



Clinical and radiological outcome at mean follow-up of 11 years after hip arthroscopy

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Abstract

Introduction The use of hip arthroscopy (HA) has substantially increased over the last decade. However, while the benefits of HA after 1 year in patients with femoroacetabular impingement (FAI) are well documented, long-term data on the progression of osteoarthritis (OA) or patient-reported outcomes (PROMs) are lacking.

Objectives To evaluate long-term clinical and radiological outcomes after HA.

Materials and methods Preoperative clinical records, operative notes, and radiographs from all patients who underwent HA at our hospital between 1998 and 2006 were reviewed. Exclusion criteria were previous hip surgery or diagnostic HA. Primary endpoints were subsequent total hip arthroplasty (THA) or other hip surgery. Secondary endpoints were OA progression and PROMs.

Results HA was performed in 92 consecutive patients from 1998 to 2006. Indications for HA were FAI, labral lesions, early OA, and focal osteochondral defects. Mean follow-up was 11.2 years (SD 2.5, range 7.9–16). Data from 43 patients were available for analysis; 38 patients were excluded, and 11 were lost to follow-up. 20 patients had subsequent hip surgery, of which 11 patients required THA. 33 patients (77%) stated that they would undergo HA again under the same circumstances. Longitudinal radiological analysis showed no significant OA progression in patients without THA. The Forgotten Joint Score-12 was the only PROM to significantly differ between patients who had no further surgery and patients who had undergone revision ($p = 0.037$).

Conclusion There was no significant OA progression on plain radiography at an average of 11 years post-HA. Sound indication criteria is essential, as 45% of patients required subsequent surgery.

Keywords Clinical and radiological outcome · Forgotten joint score · Hip arthroscopy · Hip disability and osteoarthritis outcome score · Long-term follow-up

Introduction

Hip arthroscopy (HA) is widely used and an established technique for the treatment of intraarticular hip pathologies [1]. However, evaluation of the long-term outcome after HA is scarce, with only few studies describing a follow-up of longer than 10 years [1–3]. The overall complication rate of HA is reported around 1.4% [4]. The described complications include neurapraxia, portal wound bleeding, portal

hematoma, trochanteric bursitis, and damage to cartilage or the labrum. Complication rates are often related to distraction [5]; the most common neurovascular complication is pudendal nerve injury. The HA procedure can be performed in supine or lateral position. Standard portals include the anterolateral, posterolateral, anterior, and distal anterolateral portals. The use of arthroscopy solely as a diagnostic procedure has been increasingly replaced by high resolution MRI [6]. In our study, we focused on the long-term course of osteoarthritis (OA) progression, the necessity of any subsequent hip surgery, including total hip arthroplasty (THA), and patient-reported outcome measures (PROMs).

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Materials and methods

We retrospectively analyzed 92 consecutive patients who underwent HA between 1998 and 2006 at a large teaching hospital in Switzerland. The local cantonal ethics committee granted ethical approval for this study. Preoperative clinical records, operative notes, and radiographs were reviewed. Thirty-eight patients were excluded due to our exclusion criteria (previous hip surgery, arthroscopic hip lavage, diagnostic arthroscopy). Of the remaining 54 patients, 11 (20.4%) were lost to follow-up. A final total of 43 patients (79.6%) were available for data analysis. The patient sample comprised 26 males (60.5%) and 17 females (39.5%) with a mean age of 36 years (SD 15.5) at the time of HA (Table 1, sociodemographic data). Mean follow-up was 11.2 years (SD 2.5, range 7.9–16). 7 out of 43 patients had a follow-up period shorter than ten years. All procedures were performed

in the supine position [7]. Patients were retrospectively categorized into five groups according to their original diagnoses (Fig. 1). The OA group had radiographic signs of OA (> 2 according to the Kellgren and Lawrence [8] classification) or intraoperative findings that represented marked OA. Patients without signs of OA were assigned to the femoroacetabular impingement (FAI) group, labral lesion group, or focal osteochondral defect group. FAI was differentiated from labral tears by CAM or Pincer bone formation and intraoperative conflict of the femur with the acetabulum in flexion and internal rotation. Four patients did not meet any of the abovementioned criteria (synovitis, capsular or ligament tears, plicae); hence, they were referred to a separate group. The labrum was resected in the labral lesion group. No labral refixations were performed during the study period.

30 out of 43 patients attended our institution for questionnaire completion, clinical examination and a pelvic radiograph. Additionally, PROM data of 13 patients were collected via postal survey and telephone interview. PROMs were assessed using the following instruments: Forgotten Joint Score (FJS-12) [9], Hip Disability and Osteoarthritis Outcome Score [10] (HOOS; dimensions: pain, symptoms, activity of daily living, sport/recreation, quality of life), Tegner Score [11], Harris Hip Score (HHS) [12], and the Visual Analogue Scale for pain (VAS). Radiographs were analyzed according to the Kellgren and Lawrence classification system [8] by three independent observers. Primary endpoints were subsequent THA or any other hip surgery (e.g. pelvic osteotomy). Secondary endpoints were OA progression and PROMs. For further analysis, we assigned the patients into

Table 1 Sociodemographic data

	<i>n</i>	Side (left/ right)	Age in years [mean (SD; min–max)]	BMI [mean (SD; min– max)]
All hip arthroscopy patients	43	16/27	36 (16; 6–64)	25 (3.9; 17–35)
Males	26	8/18	36 (16; 6–62)	25 (4.3; 17–35)
Females	17	8/9	36 (15; 13–64)	25 (3.4; 21–31)

BMI body mass index

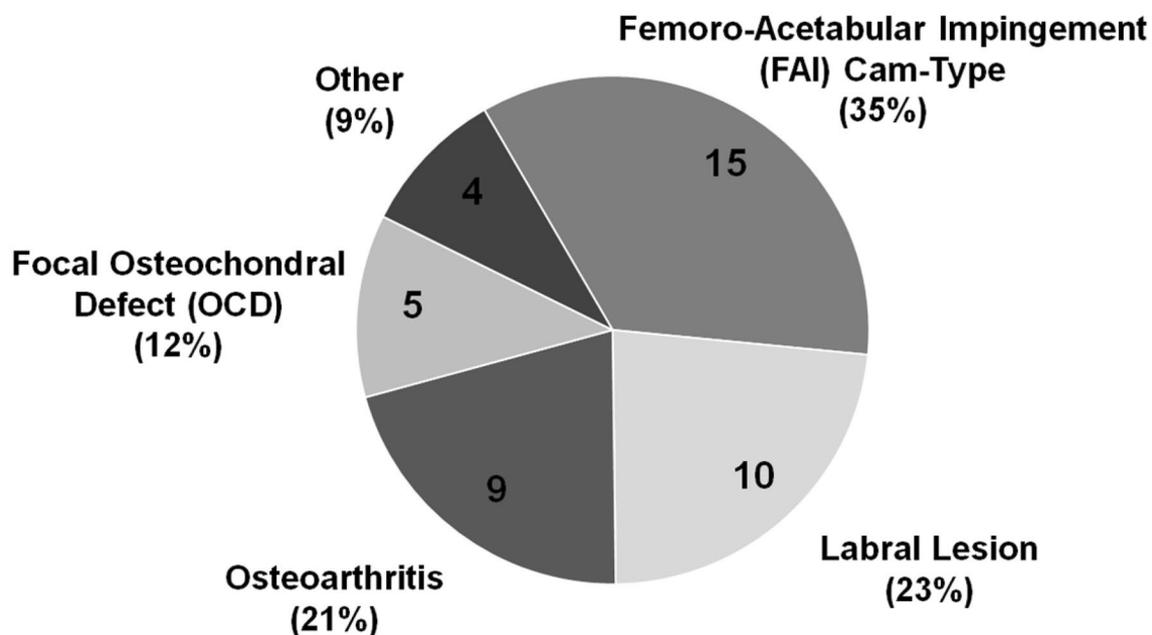


Fig. 1 Diagnoses

three treatment categories depending on whether they underwent revision surgery, THA, or had no further surgery.

Statistical analysis

All statistical analyses were performed with R (R: A language and environment for statistical computing—R Foundation for Statistical Computing, Vienna, Austria. <http://www.R-project.org>). Descriptive statistics included means, standard deviations (SDs), ranges, frequencies, and percentages. Intraclass correlation coefficients were calculated to determine interobserver reliability for OA grading on anteroposterior pelvic radiographs. OA progression was analyzed using the Wilcoxon test. A Kruskal–Wallis test was conducted with a subsequent Mann–Whitney *U* test to compare PROM differences between different treatment categories. The confidence level for rejecting null hypotheses was set at 95% (p value < 0.05).

Results

The conversion rate to THA in our patient sample was 25.6% ($n = 11$) at a mean follow-up of 11.2 years (SD 2.5 years). Nine patients (20.9%) had other revision surgery (one derotational osteotomy, two pelvic osteotomies, and six open femoral neck plasties). When comparing the different age groups, the reoperation rate did not increase with a greater age at the time of HA. The revision rate varied greatly between the different diagnosis groups. Patients with OA (Kellgren and Lawrence grades 3 and 4) showed the highest revision rate of all groups (67%). The labral lesions group also showed a high revision rate of 60%, while only one-third of CAM-type FAI patients (33%) underwent reoperation (Fig. 2). The CAM-type FAI group had the highest survival rate compared to the other diagnosis groups. Body-weight did not significantly differ between revised and non-revised patients ($p = 0.59$). Regarding the various PROMs, the FJS-12 showed statistically significant differences

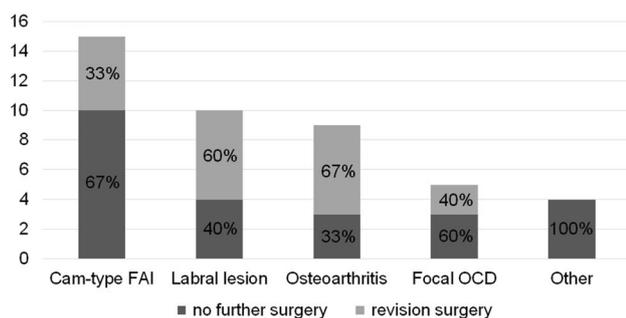


Fig. 2 Revision rate. FAI femoroacetabular impingement, OCD osteochondral defect

between patients who had no further surgery and patients who had undergone revision ($p = 0.037$). In contrast, the HHS, HOOS, Tegner Score, and VAS did not show statistically significant differences between the three treatment categories. However, most outcome parameters showed the same statistical trend in outcome (Table 2; Fig. 3).

There were 20 longitudinal radiographs (preoperative and follow-up) available for analysis. There was no significant OA progression over the average follow-up period of 11 years (Wilcoxon test, $p = 0.25$). The three independent observers scored the preoperative radiographs as a mean of 1.82, and the follow-up radiographs as a mean of 1.98. Intraclass correlation coefficients between the three observers were 0.79 preoperatively and 0.75 postoperatively.

Regarding patient satisfaction, 33 patients (77%) would undergo HA again under the same circumstances. The remaining 10 patients (23%) had significantly more reoperations than the patients who would undergo HA again ($p = 0.02$). One complication was recorded; this was a transient neuroparaxia of the lateral femoral cutaneous nerve.

Discussion

During the last decade, HA has gained increasing popularity for the treatment of various pathologies. A considerable number of orthopedic units now provide this minimally invasive treatment option as a routine intervention, depending on availability in different countries. In our institution, HA has been regularly performed since 1998. The current patient sample represents a cohort from the very early days of HA and, therefore, clear indications for HA had not yet been established. Recent literature reports no benefit of HA in the presence of marked OA [13, 14], however, minimal signs of OA may not be an absolute contraindication [15]. Literature on long-term follow-up after HA is still scarce. While the benefits of HA after a minimum follow-up of 1–2 years in patients with FAI are well documented [16, 17], clinical and radiological long-term data on OA progression or PROMs are lacking.

A systematic review published in 2010 that graded evidence according to the Grades of Recommendation scale of Wright et al. [18] showed grade B recommendation for the treatment of FAI and grade C for labral tears, extraarticular lesions, septic arthritis, loose bodies, and OA [3]. Most of the studies included in the review were short-term outcome studies with Level IV evidence [3].

Regarding long-term follow-up, Byrd et al. [1] published a prospective follow-up analysis in 2009 of all cases of HA performed after 1993. They reported on 50 consecutive patients with 10-year follow-up data to substantiate the long-term effectiveness of HA as a treatment for various disorders, including labral pathology, chondral

Table 2 PROM data

Patient-reported outcome measure	Group	<i>n</i>	Mean (SD)	Kruskal–Wallis test	THA versus no reoperation	No reoperation versus reoperation	THA versus reoperation
Forgotten joint score-12	THA	11	52.5 (34.2)	<i>p</i> =0.037	<i>p</i> =0.197	<i>p</i> =0.013	<i>p</i> =0.287
	No reoperation	23	70.3 (27.8)				
	Reoperation	9	36.8 (26.2)				
Harris hip score	THA	8	83.3 (18.0)	<i>p</i> =0.197	<i>p</i> =0.161	<i>p</i> =0.226	<i>p</i> =0.948
	No reoperation	16	88.4 (14.5)				
	Reoperation	6	84.3 (10.2)				
HOOS	THA	9	83.6 (14.5)	<i>p</i> =0.246	<i>p</i> =0.877	<i>p</i> =0.718	<i>p</i> =0.773
	No reoperation	18	81.2 (19.7)				
	Reoperation	8	81.2 (15.9)				
Tegner score	THA	11	4.3 (1.4)	<i>p</i> =0.253	<i>p</i> =0.316	<i>p</i> =0.345	<i>p</i> =0.118
	No reoperation	23	4.9 (1.4)				
	Reoperation	9	5.44 (1.59)				
VAS	THA	11	2.7 (2.4)	<i>p</i> =0.555	<i>p</i> =0.892	<i>p</i> =0.286	<i>p</i> =0.478
	No reoperation	23	2.4 (2.0)				
	Reoperation	9	2.8 (1.5)				

THA total hip arthroplasty, HOOS hip disability and osteoarthritis outcome score, VAS visual analogue scale for pain

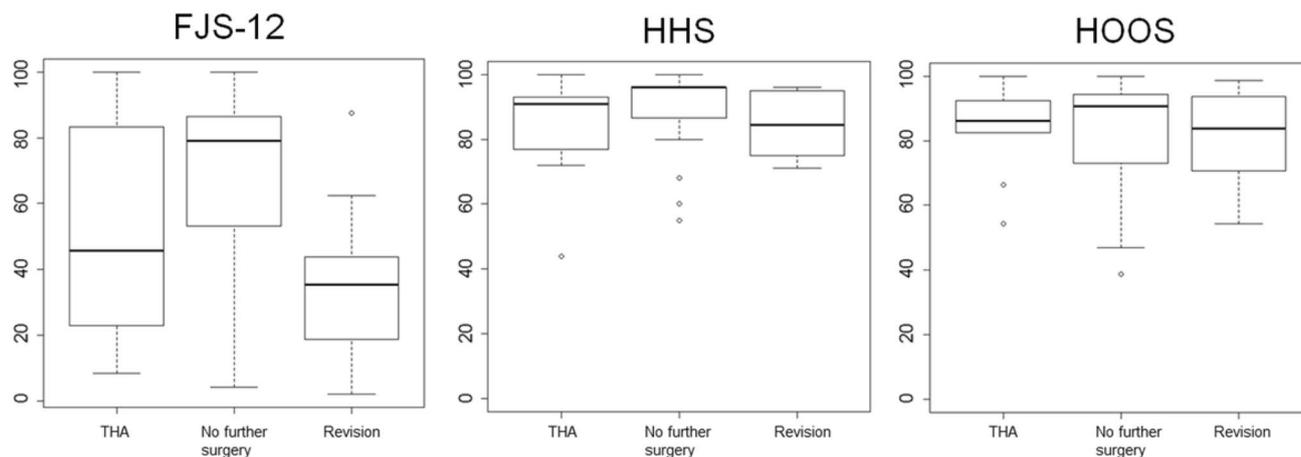


Fig. 3 PROMs. *FJS-12* forgotten joint score-12, *HHS* harris hip score, *HOOS* hip disability and osteoarthritis outcome score, *THA* total hip arthroplasty

damage, synovitis, and loose bodies. Byrd et al. [1] concluded that the presence of arthritis at the time of the index procedure was an indicator of poor prognosis, with poor long-term outcomes. Similarly to our study, numerous limitations have to be considered. FAI was known as a concept in the late 1990s, but FAI patients were not identified as such at that time.

In our study, we were able to categorize FAI patients retrospectively according to the intraoperative findings, which were well described in the operative notes. Therefore, we were able to define an FAI group and compare this FAI group with a labral lesion group, a chondral defect group, and an OA group. Patients with moderate to severe OA showed the highest revision rate and highest conversion

rate to THA (67% in our sample OA group). Similar findings have been well documented in recent literature [1, 5, 19–22]. Jacobsen et al. [23] reported that a joint space of < 2 mm was correlated with pain caused by degenerative changes. The pain relief achieved through arthroscopy in patients with marked osteoarthritic changes is often only temporary [5].

An important finding of our study was that longitudinal radiological follow-up did not show OA progression at a mean follow-up of 11 years after HA. The small sample size has to be considered, and the results have to be confirmed in larger trials; however, our study is the first to our knowledge to show linked radiological long-term follow-up.

In our study, patients with labral tears showed a worse outcome than that reported in several other long-term follow-up studies [1, 20, 21]. One potential reason is that some labral lesions may have been accompanied by FAI. It is possible that in these cases the femoral neck as the underlying pathology was not addressed properly. Untreated CAM deformity with labral tears is correlated with worse results [20, 22]. Another reason for the inferior results of patients with labral tears in our study compared with previous studies could be that labral lesions were resected instead of reconstructed, as is currently recommended [22, 24–28]. Today it is considered important to preserve the labral function as a ‘shock absorber’ and a ‘seal’ that allows continual lubrication of the hip joint, which contributes to the overall health of articular cartilage [22, 29]. Our data substantiate these findings.

Most authors have used the HHS as an outcome assessment tool after HA, although it was not designed for this type of intervention. Byrd et al. [1, 30] recognized that the HHS was not sensitive enough, as most HA patients experience a lower level of pain, and stated that “A more applicable recording instrument is needed, especially for patients who do not have arthroplasty”. A major limitation of the HHS is, therefore, the ceiling effect in this patient group. This was also found in our study, especially in patients who had no further surgery. A strength of our study is that we used the FJS-12, a more recent questionnaire, which is known to be more sensitive in well-performing patients with low symptom burden [9, 31]. The FJS-12 score also showed less of a ceiling effect in this study compared with other PROMs used in previous studies [32]. This may explain why the HOOS and the HHS only showed statistical trends in the present study, while these intergroup differences were significant when assessed with the FJS-12.

In our study, older age in the absence of arthritic changes did not lead to poorer results. In contrast, McCarthy et al. [21] found age > 40 years to be a risk factor for eventual THA in multivariate analysis; however, they did not differentiate between patients with or without OA and, therefore, these results are probably due to the higher incidence of OA in this age group.

Limitations

Our study has a number of limitations. The retrospective study design is associated with common limitations such as the lack of a control group and a potential selection bias in terms of loss to follow-up. The heterogeneous study cohort and the relatively small sample size do not allow generalizations to be made from our results, i.e. extensive inferential statistics. Furthermore, preoperative PROM scores were not available to analyze individual change over time. High quality long-term follow-up studies with a control group and a larger sample size are needed.

Conclusion

HA in general is a safe and well-established operative procedure. Provided that the correct indications are adhered to, the majority of patients show benefits also in the longer term. There was no significant OA progression on plain radiography at a mean of 11 years after HA, thus showing that the HA procedure is not a risk factor for more rapid degeneration of the joint. Preoperative signs of OA increased the risk of later THA. Although 25% of patients received a THA and another 20% had any other reoperation on their hip joint within the study duration, patient satisfaction was high.

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References

1. Byrd JWT, Jones KS (2009) Prospective analysis of hip arthroscopy with 10-year followup. *Clin Orthop Relat Res* 468(3):741–746. <https://doi.org/10.1007/s11999-009-0841-7>
2. Londers J, Melkebeek J (2007) Hip arthroscopy: outcome and patient satisfaction after 5 to 10 years. *Acta Orthop Belg* 73(4):478
3. Stevens MS, LeGay DA, Glazebrook MA, Amirault D (2010) The evidence for hip arthroscopy: grading the current indications. *Arthrosc J Arthrosc Relat Surg* 26(10):1370–1383. <https://doi.org/10.1016/j.arthro.2010.07.016>
4. Clarke MT, Arora A, Villar RN (2003) Hip arthroscopy—complications in 1054 cases. *Clin Orthop Relat Res* 406(1):84–88
5. McCarthy JC, Lee J (2005) Hip arthroscopy: indications, outcomes, and complications. *J Bone Joint Surg* 87(5):1137–1145
6. Simpson J, Sadri H, Villar R (2010) Hip arthroscopy technique and complications. *Orthop Traumatol: Surg Res* 96(8):S287–S295. <https://doi.org/10.1016/j.otsr.2010.09.010>
7. Byrd JWT (2001) Hip arthroscopy: the supine position. *Clin Sports Med* 20(4):703–732
8. Kellgren JH, Lawrence JS (1957) Radiological assessment of osteo-arthrosis. *Ann Rheum Dis* 16:494
9. Behrend H, Giesinger K, Geisinger JM, Kuster MS (2012) The “forgotten joint” as the ultimate goal in joint arthroplasty.

- J Arthroplast 27(3):430–436. <https://doi.org/10.1016/j.arth.2011.06.035>
10. Nilsdotter AK, Lohmander LS, Klässbo M, Roos EM (2003) Hip disability and osteoarthritis outcome score (HOOS): validity and responsiveness in total hip replacement. *BMC Musculoskelet Disord* 4(1):10. <https://doi.org/10.1186/1471-2474-4-10>
 11. Tegner Y, Lysholm J (1985) Rating systems in the evaluation of knee ligament injuries. *Clin Orthop Relat Res* 198:42–49
 12. Harris WH (1969) Traumatic arthritis of the hip after dislocation and acetabular fractures: treatment by mold arthroplasty. An end-result study using a new method of result evaluation. *J Bone Joint Surg Am* 51(4):737–755
 13. Philippon MJ, Briggs KK, Yen YM, Kuppersmith DA (2009) Outcomes following hip arthroscopy for femoroacetabular impingement with associated chondrolabral dysfunction. *Bone Jt J* 91(1):16–23. <https://doi.org/10.1302/0301-620X.91B1>
 14. Ganz R, Leunig M, Leunig-Ganz K, Harris WH (2008) The etiology of osteoarthritis of the hip: an integrated mechanical concept. *Clin Orthop Relat Res* 466(2):264–272. <https://doi.org/10.1007/s11999-007-0060-z>
 15. Herzog RF (2010) Hüftarthroskopie: therapeutische Möglichkeiten, Grenzen und Gefahren. *Schweizerische Zeitschrift für Sportmedizin Sporttraumatologie* 58(1):22–25
 16. Byrd JWT, Jones KS, Gwathmey FW (2016) Femoroacetabular impingement in adolescent athletes: outcomes of arthroscopic management. *Am J Sports Med* 44(8):2106–2111. <https://doi.org/10.1177/0363546516648325>
 17. Sansone M, Ahldén M, Jónasson P et al (2017) Outcome after hip arthroscopy for femoroacetabular impingement in 289 patients with minimum 2-year follow-up. *Scand J Med Sci Sports* 27(2):230–235. <https://doi.org/10.1111/sms.12641>
 18. Wright JG, Einhorn TA, Heckman JD (2005) Grades of recommendation. *J Bone Joint Surg Am* 87(9):1909–1910. <https://doi.org/10.2106/JBJS.8709.edit>
 19. Philippon MJ, Briggs KK, Yen Y-M, Kuppersmith DA (2009) Outcomes following hip arthroscopy for femoroacetabular impingement with associated chondrolabral dysfunction: minimum two-year follow-up. *J Bone Jt Surg Br* 91(1):16–23. <https://doi.org/10.1302/0301-620X.91B1.21329>
 20. Meftah M, Rodriguez JA, Panagopoulos G, Alexiades MM (2011) Long-term results of arthroscopic labral debridement: predictors of outcomes. *Orthopedics* 34(10):e588–e592. <https://doi.org/10.3928/01477447-20110826-04>
 21. McCarthy JC, Jarrett BT, Ojeifo O, Lee J-A, Bragdon CR (2011) What factors influence long-term survivorship after hip arthroscopy? *Clin Orthop Relat Res* 469(2):362–371. <https://doi.org/10.1007/s11999-010-1559-2>
 22. Lynch TS, Terry MA, Bedi A, Kelly BT (2013) Hip arthroscopic surgery: patient evaluation, current indications, and outcomes. *Am J Sports Med* 41(5):1174–1189. <https://doi.org/10.1177/0363546513476281>
 23. Jacobsen S, Sonne-Holm S, Søballe K, Gebuhr P, Lund B (2004) The relationship of hip joint space to self reported hip pain. A survey of 4,151 subjects of the Copenhagen city heart study: the osteoarthritis substudy. *Osteoarthr Cartil* 12(9):692–697. <https://doi.org/10.1016/j.joca.2004.05.010>
 24. Philippon MJ, Arnoczky SP, Torrie A (2007) Arthroscopic repair of the acetabular labrum: a histologic assessment of healing in an ovine model. *Arthroscopy* 23(4):376–380. <https://doi.org/10.1016/j.arthro.2007.01.017>
 25. Espinosa N, Rothenfluh DA, Beck M, Ganz R, Leunig M (2006) Treatment of femoro-acetabular impingement: preliminary results of labral refixation. *J Bone Jt Surg Am* 88(5):925–935. <https://doi.org/10.2106/JBJS.E.00290>
 26. Kelly BT, Weiland DE, Schenker ML, Philippon MJ (2005) Arthroscopic labral repair in the hip: surgical technique and review of the literature. *Arthrosc: J Arthrosc Relat Surg* 21(12):1496–1504. <https://doi.org/10.1016/j.arthro.2005.08.013>
 27. McCarthy JC, Noble PC, Schuck MR, Wright J, Lee J. The Otto E (2001) Aufranc award: the role of labral lesions to development of early degenerative hip disease. *Clin Orthop Relat Res* 393:25–37
 28. Murphy KP, Ross AE, Javernick MA, Lehman RA (2006) Repair of the adult acetabular labrum. *Arthroscopy* 22(5):567, e1–e3. <https://doi.org/10.1016/j.arthro.2005.07.033>
 29. Ferguson SJ, Bryant JT, Ganz R, Ito K (2003) An in vitro investigation of the acetabular labral seal in hip joint mechanics. *J Biomech* 36(2):171–178
 30. Byrd JWT, Jones KS (2009) Hip arthroscopy in athletes: 10-year follow-up. *Am J Sports Med* 37(11):2140–2143. <https://doi.org/10.1177/0363546509337705>
 31. Homma Y, Baba T, Sano K et al (2016) Lateral femoral cutaneous nerve injury with the direct anterior approach for total hip arthroplasty. *Int Orthop* 40(8):1587–1593. <https://doi.org/10.1007/s00264-015-2942-0>
 32. Hamilton DF, Giesinger JM, MacDonald DJ, Simpson AHRW, Howie CR, Giesinger K (2016) Responsiveness and ceiling effects of the forgotten joint score-12 following total hip arthroplasty. *Bone Jt Res* 5(3):87–91. <https://doi.org/10.1302/2046-3758.53.2000480>