

REVIEW ARTICLE

# Reporting of non-hip score outcomes following femoroacetabular impingement surgery: a systematic review

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## ABSTRACT

This systematic review was designed to evaluate the reporting of non-hip score outcomes following surgical management of femoroacetabular impingement (FAI). MEDLINE, EMBASE and PubMed were searched and screened in duplicate for studies involving non-hip score outcomes following the surgical management of FAI. A full-text review of eligible studies was conducted and references were searched using pre-determined inclusion and exclusion criteria. Thirty-three studies involving 3198 patients were included in this review. The most common non-hip score outcomes reported included: patient satisfaction (72.7%), symptom improvement (24.7%), pain improvement (12.4%), hip range of motion (12.3%) and return to sport (6.8%). The most frequently reported standardized hip outcome scores used were the modified Harris Hip Score (mHHS) (41.2%), Non-Arthritic Hip Score (NAHS) (29.4%), Hip Outcome Score—Activities of Daily Living (HOS-ADL) (26.5%), the Western Ontario McMaster Universities Index of Osteoarthritis (WOMAC) (17.6%), the HOS Sport-Specific Subscale (SSS) (17.6%). The most commonly reported non-hip score outcomes are patient satisfaction, symptom improvement and pain improvement. Patients report high levels of satisfaction when surveyed post-operatively. A discrepancy exists between what outcomes the literature suggests should be reported and what outcomes are actually reported. Return to sport is often held as a major patient-important outcome yet it is seldom reported in studies assessing the efficacy of FAI surgery. Second, despite emerging evidence that outcome measures such as the HOS or IHOT evaluate the FAI patient population precisely, other standardized hip score outcomes (mHHS and NAHS) are still more commonly reported.

**Level of Evidence:** Level IV, systematic review of Level I, II, III and IV studies

## INTRODUCTION

Hip pain in the young adult is frequently attributed to soft tissue groin or hip strains. However, an increasingly recognized source of pain and hip dysfunction in this population is femoroacetabular impingement (FAI). FAI results from repetitive abnormal contact of the femoral head and neck against the acetabulum. This condition occurs more

frequently in athletes as repetitive hip movements are associated with developmental bony alterations resulting in this condition [1–3]. Evidence has shown an association of FAI-related groin pain with the development of osteoarthritis (OA) of the hip [4–6].

There is evidence to suggest that surgical interventions, through either open or arthroscopic approaches, may prevent

worsening of symptoms and progression of osteoarthritis. Operative success is measured by using objective measures such as: radiologic imaging of deformity correction, and improvements in range of motion [7]. Additionally, standardized hip outcome scores are frequently used in the literature including the modified Harris Hip Score (mHHS), Hip Outcome score Activities of Daily Living (HOS-ADL), HOS-Sport-Specific Subscales (HOS-SSS), 12-item Short Form Health Survey (SF-12) and Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC) [8–10].

While these scores have been validated, they were originally designed for assessing advanced OA in older populations and do not account for the high impact activities that young adult athletes with FAI will demand of their hips post-operatively [1, 8]. New outcome measures have been developed such as the Non-Arthritic Hip Score (NAHS), Hip Outcome Score (HOS), the International Hip Outcome Tool-33 (iHOT-33) and the Copenhagen Hip and Groin Outcome Score (HAGOS). Many of these of outcome measures have even undergone cross cultural adaptations for assessment of specific populations [11, 12]. Lodhia *et al.* [8] identified Hip Outcome Score, WOMAC and NAHS as reliable measures to identify outcomes in FAI. In particular, HOS was identified as the most proven instrument for use in this population [8].

The iHOT-33 was developed using a large sample size of young and active patients [13]. The iHOT-33 aims to improve upon the responsiveness of the WOMAC, HOS, HAGOS and other hip scores as a primary objective measure [13]. Impellizzeri *et al.* [14] established that defining patient-rated expectations is vital in predicting patient satisfaction with surgery and improving patient-rated outcome (PRO). Consequently, there has been an increased emphasis placed on reporting patient's perspectives and quality of life as the primary objective.

This systematic review aims to ascertain the specific non-hip score outcomes that are being reported in the literature, to determine if the outcomes are being reported consistently. Furthermore, we hope to determine whether the outcomes that patients consider to be most important are the outcomes that are reported most frequently in the literature or if there is often a disconnect between what patients and clinicians consider to be most important. Also, the authors hypothesize that there is a positive relationship between non-hip score outcomes and standardized hip outcome scores.

## MATERIALS AND METHODS

### Search strategy

Two reviewers searched EMBASE, MEDLINE and PubMed for literature related to non-hip score outcomes

after surgical treatment of FAI (Fig. 1). The database search was conducted on 15 October 2014 and retrieved articles from database inception to the search date. The research question and individual study inclusion and exclusion criteria were established *a priori*. The inclusion criteria were: (i) all levels of evidence; (ii) male and female patients of all ages; (iii) papers published in English; (iv) studies on humans and (v) studies reporting non-hip score outcomes (e.g. patient satisfaction, improvement in pain, return to sport, etc.). Exclusion criteria were: (a) any non-surgical treatment studies (e.g. conservative treatment, technique articles without outcomes, cadaver studies, review articles, etc.); (b) patients with unrelated diagnoses such as osteoarthritis, septic joint, etc. and (c) studies that used the same patient population in order to avoid duplication of patients in the data analysis. In these cases, the study with the larger patient population was included. If a follow-up study of the same patient population was identified, the more recent study was included.

The following key terms were used in the search; 'patient satisfaction', 'quality of life', 'arthroscopy' and 'hip'. A table outlining the search strategy is presented in [Appendix Table AI](#).

### Study screening

Two reviewers independently screened the titles, abstracts and full texts of the retrieved studies. If at any point during the title and abstract screening phases, one reviewer believed an article should proceed to the next stage, it was included to ensure thoroughness. At the full text stage, any disagreements were first discussed by the two reviewers and unresolved conflicts mediated by a third reviewer until a consensus was reached. The references of included studies were further searched to capture any articles that may have been missed by the initial search strategy. A second list of references for the papers eliminated at the full text review stage can be found in [Appendix A2](#).

### Quality assessment of included studies

A quality assessment analysis of all the non-randomized included studies was done using a Methodological Index for Non-Randomized Studies (MINORS) Criteria [15]. The MINORS criteria is a validated scoring tool for non-randomized studies. Each of the 12 items in the MINORS criteria is given a score of 0, 1 or 2 giving an ideal score of 16 for non-comparative studies and 24 for comparative studies. In the case of randomized studies the methodology was assessed using the Coleman Methodology Score which is a commonly used methodology scoring system (maximum score 100) in orthopaedic literature. The agreement

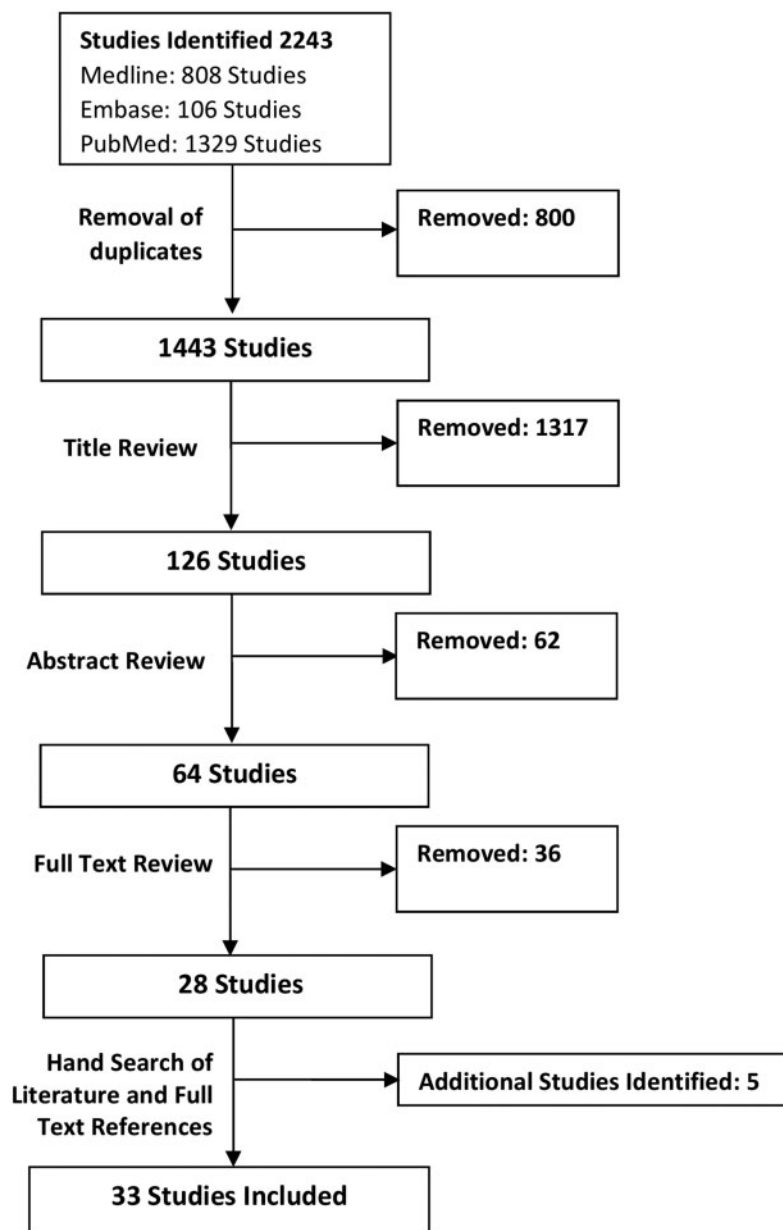


Fig. 1. Outline of systematic search strategy used.

between the two reviewers was calculated using an inter-class correlation coefficient (ICC).

#### Data abstraction

Two reviewers independently abstracted study data from the final pool of included articles and recorded this data in Microsoft Excel (2013). Demographic information included author, year of publication, sample size, study design, level of evidence, patient demographics (i.e. sex, age, affected hip, etc.) and type of surgery. Additionally, a variety of outcome information was abstracted including

pre-operative and post-operative standardized hip outcomes scores (mHHS, WOMAC, HOS-ADL, HOS-SSS, UCLA, SF-12 and NAHS) along with non-hip outcomes such as: improvement in pain, post-operative ROM, ability to return to sport and patient satisfaction. Finally, the number of patients requiring further surgery and any complication of treatment was also abstracted.

#### Statistical analysis

A weighted  $\kappa$  (kappa) was calculated for each stage of article screening in order to evaluate inter-reviewer agreement

[16]. Agreement was categorized *a priori* as follows:  $\kappa > 0.61$  to indicate substantial agreement,  $0.21 < \kappa < 0.60$  to indicate moderate agreement, and  $\kappa < 0.20$  to indicate slight agreement [17]. Descriptive statistics, such as means, ranges and confidence intervals (CI) are presented.

## RESULTS

### Study identification

Our initial literature search yielded 2243 studies, of which 33 met the inclusion and exclusion criteria for this review (Fig. 1). The characteristics of each of the included studies can be found in Table I. There was excellent agreement among reviewers at the title ( $\kappa = 0.81$ ; 95% CI, 0.78–0.84), abstract ( $\kappa = 0.76$ ; 95% CI, 0.71–0.82) and full-text screening ( $\kappa = 1.0$ ).

### Study characteristics

All included studies were conducted between 2007 and 2014. This included a total of 3198 patients, with 281 patients treated by surgical hip dislocation, 33 mini-open procedures and 2422 arthroscopic procedures. A remaining 462 patients were treated with either arthroscopy, mini-open or combined procedures that were not otherwise specified. Mini-open procedures were performed according to the techniques developed by Clohisy or Hartmann *et al.* [18]. Mean sample size of the included studies was 94 patients, 45.0% of which were female, with a mean age 33.6 years and mean follow-up 26.6 months.

### Study quality

The majority of these studies were of level IV evidence (27 case series). Two studies were level III evidence, three studies were of level II evidence and a single arthroscopic study comparing labral debridement with labral repair was of level I evidence. There was high agreement amongst quality assessment scores of included studies using MINORS criteria, with ICC = 0.99. The included studies had an average MINORS score of 10/16 (Table I). The one level I evidence study was methodologically assessed using the Coleman Methodology Score and received a score of 75/100.

### Reported outcomes

#### A. Non-hip score outcomes

The most common non-hip score outcomes reported included: patient satisfaction as measured through a post-operative survey of patients ( $n = 21$  studies, 72.7% of patients), symptom improvement ( $n = 7$  studies, 24.7% of patients), pain improvement ( $n = 7$  studies, 12.4% of patients), hip range of motion ( $n = 4$  studies, 12.3% of

patients) and return to sport ( $n = 6$ , 6.8% of patients) (Table II). The majority (55–70%) of patients stated they had an ‘acceptable state’ of symptoms with only 12–17.6% of patients reported being unsatisfied with outcomes in post-operative surveys. It was found that 50–82% of patients had pain improvement among the two studies which specifically commented on this and average visual analog scores (VASs) ranged from 0 to 2.8 post-operatively across the six studies which reported this outcome. Across the studies, 60–100% of patients were able to return to pre-injury levels of competition. Bizzini *et al.* reported the lowest return to pre-injury sport (60%) in a small cohort of five professional hockey players, while the remainder of studies with larger cohorts reported 71.4–100% return to sport. The mean reported patient satisfaction across 21 studies was 85% when surveyed post-operatively. Furthermore, 81–100% of patients said that they would undergo the procedure again after being surveyed post-operatively across the four studies that reported this measure.

#### B. Standardized hip outcome scores

Standardized hip outcome scores reported included the mHHS ( $n = 15$  studies, 41.2%), NAHS ( $n = 10$  studies, 29.4%), HOS ADL ( $n = 8$  studies, 26.5%), HOS SSS ( $n = 5$  studies, 17.6%), WOMAC ( $n = 6$  studies, 17.6%), UCLA ( $n = 4$  studies, 14.7%) and SF-12 ( $n = 2$  studies, 5.9%) scores among others. Mean improvement of mHHS was 23.4, NAHS 24.0, HOS ADL 24.3, HOS SSS 23.6, WOMAC 15.5 and UCLA 1.5 (Table III). Although inconsistent outcome reporting prevented a formal comparison, these standardized hip outcome scores generally improved.

#### C. Relationship between non-hip score outcomes and standardized hip outcome scores

No clear relationship between standardized hip outcome scores and non-hip score outcomes was able to be established due to the inconsistency of outcome reporting between studies.

#### D. Complications

There were only 25 (0.8%) complications overall from the 3198 patients (3342 hip surgeries). These complications included: nine transient paresthesias that resolved over time, one scrotal skin burn from antiseptic solution, two anchor replacements, four pudendal nerve neuropraxias, two lateral femoral cutaneous nerve neuropraxias, two labral perforations, one labral tear and four femoral head cuffs [19–21].

Table I. Characteristics of included studies

Primary author	Location	Study design	Level of evidence	Sample size— (hips)	% male	Mean age (years)	Follow-up	Type of surgery	Consensus MINORS score (0–16 for non- comparative studies, 0–24 for comparative studies)
Beaule <i>et al.</i> [22]	Canada	Case series	IV	34 (37)	52.9%	40.5 (19–54)	3.1 (2.1–5.0)	Surgical hip dislocation	9
Bizzini <i>et al.</i> [23]	Switzerland	Case series	IV	5 (6)	100%	21.4 (20–22)	32.2 (20–44)	Surgical hip dislocation	10
Boone <i>et al.</i> [24]	USA	Case series	IV	21 (22)	66.7%	44 (40–5)	3.8 (0.9–8.4) years	Surgical hip dislocation	10
<sup>a</sup> Domb <i>et al.</i> [25]	USA	Prospective matched-pair	II	A: 10, B: 20	A: 20%, B: 20%	A: 19, B: 19.6	A: 24.8 (12–39), B: 25.5 (21–34)	A: surgical hip dislocation, B: arthroscopic	20
Ejnisman <i>et al.</i> [26]	USA	Case series	IV	70	31%	15	3 years (2–5)	Arthroscopic	11
Gedouin <i>et al.</i> [19]	France	Case series	IV	110 (111)	70.9%	31 (16–49)	10 (6–18) months	Arthroscopic	11
Guanche <i>et al.</i> [27]	USA	Case series	IV	60(61)	NA	Unknown	32.8 (21–48) months	Arthroscopic	10
Hartmann <i>et al.</i> [18]	Germany	Case series	IV	33(34)	51.5%	31(15–47)	15 (6–27) months	Mini-open	10
Herrmann <i>et al.</i> [28]	Germany	Case series	IV	83	Unknown	48.6(40–65)	26 months	Arthroscopic	11
Impellizzeri <i>et al.</i> [9]	Switzerland	Case series	IV	172	44%	35.9 (11.5 SD)	6 months	Arthroscopic and mini-open	10
Impellizzeri <i>et al.</i> [29]	Switzerland	Case series	IV	162	50%	35 (12 SD)	Minimum 12 months	Arthroscopic and mini-open surgery	10
Jackson <i>et al.</i> [20]	USA	Case series	IV	66	37%	28.8 ± 12.8 (14–57)	2.4 ± 0.6 (1.7–4.1) years	Arthroscopy	10

(continued)

Table I. (continued)

Primary author	Location	Study design	Level of evidence	Sample size—patients (hips)	% male	Mean age (years)	Follow-up	Type of surgery	Consensus MINORS score (0–16 for non-comparative studies, 0–24 for comparative studies)
Javed and O'Donnell [30]	Australia	Case series	IV	40 (40)	65%	65 (60–82)	30 (12–54) months	Arthroscopic	9
<sup>b</sup> Krych <i>et al.</i> [31]	USA	Prospective randomized control trial	I	A: 18, B: 18	0	A: 38 (20–59), B: 39 (19–55)	32 (12–48) months	Arthroscopic	N/A <sup>f</sup>
<sup>c</sup> Larson and Giveans [32]	USA	Retrospective comparative study	III	A: 34 (36), B: 37 (39)	A: 73.5%, B: 62.1%	A: 31 (16–57), B: 26 (16–56)	A: 21.4 (12–36) months, B: 16.5 (12–24) months	Arthroscopic	16
Lo and Guanche [33]	Unknown	Case series	IV	94(100)	Unknown	Unknown	60 (40–74) months	Arthroscopic	8
Malviya <i>et al.</i> [34]	UK	Case series	IV	612 patients	58%	36.7 (14–75)	3.2 (1–7) years	Arthroscopic	11
Mannion <i>et al.</i> [14]	Switzerland	Case series	IV	128	46%	35.9 (SD: 12)	Min 12 months	Arthroscopic or mini-open	10
<sup>d</sup> Matsuda <i>et al.</i> [35]	USA	Prospective comparative cohort	II	A: 15 (18), B: 126 (130)	A: 66.7%, B: 48.5%	A: 37.2, B: 40.2	NA	Arthroscopic	15
<sup>e</sup> Matsuda and Burchette [36]	USA	Retrospective comparative study	III	A: 8(8), B: 46 (46)	A: 87.5%, B: 54.0%	A: 34.6 (18–58), B: 37.5 (18–73)	A: 30 (24–37) months, B: NA	Arthroscopic	17
<sup>f</sup> Murata <i>et al.</i> [37]	Japan	Prospective comparative cohort	II	A: 50, B: 37	A: 64%, B: 32%	A: 34.7, B: 42.5	Minimum 12 months	Arthroscopic	16

(continued)

Table I. (continued)

Primary author	Location	Study design	Level of evidence	Sample size— (hips)	% male	Mean age (years)	Follow-up (years)	Type of surgery	Consensus MINORS score (0–16 for non-comparative studies, 0–24 for comparative studies)
Naal <i>et al.</i> [21]	Switzerland	Case series	IV	192 (240)	60%	30.0 ± 9.3 (14–55)	60.7 ± 11.8 (24–120) months	Surgical hip dislocation	10
Palmer <i>et al.</i> [38]	USA	Case series	IV	185 (201)	49.3%	40.2 (14–87)	46 (36–NA) months	Arthroscopically	12
Park <i>et al.</i> [39]	South Korea	Case series	IV	197 (200)	49.2%	44.6 (19–70)	28.2 (19–42) months	Arthroscopy	9
Philippon <i>et al.</i> [40]	USA	Case series	IV	45	93.3%	31 (17–61)	1.6 (0.5–5.5) years	Arthroscopy	9
Philippon <i>et al.</i> [41]	USA	Case series	IV	112	44.6%	40.6 (37.7–43.5)	2.3 (2.0–2.9) years	Arthroscopic	10
Philippon <i>et al.</i> [42]	USA	Case series	IV	60 (65)	31%	15 (11–16)	3.5 (2–5) years	Arthroscopy	10
Philippon <i>et al.</i> [43]	USA	Case series	IV	153	47%	57 (50–77)	35.7 (12–64) months	Arthroscopy	9
Polesello <i>et al.</i> [44]	Brazil	Case series	IV	24 (26)	87.5%	34 (13–51)	6.1 (5–8) years	Arthroscopy	7
Singh <i>et al.</i> [45]	Australia	Case series	IV	24 (27)	100%	22 (16–29)	22 (6–60) months	Arthroscopic	10
Sink <i>et al.</i> [46]	USA	Case series	IV	44 (52)	15.9%	16.2 (13–19)	27 (12–60) months	Arthroscopic	9
Tran <i>et al.</i> [47]	Australia	Case series	IV	34 (41)	85.3%	15.7 (11–18)	14 months (1–2 years)	Arthroscopic	12
Walker <i>et al.</i> [48]	USA	Case series	IV	19 (20)	25%	28.6 (16–50)	26.4 (12–56) months	Surgical hip dislocation	10

<sup>a</sup>Domb *et al.* [25]—**A**: Surgical hip dislocation; **B**: Arthroscopic. <sup>b</sup>Krych *et al.* [31]—**A**: Labral repair; **B**: Labral debridement. <sup>c</sup>Larson and Giveans [32]—**A**: Labral debridement; **B**: Labral refixation. <sup>d</sup>Matsuda *et al.* [35]—**A**: Global FAI; **B**: Pincer FAI. <sup>e</sup>Matsuda and Burchette [36]—**A**: Labral reconstruction; **B**: Labral refixation. <sup>f</sup>Murata *et al.* [37]—**A**: Athlete; **B**: Non-athlete. <sup>g</sup>Methodology analyzed using the Coleman methodology score as MINORS criteria can not be used in randomized studies. Coleman methodology score: 75/100.

Table II. Non-hip score outcomes reported in included studies

Primary author, year	Patient satisfaction	Pain	Improvement of overall symptoms	Return to sport	ROM	Other
Beaule <i>et al.</i> [22]	17.6% with unsatisfactory outcomes.	NR	NR	NR	NR	NR
Bizzini <i>et al.</i> [23]	NR	Pain score: 0	NR	Return to practice 6.7 (5.5–9.5) months. Participation in first competitive game 9.6 (7–14) months. 60% reached their pre-operative level of performance	Return to pre-op Rom: 10.3 (8–13) weeks	NR
Boone <i>et al.</i> [24]	NR	50% had pain relief	NR	NR	NR	NR
*Domb <i>et al.</i> [25]	Satisfaction rating (1–10): A: 8.1, B: 9.2	A: Post-op VAS: 2.8 B: Post-op VAS: 2.0	NR	NR	NR	NR
Ejnisman <i>et al.</i> [26]	Satisfaction rating (1–10) Patients not requiring revision: 10 Patients requiring revision, after revision: 10	NR	NR	NR	NR	NR
Gedouin <i>et al.</i> [19]	77% satisfied or very satisfied, 27% moderately satisfied, 12% disappointed.	NR	NR	NR	NR	NR
Guanche <i>et al.</i> [27]	Patient satisfaction: 80%	NR	NR	NR	NR	NR
Hartmann and Gunther [18]	Patient satisfaction VAS (0–10): 7 87.8% of patients said they would undergo the surgery again	NR	81.2% reported improvement in symptoms, 18.8% reported no change in symptoms.	NR	NR	All patients returned to pre-operative occupation level within 6 weeks post-operatively.
Herrmann and Hauschild [28]	NR	NR	Self-reported improvement of symptoms of 84%.	NR	NR	NR
Impellizzeri <i>et al.</i> [9]	NR	NR	How much did the operation help your hip problem? Helped a lot: 24%, Helped: 36%, helped only a little: 31%, did not help: 8% 55% of patients reported an 'acceptable state'.	NR	NR	If you had to spend the rest of your life with the symptoms you have now how would you feel about it? Very satisfied: 13%, Somewhat satisfied: 27%, neither satisfied nor dissatisfied: 15%, Somewhat dissatisfied: 23%, Very dissatisfied: 22%.
Impellizzeri <i>et al.</i> [29]	NR	NR	66.4% of patients said the operation 'helped' or 'helped a lot' 70% of patients reported an 'acceptable state'.	NR	NR	Most important change actually occurring as a result of surgery 45.5% pain improvement, 16.2% improvement in general physical capacity, 10.1% improvement in walking capacity, 23.2% improvement in the ability to do sport, 5.0% improvement in independence in everyday activity.

(continued)



**Table II. (continued)**

Primary author, year	Patient satisfaction	Pain	Improvement of overall symptoms	Return to sport	ROM	Other
Jackson <i>et al.</i> [20]	Patient satisfaction (1–10): 8.6	VAS: 2.3	NR	NR	NR	NR
Javed and O'Donnell [30]	Satisfaction rate: 75%	NR	NR	NR	NR	NR
<sup>b</sup> Krych <i>et al.</i> [31]	NR	NR	NR	NR	NR	Self-described post-operative hip condition <b>A:</b> 72%—normal, 22%—near normal, 6% abnormal, 0% severely abnormal. <b>B:</b> 28%—normal, 50%—near normal, 17% abnormal, 6% severely abnormal.
<sup>c</sup> Larson and Giveans [32]	NR	<b>A:</b> VAS: ~1.2 <b>B:</b> VAS: ~1.0	NR	NR	NR	NR
Lo and Guancho [33]	Patients satisfaction 70%	NR	NR	NR	NR	NR
Malviya <i>et al.</i> [34]	73.5% of patients were 'happy' with the results.	NR	NR	NR	NR	QOL Improved 76.6%, unchanged 14.4%, deteriorated in 9.0%. QOL increased from 0.95 to 0.97.
Mannion <i>et al.</i> [14]	NR	NR	Overall effectiveness of treatment Helped a lot (29%), helped (39%), helped only a little (21%), didn't help (9%), made things worse (2%)	NR	NR	NR
<sup>d</sup> Matsuda <i>et al.</i> [35]	Five-point likert satisfaction scale: <b>A:</b> 4.2 <b>B:</b> 4.2	NR	NR	NR	NR	NR
<sup>e</sup> Matsuda and Burchette [36]	<b>A:</b> 87.5% high satisfaction, 12.5% moderate satisfaction	NR	NR	NR	NR	NR
<sup>f</sup> Murata <i>et al.</i> [37]	NR	NR	NR	<b>A:</b> 100% return to pre-injury activity	NR	NR
Naal <i>et al.</i> [21]	47.4% very satisfied, 34.5% satisfied, 9.2% 'neither/nor', 3.9% dissatisfaction, 4.9% very dissatisfied 54.1% said expectations were completely fulfilled, 32.7% said their expectations were largely fulfilled, 13.2% stated their expectations were only partially or not fulfilled 81% of patients would undergo the same surgery again	NR	84.5% indicated that their overall health status would be acceptable	NR	Hip flexion Pre-op: 91.1 Post-op: 96.0	Self-described post-operative hip condition 33.1% normal, 50.3% nearly normal, 13.9% abnormal, 2.7% severely abnormal
Palmer <i>et al.</i> [38]	Satisfaction level of 75%	VAS: 2.7	NR	NR	NR	NR
Park <i>et al.</i> [39]	Patient satisfaction (1–10): 8.9	NR	NR	NR	NR	NR

(continued)

**Table II. (continued)**

Primary author, year	Patient satisfaction	Pain	Improvement of overall symptoms	Return to sport	ROM	Other
Philippon <i>et al.</i> [40]	NR	NR	NR	93% returned to professional sport, 78% remained active at professional level at 1.6 years after hip arthroscopy	NR	NR
Philippon <i>et al.</i> [41]	Patient satisfaction (1–10): 9	NR	NR	NR	NR	Time line to return to work 1 week (15%), 1–5 weeks (53%), 6–8 weeks (18%), 2–6 months (14%)
Philippon <i>et al.</i> [42]	Patient satisfaction (1–10): 10	NR	NR	NR	NR	NR
Philippon <i>et al.</i> [43]	Patient satisfaction (1–10): 9	NR	NR	NR	Mean flexion: 109 (90–145) Mean internal rotation: 32 (10–55%) Mean external rotation: 39 (20–65)	NR
Polesello <i>et al.</i> [44]	100% patients satisfied with procedure 100% would have the operation again	NR	NR	71.4% returned to normal sporting activity	NR	NR
Singh and O'Donnell [45]	100% patients satisfied with procedure 100% would have the operation again	NR	NR	95.8% returned to previous activity level	NR	NR
Sink <i>et al.</i> [46]	NR	NR	NR	NR	Flexion Pre-op: 97.5 Post-op: 106.2 Internal rotation Pre-op: 18.19 Post-op: 34	Self-described post-operative hip condition 78.9% excellent, 21.1% good
Tran <i>et al.</i> [47]	88.2% patient satisfaction.	NR	NR	78.1% were able to return to full competitive sports. 12.5% were able to return to lower level. 8.8% unable to return	NR	NR
Walker <i>et al.</i> [48]	NR	82% said pain improved.	88% said symptoms improved.	NR	NR	NR
Patients	2325	397	789	219	394	1363
Percentage of patients	73.7%	12.4%	24.7%	6.8%	12.3%	42.6%
Number of papers reporting outcome	21	7	7	6	4	8

<sup>a</sup>Domb *et al.* [25]—**A**: Surgical hip dislocation; **B**: Arthroscopic. <sup>b</sup>Krych *et al.* [31]—**A**: Labral repair; **B**: Labral debridement. <sup>c</sup>Larson and Giveans [32]—**A**: Labral debridement; **B**: Labral refixation. <sup>d</sup>Matsuda *et al.* [35]—**A**: Global FAI; **B**: Pincer FAI. <sup>e</sup>Matsuda and Burchette [36]—**A**: Labral reconstruction; **B**: Labral refixation. <sup>f</sup>Murata *et al.* [37]—**A**: Athlete; **B**: Non-athlete.

Table III. Standardized hip outcome scores reported in included studies

Primary author, year	mHHS	NAHS	HOS ADL	HOS SSS	WOMAC	UCLA	SF-12	Other
Beaulé <i>et al.</i> [22]	NR	NR	NR	NR	Pre-op: 61.2 Post-op: 81.4	Pre-op: 4.8 Post-op: 7.5	Physical component Pre-op: 37.3 Post-op: 45.6 Mental component Pre-op: 46.4 Post-op: 51.2	NR
Bizzini <i>et al.</i> [23]	NR	NR	NR	NR	NR	NR	NR	NR
Boone <i>et al.</i> [24]	NR	NR	NR	NR	NR	Post-op: 7	NR	NR
<sup>a</sup> Domb <i>et al.</i> [25]	A: Pre-op: 69.6 Post-op: 92 B: Pre-op: 68.2 Post-op: 92.4	A: Pre-op: 67.4 Post-op: 85.7 B: Pre-op: 66.1 Post-op: 94.2	A: Pre-op: 68.6 Post-op: 91.5 B: Pre-op: 72.2 Post-op: 95.3	A: Pre-op: 53.8 Post-op: 77.3 B: Pre-op: 44.3 Post-op: 87.1	NR	NR	NR	NR
Ejnisman <i>et al.</i> [26]	Pre-op: 60 Post-op: 93	NR	NR	NR	NR	NR	NR	NR
Gedouin <i>et al.</i> [19]	NR	NR	NR	NR	Pre-op: 60.3 Post-op: 83	NR	NR	NR
Guanche <i>et al.</i> [27]	NR	Pre-op: 49.2 Post-op: 71.2	NR	NR	Pre-op: 67.2 Post-op: 72.8	NR	NR	NR
Hartmann and Gunther [18]	Pre-op: 63.9 Post-op: 85.1	NR	NR	NR	NR	NR	NR	NR
Herrmann and Hauschild [28]	NR	NR	Post-op: 84	NR	NR	NR	NR	NR
Impellizzeri <i>et al.</i> [9]	NR	NR	NR	NR	Pre-op: 33.2 Post-op: 14.5 Note: scored with 100 being worst and 0 being best in this study.	NR	NR	EQ-VAS Pre-op: 64.1 Post-op: 75.9 EQ-SD Pre-op: 0.57 Post-op: 0.75
Impellizzeri <i>et al.</i> [29]	NR	NR	NR	NR	NR	NR	NR	OHS Pre-op: 33.3 Post-op: 41.6
Jackson <i>et al.</i> [20]	Improvement: 25.5	Improvement: 27.3	Improvement Post-op: 23.2	Improvement Post-op: 32.6	NR	NR	NR	NR

(continued)

Table III. (continued)

Primary author, <i>year</i>	mIHS	NAHS	HOS ADL	HOS SSS	WOMAC	UCLA	SF-12	Other
Javed and O'Donnell [30]	Pre-op: 60.5 Post-op: 79.7	Pre-op: 62.1 Post-op: 77.2	NR	NR	NR	NR	NR	NR
<sup>b</sup> Krych <i>et al.</i> [31]	NR	NR	A- Pre-op: 68.2 Post-op: 91.2 B- Pre-op: 60.2 Post-op: 80.9	NR	NR	NR	NR	NR
<sup>c</sup> Larson and Giveans [32]	A- Pre-op: ~64 Post-op: 88.9 B- Pre-op: ~62 Post-op: 94.3	NR	NR	NR	NR	NR	A- Pre-op: ~62 Post-op: ~82 B- Pre-op: ~60 Post-op: ~84	NR
Lo and Guanche [33]	NR	Pre-op: 48.9 Post-op: 78	NR	NR	Pre-op: 66.8 Post-op: 77	NR	NR	NR
Malviya <i>et al.</i> [34]	NR	NR	NR	NR	NR	NR	NR	NR
Mannion <i>et al.</i> [14]	NR	NR	NR	NR	NR	NR	NR	NR
<sup>d</sup> Matsuda <i>et al.</i> [35]	NR	A- Pre-op: 51.5 Post-op: 74.1 B- Pre-op: 54.8 Post-op: 76.9	NR	NR	NR	NR	NR	NR
<sup>e</sup> Matsuda and Burchette [36]	NR	A- Pre-op: 41.9 Post-op: 92.4 B- Pre-op: 55.4 Post-op: 77.9	NR	NR	NR	NR	NR	NR
<sup>f</sup> Murata <i>et al.</i> [37]	A- Pre-op: 66.4 Post-op: 96.5 B- Pre-op: 63.9 Post-op: 89.5	NR	NR	NR	NR	NR	NR	NR

(continued)

Table III. (continued)

Primary author, year	mHHS	NAHS	HOS ADL	HOS SSS	WOMAC	UCLA	SF-12	Other
Naal <i>et al.</i> [21]	NR	NR	Pre-op: 75.6 Post-op (satisfied): 81.3 Post-op (unsatisfied): 46.6	Pre-op: 89.0 Post-op (satisfied): 92.8 Post-op (unsatisfied): 72.7	Pain component Pre-op: 10.3 Post-op (satisfied): 6.5 Post-op (unsatisfied): 28.6 Stiffness component Pre-op: 15.9 Post-op (satisfied): 13.1 Post-op (unsatisfied): 30.2 Function component Pre-op: 9.6 Post-op (satisfied): 6.6 Post-op (unsatisfied): 24.7	Pre-op: 7.7 Post-op (satisfied): 7.9 Post-op (unsatisfied): 6.8	Physical component Pre-op: 47.4 Post-op (satisfied): 48.5 Post-op (unsatisfied): 42.2 Mental component Pre-op: 52.3 Post-op (satisfied): 52.5 Post-op (unsatisfied): 51.5	NR
Palmer <i>et al.</i> [38]	NR	Pre-op: 56.1 Post-op: 78.2	NR	NR	NR	NR	NR	NR
Park <i>et al.</i> [39]	Pre-op: 69.0 Post-op: 80.4	NR	NR	NR	NR	NR	NR	NR
Philippon <i>et al.</i> [40]	NR	NR	NR	NR	NR	NR	NR	NR
Philippon <i>et al.</i> [41]	Pre-op: 58 Post-op: 84.3	Pre-op: 66 Post-op: 81	Pre-op: 43 Post-op: 69	Pre-op: 70 Post-op: 87.8	NR	NR	NR	NR
Philippon <i>et al.</i> [42]	Pre-op: 57 Post-op: 91	NR	Pre-op: 38 Post-op: 82	NR	NR	NR	NR	NR
Philippon <i>et al.</i> [43]	Pre-op: 58 Post-op: 84	NR	Pre-op: 42 Post-op: 72	Pre-op: 66 Post-op: 87	NR	NR	Physical component Pre-op: 38 Post-op: 49 Mental component Pre-op: 54 Post-op: 53	NR
Polesello <i>et al.</i> [44]	Pre-op: 62.7 Post-op: 90.9	NR	NR	NR	NR	NR	NR	NR
Singh and O'Donnell [45]	Pre-op: 86 Post-op: 96	NR	NR	NR	NR	NR	NR	NR

(continued)

**Table III. (continued)**

Primary author, year	mHHS	NAHS	HOS ADL	HOS SSS	WOMAC	UCLA	SF-12	Other
Sinkov et al. [46]	Pre-op: 57.7 Post-op: 85.8	NR	NR	NR	NR	NR	Physical component Pre-op: 42.4 Post-op: 50.5 Mental component Pre-op: 51.9 Post-op: 53.9	NR
Tran et al. [47]	Pre-op: 77.4 Post-op: 76.3	Pre-op: 76.3 Post-op: 93.2	NR	NR	NR	NR	NR	NR
Walker et al. [48]	NR	NR	NR	NR	NR	Post-op: 8.5	NR	NR
Patients	1237	816	732	556	662	266	491	334
Percentage of patients	38.7%	25.5%	22.9%	17.4%	20.7%	8.3%	15.4%	10.4%
Number of papers reporting outcome	15	10	8	5	6	4	5	2

<sup>a</sup>Domb et al. [25]—A: Surgical hip dislocation; B: Arthroscopic. <sup>b</sup>Krych et al. [31]—A: Labral repair; B: Labral debridement. <sup>c</sup>Larson and Giveans [32]—A: Labral debridement; B: Labral refixation. <sup>d</sup>Matsuda et al. [35]—A: Global FAI; B: Pincer FAI. <sup>e</sup>Matsuda and Burchette [36]—A: Labral reconstruction; B: Labral refixation. <sup>f</sup>Murata et al. [37]—A: Athlete; B: Non-athlete.

## DISCUSSION

This is the first systematic review to examine the reporting of non-hip score outcomes in patients treated surgically for FAI. The major finding was that the most commonly reported non-hip score outcomes included patient satisfaction (72.7%), symptom improvement (24.7%), pain improvement (12.4%), hip range of motion (12.3%) and return to sport (6.8%). The results of this review show that the majority of the 3198 patients undergoing FAI surgery (arthroscopic, mini-open, open, surgical hip dislocation) were satisfied post-operatively based off results from 21 studies which surveyed patients on satisfaction post-operatively. This systematic review focused on reporting non-hip score outcomes whereas previous literature has emphasized reporting on standardized hip scores [7]. Only 12–17.6% of patients were unsatisfied with outcomes after surgery and 81–100% of patients reported that they would undergo FAI surgery again. In a subgroup of six studies primarily focused on athletes, 83.1% of patients were able to return to sport at a professional level or similar level of pre-injury activity. Surprisingly, return to sport was the least reported outcome in this review.

In attempt to determine any changes in the reporting of the various outcomes over time, the frequency of each outcome being reported was plotted against the year of publication (tables not included in this manuscript). Unfortunately, there were no clear trends, in large part due to the fact that all but three of the included studies were published in the last 4 years making it difficult to establish any sort of pattern over such a short time period.

Based on this systematic review, there appears to be differences between what patients consider to be an important outcome and what non-hip score outcomes are reported in the literature. Impellizzeri *et al.* [9] found that reduction in hip pain was the most cited reason for pursuing surgery followed by ability to return to sport and general physical capacity. Interestingly, in this systematic review, pain improvement as a non-hip score outcome was only reported in 12.4% of the included studies. That being said many of the standardized hip outcome scores (i.e. mHHS, NAHS, etc.) have pain components included in their questionnaires. Furthermore, although pain and symptom improvement was discussed quite frequently in the literature, it is of concern that only 6.8% of the studies reported statistics on return to sport, in this young active population. This further lends credence to the fact that clinical trials should incorporate the outcomes that are most important to patients. Finally, with regards to hip outcome scores, Lodhia *et al.* [8] conclude that the HOS has the most 'clinimetric evidence and is the most proven instrument' for use in the FAI patient population.

However, despite this, the mHHS and NAHS were found to be more frequently reported in the literature. It is possible that the use of validated outcome measures in the FAI population needs further adoption.

The strength of this review lies in the use of a duplicate, systematic approach to review multiple databases ensuring a comprehensive review of literature. Furthermore, this review provides a unique focus on the reporting of non-hip score outcomes in surgical FAI treatment which has not been previously explored in a systematic review.

Given that the majority of the studies in this review were of low quality evidence, we are limited by potential bias due to a lack of control groups, heterogeneous outcomes reporting, and small sample sizes. In this study, an English-only search was conducted and therefore some relevant literature published in other languages may potentially be excluded. It has not escaped notice that this language restriction may introduce bias and limit generalizability, as different cultures may emphasize different outcomes as top priorities. Moreover, as most studies provide only a summary of their raw data it was not possible to delineate any correlations between outcomes such as patient satisfaction or return to sport, and demographic variables such as age and sex. Finally, it is possible that the age of the patient may impact their perception of outcomes, but our included studies did not provide sufficient data to support or refute this claim.

Future research should further explore what outcomes are most important to patients with FAI. Increased consistency is needed in the literature in the reporting of outcomes before a relationship between standardized hip score outcomes and non-hip score outcomes can be explored. Although Impellizzeri *et al.* [9] specifically attempted to answer this question, additional efforts are required to ensure that future research focuses on outcomes that patients value. Specifically, a survey analysing how the importance of outcomes changes with demographic information such as age, sex and activity level would provide valuable information not currently provided in the literature. Furthermore, it is unclear in the literature if the post-operative patient surveys being used to measure certain outcomes (e.g. pain improvement, patient satisfaction) are the same across studies. However, unlike non-hip score outcomes, standardized hip scores have the advantage of higher reproducibility and objectivity given their more consistent format of surveying patients. This adds the potential for increased bias when comparing across studies if the outcomes are not being measured in the exact same way. Future research should also focus on developing standardized post-operative surveys for FAI patients that will help to increase the consistency of how these

outcomes are measured allowing for better cross study comparisons.

### CONCLUSION

The most commonly reported non-hip score outcomes in the literature addressing surgical management of FAI are patient satisfaction, symptom improvement and pain improvement. Generally, patients report a high level of satisfaction when surveyed post-operatively. However, differences exist between what outcomes the literature suggests are patient important and what outcomes are actually reported. Most noticeably is the fact that pain reduction is reported 12.4 % of the time and return to sport is seldom reported in assessing the efficacy of FAI surgery (6.8%). Secondly, despite the literature suggesting that outcome measures such as the HOS has important use in the FAI patient population, other standardized hip score outcomes (mHHS and NAHS) are still more commonly employed. The results of this systematic review have significant clinical relevance as it allows future research to focus on outcomes which are currently under addressed.

### CONFLICT OF INTEREST STATEMENT

None declared.

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### Appendix Table AI: Search strategy

	MEDLINE	EMBASE	PubMed
Search strategy	1. Exp 'quality of life' 2. Exp patient satisfaction 3. Exp hip joint 4. Exp arthroscopy 5. 1 or 2 6. 3 and 5 7. 4 and 5 8. 6 or 7	1. Exp patient satisfaction 2. Exp 'quality of life' 3. Exp hip/su [surgery] 4. Exp hip arthroscopy 5. 1 or 2 6. 3 and 5 7. 4 and 5 8. 6 or 7	(((((('Patient satisfaction') OR 'quality of life')) AND 'hip joint')) OR (((('patient satisfaction') OR 'quality of life')) AND 'arthroscopy')).
Number of papers retrieved	808	106	1329

**APPENDIX A2: REFERENCES OF STUDIES  
ELIMINATED AT FULL TEXT SCREEN**

1. Ackerman IN, Ademi Z, Osborne RH *et al*. Comparison of health-related quality of life, work status, and health care utilization and costs according to hip and knee joint disease severity: a national Australian study. *Phys Ther* 2013; **93**: 889–99.
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