Journal of Hip Preservation Surgery Vol. 7, No. 2, pp. 225–232
doi: 10.1093/jhps/hnaa013
Advance Access Publication 28 March 2020
Review article

Bilateral versus unilateral hip arthroscopy for femoroacetabular impingement: a systematic review

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Submitted 17 February 2019; revised version accepted 24 February 2020

ABSTRACT

One in four patients presenting with femoroacetabular impingement (FAI) has bilateral symptoms, and despite excellent outcomes reported after arthroscopic treatment of FAI, there remains a paucity of data on the outcomes following bilateral hip arthroscopy. This systematic review aims to examine the outcomes following bilateral (either 'simultaneous' or 'staged') versus unilateral hip arthroscopy for FAI. A systematic review of multiple electronic databases was conducted using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines and checklist. All studies comparing simultaneous, staged and/or unilateral hip arthroscopy for FAI were eligible for inclusion. Case series, case reports and reviews were excluded. All study, patient and hip-specific data were extracted and analyzed. The Newcastle–Ottawa Scale was used to assess study quality. A meta-analysis was not performed due to heterogeneity among outcome measures. A total of six studies, including 722 patients (42.8% male) and 933 hips were eligible for inclusion. The mean age across patients was 35.5. The average time between staged procedures was 7.7 months. Four of the six studies were retrospective cohort studies, while the remaining two were prospective in nature. The overall quality of the eligible studies was found to be good. No significant difference was noted among patient-reported outcomes (modified Harris hip score, hip outcome score and non-arthritic hip score), visual analog scale, return to sport, traction time and complications between those undergoing bilateral (simultaneous or staged) versus unilateral hip arthroscopy. Based on the current available evidence, bilateral hip arthroscopy (whether simultaneous or staged) exhibits similar efficacy and safety when compared with unilateral hip arthroscopy. However, further prospective study is required to confirm this finding.

INTRODUCTION

Femoroacetabular impingement (FAI), first described by Ganz *et al.* [1], is a common cause of cartilage and labral damage, hip pain and disability. FAI is due to bony abnormalities of three morphologic types: cam, pincer and mixed cam/pincer. Cam morphology results from femoral head–neck pathology including retrotorsion and asphericity, while pincer morphology results from acetabular over-coverage [1]. Over time, the mechanical stress due to these anatomic abnormalities can lead to hip degeneration and development of osteoarthritis [2].

The prevalence of radiographic hip impingement has been reported to be as high as 29% in the asymptomatic general population; with many individuals having bilateral findings [3–6]. Among patients with unilateral symptoms, Allen *et al.* [6] reported radiographic evidence of FAI in up to 78% of contralateral hips, with 26% of these individuals experiencing painful bilateral hips.

In the treatment of unilateral FAI, hip arthroscopy has been found to have excellent functional outcomes, high levels of patient satisfaction, high rates of return to sport and low complication rates [7–12]. Degen *et al.* [13]

reported the survivorship of primary hip arthroscopy at a 2-year survival rate of 88.1%, 5 years of 80% and 10 years of 74.9%.

However, there remains a paucity of data on the clinical outcomes following bilateral hip arthroscopy and the associated risks and complications. Risk factors for requiring bilateral hip arthroscopy include high-level athletes, male sex, younger age, higher alpha angles and reduced acetabular anteversion at initial presentation [14, 15]. Risk considerations of bilateral procedures include increased traction and anesthesia time with a simultaneous procedure, thereby increasing the potential risk of neurological and soft-tissue complications. In addition, a paucity of data exists as to the ideal timing between bilateral staged procedures. Considering the common incidence of bilateral FAI and the relative lack of data that exists following bilateral hip arthroscopy, this systematic review aims to examine the clinical outcomes and safety of bilateral (either staged or simultaneous) versus unilateral hip arthroscopy for FAI.

MATERIALS AND METHODS

A systematic review was conducted following the Preferred Reporting Items for Systematic Reviews (PRISMA) guidelines.

Literature search

A literature search of EMBASE, MEDLINE and PubMed databases was conducted for sources available as of 28 October 2018. The keywords 'femoroacetabular impingement.pm' or 'exp Femoracetabular Impingement', 'hip adj2 arthroscop*' and 'bilateral' were searched on MEDLINE, 'femoroacetabular impingement', 'hip arthroscop*' and 'bilateral' on EMBASE and PubMed. In addition, the conference abstracts from the five most recent (2013–2018) annual meetings of the International Society for Hip Arthroscopy (ISHA) and American Academy of Orthopaedic Surgery (AAOS) were reviewed for eligible studies. Lastly, the references cited by eligible studies were searched for additional articles.

Eligibility criteria

We identified all published studies fulfilling the following eligibility criteria: the study evaluated the clinical outcomes of bilateral hip arthroscopy (simultaneous and/or staged) for the treatment of FAI with at least 1-year follow-up and an appropriate comparative cohort. There were no age or language restrictions. We excluded case series and case reports, surgical technique, basic science and editorial commentary articles.

Study selection

Two independent reviewers screened all titles and abstracts generated by the literature search to assess eligibility. Studies meeting eligibility criteria were included for full-text review. Any disagreement between the two reviewers during the study selection process was resolved through discussion with a third reviewer to reach consensus.

Data extraction

Two reviewers extracted relevant data from the identified eligible studies into a single collection spreadsheet. Data collected included the following: title, authors, journal, year, level of evidence, demographics (i.e. age and sex), indications for arthroscopy, arthroscopic procedures performed, timing of staged procedures and reported outcomes [including modified Harris hip score (mHHS), hip outcome score (HOS), visual analog scale (VAS), complications, return to sport, etc.]. An additional comments section collected any other relevant data specific to particular studies.

Assessment of risk of bias in eligible studies

The overall quality of each eligible study was evaluated with the Newcastle–Ottawa Scale (NOS) [16]. The NOS assesses cohort studies using the areas of selection, comparability and outcome to rate quality as good, fair or poor. Two reviewers assessed each eligible study utilizing the NOS. Disagreements were resolved were consensus discussion with a third reviewer.

Statistical analysis

Descriptive statistics were calculated with continuous data (e.g. traction time) reported as weighted means with their associated standard deviation and categorical data (e.g. complication rate) reported as frequencies with percentages.

RESULTS

Literature search

The results of our electronic literature search are depicted in Fig. 1. The search generated 102 results and after screening the titles and abstracts, 17 underwent full-text review. Ultimately, six studies met the inclusion criteria [17–22].

Study characteristics

The six studies reviewed included two prospective [19, 22] and four retrospective [17, 18, 20, 21] studies. There were two conference abstracts [21, 22] from the ISHA annual meeting, for which further information was obtained

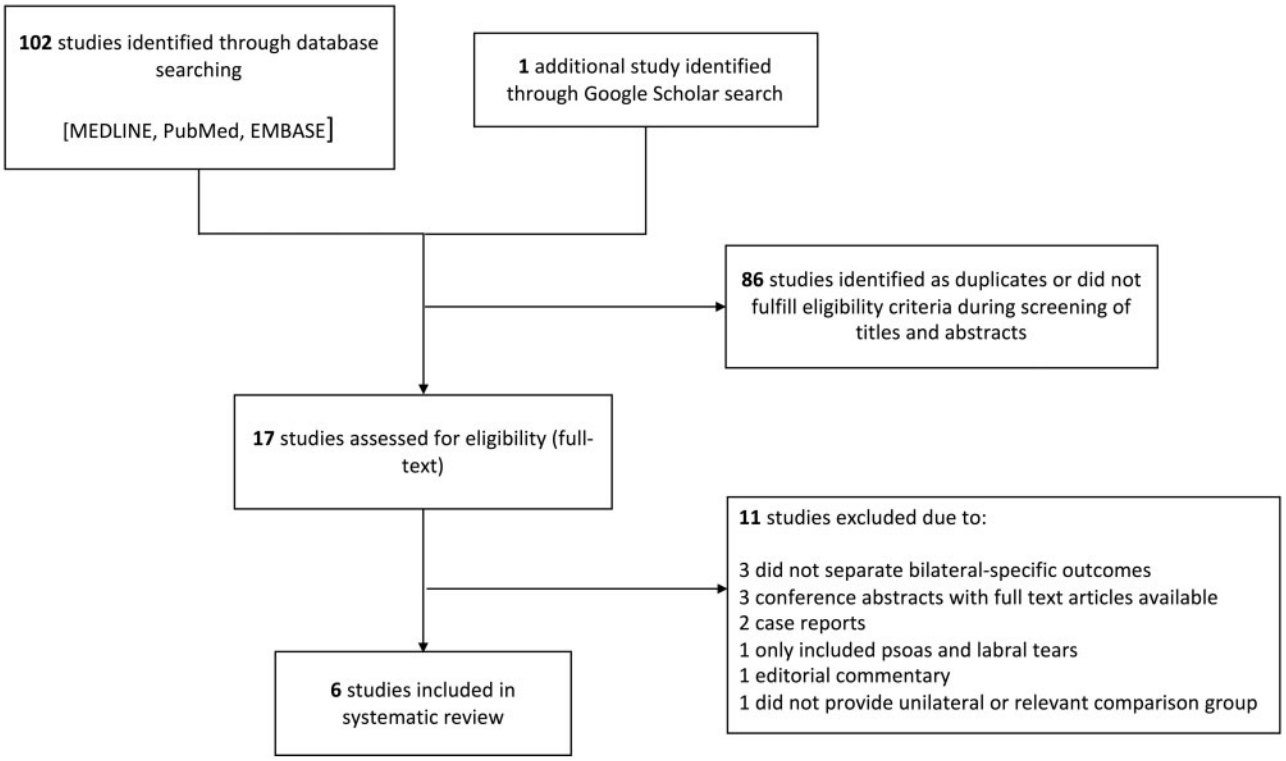

Fig. 1. Flow diagram of systematic search and study selection.

directly from the authors of one of the studies [21] via email correspondence. A total of 722 patients were enrolled in the six available studies [17–22], of which 511 (70.8%) patients underwent unilateral hip arthroscopy, 144 (19.9%) patients underwent bilateral staged procedures and 67 (9.3%) patients underwent bilateral simultaneous hip arthroscopy [17–22]. The average time between staged procedures was 7.7 months across four studies [17, 18, 20, 22]. Baseline characteristics of these studies are depicted in Table I. The mean age across participants was 35.5 years and 42.8% were male. Minimum follow-up was 12 months for three studies [17, 19, 20] and 24 months for three studies [18, 21, 22]. Procedures performed included labral repair, cam resection, pincer resection, AIIS decompression, labral debridement, microfracture, trochanteric bursectomy and loose body removal. Three of the six studies [18, 21, 22] reported that of all patients who underwent hip arthroscopy, 15–17% underwent bilateral procedures.

Bilateral (staged) versus unilateral hip arthroscopy

Modified Harris hip score

Kuhns *et al.* [18] found unilateral hip arthroscopy had a significantly higher mHHS compared with bilateral staged procedures ($P = 0.01$), while Wolfson *et al.* [22] found no significant difference between groups at the 2-year follow-up ($P > 0.05$). Kuhns *et al.* [18] also noted a greater post-operative improvement in the mean mHHS with unilateral compared with staged bilateral hip arthroscopy ($P = 0.002$), while Wolfson *et al.* found no difference between groups.

Hip outcome score–activities of daily living and sport-specific subscale

Kuhns *et al.* [18] found no significant difference between groups in HOS–activities of daily living (ADL) or HOS–sport-specific subscale (SSS) at final follow-up. They also stratified the bilateral staged cohort, reporting outcomes for patients who had their second surgery within 10 months and after 10 months of the first procedure. They noted that patients who had their second procedure more than 10 months after the first had less improvement in HOS–SSS ($P = 0.05$) and lower post-operative HOS–ADL ($P = 0.04$) [18].

Non-arthritic hip score

Two studies [20, 22] compared the non-arthritic hip score (NAHS) between those undergoing staged bilateral and unilateral hip arthroscopy and found no significant

Table I. ***Baseline characteristics of eligible studies***

Author (year)	*Level of evidence*	*Intervention (N)*	*Control (N)*	*Mean time between staged procedures (months)*	*Sample size (% male)*	*Mean age*	*Minimum follow-up (months)*	*Operative measures*	*Outcomes reported*
McConkey (2017)	II	Bilateral simultaneous (12)	Unilateral (12)	NR	24 (41.7)	16.1	12	NR	Primary: iHOT Secondary: return to sport
Degen (2016)	III	Bilateral simultaneous (12)	Bilateral staged (24)	1.52	36 (58.3)	20.9	12	Traction time	mHHS, HOS–ADL, HOS–SSS
Mei-Dan (2014)	III	Bilateral simultaneous (26) and staged (20)	Unilateral (30)	3.35	76 (55.3)	33	12	Surgical time Anesthesia time	Primary: VAS Secondary: WOMAC, NAHS
Rafols (2013)	Conference abstract	Bilateral simultaneous (17)	Unilateral (79)	NA	96 (59.4)	36.1	24	Traction time Fluids used	Primary: HOS, VAS
Kuhns (2017)	III	Bilateral staged (43)	Unilateral (86)	6.10	129 (32.6)	28.6	24	NR	Primary: HOS–ADL Secondary: HOS–SSS, VAS, mHHS
Wolfson (2016)	Conference abstract	Bilateral staged (57)	Unilateral (304)	13.0	361 (37.9)	40.9	24	NR	mHHS, NAHS

HOS–ADL, hip outcome score–activities of daily living; HOS-SSS, hip outcome score–sport specific subscales; iHOT, international hip outcome tool; mHHS, modified Harris hip score; *N*, sample size; NAHS, non-arthritic hip score; NA, Not necessary; NR, not reported; VAS, visual analog scale; WOMAC, Western Ontario-McMaster University pain score.

difference between groups at final follow-up. In addition, there was no significant difference noted in the change in NAHS from pre- to post-operative between groups in either study [20, 22].

Visual analog scale

Mei-Dan *et al.* [20] found no significant difference between groups at any follow-up interval up to and including 30 days post-operatively, while Kuhns *et al.* [18] noted significantly lower mean pain scores in the unilateral cohort compared with the bilateral staged group at 2 years ($P = 0.02$). Kuhns *et al.* [18] stratified outcomes within the bilateral staged cohort, demonstrating patients who had their second procedure more than 10 months after the first had significantly less improvement in their VAS pain scores ($P < 0.0001$).

Bilateral (simultaneous) versus unilateral hip arthroscopy

Hip outcome score

Rafols *et al.* [21] examined the HOS among patients undergoing bilateral simultaneous and unilateral procedures and reported no significant difference between groups in HOS–ADL or HOS–SSS at final follow-up.

Non-arthritic hip score

The NAHS was evaluated in one study [20] and demonstrated no significant difference between those undergoing bilateral simultaneous and unilateral arthroscopy.

Visual analog scale

Two studies [18, 19] measured pain outcomes using the VAS and showed no difference in scores between groups at final follow-up.

Return to sport

One study [19] reported return to pre-injury level of activity as an outcome measure. This study evaluated adolescent athletes with symptomatic FAI and found no significant difference in return to activity between unilateral and bilateral simultaneous hip arthroscopy ($P = 0.40$).

Bilateral (staged) versus bilateral (simultaneous) hip arthroscopy)

Modified Harris hip score

Degen *et al.* [17] compared bilateral staged to simultaneous procedures and reported similar improvement between groups at 2-year follow-up ($P = 0.662$).

Hip outcome score

One study [17] evaluated the HOS–ADL and HOS–SSS among patients undergoing staged versus simultaneous bilateral hip arthroscopy and reported no difference between groups at final follow-up.

Non-arthritic hip score

At final follow-up, Mei-Dan *et al.* [20] found no significant difference in NAHS between patients undergoing staged and simultaneous bilateral hip arthroscopy.

Visual analog scale

Mei-Dan *et al.* [20] reported no difference in VAS scores between unilateral and bilateral staged groups at final follow-up.

Traction time

Two studies [17, 21] reported traction time for unilateral, bilateral staged and simultaneous hip arthroscopy procedures for patients with symptomatic FAI. Rafols *et al.* [21] noted a mean traction time of 34.4 min in the unilateral group, Degen *et al.* [17] reported a mean traction time of 85.7 min in the bilateral staged group, and pooled data across both studies for bilateral simultaneous procedures demonstrated an average traction time of 78.8 min.

Complications

The overall rate of complication was 1.4% (5/352) across the four studies reporting this data [17–20]. Two transient lateral femoral cutaneous nerve palsies were reported by McConkey *et al.* [19]; one from the bilateral simultaneous group and one from the unilateral group, both of which resolved within 2 weeks of surgery. There were no reported pudendal or superficial peroneal nerve palsies, soft-tissue complications, infections, deep vein thromboses or pulmonary emboli. Two studies did not report complications [21, 22].

Reoperations

There were three reported reoperations [17, 18] among patients undergoing staged bilateral hip arthroscopy (1.7%) and no reoperations in the bilateral simultaneous and unilateral groups [17–20].

Study quality

The quality of eligible studies [17–20] was evaluated utilizing the NOS [16] (see Supplementary Data). Four studies [17–20] were determined to be of good quality. We could not adequately evaluate the quality of the conference abstracts [21, 22] using the NOS due to the lack of information provided in the abstracts.

DISCUSSION

The results of this systematic review have identified several trends in the existing literature. First, based on the current evidence, there are no significant differences in clinical outcomes when comparing unilateral, bilateral staged or bilateral simultaneous procedures for the arthroscopic treatment of FAI. Second, there is no significant difference in the rate of complication when comparing unilateral, bilateral staged or simultaneous procedures [17–20]. The overall complication rate (1.4%) was low across all studies [17–20]. Only two neurological complications were reported, which were both sensory deficits of the lateral femoral cutaneous nerve which resolved within 2 weeks.

Previous literature has suggested bilateral simultaneous procedures may not be ideal for patients with more severe pathology or for those who will have prolonged protected weight bearing [23], which was reflected in the current review. One study [20] noted that patients for whom significant microfracture was anticipated were excluded from the bilateral simultaneous group and underwent staged procedures due to the significant weight-bearing restriction of 4–6 weeks and cutting/pivoting sport avoidance for 5–6 months. Another study [17] allowed patients to choose bilateral simultaneous or staged procedures regardless of age, pathology or other factors. However, this cohort may have been comprised of more physically fit or motivated individuals who underwent a bilateral simultaneous procedure due to the more challenging 4-point gait rehabilitation required.

The present review included three studies [18, 21, 22] which found that among patients undergoing hip arthroscopy, 15–17% required bilateral arthroscopy, consistent with previously reported rates of approximately 20% [14, 15]. Notably, a significant proportion of patients ultimately undergoing staged bilateral hip arthroscopy present initially with unilateral hip pain. In Kuhns *et al.*' [18] bilateral staged cohort, 34.8% of patients undergoing bilateral surgery presented with a single painful hip and later required surgery on the contralateral hip. In addition, in a previous study by Haviv and O'Donnell [24], 45.1% of patients undergoing bilateral surgery presented initially with unilateral pain. These findings suggest that a significant number of patients presenting with unilateral hip pain may develop contralateral hip pain and ultimately require bilateral surgery. As such, patients presenting with unilateral hip pain may benefit from evaluation of both hips at initial presentation to allow for recognition and initiation of symptomatic management earlier in the disease process.

While four studies evaluated bilateral staged procedures, a paucity of data exists in the optimal timing between staged hip arthroscopy. In the current review, the time between staged operations ranged from 3 weeks to 58 months with a mean time of 7.7 months [17, 18, 20, 22]. Kuhns *et al.* [18] was the only study to stratify results based on the time interval between staged procedures. They associated a delay of greater than 10 months between staged procedures with significantly higher VAS pain scores and poorer patient-reported outcomes (final HOS–ADL and HOS–SSS improvement). These preliminary findings by Kuhns *et al.* [18] indicate there may be greater improvement with less time between procedures. Interestingly, Haviv and O'Donnell [24] examined clinical outcomes among patients who had undergone staged bilateral hip arthroscopy for cam-type FAI and found that patients undergoing hip arthroscopy on the contralateral hip within 1.2 months and 9.9 months, both had significant improvement in pain and function. However, they noted that the time interval between surgeries was shorter among younger patients, those with higher grade cartilage lesions and better post-operative scores following the first surgery.

Our review also suggests that simultaneous surgery and rehabilitation may be a safe option for those presenting with bilateral hip pain secondary to FAI. Kuhns *et al.* [18] noted that patients undergoing two full rehabilitation protocols are less satisfied and experience more pain than those undergoing one. In addition, among patients requiring surgical management of both hips, those undergoing staged procedures may not be able to fully participate in the first rehabilitation due to contralateral symptoms. While bilateral rehabilitation may be more rigorous, requiring the more challenging 4-point gait [17], a single rehabilitation period may allow return to sports/activity earlier than two complete rehabilitation protocols in motivated patients [19]. Of note, a single simultaneous procedure requires greater traction time and anesthetic time, which may limit these procedures to more experienced hip arthroscopists who are able to perform these procedures more efficiently [19–21]. In the hands of an experienced surgeon and an appropriately selected patient, a single operation and rehabilitation period may be preferred to staged procedures with the added benefit of cost savings associated with a single surgery [18, 21, 23, 25].

Limitations

The primary limitation of the present review was the significant heterogeneity in outcome measures utilized to evaluate surgical success, patient function and satisfaction following hip arthroscopy. The most commonly reported outcome was complication rate, yet only four out of six studies provided this data, limiting our ability to make any definitive conclusions on the safety of bilateral compared with unilateral hip arthroscopy [17–20]. Moreover,

'transient' neurological and soft-tissue complications, such as pudendal nerve neuropraxia, may not have been captured within the follow-up period of the eligible studies. Our review reaffirms the findings from previous studies indicating the lack of and need for more standardization in outcome measurements for patients undergoing hip arthroscopy for FAI [26, 27]. Furthermore, patient-reported outcome measures were collected at different time points following surgery, diminishing comparability. Although all eligible studies [17–22] provided at least 1-year follow-up, it is possible that outcomes would have differed with longer follow-up, especially given the fact that many patients with unilateral FAI often develop symptoms in the contralateral hip. As a result, it is possible that with longer follow-up a greater proportion of patients who underwent unilateral hip arthroscopy would have ultimately undergone a second, contralateral, hip surgery. In addition, as previously acknowledged, patient selection for simultaneous versus bilateral staged arthroscopy was non-randomized, potentially selecting for more physically fit and motivated patients in the bilateral simultaneous groups or in those with shorter time between staged procedures [17]. Lastly, due to the heterogeneity across studies, this systematic review was unable to provide pooled analysis of patient-reported outcomes.

CONCLUSIONS

Based on the current evidence available, there is no significant difference in patient-reported outcomes or complication rates when comparing unilateral to bilateral simultaneous or staged hip arthroscopy procedures for FAI. However, the heterogeneity in outcome measures, timing between staged bilateral procedures and patient demographics limit our conclusions. As such, further prospective studies are needed to confirm the findings of this review.

SUPPLEMENTARY DATA

Supplementary data are available at *Journal of Hip Preservation Surgery* online.

CONFLICT OF INTEREST STATEMENT

None declared.

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