Journal of Hip Preservation Surgery Vol. 4, No. 3, pp. 224–230
doi: 10.1093/jhps/hnx016
Advance Access Publication 27 April 2017
Research article

OXFORD

Predictors of outcome at 2-year follow-up after arthroscopic treatment of femoro-acetabular impingement

Axel Öhlin[1], Mikael Sansone[2], Olufemi R. Ayeni[1,3], Leif Swärd[2], Mattias Ahldén[2], Adad Baranto[1] and Jón Karlsson[1]*

[1]Department of Orthopaedics, Institute of Clinical Sciences, Sahlgrenska Academy, Gothenburg University, Gothenburg 413 45, Sweden,
[2]Orthocenter/IFK-Kliniken, Gothenburg 413 46, Sweden and
[3]Division of Orthopaedic Surgery, McMaster University, Hamilton, ON L8N 3Z5, Canada
*Correspondence to: J. Karlsson. E-mail: jon.karlsson@telia.com
Submitted 3 December 2016; revised 9 March 2017; revised version accepted 4 April 2017

ABSTRACT

Femoro-acetabular impingement (FAI) is a common cause of hip pain and dysfunction in the young and active population. Despite reports of good short-term outcomes following treatment for FAI, less is known about the possible preoperative predictors of treatment outcome. The purpose of this study was to identify predictors of treatment outcome, using a patient-reported outcome measurement score (PROM) validated for use in a young and active population undergoing arthroscopic surgery for FAI. Patients were prospectively enrolled and analysed using the PROM International Hip Outcome Tool (iHOT-12) preoperatively and at a 2-year follow-up. Predictors of treatment outcome chosen for analysis were age, gender, duration of symptoms until surgery, level of cartilage damage, preoperative score and FAI type. A total of 198 patients, 122 males and 76 females (M: 61.6%, F: 38.4%), with a mean age of 41 ± 12.1 years, were analysed. The preoperative iHOT-12 score correlated with the postoperative iHOT-12 score at the 2-year follow-up. For one iHOT-12 point positive difference preoperatively, an additional 0.65 points were gained postoperatively at the 2-year follow-up ($P \leq 0.001$). Age, gender, symptom duration until surgery, level of cartilage damage and FAI type did not have a statistically significant correlation to the postoperative score. Preoperative hip function as measured by the iHOT-12 is a potential predictor of outcome following FAI surgery relative to other factors.

INTRODUCTION

The idea that impingement in the form of mechanical conflict in the moving hip causes pain and leads to a decreased range of motion was reported as early as 1936 by Smith-Petersen, who performed acetabular rim trimming and femoral neck osteoplasty in patients with acetabular protrusion and a chronic slipped capital epiphysis [1].

However, it was not until 2003 that Ganz *et al.* [2] formulated the modern concept of femoro-acetabular impingement (FAI) and proposed FAI as a primary cause of idiopathic osteoarthritis. FAI can be divided into cam type and pincer type, describing bony deformities at the femoral neck and the acetabular rim, respectively. Both types have the potential to damage the cartilage and the labrum [3]. A combination of the two types is also frequently seen [4].

Initially, FAI was treated by an open surgical hip dislocation [5]. Even though this open surgical technique is considered to be safe, it involves extensive tissue dissection and requires hospital admission. The development of hip arthroscopy has allowed for the successful management of FAI using a less invasive approach in an outpatient setting. The arthroscopic technique has demonstrated lower rates of complication compared with the open surgical technique for the treatment of FAI [6, 7].

Several studies have reported good overall results following the arthroscopic treatment of FAI [8–15].

Nevertheless, predictors of outcome are less well understood. Less cartilage damage [12, 13] and younger age [12] have been noted among patients with better treatment outcomes. Interestingly, both these factors and others such as duration of symptoms until surgery have been reported not to predict treatment outcome [13]. Moreover, male gender has been reported both as being associated with a higher postoperative score [16] but also as not affecting it [17]. These contrasting reports are fuelling the debate on the best predictors of FAI surgery outcome.

More recently, newer patient-reported outcome measurement scores (PROMs), such as the International Hip Outcome Tool (iHOT-12) [18], have been developed and validated for use in the young and active population. The iHOT-12 consists of 12 questions which span four domains, symptoms and functional limitations, sport and recreational activities, job-related concerns and social, emotional and lifestyle concerns. The iHOT-12 has been translated into Swedish and validated for use in young and active patients undergoing arthroscopic treatment for FAI [19]. In the Swedish version, no floor or ceiling effect was seen for the iHOT-12 in this patient group, suggesting this PROM is sensitive to measure changes over time when evaluating arthroscopic treatment of FAI.

The purpose of the present study was to identify predictors of treatment outcome at a 2-year follow-up in a large cohort undergoing arthroscopic treatment for FAI, using PROMs validated for use in a young and active population. The hypothesis was that age, gender, duration of symptoms until surgery, type of cartilage damage, preoperative iHOT-12 score and FAI type correlated to the iHOT-12 score at the 2-year follow-up.

MATERIALS AND METHODS

Between January 2012 and January 2014, all patients at a single centre meeting the inclusion criteria were consecutively included in the study. A total of 315 patients were included. The inclusion criteria included a diagnosis of symptomatic cam-type, pincer-type or combined-type FAI. The clinical diagnostic criteria were a positive FADIR test and painful hip rotation. Radiological diagnostic criteria consisted of a cross-over sign, pistol grip deformity and alpha angle. As no consensus has been reached on the cut-off value for the alpha angle, this was left to individual surgeons to decide and was not further recorded in the study. The indication for surgery was an established diagnosis of FAI and failed non-surgical treatment. The exclusion criteria included previous surgery on the affected hip and surgery on the contralateral hip previous to or during the study period. Moreover, patients undergoing total hip arthroplasty (THA) during the study period were excluded.

Demographic data including gender, age and duration of symptoms were collected preoperatively. Preoperatively and at the 2-year follow-up, patients was asked to complete the self-administered web-based PROM iHOT-12. At the 2-year follow-up, the patients were also asked to report whether or not they were satisfied with the surgery. Peroperative data were registered at the time of surgery and included type of surgical procedure and a description of cartilage status according to Konan *et al.* [20].

Ethical approval for this study was granted by the Regional Ethical Review Board in Gothenburg at the Sahlgrenska Academy, Gothenburg University, Gothenburg, Sweden (registration number EPN 071-12) and is in accordance with the Helsinki Declaration. Written consent was obtained from all patients.

Surgical procedure

All hip arthroscopy procedures were performed at a single centre by a total of three experienced surgeons in an outpatient setting. The surgical technique previously described by Sansone *et al.* [21] utilizes an antero-lateral portal and a mid-anterior portal with the patient in the supine position. Axial traction was used in order to gain access to the central compartment. Access to the peripheral compartment was achieved through a ligament-sparing interportal capsulotomy parallel to the fibres and with a minimal transverse cut in order to minimize the risk of iatrogenic instability [22, 23]. Pincer deformities were addressed using a motorized burr to ensure the radiographic cross-over sign was eliminated. When possible, an 'over-the-top' technique, with the labrum left *in situ*, was used to repair the labrum. Otherwise, for larger rim resections, the labrum was detached and repaired using suture anchors. Cam deformities were handled by meticulous resection under the guidance of intra-operative fluoroscopy in order to assess the correct reshaping of the femoral head and neck junction. Care was always taken to preserve the retinacular folds and the blood supply to the femoral head. An intra-operative dynamic assessment was used to evaluate the completeness of resection.

Postoperatively, patients was prescribed non-steroidal anti-inflammatory drugs (NSAID) equivalent to 50 mg TID of diclofenac for 4 weeks to reduce the risk of heterotopic bone formation [24]. No restriction in terms of range of motion or weight-bearing was made, although crutches were recommended for outdoor walking for the first 4 weeks. Rehabilitation was initiated immediately post-operatively and consisted of exercises for range of motion, strength, endurance, balance and co-ordination. The intensity of the rehabilitation was gradually increased, according to what was tolerated by the patient.

Statistical analysis

Statistical analysis was performed using IBM SPSS statistics for Windows, Version 22.0, Armonk, NY: IBM Corp. Descriptive data were reported as the mean, standard deviation (SD), median and range. The paired Wilcoxon sign rank test was used to calculate the difference between preoperative and postoperative iHOT-12 scores, as the data were not normally distributed. The preoperative factors included for analysis were age, gender, duration of symptoms until surgery, level of cartilage damage, preoperative score and FAI type. The preoperative factors were correlated to the iHOT-12 score at the 2-year follow-up. Age (years), symptom duration (months) and the preoperative iHOT-12 score were correlated to the iHOT-12 at follow-up using Pearson's correlation. Spearman's rho was used to correlate gender, FAI type and cartilage status to the iHOT-12 at follow-up. Moreover, multivariable analysis was used to examine potential predictors of the iHOT12 score at the 2-year follow-up. A multiple linear regression analysis was performed with backward elimination with α to remove at 0.08. Potential predictors of the postoperative iHOT-12 score were age at surgery, gender, symptom duration (months), cartilage damage (classified in four categories and compared with those with no cartilage damage), the preoperative iHOT-12 score and FAI type (cam type versus mixed type).

RESULTS

Three hundred and fifteen patients were enrolled in the study. Two hundred and four patients completed the self-administered web-based PROM, the iHOT-12, at the 2-year follow-up (64.8%). Six of these patients (3%) received a THA within the 2-year follow-up period and were therefore excluded from the study. A total of 198 patients were considered for further analysis. The mean age was 41.0 ± 12.1 years, with 122 males and 76 females (M: 61.6%, F: 38.4%). The mean duration of symptoms prior to surgery was 37.0 ± 38.1 months. Patient demographics are shown in Table I. The distribution of cartilage damage type according to Konan *et al.* is shown in Table II, with 0 (no cartilage damage) being the most common type. Of the procedures performed, 60 (30.3%) were isolated cam resections, none were isolated pincer resections and 138 (69.7%) were combined cam and pincer resections. Two re-operations were performed after the index surgery during the follow-up period. The arthroscopic procedures are reported in Table III.

Table I. Patient demographics

Demographics	*Total*
Total number of patients	198
Operated side, R/L (%)	60.4/39.6
Gender, male/female (%)	61.6/38.4
Symptom duration, mean±SD (months)	37.0±38.1
Age, mean±SD (years)	41.0±12.1
BMI, mean±SD	25.1±3.5

R, right; L, left; SD, standard deviation; BMI, body mass index.

Table II. Distribution of cartilage damage type

Classification	N *(%)*
0	40 (20.2)
1a	12 (6.1)
1b	2 (1)
1c	0 (0)
2	32 (16.1)
3a	19 (9.6)
3b	6 (3)
3c	3 (1.5)
4a	12 (6.1)
4b	13 (6.6)
4c	7 (3.5)
Not visualized	30 (15.2)
No data	22 (11.1)

N, number of patients.

Table III. Arthroscopic procedures performed

Surgical procedures	N *(%)*
Cam	60 (30.3)
Pincer	0 (0)
Cam+pincer	138 (69.7)
Re-operation	2 (1)

N, number of patients.

A comparison of the preoperative iHOT-12 score compared with the postoperative iHOT-12 score obtained at the 2-year follow-up revealed statistically significant and clinically relevant improvements, 44.2 versus 65.5 ($P < 0.001$). The outcome data are shown in Table IV. One hundred and sixty-seven (84.3%) patients were satisfied with surgery.

Correlations between preoperative factors and the postoperative iHOT-12 score at the 2-year follow-up revealed a statistically significant correlation only for the preoperative iHOT-12 score. Correlations are shown in Table V.

The multiple linear regression model, after the elimination of non-significant independent variables, contained only the iHOT-12 preoperative score and had an R^2 of 0.19: postoperative iHOT-12 score at 2-year follow-up = 35.2 + 0.65×preoperative iHOT-12 score. The multiple linear regression model thereby implies that a patient with a one point higher preoperative iHOT-12 score will have a 0.65 point higher iHOT-12 score at the 2-year follow-up compared with a patient with a one point lower preop iHOT-12 score. The outcome of the multiple linear regression model is reported in Table VI.

DISCUSSION

The most important finding in the present study is that the preoperative iHOT-12 score correlates with the postoperative iHOT-12 score at the 2-year follow-up. The results of the multiple linear regression model suggest that a patient with a one point higher preoperative iHOT-12 score will have a 0.65 point higher postoperative iHOT-12 score at the 2-year follow-up compared with a patient with a one point lower preoperative iHOT-12 score. Based on these findings, it is possible to advocate the importance of surgical treatment before a possible further decline in function. The minimal important change (MIC) value has been reported to be nine points for the Swedish version of the iHOT-12 [19]. One limitation to the present study is that

Table V. Correlations between preoperative factors and iHOT-12 score at the 2-year follow-up

Factor	N	*Correlation*	P-*value*
Age	198	−0.010	0.889
Symptom duration	183	0.021	0.777
Preop iHOT-12	198	0.427	0.000
Gender	198	−0.106	0.137
Cartilage damage	146	−0.052	0.531
FAI type	198	−0.042	0.561

N, number of patients with data.

Table IV. Outcome data

Score	*Preoperative, mean ± SD*	*2-year follow-up, mean ± SD*	*Change, mean ± SD)*	P-*value*
iHOT-12 total	44.2±18.7	65.5±27.0	21.3±25.5	<0.001
Q1	35.8±22.2	62.4±31.3	26.6±34.1	<0.001
Q2	56.1±28.7	73.6±28.1	17.5±28.9	<0.001
Q3	46.4±31.0	65.0±32.7	18.6±33.6	<0.001
Q4	62.5±31.2	73.9±29.2	11.4±33.7	<0.001
Q5	51.7±29.1	67.6±31.6	15.9±32.7	<0.001
Q6	41.9±29.0	60.5±33.3	18.6±37.4	<0.001
Q7	33.7±25.9	61.9±31.1	28.2±35.4	<0.001
Q8	66.6±30.2	78.5±29.1	11.9±30.0	<0.001
Q9	61.5±32.0	75.6±29.5	14.1±28.9	<0.001
Q10	22.9±22.0	53.2±35.8	30.3±35.9	<0.001
Q11	27.0±21.5	57.7±34.1	30.7±34.7	<0.001
Q12	24.2±20.3	56.2±34.7	32.0±36.6	<0.001

SD, standard deviation; Q, question number.

Table VI. Multiple linear regression model with iHOT-12 score at the 2-year follow-up as the dependent variable

Variable	*Coefficient*	*Standard error*	P-*value*	*95% CI*
Intercept	35.20	5.50	–	–
iHOT-12 preop score	0.65	0.10	<0.001	0.45–0.85

Model $R^2 = 0.19$. CI, confidence interval.

there was insufficient data to formerly calculate the MIC value for the present cohort. However, the present cohort and the cohort used for the validation of the Swedish iHOT-12 have many similarities, for example in terms of diagnostic procedure and surgical technique. Based on these premises, it is still possible to suggest that there must be a difference of approximately 14 points in the preoperative iHOT-12 score to result in a clinically relevant difference in the postoperative iHOT-12 score. Age, gender, symptom duration before surgery, level of cartilage damage and FAI type did not have a statistically significant correlation to the postoperative iHOT-12 score. The present study highlights the importance of the potential benefits a surveillance programme using the iHOT-12 may provide for those with symptomatic FAI.

The use of the iHOT-12 to evaluate outcome is a major strength of the present study compared with previous studies. The Swedish version of the iHOT-12 has been validated for use in a young and active population undergoing arthroscopic treatment for FAI. No floor or ceiling effect was present in the validation, indicating that the PROM is able to detect both improvement and deterioration over time. The iHOT-12 was chosen instead of the iHOT-33 in order to limit the number of questions presented to the patients. The iHOT-12 has been shown to possess characteristics very similar to the iHOT-33 [18], making a comparison of studies relevant. Although the surgical criteria for intervention were at the discretion of the surgeon, and thus not standardized, the pragmatic approach that was used may allow for further generalizability.

It is a limitation that the alpha-angle and lateral centre-edge angle (LCEA) was not recorded in the study, this reduces the ability to compare the results of the present study to other populations. As a power analysis was not performed beforehand, we cannot exclude a type-2 error when rejecting a correlation of age, gender, symptom duration before surgery, level of cartilage damage and FAI type to the postoperative iHOT-12 score. Still being among the largest studies of its kind to date, the dropout rate was rather high, and this might be due to the young and mobile population lacking motivation to follow-up once treated successfully. For the patients that did not complete the web-based follow-up protocol, further contact by phone and e-mail was attempted before considered as drop-outs. Another limitation of the present study is the incomplete documentation of cartilage classification status with 52 (26.3%) patients having no documentation. In 22 (11.1%) of these cases, there was no documentation of cartilage status and in 30 (15.2%) cases the cartilage was never visualized. This has several possible explanations. For the cases where the cartilage was not visualized this could be due to inability to distract the hip or that there were no cartilage damage and therefore no entry may have been made. For the remaining cases lacking a documentation of cartilage status, this was in most cases due to difficulties using the classification system and therefore no status was recorded.

Philippon *et al.* [13] reported a higher preoperative score together with a joint space of ≥ 2 mm and labral repair rather than debridement as independent predictors of a higher postoperative modified Harris Hip Score (mHHS) at the 2-year follow-up. Other factors analysed by Philippon *et al.* that were not found to be statistically significant were age, symptom duration, alpha angle, overall cartilage condition and use of micro-fracture. In the present study, joint space height was not recorded and patients were consequently treated with labral repair rather than debridement. Moreover, Byrd and Jones [12] noted a relationship between a higher preoperative mHHS and a higher score at the 2-year follow-up. However, Byrd and Jones did not consider confounders in their analysis. Joseph *et al.* [17] specifically evaluated gender differences in outcome and concluded that, even if females had a significantly lower preoperative score (iHOT-33) than men, their postoperative score did not differ significantly from that of males. However, the study was underpowered to detect differences at follow-up times longer than 12 months. The present study was not able to confirm an association between age, gender and level of cartilage damage and the treatment outcome, as suggested by some earlier studies [12, 13, 16]. Malviya et al. [16] reported that quality of life (QoL) score was higher for males both before surgery and at follow-up and that gender was a predictor for changes in the QoL score. Their cohort consisted of 612 patients compared with 198 patients in the present study. A type-2 error might be an explanation to why we were not able to confirm gender as a predicting factor for the postoperative score. Philippon et al. [13] reported that patients with poor overall cartilage status had a lower postoperative mHHS compared with patients with moderate or mild changes. Byrd and Jones [12] reported a higher prevalence of more severe cartilage damage and older age among patients with fair/poor results compared with patients with excellent results measured by mHHS. The data by Philippon et al. and Byrd and Jones were not controlled for confounders, and this might be an explanation for the conflicting results compared with the present study as there might be other factors actually affecting the outcome than cartilage damage and age. The above studies also use other tools to evaluate outcome and classify cartilage damage than the present study, which limits the possibility to make comparisons between the studies. The use of only one outcome tool in the present study is a limitation and inclusion of more outcome tools would have been beneficial as it would have made the results more comparable to earlier studies. The different pattern of damage caused by the cam type and the pincer type [3] suggest there might be a difference in treatment outcome. However, no such difference was found in the present study.

The model in the present study was only able to explain 19% of the postoperative score, implying that there might be other factors not studied that also predict the outcome, including possible confounders of the preoperative score. The restricted number of factors analysed is a limitation of the present study. In order to be able to provide patients with realistic expectations following the arthroscopic treatment of FAI, further studies including more factors are important. In the future it is also important to evaluate different predictors' influence on the change in outcome, and evaluate if there are specific threshold values to predict a clinically relevant effect of surgery.

CONCLUSION

The preoperative iHOT-12 score correlates with the postoperative iHOT-12 score at the 2-year follow-up. The results of the present study suggest that a patient with a one point higher preoperative iHOT-12 score will have a 0.65 point higher postoperative iHOT-12 score at the 2-year follow-up compared with a patient with a one point lower preoperative score. However, the preoperative score only explained 19% of the postoperative score, indicating that there might be other factors also predicting the outcome.

CONFLICT OF INTEREST STATEMENT

None declared.

FUNDING

None.

REFERENCES

1. Smith-Petersen MN. The classic: treatment of malum coxae senilis, old slipped upper femoral epiphysis, intrapelvic protrusion of the acetabulum, and coxa plana by means of acetabuloplasty. 1936. *Clin Orthop Relat Res* 2009; **467**:608–15.
2. Ganz R, Parvizi J, Beck M *et al*. Femoroacetabular impingement: a cause for osteoarthritis of the hip. *Clin Orthop Relat Res* 2003; **417**:112–20.
3. Beck M, Kalhor M, Leunig M, Ganz K. Hip morphology influences the pattern of damaga to the acetabular cartilage: femoroacetabular impingement as a cause of early osteoarthritis of the hip. *J Bone Joint Surg Br* 2005; **87-B**:1012–8.
4. Clohisy JC, Baca G, Beaule PE *et al*. Descriptive epidemiology of femoroacetabular impingement. *A North American cohort of patients undergoing surgery. Am J Sports Med* 2013; **41**:1348–56.
5. Ganz R, Gill TJ, Gautier E *et al*. Surgical dislocation of the adult hip a technique with full access to the femoral head and acetabulum without the risk of avascular necrosis. *J Bone Joint Surg Br* 2001; **83-B**:1119–24.
6. Matsuda DK, Carlisle JC, Arthurs SC *et al*. Comparative systematic review of the open dislocation, mini-open, and arthroscopic surgeries for femoroacetabular impingement. *Arthroscopy* 2011; **27**:252–69.
7. Botser IB, Smith TW, Jr, Nasser R, Domb BG. Open surgical dislocation versus arthroscopy for femoroacetabular impingement: a comparison of clinical outcomes. *Arthroscopy* 2011; **27**:270–8.
8. Byrd JW, Jones KS. Arthroscopic management of femoroacetabular impingement in athletes. *Am J Sports Med* 2011; **39(Suppl)**:7S–13S.
9. Brunner A, Horisberger M, Herzog RF. Sports and recreation activity of patients with femoroacetabular impingement before and after arthroscopic osteoplasty. *Am J Sports Med* 2009; **37**:917–22.
10. Nho SJ, Magennis EM, Singh CK, Kelly BT. Outcomes after the arthroscopic treatment of femoroacetabular impingement in a mixed group of high-level athletes. *Am J Sports Med* 2011; **39(Suppl)**:14S–9S.
11. Philippon MJ, Weiss DR, Kuppersmith DA *et al*. Arthroscopic labral repair and treatment of femoroacetabular impingement in professional hockey players. *Am J Sports Med* 2010; **38**:99–104.
12. Byrd JW, Jones KS. Arthroscopic management of femoroacetabular impingement: minimum 2-year follow-up. *Arthroscopy* 2011; **27**:1379–88.
13. Philippon MJ, Briggs KK, Yen Y-M, Kuppersmith DA. Outcomes following hip arthroscopy for femoroacetabular impingement

with associated chondrolabral dysfunction minimum two-year follow-up. *J Bone Joint Surg Br* 2009; **91-B**:16–23.

14. Horisberger M, Brunner A, Herzog RF. Arthroscopic treatment of femoroacetabular impingement of the hip: a new technique to access the joint. *Clin Orthop Relat Res* 2010; **468**:182–90.
15. Sansone M, Ahlden M, Jonasson P *et al*. Outcome after hip arthroscopy for femoroacetabular impingement in 289 patients with minimum 2-year follow-up. *Scand J Med Sci Sports* 2016; Jan 21
16. Malviya A, Stafford GH, Villar RN. Impact of arthroscopy of the hip for femoroacetabular impingement on quality of life at a mean follow-up of 3.2 years. *J Bone Joint Surg Br* 2012; **94-B**:466–70.
17. Joseph R, Pan X, Cenkus K *et al*. Sex Differences in Self-Reported Hip Function Up to 2 Years After Arthroscopic Surgery for Femoroacetabular Impingement. *Am J Sports Med* 2016; **44**:54–9.
18. Griffin DR, Parsons N, Mohtadi NG, Safran MR. A short version of the International Hip Outcome Tool (iHOT-12) for use in routine clinical practice. *Arthroscopy* 2012; **28**:611–6. quiz 6–8.
19. Jonasson P, Baranto A, Karlsson J *et al*. A standardised outcome measure of pain, symptoms and physical function in patients with hip and groin disability due to femoro-acetabular impingement: cross-cultural adaptation and validation of the international Hip Outcome Tool (iHOT12) in Swedish. *Knee Surg Sports Traumatol Arthrosc* 2014; **22**:826–34.
20. Konan S, Rayan F, Meermans G *et al*. Validation of the classification system for acetabular chondral lesions identified at arthroscopy in patients with femoroacetabular impingement. *J Bone Joint Surg Br* 2011; **93-B**:332–6.
21. Sansone M, Ahlden M, Jonasson P *et al*. A Swedish hip arthroscopy registry: demographics and development. *Knee Surg Sports Traumatol Arthrosc* 2014; **22**:774–80.
22. Matsuda DK. Acute iatrogenic dislocation following hip impingement arthroscopic surgery. *Arthroscopy* 2009; **25**:400–4.
23. Sansone M, Ahlden M, Jonasson P *et al*. Total dislocation of the hip joint after arthroscopy and ileopsoas tenotomy. *Knee Surg Sports Traumatol Arthrosc* 2013; **21**:420–3.
24. Beckmann JT, Wylie JD, Kapron AL *et al*. The Effect of NSAID Prophylaxis and Operative Variables on Heterotopic Ossification After Hip Arthroscopy. *Am J Sports Med* 2014; **42**:1359–64.