Is Limited Incision Better Than Standard Total Hip Arthroplasty? A Meta-analysis

Joseph T. Moskal MD, Susan G. Capps PhD

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Abstract

Background The literature comparing limited incision and standard incision THAs is confusing regarding whether limited incision THA improves short-term recovery without compromising long-term durability and survival. Further, previously published meta-analyses cannot

conclude that limited incision THA is better. With new data, we seek to discover if the answers now exist.

Purpose We used meta-analysis to compare surgical and hospitalization data, clinical outcomes, and complication rates, and thus (1) confirm whether limited incision THA is at least comparable to standard incision THA; and (2) determine whether limited incision THA is an improvement over standard incision THA.

Methods The PubMed database was searched using the terms “minimally”, “invasive”, and “total hip”. Inclusion was limited to studies directly comparing limited incision with standard incision THA and reporting effect sizes.

Results We identified 418 articles. Of these 11 provided background information and 30 provided data (3548 THAs) for the systematic review. Limited incision THA was better than standard incision THA in four measures: length of hospitalization (6 versus 7 days), VAS pain at discharge (2 versus 4), blood loss (421 mL versus 494 mL), and the Harris hip score at 3 months postoperation (90 versus 84). There were no outcomes for which standard incision was better. There was no major difference in the rate of complications.

Conclusions Short-term recovery favors limited incision over standard incision THA. The lack of consistent reporting for surgical outcomes, clinical outcomes, and complications continues to create difficulties when comparing limited and standard incision THAs.

One of the authors certifies that he (JTM), or a member of his immediate family, has or may receive payments or benefits, during the study period, an amount of \$10,000–\$100,000 from DePuy, a Johnson & Johnson Company (Warsaw, IN, USA); an amount of \$10,000–\$100,000 from Zimmer (Warsaw, IN, USA); and an amount of \$10,000–\$100,000 from Medtronic (Minneapolis, MN, USA). One of the authors certifies that she (SGC), or a member of her immediate family, has or may receive payments or benefits, during the study period, an amount of \$10,000–\$100,000 from DePuy, a Johnson & Johnson Company; and an amount of \$10,000–\$100,000 from J&P Moskal, Inc. (Roanoke, VA, USA).

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J. T. Moskal (✉)
Virginia Tech Carilion School of Medicine, No – 3 Riverside
Circle – 1st Floor, Roanoke, VA 24016, USA
e-mail: jtmoskal@carilionclinic.org

S. G. Capps
BENSOL Inc, Warsaw, IN, USA

Introduction

Limited incision THA promises improved short-term recovery without compromising long-term durability and pain relief compared with standard incision THA. The

claims of limited incision THA can be categorized into major goals (reduced complication rates, reduced pain, a quicker return to function, and long-term survival) on par with standard incision THA and minor goals (improved cosmesis and shorter hospital stay) [3, 4, 10, 13, 15, 19, 22, 23, 26, 36, 37, 43, 51–53, 56–58].

In any limited incision THA approach (direct anterior, anterolateral, lateral, two-incision, posterior, or posterolateral) there is a possibility of injuring the skin and soft tissues by stretching and/or tearing in the effort to see while in a reduced visual surgical field [5, 31]. As the surgical team becomes more familiar with the procedures, there is the possibility of shorter surgical times. Implant insertion in a reduced visual field may lead to an increased rate of fractures [2, 39] and poor component position [2, 5, 48], which in turn may lead to more frequent dislocations and failures, resulting in decreased survivorship of the index components [2, 29]. There is a higher risk of neurovascular injury leading to nerve damage and thromboembolism [2, 5, 39]. Finally, because of these difficulties and possibly higher complication rates, there is the risk of higher reoperation rates [2, 5, 39].

The goal of evidence-based medicine, as informed by meta-analysis, is better outcome-based decision-making. Numerous studies [9, 12, 14, 26, 27, 29, 30, 44, 46, 49, 50, 52, 58, 60] have used systematic review techniques to investigate the claims that limited incision THA is an improvement over standard incision THA. According to the studies using quantitative analysis, the published data cannot clearly conclude that limited incision is better than standard incision THA. However, length of surgery [9, 12, 60] and blood loss [9, 12, 50, 60] tend to favor limited incision THA while the quantitative analyses do not find differences for length of hospital stay [29, 60], hip scores [27, 29, 50], or complication rates [27, 29, 50, 60]. The impact of the changes to anesthesia, pain management, and rehabilitation practices have occurred during the same period as the increased prominence of limited incision THA; this further complicates the conclusions of studies comparing limited incision and standard incision THAs [44].

Currently published studies comparing limited incision and standard incision THAs do not clearly establish whether limited incision THA improves short-term recovery without compromising long-term durability and survival. Further, existing meta-analyses [9, 12, 27, 29, 44, 50, 60] cannot conclude that limited incision THA is better in all aspects. With new data, we seek to discover if the answers now exist.

Therefore we performed a meta-analysis to compare surgical outcomes, clinical outcomes, and complication rates and thus: (1) confirm whether limited incision THA is at least comparable to standard incision THA; and

(2) determine whether limited incision THA is an improvement over standard incision THA as claimed.

Search Strategy and Criteria

We conducted a survey using PubMed databases that focused on English language orthopaedic literature that has been published since 2000. Three search terms, “minimally”, “invasive”, and “total hip”, were used. The references from the resulting sources were checked to supplement electronic searches and to identify any additional searches.

The searches yielded 418 references (Fig. 1). The titles and journal of origin were screened (SGC) and records were excluded based on three criteria: not clinical data, not limited incision THA, and not in English. Potentially eligible articles ($n = 193$) were further assessed by reviewing the abstracts in greater detail (SGC). Of the 193 studies 41 full text articles were examined in detail for inclusion (JTM and SGC). Included studies had to satisfy a single criterion: they had to compare limited incision with standard incision THA. Both authors independently reviewed the 30 studies that met this criterion; rejection of articles required both authors' agreement (JTM and SGC). The level of evidence was rated for each study at the time of data extraction, based on the guideline of the Centre for Evidence-Based Medicine (Oxford, UK) [7]. Using the PRISMA Statement (an update of the QUOROM Statement) as a guideline, risk of bias, rather than study quality, was evaluated using (1) clarity of presentation, (2) numbers lost to followup, (3) allocation concealment (where applicable), and (4) completeness of outcome reporting [28]. In addition, the publication bias was assessed using forest plots and weighted means as described in Borenstein et al. [6]. When data from a single population were presented in multiple publications, the data were combined to create one kinship study to avoid double-counting cases and creating undue bias in the dataset.

Thirty sources provided data comparing 32 limited incision THA datasets and 32 standard incision THA datasets; 3548 THAs were analyzed (Table 1). Four studies were blinded randomized controlled trials (RCTs) (Level I evidence) [14, 17, 38, 59], three were nonblinded RCTs (Level II) [10, 15, 32], and 23 were nonRCT comparative studies (Level III) [1, 8, 11, 16, 18, 21, 22, 24, 25, 33–37, 40–42, 45, 47, 51, 54, 55, 58]. The studies comparing limited incision and standard incision THAs were predominantly from Europe (40%) and primarily from single centers (97%).

Both authors (JTM and SGC) independently extracted data elements from the included studies using a data collection sheet developed internally (SGC) using principles

Fig. 1 This flow diagram illustrates the number of articles selected from PubMed searches and the number remaining after the exclusion criteria were applied. LITHA = limited incision THA; SITHA = standard incision THA.

from the Cochrane Handbook for Systematic Reviews of Interventions [20]. Differences were resolved before the data entry and analysis through consensus.

To consider a variable for data analysis, it must have been reported in at least four references, less than four references created excessive opportunity for bias (for example, to perform data analysis on variable X, four references must report variable X for limited incision and standard incision THAs, three references contained two data sets per variable [40, 45, 47]). Data were not always reported consistently or frequently enough to meet this criteria, and thus, there was a limited pool of variables available for comparison. Patient characteristics, such as age, BMI, and the percentage of male patients, were available for analysis of limited incision and standard incision THAs. Surgical and hospitalization variables, such as the length of surgery, blood loss, units of blood transfused, transfusion rate (percentage of patients having THAs receiving transfusion), preoperative hemoglobin, pain at discharge, length of hospitalization, and the rate of discharge to home, were sufficient for analysis. Complication rates (total, fractures, infections, wound healing issues, nerve issues, dislocation, deep vein thrombosis or pulmonary embolism, and aseptic loosening), along with Harris hip scores at 3 months, were reported frequently and available for meta-analysis.

Statistical analysis was done using JMP[®] software Version 9.02, (SAS[®] Institute Inc, Cary, NC, USA) and Comprehensive Meta-Analysis Version 2 (Biostat[™], Englewood, NJ, USA). Statistical significance was defined

by $p < 0.05$; clinical importance is not easily defined by a numerical value and must be determined based on clinical experience. We report the findings considering statistical significance and our judgment of clinical importance. JMP[®] Statistical Analysis software was used to create distributions of various data characteristics and weighted means where possible by using the number of THAs of enrolled patients as the denominator.

A random effects meta-analysis, using Comprehensive Meta-Analysis software, was used to reflect variation among studies. According to Borenstein et al. [6], random effects meta-analysis should be used when data are accumulated from a series of studies that were performed by independently functioning researchers, and this form of meta-analysis allows for the inclusion of studies regardless of population sizes without assigning too little or too much weight to the data [6]. Continuous variables were analyzed by using the reported means and SDs for effect sizes; meta-analysis results were shown as standard difference in means. The meta-analysis results for variables that were reported as incidents or rates are shown as relative risks (RR).

Results

Most variables showed no difference between limited incision and standard incision THAs. Because standard incision THA was not favored over limited incision THA, limited incision THA is comparable to standard incision THA regarding surgery, hospitalization, and adverse

Table 1. Thirty studies meeting the inclusion and exclusion criteria

Study	Location	Setting	Institution	Level of evidence	Industry sponsorship	Limited incision THA (number)	Standard incision THA (number)
Alecci et al. [1]	Europe	Single center		Level III		221	198
Goosen et al. [17]	Europe	Single center		Level I	No	60	60
Martin et al. [32]	Europe	Single center		Level II		42	41
Muller et al. [34]	Europe	Single center		Level III		24	20
Schleicher et al. [42]	Europe			Level III		64	64
Yang et al. [59]	Asia	Single center		Level I		55	55
Chen et al. [8]	Asia	Single center	Teaching	Level III	No	83	83
Han et al. [18]	Asia	Single center	Teaching	Level III		18	19
Mazoochian et al. [33]	Europe	Single center		Level III	No	26	26
Shitama et al. [45]	Asia	Single center	Teaching	Level III		34	28
Vicente et al. [51]	South America	Single center	Teaching	Level III		34	42
Williams et al. [54]	North America	Single center	Teaching	Level III	No	67	42
Dorr et al. [14]	North America	Single center		Level I	Yes	30	30
Dutka et al. [15]	Europe	Single center		Level II		60	60
Rapala et al. [41]	Europe	Single center	Teaching	Level III		23	29
Wong et al. [55]	Asia	Single center		Level III		12	12
Khan et al. [24]	Asia	Single center		Level III		100	100
Laffosse et al. [25]	Europe	Single center		Level III	No	42	58
Murphy et al. [35]	North America	Single center	Teaching	Level III		185	189
Peck et al. [40]	Europe	Multicenter	Teaching & community	Level III		51	45
Szendrői et al. [47]	Europe	Single center		Level III		38	21
Chimento et al. [10]	North America	Single center		Level II	No	28	32
O'Brien & Rorabeck [37]	North America	Single center	Teaching	Level III	No	34	53
Ogonda et al. [38]	Europe	Single center		Level I	Yes	109	110
Chung et al. [11]	Asia	Single center		Level III		60	60
Howell et al. [22]	North America	Single center	Teaching	Level III		50	57
Nakamura et al. [36]	Asia	Single center	Teaching	Level III	No	50	42
Wright et al. [58]	North America	Single center		Level III		42	42
Goldstein et al. [16]	North America	Single center		Level III	No	85	85
Higuchi et al. [21]	Asia	Single center		Level III		108	24
Total	Asia (9/30 = 30%)	Single center	Teaching	Level I	No	1835	1713
	Europe (12/30 = 40%)	(28/29 = 97%)	(11/12 = 92%)	(4/30 = 13%)	(9/11 = 82%)		
	North America (8/30 = 27%)	Multicenter (1/29 = 3%)	Teaching & community (1/12 = 8%)	Level II (3/30 = 10%)	Yes (2/11 = 18%)		
	South America (1/30 = 3%)			Level III (23/30 = 77%)			

events. The study groups were well matched in terms of age at the time of surgery and the percentage of males in each group (Table 2), however, BMI was slightly lower ($p < 0.001$) for limited incision THA (Fig. 2).

Limited incision THA was better than standard incision THA for four variables: length of hospitalization ($p = 0.001$) (Fig. 3), VAS pain at discharge ($p = 0.010$) (Fig. 4), blood loss ($p = 0.022$) (Fig. 5), and Harris hip

score at 3 months ($p = 0.001$) (Fig. 6). Patients with limited incision THAs experienced shorter hospitalizations (6 versus 7 days) (Table 3), less VAS pain at discharge (2 versus 4) (Table 3), less blood loss (421 mL versus 494 mL) (Table 4), and better Harris hip score at 3 months after surgery (90 versus 84) (Table 5). Meta-analysis of adverse events found no preference for limited incision or standard incision THA (Table 6).

Table 2. Patient characteristics by study group

Study	Limited incision THA				Standard incision THA			
	Number of patients	Age (years)	BMI (kg/m ²)	Male patients (number)	Number of patients	Age (years)	BMI (kg/m ²)	Male patients (number)
Alecci et al. [1]	221	71 ± 8		100 (45%)	198	70 ± 10		75 (38%)
Goosen et al. [17]	60	60 ± 7	27 ± 3	30 (50%)	60	62 ± 7	26 ± 3	30 (50%)
Martin et al. [32]	42	67 ± 10	31 ± 6	12 (29%)	41	63 ± 10	29 ± 6	14 (34%)
Muller et al. [34]	24			12 (50%)	20			12 (60%)
Schleicher et al. [42]	64	68 ± 10	27 ± 4	20 (31%)	64	69 ± 9	29 ± 4	16 (25%)
Yang et al. [59]	55	59 ± 13	23 ± 3	26 (47%)	55	56 ± 14	22 ± 4	30 (55%)
Chen et al. [8]	83	54 ± 14	25 ± 4	46 (55%)	83	55 ± 14	25 ± 4	41 (49%)
Mazoochian et al. [33]	26		27 ± 5	11 (42%)	26		26 ± 4	9 (35%)
Shitama et al.* [45]	19	58 ± 8			20	61 ± 11		
Shitama et al.† [45]	15	62 ± 12			8	53 ± 13		
Vicente et al. [51]	34	50 ± 13	27 ± 4	21 (62%)	42	57 ± 11	27 ± 4	26 (62%)
Williams et al. [54]	67	58 ± 12	26 ± 4		28	63 ± 17	29 ± 6	
Dorr et al. [14]	30	70 ± 10	28 ± 5	17 (57%)	30	64 ± 14	30 ± 6	14 (47%)
Dutka et al. [15]	60			10 (17%)	60			12 (20%)
Rapala et al. [41]	23	51 ± 11	26 ± 3	12 (52%)	29	55 ± 8	30 ± 5	11 (38%)
Wong et al. [55]	12	56 ± 16	25 ± 3	3 (25%)	12	54 ± 17	24 ± 2	4 (33%)
Khan et al. [24]	100	69 ± 11	26 ± 5	42 (42%)	100	69 ± 13	25 ± 4	52 (52%)
Laffosse et al. [25]	42	57 ± 13	26 ± 4	24 (57%)	58	60 ± 15	26 ± 5	33 (57%)
Murphy et al. [35]	185	56 ± 12	27 ± 5	98 (53%)	189	50 ± 12	28 ± 6	94 (50%)
Peck et al. [40]*	22	71 ± 10	25 ± 4	9 (41%)	19	70 ± 11	27 ± 4	10 (53%)
Peck et al. [40]†	29	71 ± 10	26 ± 4	10 (34%)	26	70 ± 10	26 ± 4	11 (42%)
Szendrői et al. [47]	38	64 ± 12	26 ± 3		21	57 ± 13	30 ± 7	
Chimento et al. [10]	28	67 ± 9	25 ± 3	16 (57%)	32	67 ± 11	25 ± 3	13 (41%)
O'Brien and Rorabeck [37]	34		27 ± 4	20 (59%)	53		30 ± 9	27 (51%)
Ogonda et al. [38]	109	67 ± 10	28 ± 4	59 (54%)	110	66 ± 10	29 ± 4	58 (53%)
Chung et al. [11]	60			24 (40%)	60			28 (47%)
Howell et al. [22]	50	60 ± 12	26 ± 4	34 (68%)	57	62 ± 14	29 ± 6	27 (47%)
Nakamura et al. [36]	50	62 ± 11	23 ± 3	12 (24%)	42	59 ± 10	24 ± 4	6 (14%)
Wright et al. [58]	42	64 ± 15	24 ± 6		42	65 ± 8	28 ± 6	
Goldstein et al. [16]	85	68 ± 11	27 ± 4	37 (44%)	85	67 ± 12	31 ± 7	37 (44%)
Summary		63 (50–71)	26 (23–31)	705/1528 (46%)		62 (50–70)	28 (22–31)	609/1551 (39%)
		n = 1505	n = 1301			n = 1451	n = 1304	

* Dataset 1; †dataset 2.

Discussion

The overall goal of limited incision THA is improved short-term recovery without compromising long-term performance. Most favorable claims of limited incision THAs are reduced complication rates, pain, and blood loss; shorter hospital stays; quicker return to function, and long-term survival comparable to that for standard incision THAs [3, 4, 10, 13, 15, 19, 22, 23, 26, 36, 37, 44, 51–53, 56–58]. The drawbacks of limited incision THAs are

reduced visual field and soft tissue damage; poor component positioning and the difficulties arising from same, in addition to increased complications including fractures, dislocations, and nerve injury [2, 5, 31, 39, 48]. When reading the comparative studies that form the data sets for existing meta-analyses, it is difficult to find clear consensus. According to existing meta-analyses, the published data do not clearly conclude that a limited incision THA is better than a standard incision THA, however the length of surgery [9, 12, 60] and blood loss [9, 12, 50, 60] favor

Fig. 2 BMI is illustrated by a forest plot of pooled standard differences in means. Std diff = standard difference; *Peck et al. [40] dataset 1; †Peck et al. [40] dataset 2; LITHA = limited incision THA; SITHA = standard incision THA.

Fig. 3 Length of hospitalization is illustrated by a forest plot of pooled standard differences in means. Std diff = standard difference; *Peck et al. [40] dataset 1; †Peck et al. [40] dataset 2; LITHA = limited incision THA; SITHA = standard incision THA.

Fig. 4 VAS pain is illustrated by a forest plot of pooled standard differences in means. Std diff = standard difference; LITHA = limited incision THA; SITHA = standard incision THA.

limited incision THA, whereas there are no differences for length of hospital stay [29, 60], hip scores [27, 29, 50], or complication rates [27, 29, 50, 60]. We performed a meta-

analysis, incorporating new data, to compare surgical outcomes, clinical outcomes, and complication rates and thus: (1) confirm whether limited incision THA is at least

Fig. 5 Blood loss is illustrated by a forest plot of pooled standard differences in means. Std diff = standard difference; LITHA = limited incision THA; SITHA = standard incision THA.

Fig. 6 Harris hip scores are illustrated by a forest plot of pooled standard differences in means for the 3-month followup. Std diff = standard difference; LITHA = limited incision THA; SITHA = standard incision THA.

comparable to standard incision THA; and (2) determine whether limited incision THA is an improvement over standard incision THA as claimed.

We call the reader's attention to limitations in the literature in general and describe the impacts on our meta-analysis in particular. First, there is a lack of clarity on evaluation targets. Are patient-oriented outcomes such as meeting presurgical expectations, satisfaction, and cosmesis, the goal of a particular article, or are surgeon-oriented outcomes like length of surgery, blood loss, complications, or clinical and radiologic scores the focus of an individual report? Finally, are implant- or design-oriented outcomes the target of the article, items like component failure or effectiveness of design modifications? It is acceptable to have an article contain more than one of these, but the reporting often is unclear affecting the evaluation of articles for inclusion. We had to use experience and much time to determine which articles had the potential to contribute to our meta-analysis. Second, there is a lack of standardization for reporting outcomes in general. As examples, there is a confusing array of terminology for explaining component alignment and there are numerous scoring methods in use for clinical and radiologic outcomes. The lack of agreement means that although there may be a large body of literature in existence, much of it cannot be

compared qualitatively or quantitatively. For our meta-analysis, the quantity of data available as the process progressed was less than we had expected after conducting the literature search. Third, there is the possibility that useful data were not included owing to the exclusion of nonEnglish papers. Fourth, the clinical meaning of complication rates often is limited; there are variations in reporting methods and questions regarding the source of certain complications (are they attributable to patient health status, surgical technique, or component design issues); these can lead to limitations in systematic reviews.

The data reviewed show that a limited incision THA is associated with at least comparable surgical outcomes, clinical outcomes, and complication rates in comparison to a standard incision THA. A limited incision THA is no more harmful than a standard incision THA: we found no difference in complications such as deep vein thrombosis or pulmonary embolism, fractures, nerve issues, wound healing, infection, dislocation, or aseptic loosening. This is in agreement with previous meta-analyses findings [27, 29, 50, 60].

Is it possible to claim that limited incision THA is superior to standard incision THA? This question is more complex and thus more difficult to answer simply. We found limited incision THA is better than standard incision

Table 3. Surgical and hospitalization characteristics by study group

Study	Limited incision THA					Standard incision THA				
	Number of patients	Length of surgery (minutes)	Length of hospitalization (days)	VAS pain at discharge	Patients discharged to home (number)	Number of patients	Length of surgery (minutes)	Length of hospitalization (days)	VAS pain at discharge	Patients discharged to home (number)
Alecci et al. [1]	221		7 ± 2		92 (42%)	198		10 ± 4		23 (12%)
Martin et al. [32]	42	114 ± 21	9 ± 2		39 (93%)	41	96 ± 19	9 ± 2		39 (95%)
Muller et al. [34]	24	51 ± 7				20	50 ± 7			
Schleicher et al. [42]	64	94 ± 24				64	99 ± 23			
Yang et al. [59]	55	78 ± 13		3.08 ± 2.18		55	74 ± 15		5.03 ± 1.37	
Chen et al. [8]	83	151 ± 35	5 ± 1			83	104 ± 22	5 ± 1		
Han et al. [18]	18	109 ± 15	9 ± 2	2.41 ± 0.62		19	118 ± 17	14 ± 3	2.23 ± 0.74	
Shitama et al. [45]*	19	87 ± 15				20	81 ± 17			
Shitama et al. [45]†	15	104 ± 24				8	90 ± 21			
Vicente et al. [51]	34	98 ± 26				42	125 ± 40			
Williams et al. [54]	67				67 (100%)	28				13 (46%)
Dorr et al. [14]	30	100 ± 25	3 ± 1	2.2 ± 1	29 (97%)	30	111 ± 41	3 ± 1	3.1 ± 0.9	30 (100%)
Dutka et al. [15]	60	118 ± 16				60	133 ± 18			
Rapala et al. [41]	23	134 ± 65				29	121 ± 30			
Wong et al. [55]	12	113 ± 25	11 ± 3	1.8 ± 0.7		12	115 ± 21	16 ± 5	6.6 ± 1.3	
Khan et al. [24]	100	64 ± 16				100	64 ± 12			
Laffosse et al. [25]	42	82 ± 19	9 ± 3		19 (45%)	58	73 ± 19	12 ± 3		10 (17%)
Murphy et al. [35]	185		4 ± 1		151 (82%)	189		4 ± 2		156 (83%)
Peck et al. [40]*	22		8 ± 2			19		8 ± 2		
Peck et al. [40]†	29		11 ± 5			26		12 ± 4		
Szendrői et al. [47]*	38	84 ± 16		1.5 ± 1.5		21	102 ± 12		2.1 ± 1.3	
Szendrői et al. [47]†	28	70 ± 11			24 (86%)	32	70 ± 9			30 (94%)
Chimento et al. [10]	34	74 ± 15	5 ± 2		32 (94%)	53	80 ± 10	6 ± 3		41 (77%)
O'Brien & Rorabeck [37]	60	49 ± 8	4 ± 1			60	55 ± 18	5 ± 1		
Howell et al. [22]	50	97 ± 19	4 ± 3			57	84 ± 15	6 ± 3		
Nakamura et al. [36]	50	99 ± 26				42	123 ± 30			
Wright et al. [58]	42	71 ± 11	6 ± 1			42	78 ± 13	6 ± 1		
Goldstein et al. [16]	85	57 ± 8				85	59 ± 8			
Higuchi et al. [21]	108	70 ± 15				24	95 ± 30			
Summary		87 (23–31) n = 1116	6 (3–11) n = 870	2.3 (1.5–3.1) n = 153	453/659 (70%)		88 (50–133) n = 1057	7 (3–16) n = 887	3.9 (2.1–6.6) n = 137	342/629 (54%)

* Dataset 1; † dataset 2.

Table 4. Hemodynamic characteristics by study group

Study	Limited incision THA					Standard incision THA				
	Number of THAs	Hemoglobin preoperative (g/dL)	Blood loss (mL)	Blood transfused (Units)	Number of THAs in which transfusions were needed (%)	Number of THAs	Hemoglobin preoperative (g/dL)	Blood loss (mL)	Blood transfused (Units) Number of THAs in which transfusions were needed	Number of THAs Transfused (%)
Alecci et al. [1]	21	14 ± 1			4 (2%)	198	13 ± 1			15 (8%)
Goosen et al. [17]	60	9 ± 1	540 ± 321			60	9 ± 1	490 ± 228		
Martin et al. [32]	42	14 ± 1				41	14 ± 1			
Yang et al. [59]	55		378 ± 168	0.91 ± 0.3	36 (65%)	55		605 ± 225	1.4 ± 0.52	50 (91%)
Chen et al. [8]	83		691 ± 327			83		370 ± 205		
Han et al. [18]	18			0.77 ± 0.93		19			0.86 ± 1.01	
Shitama et al. [45]*	19	12 ± 1				20	12 ± 1			
Shitama et al. [45]†	15	12 ± 1				8	12 ± 1			
Vicente et al. [51]	34				3 (9%)	42				12 (29%)
Dorr et al. [14]	30	13 ± 1	352 ± 146			30	14 ± 1	408 ± 158		
Dutka et al. [15]	60		640 ± 106			60		835 ± 165		
Wong et al. [55]	12			0.8 ± 1.3		12			1.1 ± 1.2	
Khan et al. [24]	100		468 ± 145	1.5 ± 0.8		100		838 ± 601	1.8 ± 1.2	
Laffosse et al. [25]	42			0.15 ± 0.5	3 (7%)	58			0.69 ± 1.4	15 (26%)
Szendrői et al. [47]	38		744 ± 260			21		771 ± 235		
Chimento et al. [10]	28		378 ± 151	1.14 ± 0.5		32		504 ± 205	1.06 ± 0.6	
O'Brien & Roraback [37]	34				8 (24%)	53				9 (17%)
Ogonda et al. [38]	109		314 ± 162	0.42 ± 0.95		110		366 ± 190	0.3 ± 0.66	
Chung et al. [11]	60		136 ± 41			60		201 ± 65		
Howell et al. [22]	50		387 ± 155	0.3 ± 0.7		57		469 ± 147	0.3 ± 0.7	
Wright et al. [58]	42		152 ± 54			42		173 ± 58		
Goldstein et al. [16]	85	12 ± 2	273 ± 102		65 (76%)	85	13 ± 1	408 ± 173		56 (66%)
Summary		13 (9–14) n = 472	421 (136–744) n = 800	0.78 (0.15–1.5) n = 414	119/471 (25%)		13 (9–14) n = 442	494 (173–838) n = 795	0.93 (0.3–1.8) n = 443	157/491 (32%)

* Dataset 1; † dataset 2.

Table 5. Harris hip scores preoperative and at 3-month followup

Study	Limited incision THA			Standard incision THA		
	Number of THAs	HHS preoperative	HHS at followup	Number of THAs	HHS preoperative	HHS at followup
Goosen et al. [17]	60	58 ± 16	94 ± 8	60	57 ± 12	90 ± 10
Martin et al. [32]	42	37 ± 16		41	40 ± 13	
Muller et al. [34]	24	56 ± 8	81 ± 14	20	56 ± 12	76 ± 19
Yang et al. [59]			84 ± 6			75 ± 7
Chen et al. [8]	83	58 ± 11	93 ± 6	83	61 ± 7	91 ± 5
Shitama et al. [45]*	19	58 ± 10		20	56 ± 7	
Shitama et al. [45]†	15	50 ± 13		8	56 ± 6	
Dorr et al. [14]	30	64 ± 13		30	63 ± 14	
Laffosse et al. [25]	42	42 ± 11	89 ± 9	58	44 ± 16	80 ± 18
Chimento et al. [10]	28	54 ± 9		32	53 ± 8	
Ogonda et al. [38]	109	29 ± 12		110	27 ± 13	
Summary		47 (29–64)	90 (81–94)		48 (27–63)	84 (75–91)
		n = 452	n = 264		n = 462	n = 276

HHS = Harris hip score; * dataset 1; † dataset 2.

Table 6. Pooled incidence for adverse events

Adverse event	Limited incision THA			Standard incision THA	
	Number of treatment groups	n/N	%	n/N	%
DVT/PE	18	5/1113	0.45	15/1004	1.49
Fractures	22	30/1419	2.11	22/1324	1.66
Nerve issues	15	30/960	3.13	3/943	0.32
Wound healing	16	12/1045	1.15	15/1028	1.46
Infection	17	4/1020	0.39	3/989	0.30
Dislocation	23	16/1477	1.08	17/1381	1.23
Aseptic loosening	13	8/705	1.13	6/627	0.96
Persistent pain	9	1/420	0.24	0/418	0.00
Total adverse events	25	134/1587	8.44	108/1498	7.21

DVT = deep vein thrombosis; PE = pulmonary embolism; n/N = incident ratio.

THA in four measures: length of hospitalization, VAS pain at discharge, blood loss, and Harris hip score at 3 months after THA; again, this was in keeping with other meta-analyses [9, 12, 50, 60]. However, although a limited incision THA statistically improves length of hospitalization, VAS pain at discharge, blood loss, and Harris hip score at 3 months after surgery over a standard incision THA, not all of these differences are clinically important. The 73 mL difference in mean blood loss has limited clinical importance. Although the difference in mean length of hospital stay is only 1 day, this is likely to be important to patients and payers. The difference in mean VAS pain at discharge may seem small, but the results show that patients with limited incision THA have half as

much pain at discharge as patients undergoing standard incision THA; again, this result may not take into account the difference in pain management modalities and rehabilitation protocols. In addition, although the difference in 3-month Harris hip score is only six points, the mean values are comparable to receiving an excellent (score greater than 90 points) or receiving a good (score between 80 and 89 points) Harris hip score. Additionally, other measures were not different when comparing limited incision with standard incision THA; for example: length of surgery, rate of discharge to home, units of blood transfused, or number of patients receiving transfusions. Thus, to our reasoning, it is not yet possible to claim that a limited incision THA is superior based on existing data.

It is clear from our results that a limited incision THA is not generally harmful compared with a standard incision THA. Although the most scientific method for conclusively determining if a limited incision THA is superior would be to conduct a series of longer-term, prospective, double-blinded, randomized control experiments of simultaneous bilateral THAs with one hip being replaced using each technique; this is impractical and unlikely given the ethics and resources (money, time, surgeon and site participation, and patient recruitment) involved. So, how does the practice of evidence-based medicine relative to the choice of limited incision or standard incision THA continue to grow? It grows through implementation of more well-designed, prospective comparative studies (RCTs or not) and through continued quantitative analysis of the body of knowledge as it matures. This will help inform decision-making.

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