

General

How do Rates of Return to Sports Following Direct Anterior Approach Total Hip Arthroplasty Compare to Other Approaches? A Systematic Review and Meta-analysis

Xuankang Pan, B.S.¹, Sean C. Clark, M.S.¹, Karissa N. Simon, B.S.¹, Jacob F. Oeding, B.S.¹, Cory G. Couch, M.D.¹, Michael J. Taunton, M.D.¹, Mario Hevesi, M.D., Ph.D.¹

¹ Orthopedic Surgery, Mayo Clinic

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Background

There is a paucity of literature analyzing data for return to sport (RTS) and return to work (RTW) in the setting of direct anterior approach (DAA) total hip arthroplasty (THA).

Objective

The aims of this systematic review are to identify existing literature and to aggregate rates of RTS/RTW following DAA THA in a meta-analysis.

Methods

A query of major databases yielded 1819 initial studies. A random-effects model approach was implemented for meta-analysis. Moderator effects were assessed with respect to patient demographics and functional outcomes.

Results

Five studies reporting RTS after DAA THA were identified, representing a total of 204 patients with a mean age of 60.2 ± 7.5 years and mean follow up of 31.8 ± 9.5 months. Pooled rate of RTS was 76% (95% confidence interval [CI], 63%-86%; range 58%-100%). Pooled rate of return to the same sport was 77% (95% CI, 64%-86%; range of 62%-100%). Pooled rate of RTS to the same intensity was 58% (95% CI, 48%-68%; range of 41%-68%). Meta-regression demonstrated no significant correlations between independent variables and RTS characteristics. Three studies reported RTW rates. Rates of RTW within 3-months were 30%, 45%, and 60%. One study reported rate of RTW of 79% at 6-months and 87% at 12-months. One study demonstrated a mean time to RTW of 38 ± 24.8 days.

Conclusion

Pooled rate of RTS is satisfactory following DAA THA and are comparable to rates of RTS aggregated without delineating surgical approach. Data supporting RTW rates following DAA THA limited, and thus more primary studies are needed to establish if this approach confers an advantage of faster RTS/RTW.

INTRODUCTION

Total hip arthroplasty (THA) has been well established as a safe and cost-effective treatment for end stage osteoarthritis of the hip with continuous year over year increases in surgical volume.^{1,2} The posterior, lateral, and anterior approaches represent the broad, overarching categories of modern THAs, the most common being a posterior approach (PA).^{3,4} Although an optimal technique has not been established, each approach demonstrates unique advantages. Traditional PA THAs necessitates intraoperative external rotator muscle and joint capsule violation but al-

lows for excellent femoral visualization and decreased rates of intra-operative fracture.^{5,6} Recently, the direct anterior approach (DAA) has gained popularity, as it is muscle sparing, and empirical evidence has supported lower rates of postoperative dislocation.^{5,7-9} Proponents of DAA THA also have suggested improved time to recovery, although these benefits have not been universally accepted.^{10,11}

Faster rates of return to ambulation, specifically in the immediate postoperative period, have been established in prospective studies comparing DAA to other common approaches.^{12,13} However, the broader clinical relevance, such as return to sports (RTS) and return to work (RTW), of

these findings remains to be demonstrated. Rates of RTS/RTW have been well document and aggregated in systematic reviews and meta-analyses pertaining to THA of all approaches.^{14,15} However, limited studies analyzing data for RTS/RTW exclusively in DAA THAs exist.

Therefore, the aims of this systematic review are to identify existing literature demonstrating RTS/RTW in DAA THA and to aggregate rates of RTS/RTW in a meta-analysis. Given the purported advantages of the DAA approach, we hypothesize that the rates of RTS/RTW would be modestly greater compared to rates reported in previous systematic reviews pooling data from all THA approaches.

MATERIALS AND METHODS

ETHICAL CONSIDERATIONS

Prior to initiating this systematic review, registration with PROSPERO was conducted (CRD42023448251). All steps of this study were conducted in strict adherence to Cochrane Methods¹⁶ guidelines for systematic reviews.

SEARCH STRATEGY

A comprehensive query was conducted by the Mayo Clinic Library on March 4, 2024 according to the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) guidelines ([Figure 1](#)). Results were limited to English Language. No date limits for the search were applied. Databases searched (and their content coverage dates) were Ovid MEDLINE(R) (1946+ including epub ahead of print, in-process, and other nonindexed citations), Ovid Embase (1974+), Ovid Cochrane Central Register of Controlled Trials (1991+), Ovid Cochrane Database of Systematic Reviews (2005+), Web of Science Core Collection via Clarivate Analytics (1975+), and Scopus via Elsevier (1970+).

The search strategies were designed and conducted by a medical librarian with input from the study investigators. Controlled vocabulary supplemented with keywords was used. The actual strategies listing all search terms used and how they are combined is available in the supplemental material. ([Appendix](#))

SELECTION CRITERIA

A total of 1819 studies were initially identified and screened independently by two authors (X.P. and S.C.) in Covidence (Covidence systematic review software, Veritas Health Innovation, Melbourne, Australia). Disagreements at any step of the screening process were resolved by a third independent reviewer (M.H.). Inclusion criteria comprised of the following: clinical studies (levels of evidence 1-4) studies including all patients undergoing DAA THA, studies demonstrating follow up reporting rates of RTS/RTW, and studies published in the English language. Exclusion criteria comprised of the following: studies publishing on approaches other than DAA, studies in which data pertaining to RTS/RTW was unavailable or inseparable from different approaches, narrative reviews, other systematic reviews,

and biomechanical studies. Importantly, studies published by the same author were carefully evaluated to ensure limited to nonexistent population duplication.

STATISTICAL ANALYSIS

Meta analysis was conducted with respect to RTS. A DerSimonian and Laird random effects model¹⁷ approach was implemented to account for both within-study and between-study heterogeneity. Heterogeneity was reported as Higgins and Thompson's I^2 ,¹⁸ between study variance τ^2 , and Cochran's Q (χ^2_5). Heterogeneity was categorized into either low (25%), medium (50%) and high (%) thresholds based on previously reported values by Higgins et al.¹⁹ Moderator effects were assessed with respects to average age, sex, body mass index (BMI), mean follow up time, preoperative Hip Disability and Osteoarthritis Outcome (HOOS) scores, and preoperative UCLA activity scale on rates of RTS, return to same sport, and RTS at same intensity. Results of pooled rates of RTS, return to same sport, and RTS to same intensity were tabulated into forest plots. Funnel plots were generated to provide a visual representation of study heterogeneity. Rates of RTW and associated characteristics were unable to be pooled for meta-analysis due to lack of robust data. A p -value of <0.05 was determined to be significant. All statistical analyses were conducted in the R statistical environment (version 4.3.1, Vienna Austria, 2023) utilizing the *meta* and *metafor* packages concurrently.

RISK OF BIAS

All included studies were assessed for risk of bias utilizing the Risk of Bias in Non-randomized Studies of Interventions (ROBINS I) tool.^{20,21} ROBINS I implements a systematic, stepwise assessment of bias within seven different domains. Each domain receives a designation of "low," "moderate," "serious," or "critical" risk of bias to then assess the overall risk of bias, which itself receives one of the four designations. Risk of bias assessment were conducted independently by two authors (X.P. and K.S.). Results are tabulated in a stop-light representation of all domains and overall risk of bias along with a visual breakdown of proportions ([Figure 2](#)).

DATA EXTRACTION

Two independent reviewers conducted data extraction (X.P., K.S) to ensure data fidelity in a standardized excel spreadsheet. Study characteristics, patient demographics, postoperative rehabilitation protocol, description of sports, description of work, rates of RTS/RTW, postoperative restrictions, patient reported outcome measures (PROMs), were isolated from full manuscripts ([Table 1](#) and [Table 2](#)).

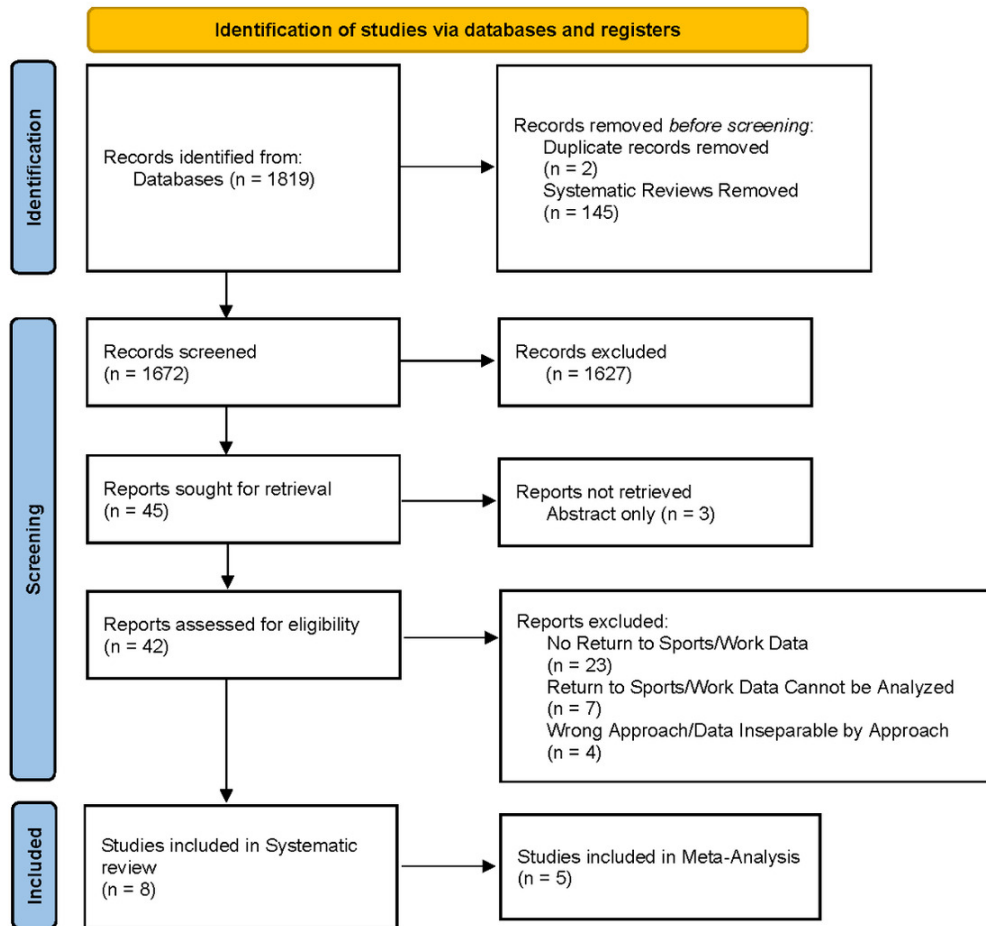


Figure 1. Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) flow chart for screening studies in this systematic review

RESULTS

RATE OF RETURN TO SPORT

Five studies²²⁻²⁶ reporting rates of RTS after DAA THA were identified, representing a total of 204 patients with a weighted mean age of 60.2 ± 7.5 years and weighted mean follow up of 31.8 ± 9.5 months. Across five studies, pooled rate of RTS was 76% (95% CI, 63%-86%) with a range of 58%-100%; heterogeneity was moderate with an I^2 of 64% (Figure 3). Across five studies, pooled rate of return to the same sport was 77% (95% CI, 64%-86%) with a range of 62%-100%; heterogeneity was moderate with an I^2 of 47% (Figure 4). Across four studies, pooled rate of RTS to the same intensity was 58% (95% CI, 48%-68%) with a range of 41%-68%; heterogeneity was low with an I^2 of 0% (Figure 5). A graphical funnel plot representation of publication bias is found in Figure 6. Analysis of the funnel plot was asymmetric with respects to rate of RTS ($p = 0.01$) and rate of return to same sports ($p = 0.01$) and symmetric with respects to RTS to same intensity ($p = 0.67$). The unilateral DAA THA patient group from Battallier et al.²⁶ was the only study population to fall outside of the 95% confidence window on the funnel plot.

MEAN TIME TO RTS

Three studies reported time to RTS. Nogier et al.²³ reported a mean time to RTS of 5.1 ± 3.9 months (range 1-14 months). Yun et al.²⁵ reported a mean time to RTS of 2.0 ± 3.0 months (range 1-12 months). Bataillier et al.²⁶ reported a mean time to RTS of 5.4 ± 5.1 months in unilateral THA patients and a mean time to RTS of 4.2 ± 2.7 months in bilateral THA patients. This difference in mean time to RTS was not statistically significant.

FACTORS AFFECTING RTS

Meta-regression analysis demonstrated no statistically significant correlations between average age, sex, BMI, mean follow up time, preoperative (HOOS) scores, and preoperative UCLA activity scale on rates of RTS, return to same sport, or RTS at same intensity ($p > 0.22$).

Nogier et al.²³ reported patient reasons for not RTS were loss of interest, fear of injury, pain or discomfort on the contralateral hip, and loss of pleasure in dance. A univariate and multivariate analysis was conducted with respect to independent variables of sex, age, BMI, indication for surgery, laterality of THA, femoral head size, years of sporting experience, preoperative sporting hours, and pre-

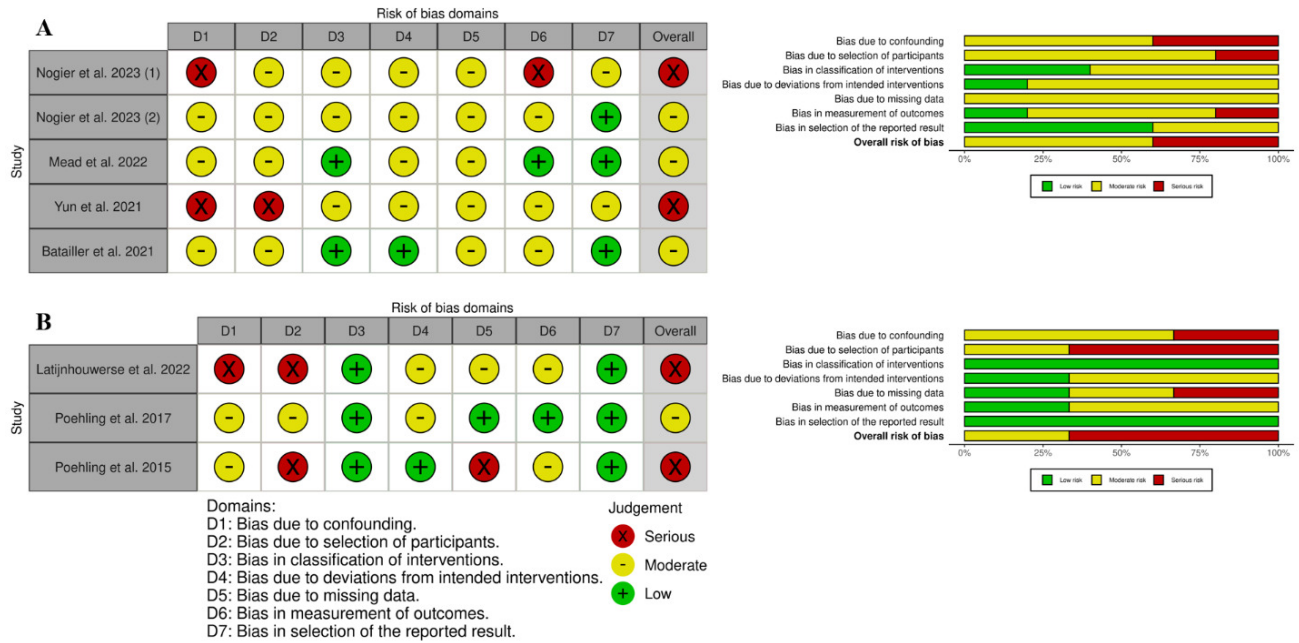


Figure 2. A) Risk of Bias in Non-randomized Studies of Interventions (ROBINS I) assessment in stoplight representation and bar graph summary for all studies pertaining to return to sport. B) ROBINS I assessment in stoplight representation and bar graph summary for all studies pertaining to return to work

Table 1. Population and follow up characteristics of studies included in the systematic review

Author	Study Design, Level of Evidence	Year	Country	Age (mean years $\pm$ SD)	Sex (Male n [%])	BMI (Mean $\pm$ SD)	Follow up (mean months $\pm$ SD) or (total months)
Return to Sport (RTS)							
Nogier et al. (1)*	Case Series, 4	2023	France	30.0 $\pm$ 8.3	2 (33.3%)	19.8 $\pm$ 2.8	43.2 $\pm$ 14.4
Nogier et al. (2)*	Case Series, 4	2023	France	50.5 $\pm$ 14.9	4 (18.2%)	20.7 $\pm$ 2.9	40.8 $\pm$ 16.8
Mead et al.	Case Control, 3	2022	United States	67.0 $\pm$ 8.9	21 (32%)	24.6 $\pm$ 3.9	30 $\pm$ 10.3
Yun et al.	Case Series, 4	2021	United States	50.0 $\pm$ 10.0	3 (21.4%)	NR	60 $\pm$ 4
Batailler et al. (Bilateral DAA THA) [†]	Case Control, 3	2019	France	61.8 $\pm$ 10	21 (65.6%)	25.9 $\pm$ 4	28.9 $\pm$ 15
Batailler et al. (Unilateral DAA THA) [†]	Case Control, 3	2019	France	60.7 $\pm$ 9.8	42 (65.6%)	26 $\pm$ 4.1	20.9 $\pm$ 10.8
Return to Work (RTW)							
Latijnhouwerse et al.	Case Control, 3	2022	Netherlands	68.0 $\pm$ 10.0	236 (37.9%)	27.0 $\pm$ 4.0	12
Poehling et al.	Prospective Cohort, 3	2017	United States	63.0 $\pm$ 9.3	26 (52.0%)	31.0 $\pm$ 5.11	1.5
Poehling et al.	Case Control, 3	2015	United States	64.8 $\pm$ 12.4	59 (46.8%)	30.0 $\pm$ 5.5	1.5

*Separate studies published by the same author during the same year

[†]Populations belonging to the same study that were unable to be combined

BMI, body mass index; NR, not reported; RTS, return to sport; RTW, return to work; SD, standard deviation

Table 2. Study Design, RTW/RTS characteristics, and Study Outcomes

Author	Sport/Work Characteristics	Factors Affecting RTS/RTW	Comparative Outcomes
RTS			
Nogier et al. (1)*	All patients were professional ballet dancers	Three dancers reporting >12 months to RTS exhibited little to no preoperative external rotation of hip.	NR
Nogier et al. (2)*	All patients were current or former professional ballet dancers	No significant drivers of RTS with respect to independent variables. Most cited reasons for not returning to sport: loss of interest (6/6), fear of injury (2/6), pain or discomfort on contralateral hip (1/6), loss of pleasure (1/6).	NR
Mead et al.	Types of recreational activity reported for DAA Low impact n (%) - Walking: 26 (40%) - Cycling: 18 (28%) - Swimming: 10 (15%) - Golf: 7 (11%) - Yoga: 5 (8%) - Gardening: 4 (6%) - Animal training: 2 (3%) - Fishing: 1 (2%) - Sailing: 1 (2%) - Snowshoeing: 1 (2%) % Activity: 61% High Impact n [%] - Exercise class: 19 (29%) - Hiking: 9 (14%) - Weightlifting: 9 (14%) - Running: 3 (5%) - Skiing: 2 (3%) - Tae Kwon do: 1 (2%) - Tennis: 1 (2%) - Surfing: 1 (2%) - Dance: 1 (2%) - Kayak: 1 (2%) % Activity: 39%	28% of patients in DAA and 4% of patients in PA group self-reported surgical approach influenced their ability to return to sport ($p < 0.01$)	Rate of RTS between DAA and PA groups did not differ. Higher percentage of patients returned to same sport in DAA group ($p = 0.10$).
Yun et al.	All patients were yoga instructors	NR	NR
Batailler et al.	Majority sports (82%) were low impact sports according to American Association of Hip and Knee Surgeons (AAHKS) recommendations	Percentage of patients citing reasons for not returning to sport, returning at a lower intensity, or returning to another sport Bilateral THA Pain: 10% Stiffness: 5% Fear of dislocation: 5% Avoid wear: ~2.5% Physician Recommendation: ~6% No motivation: ~24% Other: ~14% Unilateral THA Pain: ~2.5% Stiffness: < 2% Fear of dislocation: < 2% Avoid wear: < 2% Physician Recommendation: 0% No motivation: ~4.5% Other: ~6% Most cited reason for no RTS or RTS at lower intensity was pain unrelated to the hip joint (i.e., knee, lower back)	Motivation was the only statistically significant variable influencing RTS which differed between bilateral and unilateral cohort
RTW			
Latijnhouwerse et al.	DAA Working hours, Mean $\pm$ SD: 31.0 ± 12.0 Physical workload n (%): Light: 64 (40.0%)	NR	Difference in rates of RTW and work restrictions postoperatively not

Author	Sport/Work Characteristics	Factors Affecting RTS/RTW	Comparative Outcomes
	Medium: 66 (41.0%) Heavy: 31 (19.0) Employment n (%): Employed: 134 (82.0%) Self-employed: 29 (18.0%) On Sick leave: 40 (24.0%) Work restrictions: 130 (88.0%)		statistically significant between DAA and PLA group
Poehling et al. (2017)	NR	NR	No statistically significant difference in rate of RTW and mean time to RTW between DAA and MPA group
Poehling et al. (2015)	NR	NR	DAA RTW (n = 36) Yes: 11 (30.0%) No: 25 (69.0%) Missing: n = 90 MPA RTW (n = 35) Yes: 1 (2.0%) No: 34 (97.0%) Missing: n = 61 $p < 0.01$

*Separate studies published by the same author during the same year

DAA, direct anterior approach; MPA, minimiposterior approach; NR, not reported; PA, Posterior Approach; PLA, posterolateral approach; RTS, return to sport; RTW, return to work; THA, total hip arthroplasty

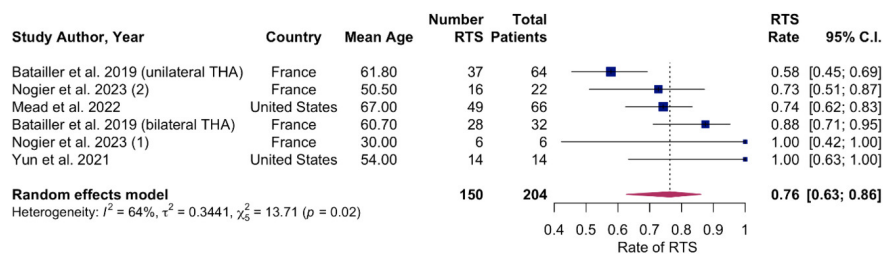


Figure 3. Forest plot representation of pooled rate of RTS weighted by number of patients.

Study author, year of publication, country of origin, number of patients per study are reported. Forest plot square size approximates the weight of each given study. RTS, return to sport; CI, confidence interval; I^2 , Higgins and Thompson's heterogeneity; τ^2 , between study variance; χ^2_5 , Cochran's Q .

operative sporting intensity. No statistical significance was demonstrated between independent variables and rate of RTS.

Mead et al.²⁴ reported that 28% of patients self-reported that surgical approach affected their ability to RTS in comparison to 4% of patients in a posterior approach group. In

the patient population of Batailler et al.²⁶ the most common reason for not returning to the same sport or to a lower intensity was physical pain unrelated to the hip (i.e. knee and lower back).

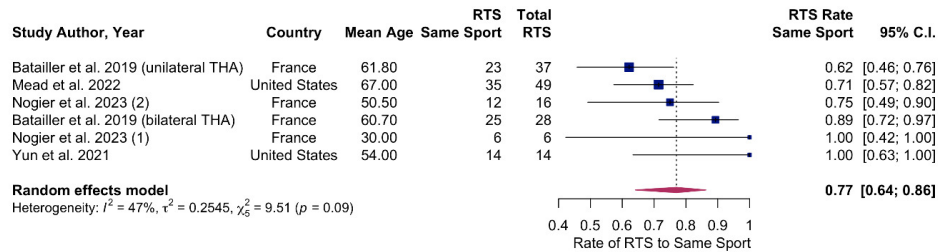


Figure 4. Forest plot representation of pooled rate of return to same sport weighted by number of patients. Study author, year of publication, country of origin, number of patients per study are reported.

Forest plot square size approximates the weight of each given study. RTS, return to sport; CI, confidence interval. I^2 , Higgins and Thompson's heterogeneity; τ^2 , between study variance; χ^2_5 , Cochran's Q .

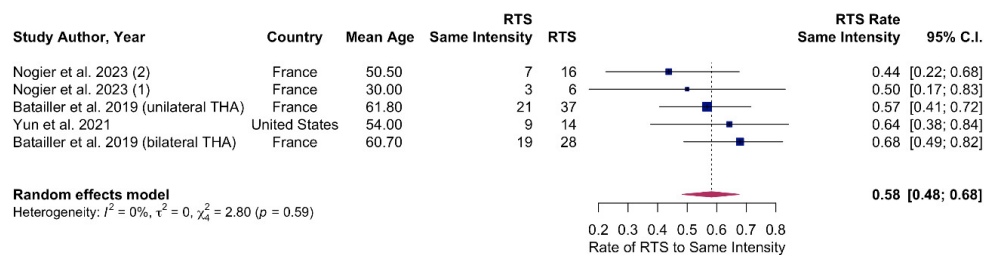


Figure 5. Forest plot representation of pooled RTS to the same intensity weighted by number of patients.

Study author, year of publication, country of origin, number of patients per study are reported. Forest plot square size approximates the weight of each given study. RTS, return to sport; CI, confidence interval. I^2 , Higgins and Thompson's heterogeneity; τ^2 , between study variance; χ^2_5 , Cochran's Q .

POSTOPERATIVE COMPLICATIONS

Four out of the five studies did not disclose any postoperative complications or surgical revisions. Nogier et al.²³

demonstrated complications in 3 patients (11.5%). One patient underwent implant removal and subsequent head and cup revision in the setting of severe leg-length discrepancy 6-months after the index surgery. Two patients had post-

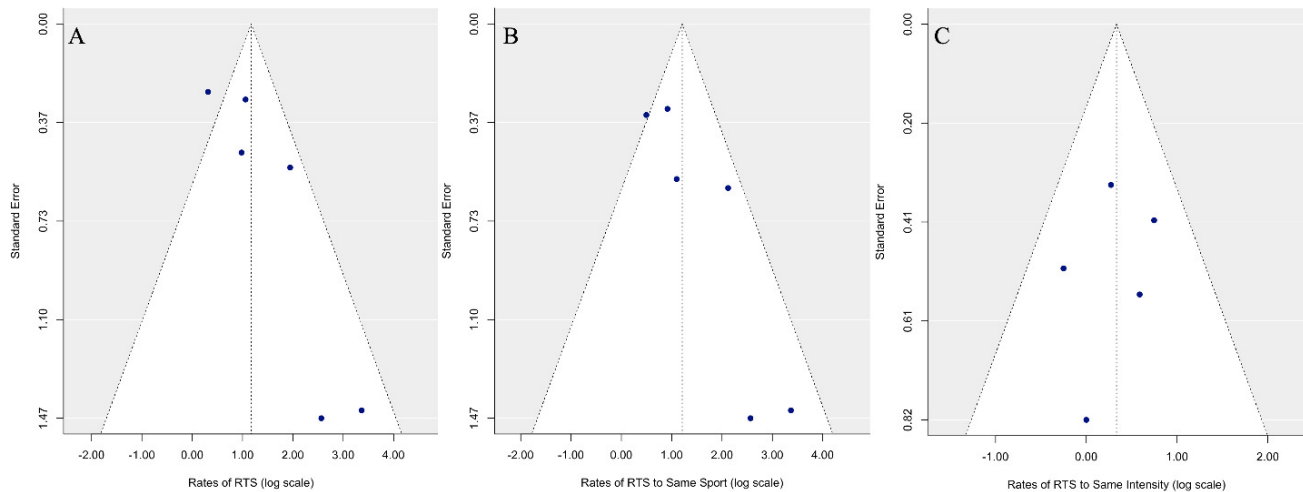


Figure 6. Funnel plot representation of (A) rates of RTS, (B) rates of return to same sport, and (C) rates of RTS to the same intensity.

RTS, return to sport. Each dot represents the log rate of RTS plotted against the standard error of each individual study. Gray represents areas outside of the 95% confidence interval.

operative iliopsoas bursitis or impingement treated conservatively with corticosteroid steroid injection and physical therapy.

RETURN TO WORK

Three studies were identified with characteristics pertaining to RTW.²⁷⁻²⁹ Rates of RTW within 3 months between three studies were 30%,²⁹ 45%,²⁷ and 60%.²⁸ One study reported rate of RTW of 79% at 6 months and 87% at 12 months.²⁷ The study that reported a RTW of 60% at 8-week follow-up demonstrated a mean time to RTW of 38 ± 24.8 days.²⁸

Latijnhouwerse et al.²⁷ reported physical workload characteristics preoperatively; 40% of patients were characterized as light, 41% of patients medium, and 19% of patients heavy. Postoperatively, 51% of patients reported work limitations due to physical constraints at 3 months, 39% of patients at 6 months, and 20% of patients at 12 months.

DISCUSSION

In this study, we analyzed the rates of RTS/RTW, with a meta-analysis conducted with respects to RTS. At a weighted mean follow up of 31.8 ± 9.5 months, pooled analysis demonstrated rate of RTS was 76%; rate of return to the same sport was 77%; rate of RTS to the same intensity was 56%. Rates of RTW were unable to be pooled due to limited data.

The rate of RTS following DAA THA is comparable to THAs of different approaches and other non-arthroplasty hip procedures. Pasqualini et al.¹⁴ conducted a systematic review of 16 studies collectively representing 1,462 patients on RTS following THA without delineating surgical approach, demonstrating an overall pooled RTS rate of 85%. Importantly, only two out of the five studies analyzed in our meta-analysis overlapped with that of Pasqualini et al.,

and the remaining studies were published following the inception of their investigation. O'Connor et al.³⁰ conducted a meta-analysis on RTS following hip arthroscopy from 22 studies representing 1296 patients with a mean age of 40.0 ± 1.3 years and reported a rate of RTS was 84.6%. Our pooled rates of RTS for DAA THA were comparable to that of hip arthroscopy, despite arthroplasty being performed on a considerably older patient population.

The majority of patients were able to resume the same preoperative sporting activities, although the intensity of activities demonstrated a decline. Pooled analysis in our study included wide range of sports participation. It is unknown how the decrease in intensity after RTS is distributed across different sporting activities based on available data. However, previous analyses with data stratified by sports categories may provide insight. A systematic review of 14 studies by Hoorntje et al.¹⁵ reported low impact sports participation of 62% preoperatively and 69% postoperatively; intermediate impact sports participation of 24% preoperatively and 23% postoperatively; and high impact sports participation of 14% and 8% postoperatively. Similarly, Pasqualini et al.¹⁴ reported a pooled RTS rate for high intensity sports of 35% and a pooled RTS rate for low intensity sports of 76%. Thus, the rate of RTS to the same intensity may be disproportionately impacted by patients participating in high impact sports preoperatively. Notably, many systematic reviews do not explicitly report rates of RTS to the same intensity.

Meta-regression analysis failed to demonstrate statistically significant correlations between age, sex, BMI, mean follow up time, and preoperative PROMs with rate of RTS. Previously published systematic reviews similarly were unable to establish consensus correlations between demographic characteristics and rates of RTS.^{14,15} However, preoperative sports participation³¹⁻³⁴ and patient motivation^{35,36} have been consistently identified as particularly important predictors for successful RTS in current lit-

erature. One study further reported a stronger correlation between motivation and RTS than postoperative level of pain and discomfort.³⁵ These trends are similarly reflected in amongst the studies in our systematic review, as two studies reported either loss of interest or motivation as the most common reasons for not RTS.^{23,26} Thus successful RTS may be less dependent on THA approach and more contingent on individual goals and expectations.

Interestingly, the unilateral THA population from Batailler et al.²⁶ in our meta-analysis had fallen outside of the 95% CI for the funnel plots, suggesting the rate of RTS from this group may be a potential outlier. This apparent heterogeneity may be partially explained by the natural history of hip osteoarthritis. Symptomatic osteoarthritis in one hip is associated with radiographic evidence of contralateral joint osteoarthritis in up to 80% of cases, with rates of severe disease progression necessitating contralateral THA within 10-years of the index surgery ranging from 17-35%.³⁷⁻⁴¹ Thus, those receiving unilateral THA in the study by Batailler et al.²⁶ may have been limited from physical activity by pathology in the contralateral hip. The unilateral THA group in subsequent funnel plots approached the 95% CI in return to the same sport and was within the 95% CI in RTS to same intensity, which may suggest that those who did RTS were less limited by joint pathology in the contralateral hip at baseline.

Limited studies exist which reports rates of RTW following DAA THA. Only found one study was identified which reporting RTW rates and characteristics as the primary study outcome, while two other studies had analyzed RTW rates as a secondary study outcome. All three studies were comparative. Latijnhouwer et al.²⁷ compared DAA to posterolateral approach in a propensity matched population and demonstrated no significant difference in rates of RTW or number of hours worked at three, six, and twelve months postoperatively. Poehling et al.²⁹ retrospectively demonstrated a significant difference between DAA RTS rates (30%) and minimiposterior approach (MPA) RTS rates (2%) ($p = <0.01$). However, data from 90/126 patients in the DAA group and 61/96 in the MPA group were missing. Another study by Poehling et al.²⁸ reported on outcomes between DAA and MPA THA patients from a separate prospective population. Mean number of days to RTW was significantly longer in the DAA cohort (38 ± 24.8 days) compared to the MPA cohort (26 ± 16.1 days) ($p = 0.04$). It was not reported if the rate or RTW in the DAA cohort (60%) was significantly different from the MPA cohort (54%). Existing literature lacks data to support definitive rates of RTW in DAA THA patients both in terms of quality and quantity. The lack of high-quality data underscores the need for further studies on RTW rates and characteristics following DAA THA. Considering arguments for DAA THA are framed within the context of faster recovery time compared to other approaches, more evidence is needed to accurately counsel patients on RTW expectations following surgery.

LIMITATIONS

This study should be interpreted in light of its limitations. The number of available studies published that reported on

rates RTS after DAA THA were limited, which allows individual studies with outlier data in the meta-analysis of RTS to have increasing influence on pooled averages. This was confirmed on funnel plot analysis which demonstrated asymmetry and disproportionally increased weight on the cohort represented by unilateral THA from Batailler et al.²⁶ Another limitation is that two studies analyzed rates of return to sports based on patients performing sports at a high to professional level, which may artificially deflate rates of RTS and RTS at the same intensity. The overall evidence of the pooled meta-analysis data was poor, with only level 3 and level 4 studies, as there were no published randomized controlled trials comparing DAA THA to other approaches in our literature search.

CONCLUSION

Pooled rate of RTS is satisfactory following DAA THA and are comparable to rates of RTS aggregated without delineating surgical approach. This provides further support for the utility and safety profile of THA as a whole. Data supporting RTW rates following DAA THA limited, and thus further analysis could not be conducted. More primary studies on RTS/RTW in DAA THAs are needed to establish if this approach confers an advantage of faster RTS/RTW. Although prior studies have demonstrated faster recovery rates in DAA THA the immediate perioperative period, there are few comparative studies that translate these results to clinically applicable outcomes. It is unclear whether a difference in RTS/RTW is truly attributable to the THA approach itself, or rather confounding factors such as self-selecting patients, individual goals, individual expectations.

DISCLOSURES

Xuankang Pan, Sean C. Clark, and Karissa N. Simon have no disclosures.

Jacob F. Oeding discloses the following: [Kaliber.ai](#), paid consultant

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APPENDIX

OVID

Database(s): **Ovid MEDLINE(R) 1946 to Present and Epub Ahead of Print, In-Process & Other Non-Indexed Citations and Ovid MEDLINE(R) Daily, EBM Reviews - Cochrane Central Register of Controlled Trials **June 2023**, EBM Reviews - Cochrane Database of Systematic Reviews **2005 to July 12, 2023**, Embase **1974 to 2023 July 13

Search Strategy:

Search Strategy

#	Searches
1	Arthroplasty, Replacement, Hip/
2	Arthroplasty, Replacement/
3	Hip Joint/
4	2 and 3
5	((((arthroplast* or hemiarthroplast* or "hemi-arthroplast*") adj5 hip*) or (replacement adj3 (hip or hips))))).ti,ab,hw,kf.
6	1 or 4 or 5
7	(DAA or "direct anterior" or approach*).ti,ab,hw,kf.
8	Minimally Invasive Surgical Procedures/
9	exp minimally invasive surgery/
10	("minimally-invasive" or MIS or cMIS or "less-invasive" or microsur* or "micro-surg*" or endoscop* or tubular or laparoscop* or "mini-surg*" or minisurg* or "microscopic-surg*" or "mini-endo*" or "micro-endoscop*" or microendoscop* or ((mini* or lap* or robot* or endoscop* or tubular or percutaneous or "muscle-sparing") adj4 (technique* or approach* or technolog* or access or assist* or invasive or surg*))).ti,ab.
11	7 or 8 or 9 or 10
12	exp return to sport/
13	(return* or resum* or participat* or "re-entry" or "re-enter*" or restart* or "re-start*").ti,ab,hw,kf. or (play* or sport* or function or activity or activities or work or preinjur* or "pre-injur*" or athletic* or competition or recreation*).ti,ab.
14	12 or 13
15	6 and 11 and 14
16	(exp animals/ or exp nonhuman/) not exp humans/
17	((alpaca or alpacas or algae* or amphibian or amphibians or animal or animals or antelope or armadillo or armadillos or avian or baboon or baboons or bats or beagle or beagles or bee or bees or bird or birds or bison or bovine or buffalo or buffaloes or buffalos or "c elegans" or "Caenorhabditis elegans" or camel or camels or canine or canines or canis or carp or cats or catfish or cattle or chamaeleo* or chameleon* or chick or chicken or chickens or chicks or chimp or chimpanze or chimpanzees or chimps or cow or cows or "D melanogaster" or "dairy calf" or "dairy calves" or deer or dog or dogs or donkey or donkeys or drosophila or "Drosophila melanogaster" or duck or duckling or ducklings or ducks or equid or equids or

#	Searches
	equine or equines or feline or felines or ferret or ferrets or finch or finches or fish or flatworm or flatworms or fox or foxes or frog or frogs or "fruit flies" or "fruit fly" or "G mellonella" or "Galleria mellonella" or geese or gerbil or gerbils or goat or goats or goose or gorilla or gorillas or groundhog or groundhogs or hamster or hamsters or hare or hares or heifer or heifers or horse or horses or iguana or iguanas or insect or insects or jellyfish or kangaroo or kangaroos or kitten or kittens or "laboratory animal*" or lagomorph or lagomorphs or lamb or lambs or lemur or lemurs or lemuriidae or llama or llamas or macaque or macaques or macaw or macaws or marmoset or marmosets or mice or minipig or minipigs or mink or minks or monkey or monkeys or mouse or mule or mules or muskrat or muskrats or nematode or nematodes or newt or newts or octopus or octopuses or orangutan or "orang-utan" or orangutans or "orang-utans" or oxen or parrot or parrots or pig or pigeon or pigeons or piglet or piglets or pigs or porcine or primate or primates or poultry or quail or rabbit or rabbits or rat or rats or reptile or reptiles or rodent or rodents or ruminant or ruminants or salmon or sheep or shrimp or slug or slugs or swine or tamarin or tamarins or tilapia or tilapias or toad or toads or trout or urchin or urchins or vole or voles or waxworm or waxworms or weasel or weasels or wolf or wolves or worm or worms or wrass* or xenopus or "zebra fish" or zebrafish) not (human or humans or patient or patients)).ti,ab,hw,kw.
18	(rat or rats or mice or mouse or murine or pig or pigs or porcine or swine or dog or dogs).ti.
19	or/16-18
20	15 not 19
21	(conference abstract or conference review or editorial or erratum or note or addresses or autobiography or bibliography or biography or blogs or comment or dictionary or directory or interactive tutorial or interview or lectures or legal cases or legislation or news or newspaper article or patient education handout or periodical index or portraits or published erratum or video-audio media or webcasts).mp. or conference abstract.st.
22	20 not 21
23	limit 22 to english language [Limit not valid in CDSR; records were retained]
24	remove duplicates from 23

SCOPUS

((TITLE-ABS-KEY ((arthroplast* OR hemiarthroplast* OR "hemi-arthroplast*") W/5 hip*) OR TITLE-ABS-KEY (replacement W/3 (hip OR hips))) AND (TITLE-ABS-KEY (daa OR "direct anterior" OR approach*) OR TITLE ("minimally-invasive" OR mis OR cmis OR "less-invasive" OR microsur* OR "micro-surg*" OR endoscop* OR tubular OR laparoscop* OR "mini-surg*" OR minisurg* OR "microscopic-surg*" OR "mini-endo*" OR "micro-endoscop*" OR microendoscop* OR ((mini* OR lap* OR robot* OR endoscop* OR tubular OR percutaneous OR "muscle-sparing") W/4 (technique* OR approach* OR technolog* OR access OR assist* OR invasive OR surg*)))) AND (TITLE-ABS-KEY (return* OR resum* OR participat* OR "re-entry" OR

“re-enter*”))) AND NOT (INDEX (embase) OR INDEX (medline) OR PMID (0* OR 1* OR 2* OR 3* OR 4* OR 5* OR 6* OR 7* OR 8* OR 9*)) AND (LIMIT-TO (SRCTYPE , “j”)) AND (LIMIT-TO (DOCTYPE , “ar”)) AND (LIMIT-TO (LANGUAGE , “English”))

WEB OF SCIENCE

((TS=((arthroplast* or hemiarthroplast* or “hemi-arthroplast*”) NEAR/5 hip*) or TS=(replacement NEAR/3 (hip or hips))) AND (TS=(DAA or “direct anterior” or approach*) OR TI=(“minimally-invasive” or MIS or cMIS or “less-invasive” or microsurg* or “micro-surg*” or endoscop* or tubu-

lar or laparoscop* or “mini-surg*” or minisurg* or “microscopic-surg*” or “mini-endo*” or “micro-endoscop*” or microendoscop* or ((mini* or lap* or robot* or endoscop* or tubular or percutaneous or “muscle-sparing”) NEAR/4 (technique* or approach* or technolog* or access or assist* or invasive or surg*))) AND TS=(return* or resum* or participat* or “re-entry” or “re-enter*”)) not PMID=(0* or 1* or 2* or 3* or 4* or 5* or 6* or 7* or 8* or 9*)

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