the nonoperative side to place the operative leg on while in figure of 4 position. (e) A foam roll was used during prepping so that the circulating nurse did not have to lift the legs.

muscle mass for cemented fixation account for the lack of differences between cemented and uncemented times. Exposure can be more challenging and time-consuming in younger, more muscular, and male patients who typically received uncemented implants.

When utilizing the “on-table” technique, exposure is facilitated by the table. Tight boots are fitted to the patient preoperatively and attached to rotating foot holders on the leg spars. In order to adequately expose the femur, extremes of rotation at the foot in excess of 120°-180° are often necessary. This can place a great deal of strain on the knees and ankles, raising the theoretical concern of ligamentous injury, especially in elderly patients or those with ipsilateral prosthetic knees. Several authors have described an increased fracture rate when utilizing the DAA [2,24–28]. It is possible that the torsional moment generated by external rotation of the leg on the orthopedic traction table predisposes the femur to fracture during broaching, but further study is needed to explore this relationship. Although it is uncommon following THA, injury to the pudendal nerve has been described following hip arthroscopy or fracture management on an orthopedic table as well [29]. In addition to improvements in workflow and efficiency, transitioning to an “off-table” technique may also help to mitigate these potential risks of “on-table” DAA THA.

There are several limitations to this study. This was a retrospective study, and although patients were well matched in age, gender, and body habitus, it is possible that variations in perioperative staff could confound results in unpredictable ways. To confirm these results, we intend to perform a prospective randomized controlled trial in the near future. All cases were performed by a single surgeon, so further study will be necessary to determine whether these results are generalizable. Furthermore, these data reflect the transition of a surgeon already experienced in the DAA from one technique to another and should not be considered equivalent to the learning curve transitioning to the DAA from a different approach. At our institution, administration of spinal anesthetic, placement of any necessary patient monitors or invasive lines, and induction of anesthesia are performed in the operating room and included in the setup time. The timestamp data recorded in our electronic medical record are not sufficiently granular to capture variations in setup time attributable to anesthesia which could affect our reported setup times. Finally, there exists varying technical descriptions in the literature of “off-table” THA. These data reflect one such iteration of the off-table technique as described in the Material and Methods section.

Conclusions

Transitioning from an “on-table” to an “off-table” technique for THA via the DAA is associated with substantial improvements in operative and perioperative efficiency. For surgeons experienced in the DAA, the learning curve is brief with time-savings beginning after 20 cases and continued improvement seen through the first 60. The mean surgical time improved by 28 minutes (23.11%) and total room time by 43 minutes (23.37%), which allowed for an additional case per room per day.

Conflicts of interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

T. M. Owen is a paid consultant for Metalogix. J. V. Horberg is a paid consultant for Zimmer Biomet. K. Corten receives royalties from, is in the speakers' bureau or gave paid presentations for, has stock or stock options in, receives royalties as financial or material support from, and is a paid consultant for MedEnvision and DePuy Synthes. J. T. Moskal receives royalties from DePuy and Corin; is in the speakers' bureau or gave paid presentations for and is a paid consultant for Stryker; has stock or stock options in Think Surgical; receives other financial or material support from United

Figure 2. Final positioning and draping for “off-table” hips. The operative side arm was padded in foam and hung from an ether screen mounted on the nonoperative side of the bed. Pantaloon style drapes with an anterior window were utilized. Stockinettes were rolled over each leg to tighten the drape, facilitate manual traction, and to make checking leg length easier. Finally, an ACE wrap (3M Two Harbors, MN) and Kerlix gauze (Cardinal Health Dublin, OH) were used on the operative and nonoperative legs, respectively, to help hold retractors.

Orthopaedics—Physician Advisory Board; and is a board member of AAHKS.

For full disclosure statements refer to https://doi.org/10.1016/j.artd.2022.03.026.

References

[1] Abdel MP, Berry DJ. Current practice trends in primary hip and knee arthroplasties among members of the American Association of Hip and Knee Surgeons: a long-term update. J Arthroplasty 2019;34(7S): S24–7.

[2] Higgins BT, Barlow DR, Heagerty NE, Lin TJ. Anterior vs. posterior approach for total hip arthroplasty, a systematic review and meta-analysis. J Arthroplasty 2015;30:419–34.

[3] Zawadsky MW, Paulus MC, Murray PJ, Johansen MA. Early outcome comparison between the direct anterior approach and the mini-incision posterior approach for primary total hip arthroplasty: 150 consecutive cases. J Arthroplasty 2014;29:1256–60.

[4] Barrett WP, Turner SE, Leopold JP. Prospective randomized study of direct anterior vs postero-lateral approach for total hip arthroplasty. J Arthroplasty 2013;28:1634–8.

[5] Heuter C. Fünfte abtheilung: die verletzung und krankheiten des hüftgelenkes, neunundzwanzigstes capitel. Leipzig, Germany: FCW Vogel; 1883.

[6] Rachbauer F, Kain MS, Leunig M. The history of the anterior approach to the hip. Orthop Clin North Am 2009;40:311–20.

[7] Smith-Petersen MN. A new supra-articular subperiosteal approach to the hip joint. JBJS 1917;2:592–5.

[8] Matta JM, Shahrdar C, Ferguson T. Single-incision anterior approach for total hip arthroplasty on an orthopaedic table. Clin Orthop Relat Res 2005;441: 115–24.

[9] Light TR, Keggi KJ. Anterior approach to hip arthroplasty. Clin Orthop Relat Res 1980:255–60.

[10] Clement RC, Kheir MM, Soo AE, et al. What financial incentives will be created by Medicare bundled payments for total hip arthroplasty? J Arthroplasty 2016;31:1885–9.

[11] Acuna AJ, Samuel LT, Karnuta JM, et al. Have total hip arthroplasty operative times changed over the past decade? An analysis of 157,574 procedures. J Arthroplasty 2020;35:2101–2108.e8.

[12] Wang Q, Goswami K, Shohat N, et al. Longer operative time results in a higher rate of subsequent periprosthetic joint infection in patients undergoing primary joint arthroplasty. J Arthroplasty 2019;34:947–53.

[13] Wills BW, Sheppard ED, Smith WR, et al. Impact of operative time on early joint infection and deep vein thrombosis in primary total hip arthroplasty. Orthop Traumatol Surg Res 2018;104:445–8.

[14] Manara J, Sandhu H, Wee M, et al. Prolonged operative time increases risk of blood loss and transfusion requirements in revision hip surgery. Eur J Orthop Surg Traumatol 2020;30:1181–6.

[15] Sarraj M, Chen A, Ekhtiari S, Rubinger L. Traction table versus standard table total hip arthroplasty through the direct anterior approach: a systematic review. Hip Int 2020;30:662–72.

[16] Seng BE, Berend KR, Ajluni AF, Lombardi Jr AV. Anterior-supine minimally invasive total hip arthroplasty: defining the learning curve. Orthop Clin North Am 2009;40:343–50.

[17] Masonis J, Thompson C, Odum S. Safe and accurate: learning the direct anterior total hip arthroplasty. Orthopedics 2008;31(12 Suppl 2).

[18] Bhandari M, Matta JM, Dodgin D, et al., Anterior Total Hip Arthroplasty Collaborative I. Outcomes following the single-incision anterior approach to total hip arthroplasty: a multicenter observational study. Orthop Clin North Am 2009;40:329–42.

[19] Barnett SL, Peters DJ, Hamilton WG, et al. Is the anterior approach safe? Early complication rate associated with 5090 consecutive primary total hip arthroplasty procedures performed using the anterior approach. J Arthroplasty 2016;31:2291–4.

[20] Berend KR, Lombardi Jr AV, Seng BE, Adams JB. Enhanced early outcomes with the anterior supine intermuscular approach in primary total hip arthroplasty. J Bone Joint Surg Am 2009;91 Suppl 6:107−20.
[21] Bremer AK, Kalberer F, Pfirrmann CW, Dora C. Soft-tissue changes in hip abductor muscles and tendons after total hip replacement: comparison between the direct anterior and the transgluteal approaches. J Bone Joint Surg Br 2011;93:886−9.
[22] Christensen CP, Jacobs CA. Comparison of patient function during the first six weeks after direct anterior or posterior total hip arthroplasty (THA): a randomized study. J Arthroplasty 2015;30(9 Suppl):94−7.
[23] Horberg JV, Coobs BR, Jiwanlal A, et al. In: Dislocation rates following total hip arthroplasty via the direct anterior approach regardless of spinopelvic deformity. Virginia Beach, Virginia: Virginia Orthopaedic Society; 2020.
[24] Fleischman AN, Tarabichi M, Magner Z, Parvizi J, Rothman RH. Mechanical complications following total hip arthroplasty based on surgical approach: a large, single-institution cohort study. J Arthroplasty 2019;34:1255−60.
[25] Jewett BA, Collis DK. High complication rate with anterior total hip arthroplasties on a fracture table. Clin Orthop Relat Res 2011;469:503−7.
[26] Sadoghi P, Liebensteiner M, Agreiter M, et al. Revision surgery after total joint arthroplasty: a complication-based analysis using worldwide arthroplasty registers. J Arthroplasty 2013;28:1329−32.
[27] Siljander MP, Whaley JD, Koueiter DM, Alsaleh M, Karadsheh MS. Length of stay, discharge disposition, and 90-day complications and revisions following primary total hip arthroplasty: a comparison of the direct anterior, posterolateral, and direct superior approaches. J Arthroplasty 2020;35:1658−61.
[28] Wang Z, Hou JZ, Wu CH, et al. A systematic review and meta-analysis of direct anterior approach versus posterior approach in total hip arthroplasty. J Orthop Surg Res 2018;13:229.
[29] Macheras GA, Christofilopoulos P, Lepetsos P, et al. Nerve injuries in total hip arthroplasty with a mini invasive anterior approach. Hip Int 2016;26:338−43.