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Original article

Do the outcomes of hip arthroscopy for femoroacetabular impingement change over time?

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ABSTRACT

Background

The purpose of this study was to search for changes in functional outcomes of patients undergoing hip arthroscopy for femoroacetabular impingement (FAI) between short and medium-term follow-up. Secondary aims included reporting rates of revision surgery and total hip arthroplasty (THA) at medium-term follow-up.

Hypothesis

We hypothesised that patients' functional outcomes would improve between short and medium-term follow-up.

Patients and Methods

Consecutive patients undergoing hip arthroscopy with a diagnosis of femoroacetabular impingement with labral tears between February 2013 and June 2015 were included. Twelve item international hip outcome tool (iHOT-12) and

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EuroQol 5D-5L (EQ-5D) scores were collected preoperatively, at short-term and medium-term follow-up. Short-term scores were recorded at a minimum of one year postoperatively and medium-term scores at a minimum of five years postoperatively. Survivorship was assessed with Kaplan-Meier analysis.

Results

Short-term outcome data (at median follow-up 1.6 year, Interquartile range [IQR] 1-2.5) was available for 70 of 87 patients (80.5%) and medium-term outcome data (at median follow-up of 6.5 years, IQR 6-7.1) was available for 68 patients (78.2%). Median age at the time of surgery was 31 years (IQR 25 – 37). The median iHOT-12 scores at short and medium-term follow-up were 72 (IQR 48.75 – 91.25) and 85.8 (IQR 66.7 – 96.7) respectively ($p<0.001$). Medium-term survivorship was 91.2%. Survivorship following labral repair was 94.2%, and 81.3% following labral debridement ($p=0.09$).

Discussion

Patients undergoing hip arthroscopy for FAI reported continued improvement in iHOT-12 scores between short and medium-term follow-up. Medium-term survivorship following FAI surgery may be greater when the labrum is repaired, although comparisons are limited by their differing indications. Conversion to THA was low with just 4 patients (4.6%) undergoing or being listed for THA at final follow-up.

Level of Evidence: IV, Case series

Keywords: Femoroacetabular, Impingement, Arthroscopy, Hip, Survivorship

1. INTRODUCTION

The short-term success of hip arthroscopy for femoroacetabular impingement (FAI) has been demonstrated in prospective, multicentre randomised controlled trials.[1, 2]

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However, less is known regarding the evolution of patient reported functional outcomes and satisfaction levels over time, between short and medium-term follow-up. In addition, there is limited data on the medium to longer term survivorship after arthroscopic FAI surgery.

A number of studies have reported on outcomes following hip arthroscopy for FAI minimum five-year outcomes.[3-10] Survivorship ranged from 54% to 94% at mean follow-up ranging from five to eleven years. Increasing age and Outerbridge score have been predictive of total hip arthroplasty (THA) at medium-term follow-up. [6] Additionally, Skendzel *et al*. reported 86% of patients with reduced joint space (≤2mm) underwent total hip arthroplasty (at a mean of 40 months) compared to just 16% with preserved joint space (at a mean of 88 months)[7].

The 12 item international hip outcome tool (iHOT-12) is a commonly used tool for assessing patient reported functional outcomes following hip arthroscopy and has been shown to have valid and reliable psychometric properties.[11] It has been shown to correlate well with satisfaction following hip arthroscopy at short-term follow-up but little is known about this relationship in the medium or longer term. [12, 13] Two studies have reported conflicting longitudinal data on the change of patient reported outcomes scores over time following hip arthroscopy. Perets *et al* reported no statistical difference in functional outcome measures, pain scores or satisfaction at two years and final (minimum five years) follow-up in patients undergoing hip arthroscopy.[5] The same authors reported functional outcomes at two years and final follow-up at a minimum five years in patients over 50 years of age showing improved Non-arthroplasty Hip Scores and Hip Outcome Scores (HOS) but no difference in

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satisfaction rates.[4] Kiekegaard *et al* performed a meta-analysis of change in functional outcomes following hip arthroscopy using a variety of follow-up time points from 26 studies. [14] However, the authors focussed on early outcomes and only one study reported outcomes with greater than five years follow-up.[7]

The purpose of this study was to 1) search for changes in functional outcomes (as assessed by iHOT-12 scores), quality of life, and satisfaction of patients undergoing hip arthroscopy for FAI between short and medium-term follow-up, 2) assess survivorship for patients undergoing labral repair or labral debridement, and 3) assess incidence and timing of conversion to THA.

HYPOTHESIS

We hypothesised that patients' functional outcomes would improve between short and medium-term follow-up.

2. MATERIAL AND METHODS

(2.1) Patients

All patients undergoing primary hip arthroscopy for FAI at a single hospital were entered into a prospectively collected database, for which regional ethical approval had been obtained (Research Ethics Committee, South East Scotland Research Ethics Service, Scotland [16/SS/0026])). Data for all patients undergoing primary hip arthroscopy for FAI with labral tears between January 2013 and September 2015 were included. All patients were diagnosed by the same treating consultant surgeon, using a combination of clinical history, physical examination, plain radiographs and magnetic

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resonance imaging (MRI). Exclusion criteria included patients with Tönnis grade two or above, avascular necrosis of the hip, or if they were undergoing revision surgery (Figure 1).

[FIGURE 1 HERE]

(2.2) Methods

To be considered for surgery, all patients had had undergone a trial of nonoperative treatment which included analgesia and a minimum of three months of focussed physiotherapy with reported unsatisfactory outcomes. In cases where there was diagnostic uncertainty, joint injections were used to confirm the intra-articular origin of symptoms. All patients had Tönnis grade one or below as assessed on plain preoperative radiographs.[15] Surgical technique was as follows: The supine distractor was used for patient positioning. Image intensifier was used to confirm joint distraction. Superolateral and anterior portals were used to access the hip joint. These were expanded with sequential dilators to allow instrument access. The paralabral recess was opened and a high-speed burr was used to resect the pincer lesion of the acetabular rim and enable a flat surface for anchor placement. If the labrum was repairable, Stryker Cinchlock (Stryker, Mahwah, NJ, USA) anchors were used in a vertical mattress fashion with Cobraid sutures (Smith & Nephew Endoscopy, Mansfield, Massachusetts, USA) to repair the labrum. The traction was then released and attention was turned to the femoral head/neck junction. The cam lesion was resected using a high-speed burr. Flexion was used to reach the anterior most aspects of the neck. An on-table impingement manoeuvre was performed to assess clearance of the femoral neck from the acetabulum under direct vision. Final orthogonal x-ray

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views were obtained to ensure adequate bony resection. The hip joint capsule was not repaired in any case.

Indications for arthroplasty by the treating surgeon were a combination of worsening pain, an impact on function/daily activities, clinical examination findings and radiographic osteoarthritis of Tönnis 2 or greater.

(2.3) Methods of Assessment

Patients completed the iHOT-12 and EQ-5D-5L questionnaires two weeks prior to surgery at the pre-assessment clinic and again postoperatively, at a minimum of one and five years. Here, minimum one year data is referred to as 'short-term' and minimum five year data is referred to as 'medium-term'. Satisfaction was also assessed at these postoperative time points.

Patients were asked "How satisfied are you following your surgery?" The response to the question was graded using a 5-point Likert scale: very satisfied, satisfied, neither satisfied or dissatisfied, dissatisfied or very dissatisfied.

(2.4) Statistical analysis

Normality was assessed using Shapiro-Wilk testing. Non-parametric data was reported as median with interquartile range and compared using Mann Whitney U-tests for unrelated data and Wilcoxon signed rank test for related data. Categorical data was compared using Chi squared testing. Kaplan-Meier survivorship analysis was performed to compare failure rates between patients undergoing labral repair and

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labral debridement. Failure was defined as revision hip arthroscopy or total hip arthroplasty/listed for THA surgery. A total of 87 patients were eligible for inclusion. Short-term outcome data were available for 70 patients (80.5%) and medium-term follow-up data was available for 68 of these (78%). Patients for whom follow-up data were missing were contacted by telephone by the research team. Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) software (IBM, Inc., Armonk, New York, United States) v24, and a p-value of <0.05 was considered statistically significant.

3. RESULTS

Patient characteristics

The median short-term follow-up was 1.6 years (Interquartile range [IQR] 1 – 2.5) and median medium-term follow-up was 6.4 years (IQR 6 – 7.1). The median time between follow-up timepoints was 4.5 years (IQR 4.4 – 4.6 years). Median age at the time of surgery was 31 years (IQR 25 – 37). The median iHOT-12 scores at short and medium-term follow-up were 72 (IQR 48.75 – 91.25) and 85.8 (IQR 66.7 – 96.7) respectively (Figure 2, p<0.001). 56 (80%) patients had improvements greater than the documented minimum clinically important difference (MCID) for the iHOT-12 (of 12.5 points)[16] at short-term follow-up. The median EQ-5D indices at short-term and medium-term follow-up were 0.737 (IQR 0.652 – 0.878) and 0.848 (IQR 0.75 – 1)(p=.001). The median EQ-5D VAS scores at short and medium-term follow-up were 80 (IQR 61 - 90) and 90 (IQR 73.8 - 95)(p=0.049) respectively. The demographic characteristics of included patients are summarised in Table 1. Details of the surgical procedures performed are outlined in Table 2. (Figure 2).

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[INSERT FIGURE 2]

Change between short-term and medium-term functional outcomes and satisfaction

The median change in iHOT-12 score from short to medium-term follow-up was +8.4 (IQR 0.42 – 18.5, $p < 0.001$). The median change in EQ-5D index and VAS were +0.040 (IQR 0 – 0.167, $p = 0.001$) and +5 (IQR -5 – 12, $p = 0.036$) respectively. There were 52 patients (74%) who reported being 'very satisfied' or 'satisfied' at short-term follow-up and 54 patients (79%) who reported being 'very satisfied' or 'satisfied' at medium-term follow-up ($p=0.484$). The categorisation of satisfaction by follow-up time can be seen in Table 3. Two patients who had previously been 'very dissatisfied' or 'dissatisfied' at short-term follow-up reported that they were 'satisfied' at medium-term follow-up. One patient who was 'satisfied' at short-term follow-up stated that they were 'dissatisfied' at medium-term follow-up. Median short-term iHOT-12 scores for those who were satisfied was 80 vs 34 for those who were dissatisfied ($p<0.001$). Median medium-term iHOT-12 scores for those who were satisfied was 93.3 vs 64.2 for those who were dissatisfied ($p<0.001$).

Survivorship

The survivorship of hip arthroscopy at median follow-up of 6.5 years was 91.2% (62 patients). Survivorship after labral repair was 94.2% (49 patients) compared to 81.3% (13 patients) after labral debridement ($p=0.09$) (Figure 3). There were no differences in preoperative demographics, preoperative functional outcome scores or rates of intraoperative microfracture amongst those with labral repairs compared to those

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undergoing debridement. Furthermore, there were no differences in postoperative functional outcomes between the two treatment groups at either follow-up timepoint (Table 4).

[INSERT FIGURE 3]

Revision surgery and conversion to THA

There were no cases of infection, perineal paraesthesia, or other complications postoperatively. Eight patients were considered to have failed primary surgery due to residual symptomatology. Four patients (4.6%) underwent further arthroscopic surgery at a median of 24 months (IQR 24 - 26) following the index procedure. Indications for revision surgery were recurrent tears with revision repair (n=3) and degeneration of the unrepaired labrum which underwent debridement (n=1). The median short-term iHOT-12 score for those requiring revision arthroscopy was 69 compared to 72 in the remainder of the cohort (p=0.525). Two patients (2.3%) underwent total hip arthroplasty (THA) at 55 and 70 months following the index surgery. Two further patients were on the waiting list for THA at the time of this study at 39 and 81 months postoperatively. The median short-term iHOT-12 score for those requiring THA was 37 compared to 72.5 in the remainder of the cohort however this did not reach statistical significance (p=0.11). There was no difference in one-year satisfaction between those who underwent further surgery (revision or THA) and those who did not (p=0.282).

4. DISCUSSION

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Little is known about the evolution of functional outcomes over time following hip arthroscopy. The most notable finding from this study was the continued improvement in functional outcomes between short and medium-term follow-up, with sustained satisfaction levels. A previous meta-analysis found no significant improvements in functional outcome between one to five years after hip arthroscopy.[14] However, only one study contributed data beyond five years following the index procedure.[7] Similarly, two other studies have reported a plateau in functional outcomes at 4.5 and 5 years follow-up,[5, 17] however the population studied by Perets *et al* was solely obese patients. However, conflicting results further reported by Perets *et al*, show significant changes in functional outcomes between 2 and 5 years postoperatively, in agreement with our findings.[4] Plateaus in functional outcomes have been reported following hip arthroscopy at shorter time frames, with no change in outcomes after 6 months also being reported.[18] However, a study by Flores *et al* reported significant improvements in functionality between one and two years postoperatively, and called for further research into the long term changes in patient reported outcome measures following hip arthroscopy.[19] We reported a median difference in the individual change of the iHOT-12 score between short and medium-term follow-up to be +8.4 (IQR 0.42 – 18.5). This is less than the previously reported MCID published for this outcome metric (12.5 points)[16] and therefore, patients may not notice any clinical difference in their function between short and medium-term follow-up. The absence of change in satisfaction between short and medium-term follow-up may support this, although patients did report a significant improvement in EQ-5D index and VAS over this time period.

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Overall survivorship for our cohort of patients at median 6.5 years follow-up was 91.4%. Survivorship was greater with labral repair (94.4%) compared to labral debridement (81.3%). This between group difference was not significant at p=0.10, suggesting that we are likely underpowered for this analysis as a 10 points difference in a 1-100 scale would typically indicate a substantial effect size and is of a magnitude to be considered clinically meaningful. Menge *et al* reported no difference in survivorship between labral repair and debridement at 10 year follow-up.[3] We found no statistically significant differences in functional outcome scores between the two surgical groups at either time point. A previous prospective cohort study reported Harris Hip Scores of >80 were achieved in 92% of those who received labral repair compared to only 68% in those who underwent debridement at mean follow-up of 3.5 years.[20] One confounding factor when reporting outcomes for labral repair vs debridement is the significance of an unrepairable labrum being reflective of early degenerative disease in the hip which has been associated with worse functional outcomes following hip arthroscopy.[21]

Vovos *et al*. found the average time to THA following hip arthroscopy to be 29 months.[22] Perets *et al* reported rates of conversion to THA to be 27.7% at a mean of 39.4 months,[4] and Disegni et al reported rates of 16.3% in an epidemiological study of 3699 patients.[23] These higher rates of THA compared to our study may be explained by both papers' inclusion criteria of patients who were greater than 50 years old. In our current study, we report a substantially longer time from arthroscopic surgery to THA. Patients requiring THA had lower iHOT-12 scores at short-term follow-up (although this did not reach statistical significance) and clinicians should be wary of the medium-term outcomes of those who score poorly at early follow-up.

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This study has some limitations. We do not include any patients with a Tönnis grading greater than two. However, this is in keeping with universally agreed indications for hip arthroscopy. We are also unable to determine when between short and medium-term follow-up improvements in iHOT-12 occurred, although this was not an aim of the study. It should also be noted that the study's generalisability may be limited by the hip capsule not being closed, although capsular repair is still not universally performed. Furthermore, despite a large difference in median short-term iHOT-12 scores amongst those who suffered failure of the index surgery and those who did not, this did not reach statistical significance. This was also true for the differences in survivorship amongst those who underwent labral repair vs labral debridement. These likely represent type two error secondary to being underpowered, nonetheless, despite the 'false negatives' associated with type two errors, we still present positive findings in this study. The comparison of labral repair and debridement is further limited by the differing indications for the two procedures, with debridement performed for more degenerative labrum. Additionally, we had a loss to follow-up of 20%, and whilst measures to minimise this were actively employed this is a further limitation of the study. However, this is a well-recognised limitation of retrospective analyses, and a loss to follow-up of less than 20% has previously been used as a quality benchmark for retrospective analyses.[24]

5. CONCLUSION

Patients undergoing hip arthroscopy for FAI reported continued improvement in iHOT-12 scores between short and medium-term follow-up. This corresponded with our earlier hypothesis, however, this change was less than the minimum clinically

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important difference, so whilst functional outcomes are typically maintained at medium-term follow-up, patients may not report a clinically noticeable improvement. This information will help surgeons inform patients on postoperative outcomes, manage expectations and facilitate treatment decisions.

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We thank the efforts of Dr Jason Ting and Dr Conor Rankin for their contribution to the early data collection which was used in this study.

Ethics approval and consent to participate

- Ethical approval was obtained from the regional ethics committee (Research Ethics Committee, South East Scotland Research Ethics Service, Scotland (11/AL/007) for analysis and publication of the presented data.

Consent for publication

- Not applicable

Availability of data and materials

- The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Conflicts of Interests: None

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Authors' contributions

PGR – Research idea, data collection, data analysis, writing manuscript. Read and approved the final manuscript.

HL – Data collection, data analysis, writing manuscript. Read and approved the final manuscript

TRW - Data analysis, writing manuscript. Read and approved the final manuscript

JFM – Data collection, writing manuscript. Read and approved the final manuscript

IRM – Writing manuscript. Read and approved the final manuscript

DJM – Data collection, writing manuscript. Read and approved the final manuscript

DH – Writing manuscript. Read and approved the final manuscript

PG – Operating surgeon for study patients. Read and approved the final manuscript

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FIGURE LEGEND

Figure 1. Flowchart for patient enrolment in study

Figure 2. Median iHOT-12 scores over follow-up times – median iHOT-12 scores show improvement from short-term to midterm follow up

Figure 3. Kaplan-Meier survivorship curve for labral repair vs debridement – shows improvement in survivorship

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FIGURE LEGEND

Figure 1. Flowchart for patient enrolment in study

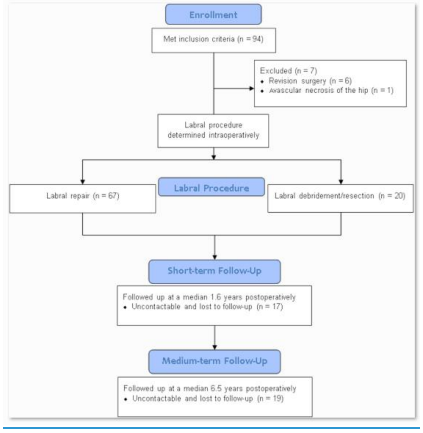

Figure 2. Median iHOT-12 scores over follow-up times – median iHOT-12 scores show improvement from short-term to midterm follow up

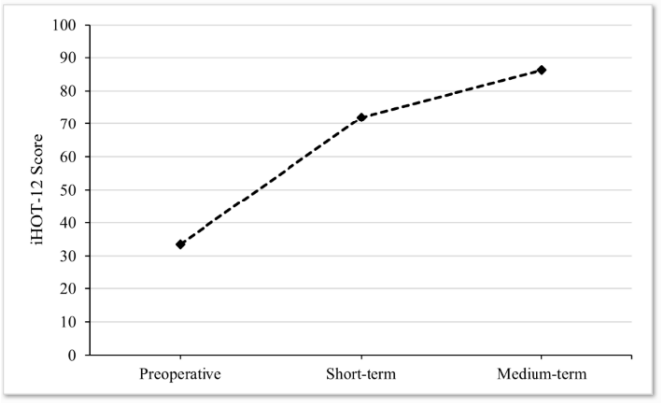

Figure 3. Kaplan-Meier survivorship curve for labral repair vs debridement – shows improvement in survivorship

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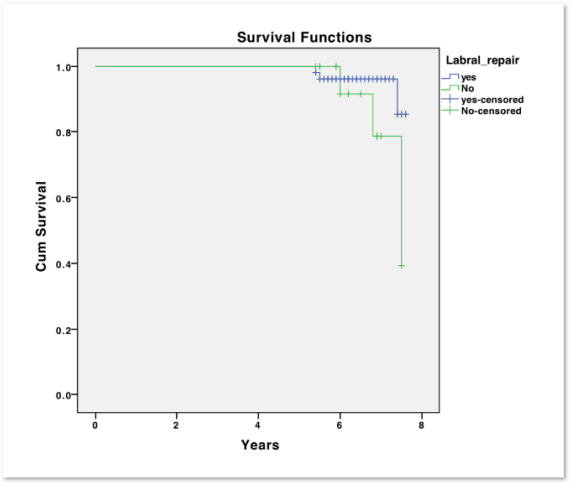

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TABLES

Table 1. Patient demographics and preoperative functional outcome scores

Age	31 (IQR 25 – 37)
BMI (kg/m^2)	23.6 (IQR 22-26)
Sex (Male/female)	39:48
Comorbidities	
Asthma	11
Hypothyroid	2
Diabetes	1
Depression	2
Preoperative iHOT-12	33.5 (IQR 21.75 – 43)
Preoperative EQ-5D Index	0.654 (IQR 0.437 – 0.727)
Preoperative EQ-5D VAS	70 (IQR 60 – 85)

IQR, Interquartile range; BMI, Body mass index; iHOT-12, International hip outcome tool 12; EQ-5D, EuroQuol-5-dimensions; VAS, Visual analogue scale

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Table 2. Summary of procedures performed

Procedure performed	Number
Acetabular procedures	
Labral repairs	
With or without rim recession	55
With microfracture with or without rim recession	11
With rim recession and psoas bursa excision	1
With rim recession and removal of os acetabuli	1
Labral resection	
With or without rim recession	12
With microfracture and rim recession	6
With removal of loose body	1
Femoral procedures	
Cam removal	
Isolated cam removal	69
With osteophyte removal	3
With microfracture	1
With decompression of impingement cyst	1
With psoas release	1
With osteophyte removal and microfracture	1
Loose body removal	1
No femoral procedure performed	11

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Table 3. Satisfaction at short and medium-term follow-up

	Short-term (n=70)	Medium-term (n=68)
Very satisfied	31	44
Satisfied	21	10
Neither satisfied nor dissatisfied	9	6
Dissatisfied	7	6
Very dissatisfied	2	2

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Table 4. Preoperative demographics, preoperative/postoperative outcome scores and intraoperative procedures by labral management

	Labral Repair (n=67)	**Labral Debridement (n=20)**	***p* value**
Age	30 (IQR 23 – 39)	32 (IQR 27 – 37)	0.384
BMI (kg/m^2)	23.5 (IQR 21.4 – 26)	24.2 (IQR 23 – 27.5)	0.523
Sex (Male/female)	29:38	10:10	0.672
Comorbidities			
Asthma	7	4	
Hypothyroid	2	1	
Diabetes	1	0	
Depression	1	1	0.282
Preoperative iHOT-12	36.5 (IQR 24 – 44.3)	28 (IQR 19 – 32)	0.14
Preoperative EQ-5D Index	0.650 (IQR 0.45 – 0.728)	0.660 (IQR 0.417 – 0.707)	0.499
Preoperative EQ-5D VAS	75 (60 – 88.5)	65.5 (IQR 59.3 – 76.3)	0.159
Femoroplasty	59 (88%)	14 (70%)	0.191
Femoral microfracture	1 (1%)	1 (5%)	0.336
Acetabuloplasty	65 (97%)	15 (75%)	0.06
Acetabular microfracture	9 (13%)	6 (30%)	0.066
Short-term iHOT-12	73.5 (IQR 53 – 91.3)	64 (IQR	0.236
Short-term EQ-5D Index	0.795 (IQR 0.708 – 0.878)	0.676 (IQR 0.415 – 0.803)	0.200
Short-term EQ-5D VAS	80 (IQR 67.3 – 90)	65 (IQR 40 – 92.5)	0.884

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Medium-term iHOT-12	87.5 (IQR 72.1 – 97.1)	85.4 (IQR 51.7 – 95.9)	0.362
Medium EQ-5D Index	0.848 (IQR 0.75 – 1)	0.884 (IQR 0.753 – 1)	0.466
Medium EQ-5D VAS	90 (IQR 70 – 90)	87.5 (IQR 80 – 95)	0.258

IQR, Interquartile range; BMI, Body mass index; iHOT-12, International hip outcome tool 12; EQ-5D, EuroQuol-5-dimensions; VAS, Visual analogue scale

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