Washington State Health Care Authority

Hip surgery for treatment of femoroacetabular impingement syndrome – re-review

Final report appendices

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Hip Surgery Procedures for Treatment of Femoroacetabular Impingement Syndrome – Update Report

Aggregate Analytics, Inc.

FINAL APPENDICES

October 22, 2019: ***Updated - 10/31/19***

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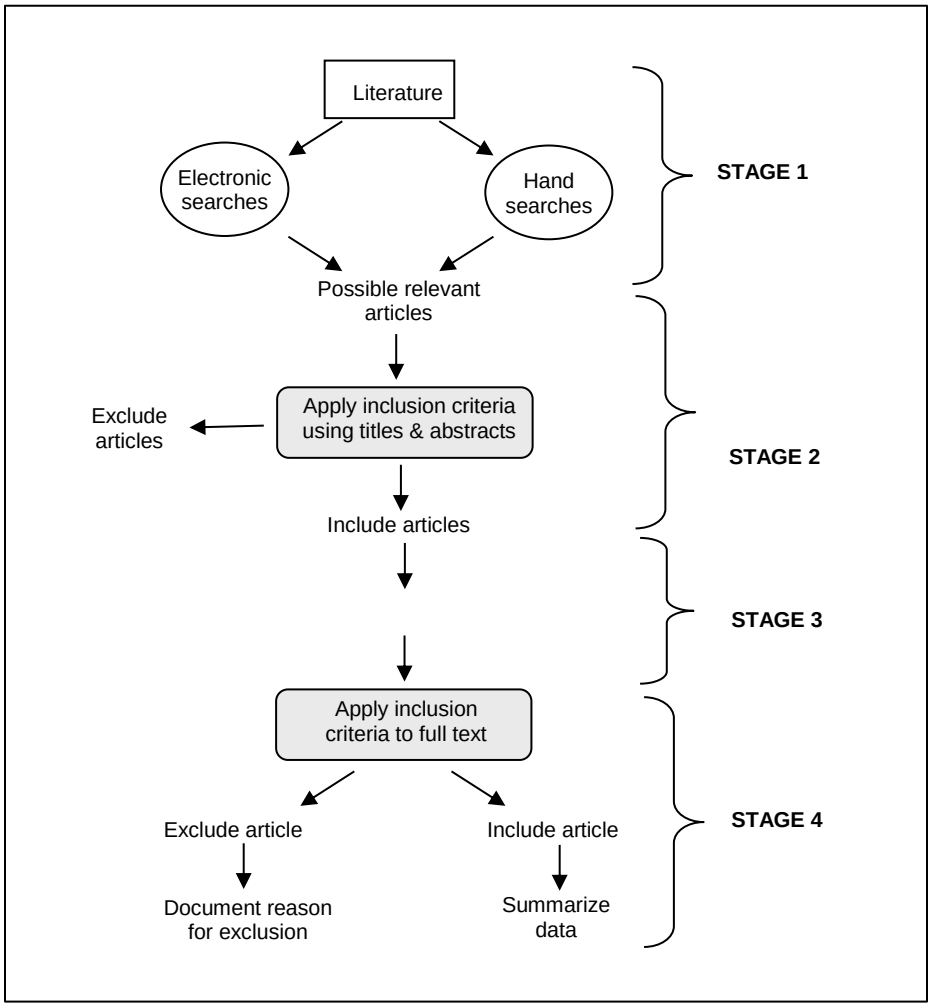
APPENDIX A. Algorithm for Article Selection



APPENDIX B. Search Strategies

Below is the search strategy for PubMed. Parallel strategies were used to search other electronic databases listed below. Keyword searches were conducted in the other listed resources. In addition, hand-searching of included studies was performed.

Appendix Table B1: PubMed Search strategy for Key Questions 1, 2, and 3

	Search Strategy (LIMITS)	Search Dates	No. of hits
1.	FEMOROACETABULAR IMPINGEMENT* OR FEMORACETABULAR IMPINGEMENT* OR "Femoracetabular Impingement"[Mesh] OR ((HIP OR ACETABUL* OR FEMUR OR FEMORAL) AND IMPINGMENT*) OR “femoral osteochondroplasty” OR “femoral osteoplasty”	04/01/2011 to 05/14/2019	
2.	"Reoperation"[Mesh] OR "Femur Head Necrosis"[Mesh] OR "Arthroplasty, Replacement, Hip"[Mesh] OR REOPERATION REATTACHMENT OR AVN OR AVASCULAR NECROSIS OR TOTAL HIP OR TOTAL JOINT OR ARTHROPLASTY OR INFECTION* OR DEATH OR COMPLICATION* OR ADVERSE EVENT OR "Intraoperative Complications"[Mesh] OR SCIATIC* OR NERVE OR NEURO* OR FRACTURE* OR INTRAABDOM* OR CARDIAC ARREST OR THROMBO* OR EMBOL* OR INSTABILITY	04/01/2011 to 05/14/2019	
3.	#1 AND #2 (LIMIT ENGLISH)	04/01/2011 to 05/14/2019	1000

Appendix Table B2: PubMed Search strategy for Key Question 4

	Search Strategy (LIMITS)	Search Dates	No. of hits
1.	FEMOROACETABULAR IMPINGEMENT* OR FEMORACETABULAR IMPINGEMENT* OR "Femoracetabular Impingement"[Mesh] OR ((HIP OR ACETABUL* OR FEMUR OR FEMORAL) AND IMPINGMENT*) OR “femoral osteochondroplasty” OR “femoral osteoplasty”	04/01/2011 to 05/15/2019	
2.	COST OR "Cost-Benefit Analysis"[Mesh])	04/01/2011 to 05/15/2019	
3.	#1 AND #2 (LIMIT ENGLISH)	04/01/2011 to 05/15/2019	25

Electronic Database Searches

The following databases have been searched for relevant information:

Cochrane Database of Systematic Reviews
Cochrane Registry of Clinical Trials (CENTRAL)
Database of Reviews of Effectiveness (Cochrane Library)
PubMed
ClinicalTrials.gov

Additional Economics, Clinical Guideline and Gray Literature Databases

AHRQ - Healthcare Cost and Utilization Project
Canadian Agency for Drugs and Technologies in Health
Centers for Medicare and Medicaid Services (CMS)
Food and Drug Administration (FDA)
Google

APPENDIX C. Excluded Articles

Articles excluded as primary studies after full text review, with reason for exclusion.

Appendix Table C1. List of Excluded Articles

Citation	Reason for exclusion after full-text review
Alaia MJ, Patel D, Levy A, et al. The incidence of venous thromboembolism (VTE)--after hip arthroscopy. Bulletin of the Hospital for Joint Disease (2013) 2014;72:154-8.	Conditions not reported
Amenabar T, O'Donnell J. Return to sport in Australian football league footballers after hip arthroscopy and midterm outcome. Arthroscopy: the journal of arthroscopic & related surgery: official publication of the Arthroscopy Association of North America and the International Arthroscopy Association 2013;29:1188-94.	Follow-up not long enough
Badylak, J.S. and Keene, J.S., 2011. Do iatrogenic punctures of the labrum affect the clinical results of hip arthroscopy? Arthroscopy: The Journal of Arthroscopic & Related Surgery, 27(6), pp.761-767.	Conditions not reported and only 17% had osteoplasty for FAIS
Bedi A, Galano G, Walsh C, Kelly BT. Capsular management during hip arthroscopy: from femoroacetabular impingement to instability. Arthroscopy : the journal of arthroscopic & related surgery : official publication of the Arthroscopy Association of North America and the International Arthroscopy Association 2011;27:1720-31.	No outcomes of interest
Bogunovic L, Gottlieb M, Pashos G, Baca G, Clohisy JC. Why do hip arthroscopy procedures fail? Clinical orthopaedics and related research 2013;471:2523-9.	Reason for primary hip surgery is unclear and of those getting revision hip surgery, only 43% had FAIS
Byrd JW, Jones KS. Arthroscopic management of femoroacetabular impingement in athletes. The American journal of sports medicine 2011;39 Suppl:7s-13s.	Follow-up not long enough
Capogna BM, Ryan MK, Begly JP, Chenard KE, Mahure SA, Youm T. Clinical outcomes of hip arthroscopy in patients 60 or older: a minimum of 2-year follow-up. Arthroscopy: The Journal of Arthroscopic & Related Surgery. 2016 Dec 1;32(12):2505-10.	Follow-up not long enough
Chambers CC, Monroe EJ, Flores SE, Borak KR, Zhang AL. Periportal Capsulotomy: Technique and Outcomes for a Limited Capsulotomy During Hip Arthroscopy. Arthroscopy : the journal of arthroscopic & related surgery : official publication of the Arthroscopy Association of North America and the International Arthroscopy Association 2019;35:1120-7.	No safety outcomes of interest
Chan EF, Farnsworth CL, Koziol JA, Hosalkar HS, Sah RL. Statistical shape modeling of proximal femoral shape deformities in Legg-Calve-Perthes disease and slipped capital femoral epiphysis. Osteoarthritis and cartilage 2013;21:443-9.	Only 78% of patients had FAIS
Domb BG, Botser IB. Iatrogenic labral puncture of the hip is avoidable. Arthroscopy. 2012 Mar 1;28(3):305-7.	Letter to the editor
Domb B, Hanypsiak B, Botser I. Labral penetration rate in a consecutive series of 300 hip arthroscopies. The American journal of sports medicine. 2012 Apr;40(4):864-9.	Conditions not reported
Frangiamore SJ, Mannava S, Briggs KK, McNamara S, Philippon MJ. Career Length and Performance Among Professional Baseball Players Returning to Play After Hip Arthroscopy. The American journal of sports medicine 2018;46:2588-93.	Follow-up not long enough

Citation	Reason for exclusion after full-text review
Fukushima K, Takahira N, Uchiyama K, Moriya M, Minato T, Takaso M. The incidence of deep vein thrombosis (DVT) during hip arthroscopic surgery. Archives of orthopaedic and trauma surgery 2016;136:1431-5.	Conditions not reported
Gicquel T, Gedouin JE, Krantz N, May O, Gicquel P, Bonin N. Function and osteoarthritis progression after arthroscopic treatment of femoro-acetabular impingement: a prospective study after a mean follow-up of 4.6 (4.2-5.5) years. Orthopaedics & traumatology, surgery & research : OTSR 2014;100:651-6.	Follow-up not long enough
Giordano BD, Suarez-Ahedo C, Gui C, Darwish N, Lodhia P, Domb BG. Clinical outcomes of patients with symptomatic acetabular rim fractures after arthroscopic FAI treatment. Journal of hip preservation surgery 2018;5:66-72.	Rim fracture at presentation, not a complication of surgery
Hesper T, Scalone B, Bittersohl B, Karlsson S, Keenan J, Hosalkar HS. Multimodal Neuromonitoring During Safe Surgical Dislocation of the Hip for Joint Preservation: Feasibility, Safety, and Intraoperative Observations. Journal of the American Academy of Orthopaedic Surgeons Global research & reviews 2017;1:e038.	Only 56% of patients had FAIS
Impellizzeri FM, Mannion AF, Naal FD, Leunig M. Acceptable symptom state after surgery for femoroacetabular impingement compared with total hip arthroplasty. Hip international : the journal of clinical and experimental research on hip pathology and therapy 2013;23 Suppl 9:S54-60.	Not a comparison of interest; comparing THA for any indication with either arthroscopic or open surgery for FAI specifically
Kockara N, Sofu H, Issin A, Camurcu Y, Bursali A. Predictors of the clinical outcome and survival without degenerative arthritis after surgical treatment of femoroacetabular impingement. Journal of orthopaedic science : official journal of the Japanese Orthopaedic Association 2018;23:117-21.	Too few patients (n=33)
Locks R, Bolia IK, Utsunomiya H, Briggs KK, Philippon MJ. Revision Hip Arthroscopy After Labral Reconstruction Using Iliotibial Band Autograft: Surgical Findings and Comparison of Outcomes With Labral Reconstructions Not Requiring Revision. Arthroscopy : the journal of arthroscopic & related surgery : official publication of the Arthroscopy Association of North America and the International Arthroscopy Association 2018;34:1244-50.	Unclear what the underlying indication was for surgery
Maldonado DR, LaReau JM, Perets I, et al. Outcomes of Hip Arthroscopy With Concomitant Periacetabular Osteotomy, Minimum 5-Year Follow-Up. Arthroscopy : the journal of arthroscopic & related surgery : official publication of the Arthroscopy Association of North America and the International Arthroscopy Association 2019;35:826-34.	Too few patients (n=16)
Mardones R, Via AG, Rivera A, et al. Arthroscopic treatment of femoroacetabular impingement in patients older than 60 years. Muscles, ligaments and tendons journal 2016;6:397-401.	Follow-up not long enough
Martinez D, Gomez-Hoyos J, Marquez W, Gallo J. Factors associated with the failure of arthroscopic surgery treatment in patients with femoroacetabular impingement: A cohort study. Revista espanola de cirugia ortopedica y traumatologia 2015;59:112-21.	Prognostic; failure defined as revision or open surgery or both
Matsuda DK, Burchette RJ. Arthroscopic hip labral reconstruction with a gracilis autograft versus labral refixation: 2-year minimum outcomes. The American journal of sports medicine 2013;41:980-7.	Not a comparison of interest; comparing surgical techniques

Citation	Reason for exclusion after full-text review
Matsuda DK, Khatod M, Antounian F, et al. Multicenter outcomes of arthroscopic surgery for femoroacetabular impingement in the community hospital setting. Journal of hip preservation surgery 2016;3:318-24.	Follow-up not long enough
Mladenovic M, Andjelkovic Z, Micic I, Mladenovic D, Stojiljkovic P, Milenkovic T. Surgical dislocation of the hip in patients with femoroacetabular impingement: Surgical techniques and our experience. Vojnosanitetski pregled 2015;72:1004-9.	Not safety specific
Mohtadi NG, Johnston K, Gaudelli C, et al. The incidence of proximal deep vein thrombosis after elective hip arthroscopy: a prospective cohort study in low risk patients. Journal of hip preservation surgery 2016;3:295-303.	A safety specific case series only reporting on PE and DVT, which are both reported in the included SR, Bolia 2018
Naal FD, Hatzung G, Muller A, Impellizzeri F, Leunig M. Validation of a self-reported Beighton score to assess hypermobility in patients with femoroacetabular impingement. International orthopaedics 2014;38:2245-50.	Follow-up not long enough
Nassif NA, Schoenecker PL, Thorsness R, Clohisy JC. Periacetabular osteotomy and combined femoral head-neck junction osteochondroplasty: a minimum two-year follow-up cohort study. The Journal of bone and joint surgery American volume 2012;94:1959-66.	Not a comparison of interest; comparing surgical techniques
Nielsen TG, Miller LL, Lund B, Christiansen SE, Lind M. Outcome of arthroscopic treatment for symptomatic femoroacetabular impingement. BMC musculoskeletal disorders 2014;15:394.	Follow-up not long enough
Nwachukwu BU, McFeely ED, Nasreddine AY, Krcik JA, Frank J, Kocher MS. Complications of hip arthroscopy in children and adolescents. Journal of Pediatric Orthopaedics. 2011 Apr 1;31(3):227-31.	Only 6% of patients had FAIS
Parry JA, Swann RP, Erickson JA, Peters CL, Trousdale RT, Sierra RJ. Midterm Outcomes of Reverse (Anteverting) Periacetabular Osteotomy in Patients With Hip Impingement Secondary to Acetabular Retroversion. The American journal of sports medicine 2016;44:672-6.	Follow-up not long enough and too few patients (n=23)
Rhon DI, Greenlee TA, Sissel CD, Reiman MP. The two-year incidence of hip osteoarthritis after arthroscopic hip surgery for femoroacetabular impingement syndrome. BMC musculoskeletal disorders. 2019 Dec;20(1):266.	Sub analysis of Rhon 2019a and no further information provided.
Ricciardi BF, Fields K, Kelly BT, Ranawat AS, Coleman SH, Sink EL. Causes and risk factors for revision hip preservation surgery. The American journal of sports medicine 2014;42:2627-33.	This is a case control study and a prognostic study where they are identifying patients based on revision surgery, and trying to identify factors associated with revision
Salvo JP, Zarah J, Chaudhry ZS, Poehling-Monaghan KL. Intraoperative Radiation Exposure During Hip Arthroscopy. Orthopaedic journal of sports medicine 2017;5:2325967117719014.	Only 55% of patients had FAIS
Scanaliato JP, Christensen DL, Salfiti C, Herzog MM, Wolff AB. Primary Circumferential Acetabular Labral Reconstruction: Achieving Outcomes Similar to Primary Labral Repair Despite More Challenging Patient Characteristics. The American journal of sports medicine 2018;46:2079-88.	Not a comparison of interest; comparing surgical techniques

Citation	Reason for exclusion after full-text review
Tjong VK, Gombera MM, Kahlenberg CA, et al. Isolated Acetabuloplasty and Labral Repair for Combined-Type Femoroacetabular Impingement: Are We Doing Too Much? Arthroscopy : the journal of arthroscopic & related surgery : official publication of the Arthroscopy Association of North America and the International Arthroscopy Association 2017;33:773-9.	Not safety specific
Wadhwani J, Correa BP, Chicote HH. Arthroscopic aproach of femoroacetabular impigement: Early clinical outcomes. A multicentric study. Journal of orthopaedics 2018;15:754-6.	No safety outcomes of interest
Walker JA, Pagnotto M, Trousdale RT, Sierra RJ. Preliminary pain and function after labral reconstruction during femoroacetabular impingement surgery. Clinical orthopaedics and related research 2012;470:3414-20.	No safety outcomes of interest
Willimon SC, Johnson MM, Herzog MM, Busch MT. Time to Return to School After 10 Common Orthopaedic Surgeries Among Children and Adolescents. Journal of pediatric orthopedics 2017.	No safety outcomes of interest
Zaltz I, Baca G, Kim YJ, et al. Complications associated with the periacetabular osteotomy: a prospective multicenter study. The Journal of bone and joint surgery American volume 2014;96:1967-74.	Only 6% of patients had FAIS
Öhlin A, Ahldén M, Lindman I, Jónasson P, Desai N, Baranto A, Ayeni OR, Sansone M. Good 5-year outcomes after arthroscopic treatment for femoroacetabular impingement syndrome. Knee Surgery, Sports Traumatology, Arthroscopy. 2019 Apr 10:1-6.	Case series with greater than 5 year follow-up but only reporting on revision surgery.

APPENDIX D. Risk of Bias, Class of Evidence, Strength of Evidence, and QHES Determination

Each included comparative study is rated against pre-set criteria that resulted in a Risk of Bias (RoB) assessment and presented in a table. Criteria for RoB assessment are listed in the Tables below. Risk of bias assessments were not conducted for case series; all were considered High risk of bias.

Appendix Table D1. Definition of the risk of bias categories

Risk of Bias	Definition
Low risk of bias	Study adheres to commonly held tenets of high quality design, execution and avoidance of bias
Moderately low risk of bias	Study has potential for some bias; does not meet all criteria for low risk of bias but deficiencies not likely to invalidate results or introduce significant bias
Moderately high risk of bias	Study has flaws in design and/or execution that increase potential for bias that may invalidate study results
High risk of bias	Study has significant potential for bias; does not include design features geared toward minimizing bias and/or does not have a comparison group

Appendix Table D2. Definition of the risk of bias for studies on therapy

	Studies of Therapy*	
Risk of Bias	**Study design**	**Criteria**
Low risk: Study adheres to commonly held tenets of high quality design, execution and avoidance of bias	Good quality RCT	Random sequence generation Statement of allocation concealment Intent-to-treat analysis Blind or independent assessment of PET/CT (interpreter blinded to clinical assessment/status) Blind or independent assessment for subjective outcome(s) Pre-specified threshold for definition of a positive test. Attrition (≤ 20% overall) Comparable f/u time or accounting for time at risk Controlling for possible confounding‡ Full reporting of specified outcomes
Moderately low risk:	Moderate quality RCT	Violation of one or two of the criteria for good quality RCT

	Studies of Therapy*	
Risk of Bias	**Study design**	**Criteria**
Study has potential for some bias; study does not meet all criteria for class I, but deficiencies not likely to invalidate results or introduce significant bias	Good quality cohort	Blind or independent assessment of PET/CT (interpreter blinded to clinical assessment/status) Blind or independent assessment for subjective outcome(s) Pre-specified threshold for definition of a positive test. Attrition (≤ 20% overall) Comparable f/u time or accounting for time at risk Controlling for possible confounding‡ Full reporting of specified outcomes
Moderately High risk: Study has significant flaws in design and/or execution that increase potential for bias that may invalidate study results	Poor quality RCT	Violation of three or more of the criteria for good quality RCT
	Moderate quality cohort	Violation of any of the criteria for good quality cohort
	Case-control	Any case-control design
High risk: Study has significant potential for bias; lack of comparison group precludes direct assessment of important outcomes	Poor quality cohort Case series	Violation of two or more criteria for a good quality cohort Any case series design

* Additional domains evaluated in studies performing a formal test of interaction for subgroup modification (i.e., HTE) based on recommendations from Oxman and Guyatt[4]:

Is the subgroup variable a characteristic specified at baseline or after randomization? (subgroup hypotheses should be developed a priori)

Did the hypothesis precede rather than follow the analysis and include a hypothesized direction that was subsequently confirmed?

Was the subgroup hypothesis one of a smaller number tested?

† Outcome assessment is independent of healthcare personnel judgment. Reliable data are data such as mortality or re-operation.

‡Groups must be comparable on baseline characteristics or evidence of control for confounding presented (e.g. by restriction, matching, statistical methods) at time of randomization or allocation to treatment based on PET results. Authors must provide a description of robust baseline characteristics, and control for those that are unequally distributed between treatment groups.

Determination of Overall Strength (Quality) of Evidence

The strength of evidence for the overall body of evidence for all critical health outcomes was assessed by one researcher following the principles for adapting GRADE (Grades of Recommendation Assessment, Development and Evaluation) as outlined by the Agency for Healthcare Research and Quality (AHRQ).[6] The strength of evidence was based on the highest quality evidence available for a given outcome. In

determining the strength of body of evidence regarding a given outcome, the following domains were considered:

Risk of Bias: the extent to which the included studies have protection against bias
Consistency: the degree to which the included studies report results are similar in terms of range and variability.
Directness: describes whether the evidence is directly related to patient health outcomes.
Precision: describes the level of certainty surrounding the effect estimates.
Publication bias: is considered when there is concern of selective publishing.

Bodies of evidence consisting of RCTs were initially considered as High strength of evidence (SoE), while those that comprised nonrandomized studies began as Low strength of evidence. The strength of evidence could be downgraded based on the limitations described above. There could also be situations where the nonrandomized studies could be upgraded, including the presence of plausible unmeasured confounding and bias that would decrease an observed effect or increase an effect if none was observed, and large magnitude of effect (strength of association). Publication and reporting bias are difficult to assess. Publication bias is particularly difficult to assess with fewer than 10 RCTs (AHRQ methods guide). When publication bias was unknown in all studies and this domain is often eliminated from the strength of evidence tables for our reports. The final strength of evidence was assigned an overall grade of high, moderate, low, or insufficient, which are defined as follows:

High - Very confident that effect size estimates lie close to the true effect for this outcome; there are few or no deficiencies in the body of evidence; we believe the findings are stable.

Moderate – Moderately confident that effect size estimates lie close to the true effect for this outcome; some deficiencies in the body of evidence; we believe the findings are probably stable but some doubt remains.

Low – Limited confidence that effect size estimates lie close to the true effect for this outcome; important or numerous deficiencies in the body of evidence; we believe that additional evidence is needed before concluding that findings are stable or that the estimate is close to the true effect.

Insufficient – We have no evidence, are unable to estimate an effect or have no confidence in the effect estimate for this outcome; OR no available evidence or the body of evidence has unacceptable deficiencies precluding judgment.

Similar methods for determining the overall quality (strength) of evidence related to economic studies have not been reported, thus the overall strength of evidence for outcomes reported in Key Question 4 was not assessed.

All AHRQ “required” and “additional” domains (risk of bias, consistency, directness, precision, and if possible, publication bias) are assessed. Bodies of evidence consisting of RCTs were initially considered as High strength of evidence, while those comprised of nonrandomized studies began as Low strength of evidence. The strength of evidence could be downgraded based on the limitations described above. There are also situations where the *nonrandomized* studies could be upgraded, including the presence of plausible unmeasured confounding and bias that would decrease an observed effect or increase an effect if none was observed, and large magnitude of effect (strength of association).

Appendix Table D3. Example methodology outline for determining overall strength of evidence (SoE):

All AHRQ "required" and "additional" domains* are assessed. Only those that influence the baseline grade are listed in table below.

Baseline strength: HIGH = RCTs. LOW = observational, cohort studies, administrative data studies.

DOWNGRADE: Risk of bias for the individual article evaluations (1 or 2); Inconsistency** of results (1 or 2); Indirectness of evidence (1 or 2); Imprecision of effect estimates (1 or 2); Sub-group analyses not stated *a priori* and no test for interaction (2)

UPGRADE (non-randomized studies): Large magnitude of effect (1 or 2); Dose response gradient (1) done for observational studies ***if no downgrade for domains above***

Outcome	Strength of Evidence	Conclusions & Comments	Baseline SOE	DOWNGRADE	UPGRADE
Outcome	**HIGH**	Summary of findings	**HIGH** RCTs	**NO** consistent, direct, and precise estimates	**NO**
Outcome	**MODERATE**	Summary of findings	**LOW** Cohort studies	**NO** consistent, direct, and precise estimates; high quality (moderately low ROB)	**YES** Large effect
Outcome	**LOW**	Summary of findings	**HIGH** RCTs	**YES (2)** Inconsistent Indirect	**NO**

*Required domains: risk of bias, consistency, directness, precision. Plausible confounding that would decrease observed effect is accounted for in our baseline risk of bias assessment through individual article evaluation. Additional domains: dose-response, strength of association, publication bias.

**Single study = "consistency unknown", may or may not be downgraded

ROB for Contextual Questions:

Risk of Bias for Diagnostic Test Studies (Test Characteristics)

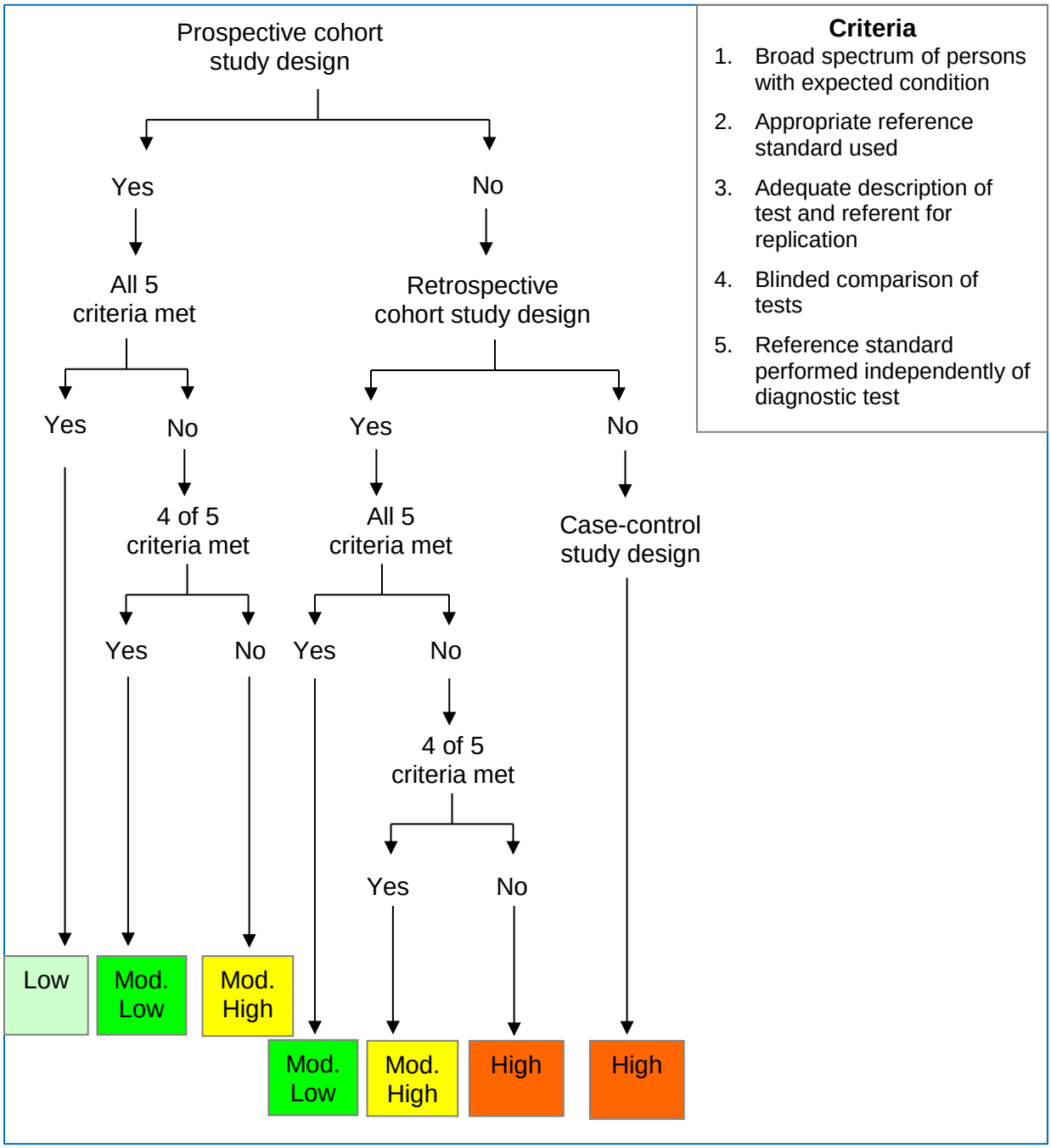
Table D4 and Figure D1 outline Aggregate Analytics' methodology for evaluating the quality of evidence for diagnostic studies and criteria used to determine the Risk of Bias (RoB). The procedure that follows describes specific considerations used to determine whether or not the various criteria were met. This method takes into account the primary sources of bias for such studies.

Each included study was evaluated independently by two investigators based on the criteria below and a RoB assigned to each article, initially at the abstract level and confirmed when the full articles were reviewed. Discrepancies in RoB determination were resolved by discussion until consensus was achieved.

Appendix Table D4. Definitions of the different levels of evidence for diagnostic test accuracy/validity studies.

RoB	Study type	Criteria
Low	Good quality prospective study	Broad spectrum of persons with the expected condition Appropriate reference standard used Adequate description of test and reference for replication Blinded comparison of tests with appropriate reference standard Reference standard performed independently of diagnostic test
Moderately Low	Moderate quality prospective study	Violation of any one of the criteria for a good quality prospective study
	Good quality retrospective study	Broad spectrum of persons with the expected condition Appropriate reference standard used Adequate description of test and reference for replication Blinded comparison of tests with appropriate reference standard Reference standard performed independently of diagnostic test
Moderately High	Poor quality prospective study	Violation of any two or more of the criteria for a good quality prospective study
	Moderate quality retrospective study	Violation of any one of the criteria for a good quality retrospective study
High	Poor quality retrospective study	Violation of any two or more of the criteria for a good quality retrospective study
	Case-Control Study	

Figure D1. Level of Evidence Algorithm – Accuracy/Validity Studies



Procedures for determining adherence to RoB criteria

The following describes the method for determining whether or not a given study has met the specific individual criterion used to assign the RoB. Table D5 provides a template for indicating whether the individual criterion is met or not. A blank for the criterion indicates that the criterion was not met, could not be determined or was not reported by the author.

Determine if the study is **prospective or retrospective.**

Accuracy of diagnostic tests is best assessed using a prospective study of consecutive series of patients from a relevant patient population (i.e. study designed for prospective collection of data using specific protocols). Ideally, a consecutive series of patients or random selection from the relevant patient population should be prospectively studied. Retrospective collection of data or evaluation of patients who have had the diagnostic test and reference test previously may be more subject to bias.

If it is cannot be determined whether a prospective or retrospective approach was taken, no credit will be given for this criterion having been met.

Was a **broad spectrum of persons with the suspected condition** used to evaluate the diagnostic test and reference standard?

The study population must be comprised of those with a broad spectrum of suspected disease who are likely to have the test now or in the future. A broad spectrum would include patients with mild as well as more severe cases, those presenting early as well as late and those whose differential diagnosis may be commonly confused with the condition of interest. Subjects from specialty referral sources may be more likely to have a specific abnormality/condition than those presenting to a general family practice clinic. Overestimation of diagnostic accuracy may occur if a population with known disease is compared with a group of normal individuals instead of those from the relevant patient population.

Studies providing a description of the demographic and clinical characteristics of subjects were given credit as appropriate for the type of disease under investigation.

Was an **appropriate reference standard** used to compare the diagnostic test being evaluated?

Ideal reference standards are termed “gold” standards and in theory, provide the “truth” about the presence or absence of a condition or disease. Such standards provide a basis for comparing the accuracy of other tests and allow for the calculation of characteristics such as sensitivity, specificity and predictive values.

In most instances, the reference standard does not perfectly classify individuals with respect to the presence or absences of disease, but may reflect the current “best” reference and/or one that can be practically applied. It should be “likely” to classify patients according to disease status. A reference measure can be performed at the time of the testing. It may be an anatomical, physiological or pathological state or measure or a specific outcome at a later date.

The reference standard should be reproducible and the description of both the referent standard and the test should be explicit enough for replication, validation and generalization.

Are the details of the test and the reference/gold standard sufficient to allow study replication?

Are the technical features of the test and protocols used to collect information about test results, any measurements performed, planes of section evaluated, diagnostic criteria used, etc. sufficient that other investigators could duplicate the conditions and reproduce the findings in a similar population?

Was there blinded comparison of the tests with the appropriate reference standard?

Interpretation of the reference standard must be done without prior knowledge of the test results and the test must be interpreted without knowledge of the results of the reference test. This is necessary to avoid bias. It must be clear from the text that tests were interpreted without knowledge of the results of the other. A statement that blinding was done (for either test, preferably both) was necessary for credit.

Was the **reference standard performed independently of the diagnostic test**?

The reference standard must have been applied objectively or blindly to all patients without the results of test influencing use of the reference. If the "test" affects the reference (or referral to the reference test) or is part of the reference standard, this does not constitute independent performance of the test.

Appendix Table D5. Assessment of RoB for individual studies of diagnostic test evaluation

Methodological Principle	Author 1 (1999)	Author 2 (2002)	Author 3 (2004)	Author 4 (2005)
Study Design				
Prospective cohort design			■	
Retrospective cohort design	■	■		■
Case-control design				
Broad spectrum of patients with expected condition	■	■		■
Appropriate reference standard used	■	■		
Adequate description of test and reference for replication				
Blinded comparison with appropriate reference	■		■	
Reference standard performed independently of test	■	■	■	■
Risk of Bias	**Mod. Low**	**Mod. High**	**Mod. High**	**High**

* Blank box indicates criterion not met, could not be determined or information not reported by author

Risk of Bias for Diagnostic Test Studies – Reliability Studies

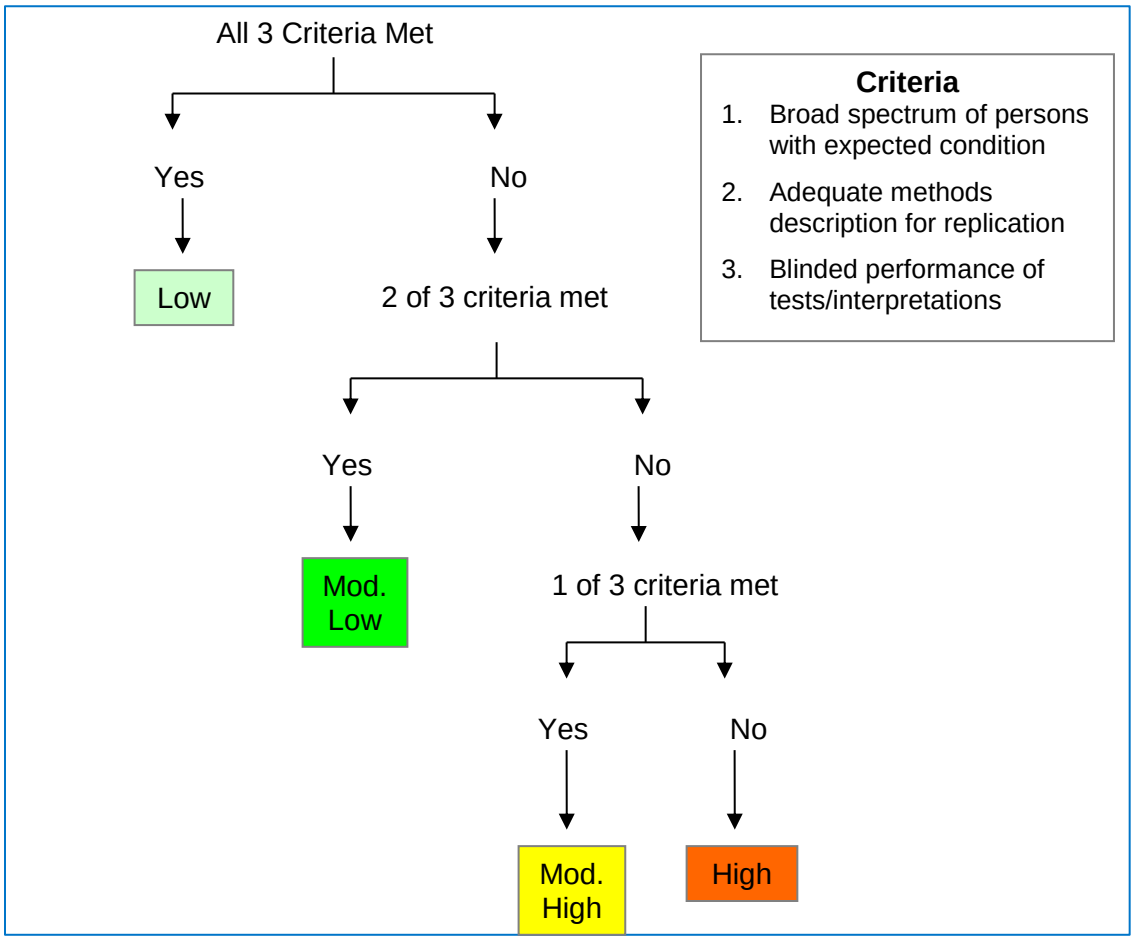
Methods for assessing the quality of evidence for reliability studies have not been well reported in the literature. Aggregate Analytics' determination of quality for such is based on epidemiologic methods for evaluating validity and reliability.

Table D6 describes the method for determining whether or not a given study has met the specific individual criterion used to assign the RoB. Table D7 provides a template for indicating whether the individual criterion is met or not. A blank for the criterion indicates that the criterion was not met, could not be determined or was not reported by the author.

Appendix Table D6. Definitions of the different levels of evidence for reliability studies

RoB	Study type	Criteria
Low	Good quality study	Broad spectrum of persons with the expected condition Adequate description of methods for replication Blinded performance of tests, measurements or interpretation Second test/interpretation performed independently of the first
Moderately Low	Moderate quality	Violation of any one of the criteria for a good quality study
Moderately High	Poor quality study	Violation of any two of the criteria
High	Very poor quality study	Violation of all three of the criteria

Figure D2. Level of Evidence Algorithm – Reliability studies



Procedures for determining adherence to RoB criteria: Reliability studies

For these studies, the first performance or interpretation of the text is usually considered the "reference" and the second performance or interpretation the "test". Typical reliability studies are done using the same method (e.g., supine MRI) and include test-retest, inter- and intra-rater reliability. Statistical analysis is based on whether the same method or different methods are compared, the types of variables measured and the goal of the study. In general, the degree (%) of concordance does not account for the role of chance agreement and is not a good index of reliability.[7] Different types of *kappa* (κ) or statistical correlation are frequently used to evaluate the role of chance.

Determination of the RoB involves evaluation of the following questions:

Was a **broad spectrum of persons with the suspected condition** used to determine reliability?

The study population must be comprised of those with a broad spectrum of suspected disease who are likely to have the test now or in the future. Since differences in gender, age, body habitus and other characteristics may influence measurements and the ability to reproduce the results, the range of patients used for reliability studies is important. Ideally a random sample of patients from the relevant clinical population would be used but may not be feasible, depending on the study. A broad spectrum would include patients with mild as well as more severe cases, those presenting early as well as late and those whose differential diagnosis may be commonly confused with the condition of interest. Reproducibility studies in a population with known disease may give different results compared with studies on a group of normal individuals and may not give an accurate picture of overall reproducibility. (If the goal of the study is to evaluate the potential for differential measurement error or bias, the separate analyses on "normal" and "diseased" populations should be done to evaluate the extent of such bias. If it is a test-retest design, the test administrations should be on the same population. If it is an inter- or inter-rater reliability study the object (e.g., radiographs) should be the same for each reading/interpretation, (e.g., the same patients' radiographs are read twice).

Are the **details of the methods sufficient to allow study replication**?

Is the description of the methods, i.e. the protocols used to collect information, measurements taken, planes of section, diagnostic criteria used, etc. sufficient that other investigators could duplicate the conditions and reproduce the findings in a similar population? Are the methods used for each part of the replication consistent?

Was there **blinded/independent performance of the repeat test administrations or interpretations**?

The second administration of the test or second interpretation of results should be done without influence of the first test/interpretation. This is necessary to avoid bias. It must be clear from the text that both tests were interpreted without knowledge of the results of the other. Examples of when the administration would not be considered blinded or independent could include:
Interpretation of the second test is to be done without prior knowledge of the test results or the first interpretation.
The timing of the second test administration or reading/interpretation of the results is not done such that sufficient time has elapsed between them to avoid influence of the first test/interpretation on the results of the second. In the case of re-administration of the test, the timing should not be so far apart that the stage/period of disease is different from the first administration.

Appendix Table D7. Assessment of risk of bias (RoB) for reliability studies

Methodological Principle	Author 1 (1999)	Author 2 (2002)	Author 3 (2004)	Author 4 (2005)
Broad spectrum of patients with expected condition	■	■		
Adequate description of methods for replication	■	■		
Blinded/independent comparison of tests/interpretations	■		■	
Risk of Bias	**Low**	**Mod. Low**	**Mod. High**	**High**

Assessment of Economic Studies

Full formal economic analyses evaluate both costs and clinical outcomes of two or more alternative interventions. The four primary types are cost minimization analysis (CMA), cost-utility analysis (CUA), cost-effectiveness analysis (CEA), and cost-benefit analyses (CBA). Each employs different methodologies, potentially complicating critical appraisal, but some common criteria can be assessed across studies.

No standard, universally accepted method of critical appraisal of economic analyses is currently in use. A number of checklists [Canadian, BMJ, AMA] are available to facilitate critique of such studies. The Quality of Health Economic Studies (QHES) instrument developed by Ofman, et al.[82] QHES embodies the primary components relevant for critical appraisal of economic studies. It also incorporates a weighted scoring process and which was used as one factor to assess included economic studies. This tool has not yet undergone extensive evaluation for broader use but provides a valuable starting point for critique.

In addition to assessment of criteria in the QHES, other factors are important in critical appraisal of studies from an epidemiologic perspective to assist in evaluation of generalizability and potential sources of study bias.

Such factors include:

Are the interventions applied to similar populations (e.g., with respect to age, gender, medical conditions, etc.)? To what extent are the populations for each intervention comparable and are differences considered or accounted for? To what extent are population characteristics consistent with "real world" applications of the comparators?
Are the sample sizes adequate so as to provide a reasonable representation of individuals to whom the technology would be applied?
What types of studies form the basis for the data used in the analyses? Data (e.g., complication rates) from randomized controlled trials or well-conducted, methodologically rigorous cohort studies for data collection are generally of highest quality compared with case series or studies with historical cohorts.
Were the interventions applied in a comparable manner (e.g., similar protocols, follow-up procedures, evaluation of outcomes, etc.)?
How were the data and/or patients selected or sampled (e.g., a random selection of claims for the intervention from a given year/source or all claims)? What specific inclusion/exclusion criteria or processes were used?

Were the outcomes and consequences of the interventions being compared comparable for each? (e.g., were all of the relevant consequences/complications for each intervention considered or do they primarily reflect those for one intervention?

APPENDIX E. Study Quality: Risk of Bias evaluation

Appendix Table E1. Risk of Bias Assessment: FAIS – Arthroscopy vs. Non-operative Care

Methodological Principle	Griffin 2018 (UK FASHIoN)	Mansell 2018	Palmer 2019	Kekatpure 2017	Pennock 2018
Study design					
Randomized controlled trial	■	■	■		
Prospective cohort study					■
Retrospective cohort study				■	
Case-control					
Case-series					
Random sequence generation*	Yes	Yes	Yes	N/A	N/A
Concealed allocation*	Yes	Yes	Yes	N/A	N/A
Intention to treat*	Yes	Yes	Yes (primary outcome, HOS) No (all other outcomes)	N/A	N/A
Independent or blind assessment‡	No	No	No	No	No
Complete follow-up of ≥80%	Yes	6 months and 1 year: Yes; 2 years: No (78%)	Yes	Unclear	No
<10% difference in follow-up between groups	Yes	6 months and 1 year: Yes; 2 years: No (10%)	Yes	Unclear	Unclear
Controlling for possible confounding†	Yes	Yes (Everything except hip laterality)	Yes	No	No
Risk of Bias	**Moderately Low**	**Moderately High**	**Moderately Low**	**High**	**High**

Unclear indicates that the study had insufficient detail to determine whether criteria were met

*Applies only to randomized controlled trials

†Groups must be comparable on a robust set of baseline characteristics or present evidence that controlling of confounding presented was performed

‡For all trials, outcome assessors were blinded; however, primary outcomes were patient-reported and patients could not be blinded due to the nature of the interventions, therefore credit was not given.

Appendix Table E2. Risk of Bias Assessment: FAIS – Arthroscopic Surgery vs. Open Surgical Dislocation

Methodological Principle	Botser 2014	Büchler 2013	Domb 2013	Rego 2018	Roos 2017	Zingg 2013
Study design						
Randomized controlled trial						
Prospective cohort study						■
Retrospective cohort study	■	■	■	■	■	
Case-control						
Case-series						
Random sequence generation*	N/A	N/A	N/A	N/A	N/A	N/A
Concealed allocation*	N/A	N/A	N/A	N/A	N/A	N/A
Intention to treat*	N/A	N/A	N/A	N/A	N/A	N/A
Independent or blind assessment	No	No	No	No	No	No
Complete follow-up of ≥80%	Unclear	No‡	Yes	No	Yes	Yes
<10% difference in follow-up between groups	Unclear	Unclear	Yes	Unclear§	No	Yes
Controlling for possible confounding†	No	No	Yes**	No††	No	No
Risk of Bias	**High**	**High**	**Moderately High**	**High**	**High**	**High**

Unclear indicates that the study had insufficient detail to determine whether criteria were met

*Applies only to randomized controlled trials

†Groups must be comparable on a robust set of baseline characteristics or present evidence that controlling of confounding presented was performed

‡43 patients were excluded because of inadequate documentation or insufficient quality.

§This study excluded those patients that converted to THA and only included patients with >24 months of follow-up

**Matched pairs analysis

††This study appeared to look at variables that might influence outcomes but no adjusted analyses were performed.

Appendix Table E3. Risk of Bias Assessment: FAIS – Labral Detachment vs. No Labral Detachment

Methodological Principle	Redmond 2015	Webb 2019
Study design		
Randomized controlled trial		
Prospective cohort study		
Retrospective cohort study	■	■
Case-control		
Case-series		
Random sequence generation*	N/A	N/A
Concealed allocation*	N/A	N/A
Intention to treat*	N/A	N/A
Independent or blind assessment	No	No
Complete follow-up of ≥80%	No	Yes
<10% difference in follow-up between groups	Unclear	Yes
Controlling for possible confounding†	No	No
Risk of Bias	**High**	**High**

Unclear indicates that the study had insufficient detail to determine whether criteria were met

*Applies only to randomized controlled trials

†Groups must be comparable on a robust set of baseline characteristics or present evidence that controlling of confounding presented was performed

Appendix Table E4. Risk of Bias Assessment: FAIS – Arthroscopic Labral Repair vs. Labral Debridement

Methodological Principle	Krych 2013	Menge 2017	Larson 2012	Cetinkaya 2016	Schilders 2011	Anwander 2017
Study design						
Randomized controlled trial	■					
Prospective cohort study						
Retrospective cohort study		■	■	■	■	■
Case-control						
Case-series						
Random sequence generation*	No	N/A	N/A	N/A	N/A	N/A
Concealed allocation*	Yes	N/A	N/A	N/A	N/A	N/A
Intention to treat*	Yes	N/A	N/A	N/A	N/A	N/A
Independent or blind assessment	No	No	No	No	No	No
Complete follow-up of ≥80%	Yes	No‡	Yes	Unclear	Unclear	Yes
<10% difference in follow-up between groups	Yes	No‡	Yes	Unclear	Unclear ‡	Yes
Controlling for possible confounding†	No	Yes§	Yes	No	Unclear	No
Risk of Bias	**Moderately High**	**High**	**Moderately High**	**High**	**High**	**High**

Unclear indicates that the study had insufficient detail to determine whether criteria were met
*Applies only to randomized controlled trials
†Groups must be comparable on a robust set of baseline characteristics or present evidence that controlling of confounding presented was performed
‡Follow-up could not be determined from information provided. It is unclear if all patients were accounted for.
§Adjusted HR for undergoing THA.

Appendix Table E5. Risk of Bias Assessment: FAIS – Rim Trim vs. No Rim Trim

Methodological Principle	Hingsammer 2015
Study design	
Randomized controlled trial	
Prospective cohort study	
Retrospective cohort study	■
Case-control	
Case-series	
Random sequence generation*	N/A
Concealed allocation*	N/A
Intention to treat*	N/A
Independent or blind assessment	No
Complete follow-up of ≥80%	Unclear
<10% difference in follow-up between groups	Unclear
Controlling for possible confounding†	No
Risk of Bias	**High**

Unclear indicates that the study had insufficient detail to determine whether criteria were met
*Applies only to randomized controlled trials
†Groups must be comparable on a robust set of baseline characteristics or present evidence that controlling of confounding presented was performed

Appendix Table E6. Quality of Health Economic Studies (QHES) scores: economic studies

QHES Question (points possible)	Griffin 2018	Mather 2018	Shearer 2012
1. Was the study objective presented in a clear, specific, and measurable manner? (7 points)	7	7	7
2. Were the perspective of the analysis (societal, third-party payer, etc.) and reasons for its selection stated? (4 points)	4	4	4
3. Were variable estimates used in the analysis from the best available source (i.e. randomized controlled trial - best, expert opinion - worst)? (8 points)	8	0	0
4. If estimates came from a subgroup analysis, were the groups prespecified at the beginning of the study? (1 point)	1	1	0
5. Was uncertainty handled by (1) statistical analysis to address random events, (2) sensitivity analysis to cover a range of assumptions? (9 points)	9	9	9
6. Was incremental analysis performed between alternatives for resources and costs? (6 points)	6	6	6
7. Was the methodology for data abstraction (including the value of health states and other benefits) stated? (5 points)	5	0	5
8. Did the analytic horizon allow time for all relevant and important outcomes? Were benefits and costs that went beyond 1 year discounted (3% to 5%) and justification given for the discount rate? (7 points)	0	7	7
9. Was the measurement of costs appropriate and the methodology for the estimation of quantities and unit costs clearly described? (8 points)	8	8	0
10. Were the primary outcome measure(s) for the economic evaluation clearly stated and did they include the major short-term, long-term and negative outcomes included? (6 points)	0	6	6
11. Were the health outcomes measures/scales valid and reliable? If previously tested valid and reliable measures were not available, was justification given for the measures/scales used? (7 points)	7	0	0
12. Were the economic model (including structure), study methods and analysis, and the components of the numerator and denominator displayed in a clear, transparent manner? (8 points)	0	8	0
13. Were the choice of economic model, main assumptions, and limitations of the study stated and justified? (7 points)	7	0	7
14. Did the author(s) explicitly discuss direction and magnitude of potential biases? (6 points)	6	0	6
15. Were the conclusions/recommendations of the study justified and based on the study results? (8 points)	8	8	8
16. Was there a statement disclosing the source of funding for the study? (3 points)	3	3	0
Total score:	**79**	**67**	**65**

Appendix Table E7. Risk of Bias Assessment: FAIS – studies of diagnostic test accuracy/validity

Methodological Principle	Tijssen 2017
Prospective study	
Retrospective study	X
Case-control study	
Broad spectrum of persons with the expected condition	No
Appropriate reference standard used	Yes
Adequate description of test and reference for replication	Yes
Blinded comparison of tests with appropriate reference standard	No
Reference standard performed independently of diagnostic test	No
Risk of Bias	**High**

Appendix Table E8. Risk of Bias Assessment: FAIS – reliability studies

Methodological Principle	Ayeni 2014	Malviya 2016	Sutter 2012	Hooper 2016	Ratzleff 2016	Ratzleff 2013
Broad spectrum of persons with the expected condition	Yes	No	Yes	No	Yes	No
Adequate description of methods for replication	No	No	Yes	Yes	No	Yes
Blinded comparison of tests, measurements or interpretation	Yes	No	Yes	No	Yes	Yes
Risk of bias	**Mod Low**	**High**	**Low**	**Mod High**	**Mod Low**	**Mod Low**

APPENDIX F. Data Abstraction of Included Studies

Appendix Table F1. Study characteristics and patient demographics: Comparative studies of Arthroscopy vs. Non-operative Treatment

Study Design ROB Country	N	Interventions	Inclusion, Exclusion Criteria	Morphology Type	Demographics	F/U, %	Outcomes (scale)	Funding COI Notes
RCTs								
Griffin 2018 [UK FASHION trial] RCT *Moderately Low* UK	348	**Arthroscopy (n=171 ITT, 144 treated per-protocol)**: Shape abnormalities and consequent labral and cartilage pathology were treated. Patients received a single course of PT rehabilitation following their surgery. **Physical Therapy (n=177 ITT, 154 treated per-protocol)**: Between 6 and 10 face-to-face contacts with the physiotherapist over 12 to 24 weeks. Program consisted of four components: an assessment of pain, function, and range of hip motion; patient education; an exercise program taught in the clinic and repeated at	**Inclusion**: hip pain, radiographic features of cam (alpha angle >55°) or pincer (lateral centre-edge angle >40° or a positive crossover sign) morphology, ≥16 years old, able to give informed consent, treating surgeon's belief that patient was likely to benefit from hip arthroscopy **Exclusion**: Presence of hip osteoarthritis (Tonnis grade >1 or less than 2 mm of superior joint space on an antero-osterior radiograph),history of hip pathology such as Perthes' disease, slipped upper femoral epiphysis, or avascular necrosis, previous hip	Arthroscopy vs. PT **Cam**: 75% vs. 75% **Pincer**: 8% vs. 8% **Combined Cam and Pincer**: 17% vs. 17%	Arthroscopy vs. PT Mean (SD) age: 35.4 (9.7) vs. 35.2 (9.4) years % Male: 58% vs. 64% Hip laterality - Right: 56% vs. 58% - Left: 44% vs. 42% -Bilateral: 6% vs. 10% Current Smoker: 18% vs. 14% Duration of hip symptoms: 37 vs. 40 months Mean LCEA ≥20° but <25°: 4% vs. 3%	**F/U**: 6 weeks (safety only), 6 months, 12 months **Loss to F/U, % (n/N)**: 8.3% (29/348) - Arthroscopy: 8.1% (14/171) - PT: 8.5% (15/177)	iHOT-33 (0-100, higher scores=better QOL; MCID=6.1) EQ-5D-5L SF-12 MCS SF-12 PCS EQ-5D-5L VAS	Funding: The Health Technology Assessment Programme of the National Institute of Health Research COI: DRG reports grants from the National Institute of Health Research (NIHR) during the conduct of the study, and personal fees from Stryker UK, outside the submitted work; he is also a board member of the International Society of Hip Arthroscopy, and is a consultant surgeon who routinely performs hip arthroscopy. PDHW, MJ, JLD,

Study Design ROB Country	N	Interventions	Inclusion, Exclusion Criteria	Morphology Type	Demographics	F/U, %	Outcomes (scale)	Funding COI Notes
		home; and help with pain relief (could include one intra-articular steroid injection)	injury, previous shape-changing surgery (open or arthroscopic) of the hip		Mean alpha angle: 61 °vs.64° <u>Baseline Outcome Scores; Mean (SD)</u> Physical Activity Score: 4.3 (2.5) vs. 4.4 (2.5) iHOT-33 score: 39.2 (20.9) vs. 35.6 (18.2) SF-12 PCS: 44 (7.6) vs. 44 (5.9) SF-12 MCS: 42 (7.1) vs. 42 (7.3) EQ-5D-5L Index Score: 0·576 (0.26) vs. 0·557 (0.25) EQ-5D-5L VAS Score: 67 (20.2) vs. 67 (18.7)			CEH, NRP, and NEF report grants from the NIHR Health Technology Assessment Programme during the conduct of this study. All other authors declare no competing interests. Notes:

Study Design ROB Country	N	Interventions	Inclusion, Exclusion Criteria	Morphology Type	Demographics	F/U, %	Outcomes (scale)	Funding COI Notes
Mansell 2018 RCT *Moderately High* USA	80	**Arthroscopy (n=40 ITT, 38 per-protocol)**: Surgery involved one or more of the following: acetabuloplasty, labral repair/debridement, and femoroplasty as indicated by the surgeon's clinical judgment with input from preoperative imaging, examination findings, and intraoperative findings. The patients all went through a postoperative physical therapy protocol developed jointly by the orthopaedic surgeons and physical therapists. **Physical Therapy (n=40 ITT, 12 per-protocol)**: 2 times/week for 6 weeks [12 sessions] Program will incorporate joint mobilizations, mobilization with motion, therapeutic exercise, soft tissue mobility, stretching and motor control exercises to address the patient's identified	**Inclusion**: Tricare beneficiaries between the ages of 18 and 60, clinical diagnosis of FAI and/or labral pathology confirmed by a combination of all the following physical examination findings: Patient self-report of pain in the anterior hip or groin, Pain reproduced with passive or active flexion, Positive FADIR (Flexion Adduction Internal Rotation) test, Subjective relief of pain after intra-articular injection, No less than 2 mm of joint space based on imaging (CT scan, radiographs and MR arthrogram), Positive crossover sign and/or alpha angle >50 degrees based on imaging (CT scan, radiographs and MR arthrogram), Failed 6	Arthroscopy vs. PT **Cam**: NR **Pincer**: NR **Combined Cam and Pincer**: NR	Arthroscopy vs. PT Mean (SD) age: 30.6 (7.4) vs. 29.7 (7.4) years % Male: 65% vs. 53% Hip laterality - Right: 47.5% vs. 72.5% NPS: 3.7 (1.7) vs. 4.0 (1.7) <u>Baseline Outcome Scores; Mean (95% CI)</u> HOS-ADL: 64.6 (60.2 to 69.0) vs. 65.6 (60.9 to 70.3) HOS-sport: 53.2 (47.9 to 58.4) vs. 52.1 (46.5 to 57.7) iHOT-33: 29.4 (24.4 to 34.4) vs. 28.5 (23.5 to 33.5)	**F/U:** 6, 12, and 24 months **Loss to F/U, % (n/N)**: 22.5% (18/80) - Arthroscopy: 17.5% (7/40) - PT: 27.5% (11/40)	HOS-ADL subscore (0-100, higher scores=increased function; MCID range, 6 to 8) HOS-sport subscale (0-100, higher scores=increased function; MCID range, 8 to 9) iHOT-33 (0-100, higher scores=better QOL; MCID=12) GROC (-7 to 7, 0=no perceived change in QOL; MCID=positive change of ≥3 points)	Funding: Funding was provided through an internal grant from the DHA (#W911QY-15-1-0007). COI: None Notes:

Study Design ROB Country	N	Interventions	Inclusion, Exclusion Criteria	Morphology Type	Demographics	F/U, %	Outcomes (scale)	Funding COI Notes
		impairments. Program is reinforced by home exercise program.	weeks of conservative management **Exclusion**: Diagnosis of hip osteoarthritis more likely (joint space narrowing less than 2 mm.), Other concurrent systemic disease that may affect the condition (cancer, rheumatoid arthritis or systemic arthralgia/arthritis), Pending litigation/workmen's compensation, Will be moving or relocating within the following 6 months, Clearing the lumbar spine reproduces the patient's hip symptoms, Pregnancy, History of prior surgery on the same hip that will be analyzed in the study, A formal course of physical therapy within the past 6 months,					

Study Design ROB Country	N	Interventions	Inclusion, Exclusion Criteria	Morphology Type	Demographics	F/U, %	Outcomes (scale)	Funding COI Notes
			Unable to give informed consent to participate in the study, Unable to speak or read or write in English					
Palmer 2019 [FAIT trial] RCT *Moderately Low* UK	222	**Arthroscopy (n=112 ITT, 79 per protocol)**: Surgical Procedure Performed - Labral procedure only: 9% - Femoral osteochondroplasty: 67%– - Acetabular osteochondroplasty (rim-trim): 5% - Femoral osteochondroplasty + acetabular osteochondroplasty (rim-trim): 19% - No labral procedure: 4% - Labral repair 70% - Labral debridement: 25% - No microfracture: 90% - Microfracture: 9% Median # of PT sessions attended (IQR): 4 (2.5 to 6)	**Inclusion**: Patients aged 18 to 60 years and referred to secondary or tertiary care with symptomatic FAI confirmed clinically and with imaging (radiography and magnetic resonance imaging). **Exclusion**: Patients that had completed a PT program targeting FAI within the preceding 12 months or received previous surgery to their symptomatic hip, patients presenting with OA (Kellgren-Lawrence grade ≥2) or hip dysplasia (centre-edge angle <20 degrees on anteroposterior pelvis radiograph).	**Cam:** 93% vs. 94% **Pincer:** 0.9% vs. 0% **Combined Cam and Pincer:** 6% vs. 5%	Arthroscopy vs. PT Mean (SD) age: 36.4 (9.6) vs. 36.0 (9.9) years % Male: 34% vs. 34% Hip laterality - Left: 40% vs. 46% - Right: 60% vs. 54% Kellgren-Lawrence grade - 0: 80% vs. 79% - 1: 14% vs. 16% - Unknown: 5% vs. 4% <u>Baseline Outcome</u>	**F/U:** 8 months post randomization (70.7%) or 6 months post intervention (29.3%)* **Loss to F/U, % (n/N)**: 15.3% (34/222) - Arthroscopy: 11% (12/112) - PT: 20% (22/110)	HOS-ADL subscore (0-100, higher scores=increased function, MCID 9 points) HOS-sport subscale (0-100, higher scores=increased function) iHOT-33 (0-100, higher scores=better QOL) Non-arthritic hip score (NAHS) Copenhagen hip and groin outcome score (HAGOS) Oxford hip score (OHS) EQ-5D-3L PainDETECT Hospital anxiety and depression score (HADS)	Funding: The study was funded by Arthritis Research UK and the National Institute for Health Research (NIHR) Oxford Biomedical Research Centre (previously the Biomedical Research Unit). The University of Oxford sponsored the study. The Nuffield Department of Orthopaedics, Rheumatology and Musculoskeletal Sciences coordinated the study via the Surgical Intervention Trials Unit from the

Study Design ROB Country	N	Interventions	Inclusion, Exclusion Criteria	Morphology Type	Demographics	F/U, %	Outcomes (scale)	Funding COI Notes
		Physical Therapy (n=110 ITT, 81 per-protocol): Maximum of 8 sessions over a 5 month period [Median # of sessions attended = 6 (IQR 4 to 8)]. PT individualized to patient needs and desired level of function, with an emphasis on muscle strengthening to improve core stability and movement control.			Scores; Mean (SD) Baseline HOS-ADL: 66.1 (18.5) vs. 65.7 (18.9)			Royal College of Surgeons (England) Surgical Trials Initiative. The study was supported by the Thames Valley Comprehensive Local Research Network, which operates as part of the National Institute for Health Research Comprehensive Clinical Research Network in England. COI: AJRP received funding from the Royal College of Surgeons of England and Dunhill Medical Trust. Unrelated to the submitted work, VK received support from Stryker and Smith and Nephew for

Study Design ROB Country	N	Interventions	Inclusion, Exclusion Criteria	Morphology Type	Demographics	F/U, %	Outcomes (scale)	Funding COI Notes
								educational consultancy, AA received support from Stryker, Smith and Nephew, and Zimmer Biomet for lectures, and SGJ received research grants and fees for lectures from Zimmer Biomet, Corin, and ConMed, and research grants from Neurotechnics, Johnson and Johnson, and Siemens.
Comparative Cohorts								
Kekatpure 2018 Retrospective Comparative Cohort *High* South Korea	87 hips	**Arthroscopic Surgery (n=44 hips):** Conservative management as listed below + arthroscopic surgery (performed after a mean of 10 months (range 3 to 29.5) failed conservative treatment) **Conservative Treatment (n=53 hips)**: activity	**Inclusion**: anterior or lateral hip pain; history of pain that worsened with activity, pivoting, hip flexion, or weight bearing; mechanical symptoms associated with pain (popping, clicking, or locking); pain at rest; positive	**Cam:** 39% vs. 59% **Pincer:** 18% vs. 11% **Combined Cam and Pincer:** 43% vs. 30%	Arthroscopy vs. Conservative care Mean (SD) age: 42 (12) vs. 48 (12) years, p=0.016 % Male: 64% vs. 60%	**Mean (range) F/U**: -After initial conservative treatment: 27.5 months (24 to 36) -Surgery group: 25.4 months (NR)	modified Harris Hip Score Nonarthritic hip score Western Ontario and McMaster Universities Arthritis Index	Funding: None COI: None

Study Design ROB Country	N	Interventions	Inclusion, Exclusion Criteria	Morphology Type	Demographics	F/U, %	Outcomes (scale)	Funding COI Notes
		modification and nonsteroidal anti-inflammatory drugs initially twice a day for 6 weeks and thereafter as required	physical examination findings of the impingement test, Patrick test, or log rolling test **Exclusion**: NR		Right hip: 55% vs. 60% <u>Baseline Outcome Scores; Mean (SD)</u> mHHS: 64.2 (NR) vs. 68.2 (NR) NAHS: 60.5 (NR) vs. 66.4 (NR) WOMAC: 52.1 (NR) vs. 53.5 (NR)	**Loss to F/U, % (n/N)**: 4.6% (4/87)		
Pennock 2018 Prospective Comparative Cohort *High* USA	76 patients (93 hips)	**Arthroscopic Surgery (n=17 hips)** (11 hips had a hip injection prior to surgery) **Steroid injection alone (n=11 hips)** **Modified activity – PT only (n=65 hips)**	**Inclusion**: all patients presenting to the clinic for evaluation of groin-based hip pain, radiographic evidence of FAI, and a positive anterior impingement test were offered participation **Exclusion**: History of hip surgery or radiographic abnormalities	Arthroscopy vs. injection vs. PT **Cam:** 35% vs. 55% vs. 32% **Pincer:** 12% vs. 9% vs. 42% **Combined:** 53% vs. 36% vs. 35%	Arthroscopy vs. Injection vs. PT Mean (SD) Age: 15.4 (0.9) vs. 16.6 (2.0) vs. 15.1 (2.0) years Open physis: 12% vs. 9% vs. 17%	**Mean (SD) F/U**: 26.8 (8.3) months **Loss to F/U, % (n/N)**: 19% of hip (22/115 hips)	modified Harris Hip Score Nonarthritic hip score	Funding: None related to this work COI: None related to this work

Study Design ROB Country	N	Interventions	Inclusion, Exclusion Criteria	Morphology Type	Demographics	F/U, %	Outcomes (scale)	Funding COI Notes
			consistent with non-FAI hip conditions, such as femoral neck stress fractures, slipped capital femoral epiphysis, tumor, or rheumatologic conditions		Labral tear: 76% vs. 100% vs. 70% <u>Baseline Outcome Scores; Mean (SD)</u> mHHS: 68.4 (9.4) vs. 68.3 (12.2) vs. 69.9 (13.9), p=0.888 NAHS: 72.8 (10.8) vs. 72.8 (13.7) vs. 74.4 (16.3), p=0.81			

COI=conflict of interest; CT=computed tomography; F/U=follow-up; FABER=Flexion Abduction External Rotation; FADIR=Flexion Adduction Internal Rotation; FAI=Femoroacetabular Impingement; FAIS=Femoroacetabular Impingement Syndrome; GROC=Global Rate of Change; HADS=Hospital anxiety and depression scale; HAGOS=Copenhagen hip and groin outcome score; HOS=Hip Outcome Score; HOS-ADL=Hip Outcome Score Activities of Daily Living; iHOT=international Hip Outcomes Tool; ITT=intention to treat; MCID=Minimally clinically important difference; MCS=mental component score; mHHS=modified Hip Harris Score; mm=millimeters; MRA=Magnetic Resonance Arthrogram; MRI=Magnetic Resonance Imaging; NAHS=Non-arthritic hip score; NPS=Numeric Pain Scale; NR=not reported; OA=osteoarthritis; PCS=physical component store; PT=physical therapy; QOL=quality of life; RCT=randomized controlled trial; ROB=risk of bias; SD=standard deviation; VAS=visual analogue scale

*Overall, 133 participants (47 arthroscopic surgery and 86 physiotherapy programme) commenced treatment within 12 weeks of randomisation and were assessed at eight months post-randomization. Intervention started 12 weeks or more after randomisation for 62 participants (52 arthroscopic surgery and 10 physiotherapy programme) and outcomes were measured eight months postrandomisation and six months post-intervention.

Appendix Table F2. Detailed Data Abstraction: Comparative studies of Arthroscopy vs. Non-operative Treatment

Study Intervention/ Comparator, Design, RoB, Country	Primary Outcomes	Secondary/ Intermediate outcomes	Harms
RCTs			
Griffin 2018 [UK FASHION trial] Arthroscopy (n=171) vs. Physical Therapy (n=177) RCT *Moderately Low* UK	*Arthroscopy vs. PT* [ITT Analysis] **Pain, Mean (SD)** 6 months EQ-5D VAS: 67.8 (19.3) vs. 70.3 (19.3), adj. MD -2.1 (95% CI -5.7 to 1.4), p=0.241 12 months EQ-5D VAS: 71.9 (20.7) vs. 69.2 (19.4), adj. MD 2.6 (-1.2 to 6.4), p=0.180	*Arthroscopy vs. PT* [ITT Analysis] **Quality of life, Mean (SD)** 6 months iHOT-33: 46.6 (25) vs. 45.6 (23), adj. MD -0.7 (95% CI -5.2 to 3.7), p=0.743 EQ-5D-5L (utility): 0.544 (0.26) vs. 0.573 (0.23), adj. MD –0.042 (95% CI –0.088 to 0.005), p=0.081 SF-12 PCS: 43.4 (7.0) vs. 44.2, adj. MD -0.7 (95% CI -2.1 to 0.7), p=0.304 SF-12 MCS: 42.1 (7.3) vs. 42.1 (7.2), adj. MD –0.1 (95% CI–1.5 to 1.3), p=0.929 12 months iHOT-33: 58.8 (27) vs. 49.7 (25), adj. MD 6.8 (95% CI 1.7 to 12.0), p=0.0093 Age <40 years: MD 5.0 (95% CI -1.2 to 11.3) >40 years: MD 10.9 (95% CI 1.7 to 20.1) Interaction p-value = 0.3023 Morphology Cam: MD 8.3 (95% CI 2.5 to 14.2) Mixed: MD 1.1 (95% CI -11.5 to 13.7) Pincer: MD 4.0 (95% CI -14.6% to 22.7%) Interaction p-value = 0.5672 EQ-5D-5L: 0.615 (0.25) vs. 0.578 (0.24), adj. MD 0.020 (95% CI-0.027 to 0.067), p=0.397	*Arthroscopy vs. PT* [Per-protocol analysis] **Non-serious Adverse Events, % (n/N)** 6 weeks All events: 73% (100/138) [147 events] vs. 60% (88/146) [102 events] Muscle soreness: 42% (58/138) vs. 47% (69/146) Hip pain or stiffness: 9% (13/138) vs. 6% (8/146) Numbness in groin, leg, or foot: 25% (35/138) vs. NA* Unscheduled hospital appointments: 9% (13/138) vs. 4% (6/146) Superficial wound problems: 7% (9/138) [4/9 required antibiotics] vs. NA* Hip joint infection: 1% (1/138) vs. NA* Fracture: 0% (0/138) vs. 0% (0/146) Deep-vein thrombosis: 0% (0/138) vs. 0% (0/146) Other AEs potentially related to intervention: 6% (8/138) vs. 1% (1/146)† Other AEs not related to intervention: 7% (10/138) vs. 13% (18/146)‡

Study Intervention/ Comparator, Design, RoB, Country	Primary Outcomes	Secondary/ Intermediate outcomes	Harms
		SF-12 PCS: 45.1 (6.3) vs. 44.2 (6.4), adj. MD 1.1 (95% CI -0.2 to 2.5), p=0.099 SF-12 MCS: 43.2 (7.1) vs. 42.6 (6.9), adj. MD 0.4 (95% CI –1.2 to 2.0), p=0.589	**Serious Adverse Events, % (n/N)** 12 months All events: 4% (6/138) vs. 1% (1/146) Overnight hospital admission: 1% (1/138) vs. 0% (0/146) Scrotal hematoma: 1% (1/138) vs. 0% (0/146) Superficial wound infection requiring antibiotics: 2% (2/138) vs. 0% (0/146) Hip joint infection requiring further surgery and THR: 1% (1/138) vs. 0% (0/146) Fall unrelated to treatment: 1% (1/138) vs. 0% (0/146) Biliary sepsis unrelated to treatment: 0% (0/138) vs. 1! (1/146)
Mansell 2018 Arthroscopy (n=40) vs. Physical Therapy (n=40) RCT *Moderately High* USA	*Arthroscopy vs. PT* **Function, Mean (95% CI)** [ITT Analysis] 6 months HOS-ADL: 68.5 (62.7 to 74.3) vs. 68.4 (62.8 to 74.0), MD 0.1 (–8.0 to 8.2) HOS-sport: 45.2 (36.4 to 54.0) vs. 53.1 (44.6 to 61.7), MD 7.9 (–4.3 to 20.2) 12 months HOS-ADL: 67.7 (61.5 to 73.8) vs. 72.5 (66.5 to 78.5), MD 4.9 (–3.7 to 13.4) HOS-sport: 51.8 (42.6 to 61.0) vs. 52.4 (43.7 to 61.0), MD 0.6 (–12.1 to 13.2) 24 months	*Arthroscopy vs. PT* **Return to work (n=72), % (n/N)** [According to randomization] 24 months 44.1% (15/34) vs. 63.2% (24/38) **Quality of life, Mean (95% CI)** [ITT Analysis] 6 months iHOT-33: 43.8 (35.3 to 52.2) vs. 37.5 (28.8 to 46.1), MD 6.3 (–5.7 to 18.4) 12 months iHOT-33: 48.9 (39.9 to 57.9) vs. 43.9 (38.8 to 53.0), MD 5.0 (–7.8 to 17.7) 24 months	*Arthroscopy vs. PT* **Adverse Events, % (n/N)** [ITT Analysis – excluding 1 deceased patient] 24 months Hip infection: 0% (0/39) vs. 0% (0/40) Hip fracture: 0% (0/39) vs. 2.5% (1/40) Avascular necrosis of hip: 0% (0/39) vs. 0% (0/40) Thrombosis of lower extremity: 0% (0/39) vs. 0% (0/40) Heterotopic ossification: 2.6% (0/39) vs. 0% (0/40) **Revision Surgery, % (n/N)** [ITT Analysis – excluding 1 deceased patient] 24 months Revision surgery: 0% (0/39) vs. 12.5% (5/40)

Study Intervention/ Comparator, Design, RoB, Country	Primary Outcomes	Secondary/ Intermediate outcomes	Harms
	HOS-ADL: 69.3 (62.5 to 76.2) vs. 73.1 (66.1 to 80.3), MD 3.8 (–6.0 to 13.6) HOS-sport: 55.3 (46.2 to 64.4) vs. 57.1 (47.8 to 66.3), MD 1.8 (–11.2 to 14.7) **Conversion to THA, % (n/N)** [ITT Analysis – excluding 1 deceased patient] 24 months 2.6% (1/39) vs. 0% (0/40)	iHOT-33: 51.2 (42.5 to 59.9) vs. 44.9 (35.9 to 53.9), MD 6.3 (–6.1 to 18.7) **Progression to OA. % (n/N)** [ITT Analysis – excluding 1 deceased patient] 24 months 12.8% (5/39) vs. 7.5% (3/40)	Contralateral hip surgery: 0% (0/39) vs. 15% (6/40)
Palmer 2019 [FAIT trial] Arthroscopy (n=112) vs. Physical Therapy (n=110) RCT *Moderately Low* USA	*Arthroscopy vs. PT* **Function, Mean (SD)** [Modified ITT analysis, unless otherwise noted] 8 months HOS-ADL [ITT Analysis using multiple imputation]: 78.2 (20.6) vs. 68.0 (20.4), adj. effect 10.0 (95% CI 5.3 to 14.7), p=0.004 HOS-ADL: 78.4 (19.9) vs. 69.2 (19.1), adj. effect 10.0 (95% CI 6.4 to 13.6), p<0.001 Sex Female: effect size 9.74 (95% CI 2.99 to 16.48) Male: effect size 8.41 (95% CI -1.18 to 18) Morphology Cam: effect size: 10.11 (95% CI 4.3 to 15.92) Mixed: -5.66 (95% CI -28.14 to 16.82) HOS-sport: adj. effect 11.7 (5.8 to 17.6), p<0.001	*Arthroscopy vs. PT* **Range of Motion, Mean (SD)** 8 months Flexion: 105.8 (16.3) vs. 99.7 (17.5), adj. MD 4.8 (0.5 to 9.1), p=0.03 Extension: 16.8 (7.4) vs. 15.7 (8.0) , adj. MD 1.6 (−0.6 to 3.8) , p=0.16 Abduction: 30.3 (10.6) vs. 29.6 (11.7) , adj. MD 1.0 (−2.1 to 4.1) , p=0.53 Adduction: 23.9 (8.2) vs. 23.2 (8.9) , adj. MD 1.1 (−1.2 to 3.5) , p=0.35 Internal Rotation: 30.8 (10.6) vs. 28.9 (11.2), adj. MD 1.4 (−1.6 to 4.4), p=0.37 External Rotation: 27.0 (8.9) vs. 27.4 (9.7), adj. MD −1.1 (−3.6 to 1.4) , p=0.38 **Quality of Life** 8 months iHOT-33: adj. effect 2.0 (95% CI 1.3 to 2.8) <0.001	*Arthroscopy vs. PT* **Complications, % (n/N)** 8 months Any complication: 3% (3/112) vs. 0% (0/110) Wound infection: 1% (1/112) vs. 0% (0/110) Injury to lateral cutaneous nerve of the thigh: 1.8% (2/112) vs. 0% (0/110) **Revision Surgery** 6 patients in the PT group crossed over to receive arthroscopic hip surgery (4 prior to completing the PT program and 2 after the 8 month follow-up mark).

Study Intervention/ Comparator, Design, RoB, Country	Primary Outcomes	Secondary/ Intermediate outcomes	Harms
	HAGOS-symptoms: adj. effect 13.3 (8.1 to 18.6), p<0.001 HAGOS-ADL: adj. effect 11.6 (6.7 to 16.6), p<0.001 HAGOS-sport: adj. effect 13.1 (7.0 to 19.1), p<0.001 HAGOS-physical activity: adj. effect 14.6 (7.2 to 22.0), p<0.001 NAHS: adj. effect 11.2 (95% CI 6.8 to 15.7), p<0.001 OHS: adj. effect 5.3 (95% CI 3.2 to 7.5), p<0.001 Proportion of patients achieving an MCID of 9 points in the HOS-ADL score: 51% (95% CI 41% to 61%) vs. 32% (95% CI 22% to 42%) Proportion of patients achieving a patient acceptable symptomatic state, defined as HOS-ADL >87 points: 48% (95% CI 98% to 58%) vs. 19% (95% CI 11% to 28%) **Pain** <u>8 months</u> EQ-5D-3L VAS: adj. effect 0.7 (0.3 to 1.2), p=0.002 HAGOS-pain: 12.7 (95% CI 8.1 to 17.2), p<0.001 PainDETECT: −2.1 (95% CI −4 to −0.2), p=0.03	HAGOS-QOL: adj. effect 13.2 (95% CI 7.5 to 19.0), p<0.001 EQ-5D-3L Index: adj. effect 0.1 (95% CI 0.0 to 0.1), p=0.003 HADS anxiety: adj. effect −0.6 (−1.4 to 0.3), p=0.18 HADS depression: adj. effect −1.3 (95% CI −2.2 to −0.4), p=0.004	
Comparative Cohorts			
Kekatpure 2018	*Arthroscopy vs. Conservative Management* **Function, Mean (SD)** mHHS: 95.7 vs. 95.8, p=0.919	NR	NR

Study Intervention/ Comparator, Design, RoB, Country	Primary Outcomes	Secondary/ Intermediate outcomes	Harms
Retrospective Comparative Cohort Arthroscopy vs. Conservative therapy (activity modification + NSAIDs) only *High* South Korea	% reporting good or excellent result: 100% (44/44) vs. 98.1% (52/53) NAHS: 93.7 vs. 95.7, p=0.087 % reporting good or excellent result: 91% (40/44) vs. 98.1% (52/53) WOMAC: 91.8 vs. 90.1, p=0.164 % reporting good or excellent result: 100% (44/44) vs. 90.6% (48/53)		
Pennock 2018 Arthroscopic surgery vs. steroid injection vs. PT and activity modification Prospective Comparative Cohort *High* USA	*Arthroscopic surgery vs. steroid injection vs. PT and activity modification* **Function, Mean (SD)** <u>Final Follow-up</u> mHHS: 89.0 (9.9) vs. 90.0 (10.2) vs. 90.0 (11.8), p=0.582 Proportion of hips meeting MCID for mHHS: 85% vs. 80% vs. 67%, p=0.364 NAHS: 86.7 (13.1) vs. 86.3 (10.4) vs. 87.1 (14.3), p=0.463	*Arthroscopic surgery vs. steroid injection vs. PT and activity modification* **Return to sport (n=71§)**: 47% (7/15) vs. 50% (5/10) vs. 57% (26/46), p=0.459	NR

adj.=adjusted; AE=adverse events; COI=conflict of interest; F/U=follow-up; FAI=Femoroacetabular Impingement; FAIS=Femoroacetabular Impingement Syndrome; GROC=Global Rate of Change; HADS=Hospital anxiety and depression scale; HAGOS=Copenhagen hip and groin outcome score; HOS=Hip Outcome Score; HOS-ADL=Hip Outcome Score Activities of Daily Living; iHOT=international Hip Outcomes Tool; MCS=mental component score; MD=mean difference; mHHS=modified Hip Harris Score; NAHS=Non-arthritic hip score; NPS=Numeric Pain Scale; NR=not reported; OA=osteoarthritis; OHS=oxford hip score; PCS=physical component store; PT=physical therapy; QOL=quality of life; RCT=randomized controlled trial; ROB=risk of bias; SD=standard deviation; VAS=visual analogue scale

*Authors report NA for patients in the PT group for some outcomes that would not be applicable to that population (i.e. only AEs that would result from surgery like wound problems).

†To include for arthroscopy: 2 numbness proximal thigh, 1 scrotal infection, 1 scrotal bruising, 1 labial swelling, 1 ankle pain, 1 erratic International Normalised Ratio, 1 nausea secondary to analgesia, 1 numbness to tip of tongue for 2 weeks after operation). To include for PT: 1 muscle spasms.

‡To include for arthroscopy: 3 knee pain, 2 lower back pain, 1 shingles, 1 urinary tract infection, 1 essential thrombocythaemia, 1 hernia surgery, 1 contralateral foot pain. To include for PT: lower back pain, 2 knee pain, 2 road traffic collisions, 2 abdominal pain under investigation, 1 viral illness, 1 endometriosis, 1 chronic pain referred to rheumatologist, 1 skin discoloration, 1 multiple sclerosis.

§Five patients were not involved in sports at their initial visits and were excluded from return to sport analysis.

Appendix Table F3. Study characteristics and patient demographics: Comparative studies of Arthroscopy with Labral Repair vs. with Labral Debridement

Study Design ROB Country	N	Interventions	Inclusion, Exclusion Criteria	Morphology Type	Demographics	F/U, %	Outcomes (scale)	Funding COI Notes
Krych 2013 RCT *Moderately High* USA	36	**Arthroscopy + labral repair (n=18)** **Arthroscopy + labral debridement (n=18)**	**Inclusion:** female, greater than 17 years of age, diagnosed with either pincer-type or combined-type, and presence of labral tear/pathology on magnetic resonance imaging **Exclusion**: male, cam-type FAI, previous hip surgery, Tonnis grade ≥2 osteoarthritis, hip dysplasia based on radiographic evidence of a Wiberg lateral center edge angle less than 25 degrees, and patient age less than 18	Labral repair vs. Labral debridement **Pincer**: 16.7% vs. 16.7% **Combined Cam and Pincer**: 8.3% vs. 8.3%	Labral repair vs. Labral debridement Mean (range) Age: 38 (20 to 59) vs. 39 (19 to 55) % Male: 0% vs. 0% <u>Baseline Outcome Scores; Mean (range)</u> HOS-ADL: 68.2 (26.6 to 92.6) vs. 60.2 (23.5 to 91.2)	**F/U**: 12 months **Loss to F/U, % (n/N)**: 0% (0/36)	HOS-ADL HOS-sport Patient subjective outcome of function	Funding: NR COI: None

Study Design ROB Country	N	Interventions	Inclusion, Exclusion Criteria	Morphology Type	Demographics	F/U, %	Outcomes (scale)	Funding COI Notes
					HOS-sport: 47.5 (0 to 80.6) vs. 40.6 (28.6 to 100)			

Appendix Table F4. Detailed Data Abstraction: RCTs of Arthroscopy with Labral Repair vs. with Labral Debridement

Study Intervention/ Comparator, Design, RoB, Country	Primary Outcomes	Secondary/Intermediate outcomes	Harms
Krych 2013 Arthroscopic labral repair (n=18) vs. Arthroscopic labral debridement (n=18) RCT *Moderately High* USA	Labral repair vs. Labral debridement **Function, Mean (range)** <u>12 months</u> HOS-ADL: 91.2 (73.3 to 100) vs. 80.9 (42.6 to 100), p<0.05 HOS-sport: 88.7 (28.6 to 100) vs. 76.3 (28.6 to 100), p<0.05 Proportion of patients reporting their hip condition as severely abnormal or abnormal: - Before surgery: 76% (13/18) vs. 76% (13/18) -After surgery: 6% (1/18) vs. 22% (4/18)	NR	NR

COI=conflict of interest; F/U=follow-up; FAI=Femoroacetabular Impingement; FAIS=Femoroacetabular Impingement Syndrome; HOS=Hip Outcome Score; HOS-ADL=Hip Outcome Score Activities of Daily Living; NR=not reported; PT=physical therapy; RCT=randomized controlled trial; ROB=risk of bias; SD=standard deviation

Appendix Table F5. Study characteristics, patient demographics and detailed data abstraction: Comparative Cohorts of various Surgical Techniques

Author, year Study Design N ROB	Interventions	Demographics	F/U, %	Outcomes	Harms
Surgery with Labral Repair/Reattachment vs. Labral Debridement/Resection					
Anwander 2017 Retrospective Comparative Cohort N=52 patients (60 hips) *High*	**A. Open surgical dislocation + labral reattachment (n=32 patients, 35 hips)** - Patients were treated between July 2001 and July 2002 **B. Open surgical dislocation + labral resection (n=20 patients, 25 hips)**: - Patients were treated between June 1999 and June 2001 **A vs. B** **<u>Surgical Components</u>** All patients underwent femoral neck osteoplasty and acetabular rim trimming. No other surgical details were provided.	**A vs. B** **Mean age (years)**: 29 vs. 29 **% Female**: 37% vs. 24% of hips **Mean preoperative alpha angle**: 70° vs. 67° **Tönnis Grade** -0: 51% vs. 40% -1: 46% vs. 60% -2: 3% vs. 0% **Positive anterior impingement test**: 86% vs. 88% **Morphology** - Combined: 100% vs. 100% **<u>Baseline Outcome Scores, Mean (SD)</u>** MAP-overall: 12.6 (1.8) vs. 12.4 (1.9) MAP-pain (0-6): 1.5 (0.9) vs. 1.4 (0.8) MAP-mobility (0-6): 5.6 (0.6) vs. 5.4 (0.8)	**A vs. B** **Mean F/U (range)**: 12 (10 to 13) years vs. 13 (12 to 14) years **Loss to F/U, % (n/N)**: 12.5% (4/32) vs. 15% (3/20) [All patients, % followed: 86.5% (45/52)]	**A vs. B*** **<u>Primary Outcomes</u>** **Functional outcomes, Mean (SD)** MAP-overall: 16.7 (1.5) vs. 15.3 (2.4), p=0.028 MAP-pain: 5.0 (1.0) vs. 3.9 (1.7), p=0.014 MAP-mobility: 5.8 (0.4) vs. 5.7 (0.7), p=0.473 MAP-walking ability: 5.9 (0.3) vs. 5.8 (0.4), p=0.228 **10-year Probability of "Hip Survival", % (95% CI)†** 78% (64% to 92%) vs. 46% (26% to 66%), p=0.009 **10-year probability of achieving MAP score of >15, % (95% CI)** 83% (70% to 97%) vs. 48% (28% to 69%), p=0.009	NR

Author, year Study Design N ROB	Interventions	Demographics	F/U, %	Outcomes	Harms
		MAP-walking ability (0-6): 5.5 (1.1) vs. 5.6 (0.7) ROM-flexion: 106° (12°) vs. 96° (12°), p<0.001 ROM-internal rotation: 15° (11°) vs. 8° (18°)		**Conversion to THA, % (n/N)** 6% (2/35) vs. 12% (3/25) **10-year probability of not converting to THA, % (95% CI)** 94% (86% to 100%) vs. 87% (74% to 100%), p=0.366 **<u>Secondary Outcomes</u>** **Range of Motion, % (n/N)** ROM-flexion: 102 (11) vs. 99 (14), p=0.388 ROM-extension: 5 (3) vs. 5 (3), p=1.00 ROM-external rotation: 36 (15) vs. 39 (26), p=0.542 ROM-internal rotation: 20 (13) vs. 21 (13), p=0.640 ROM-abduction: 45 (13) vs. 38 (8), p=0.048 ROM-adduction: 22 (6) vs. 20 (8), p=0.082 **Progression to OA, % (n/N)**	

Author, year Study Design N ROB	Interventions	Demographics	F/U, %	Outcomes	Harms
				14% (5/35) vs. 16% (4/25) **10-year probability of not progressing to OA**: 83% (68% to 97%) vs. 81% (63% to 98%), p=0.957	
Larson 2012 Retrospective Comparative Cohort N= 96 patients (100 hips) *Moderately high*	**A. Arthroscopic Labral Refixation/Repair** (n=52 patients, 54 hips) - Patients were treated between June 2006 to September 2007 - Labral repair required that there be a labral injury with an adequate amount of healthy labral tissue available for labral refixation **B. Arthroscopic Labral Debridement** (n=44 patients, 46 hips) - Patients were treated between November 2004 to June 2006 - Complex degenerative tears, labral ossifications and calcifications with intrasubtance degeneration were debrided. **A vs. B** **Surgical Components** There were no statistically significant differences for additional surgical procedures performed at the time of arthroscopy between groups (including microfracture, psoas release, Ligamentum Teres Debridement, loose body removal, Os excision, capsular pilication, sports hernia repair)	**A vs. B** **Mean age (years)**: 28 vs. 32 **% Female**: 44% vs. 39% **Mean preoperative alpha angle**: NR **Tönnis Grade** -0/1: 96% vs. 95% -2: 4% vs. 5% **Morphology** - Combined: 84% vs. 77% - Pincer: 16% vs. 23% **Baseline Outcome Scores, Mean (SD)** mHHS: 64.5 (NR) vs. 64.7 (NR) VAS: 5.7 (NR) vs. 6.5 (NR) SF-12: 58.7 (NR) vs. 63.8 (NR)	**A vs. B** **Mean F/U (range)**: 41 (24 to 56) vs. 44 (24 to 72) months **Loss to F/U, % (n/N)**: 7.6% (4/52 patients) vs. 4.5% (2/44 patients)	**A vs. B** **Primary Outcomes** **Functional outcome, Mean (SD)** Baseline to longest follow-up (mean 3.5 years) change score mHHS: 29.8 (NR) vs. 20.2 (NR), p<0.001 Longest follow-up (mean 3.5 years) mHHS: 94.3 (NR) vs. 84.9 (NR), p=NR **Conversion to THA, % (n/N)** 1.9% (1/52 patients) vs. 0% (0/44 patients) **Pain, Mean (SD)** Baseline to longest follow-up (mean 3.5 years) change score	A vs. B **Complications, % (n/N)** No patients sustained femoral neck stress fractures and iatrogenic hip instability or developed avascular necrosis postoperatively. Heterotopic Ossification: 0% (0/52 patients) vs. 6.8% (3/44 patients) **Revision Surgery. % (n/N)** 2% (1/52 patients) vs. 2% (1/44 patients) **Additional Surgery, % (n/N)**

Author, year Study Design N ROB	Interventions	Demographics	F/U, %	Outcomes	Harms
				VAS: 5.0 (NR) vs. 4.8 (NR), p=0.492 Longest follow-up (mean 3.5 years) VAS: 0.7 (NR) vs. 1.7 (NR), p=NR **Secondary Outcomes** **QOL outcomes, Mean (SD)** Baseline to longest follow-up (mean 3.5 years) change score SF-12: 31.1 (NR) vs. 18.4 (NR), p<0.001 Longest follow-up (mean 3.5 years) SF-12: 89.8 (NR) vs. 82.2 (NR), p=NR	0% (0/52) vs. 7% (3/44)
Cetinkaya 2016 Retrospective Comparative Cohort N=67 patients, 73 hips *Moderately high*	**A. Arthroscopic Labral Refixation/Repair** (n=33 patients, 34 hips) **B. Arthroscopic Labral Debridement** (n=34 patients, 39 hips) **A vs. B** **Surgical Components** All patients had acetabuloplasty. No other surgical details are provided	**A vs. B** **Mean age (years)**: 33.5 vs. 39.5 **% Female**: 45% vs. 32% **Mean preoperative alpha angle**: 61.8° vs. 58.9° **Tönnis Grade** -0: 44% vs. 62% -1: 53% vs. vs. 15% -2: 3% vs. 13%	**A vs. B** **Mean F/U**: 45.2 vs. 47.2 months **Loss to F/U, % (n/N)**: NR	**A vs. B** **Primary Outcomes** **Functional outcomes, Mean (SD)** Final follow-up HOS: 87.18 (11.3) vs. 84.24 (11.3), p>0.05 **Pain outcomes, Mean (SD)** Final follow-up VAS: 2.3 (NR) vs. 2.1 (NR), p>0.05	A vs. B **Complications, % (n/N)** Transient nerve palsy: 9% (6/67) of all patients - Femoral nerve palsy: n=2 (1 required surgical release) - Pudendal nerve: n=2 - Obturator nerve palsy: n=2

Author, year Study Design N ROB	Interventions	Demographics	F/U, %	Outcomes	Harms
		Morphology - Combined: 44% vs. 72% - Pincer: 53% vs. 15% - Cam: 3% vs. 13% **<u>Baseline Outcome Scores, Mean (SD)</u>** HOS: 55.12 (5.98) vs. 52.5 (7.11) VAS: 8 (NR) vs. 8.2 (NR)		**Conversion to THA, % (n/N)** 6% (2/33) vs. 3% (1/34)‡	**Revision Surgery, % (n/N)** 3% (1/33) vs. 3% (1/34)
Menge 2017 Retrospective Comparative Cohort N=154 *Moderately high*	**A. Arthroscopic Labral Repair** (n=79) Tears that involved the base of the labrum with separation at the chondrolabral junction were repaired. **B. Arthroscopic Labral Debridement** (n=75) Degenerative labral tears, small tears involving ≥1 cleavage plane through the outer (lateral) 50% of the labrum, and tears with multiple cleavage planes that had propagated through the substance of the labral body with insufficient remaining healthy tissue to hold sutures were debrided. **A vs. B** **<u>Surgical Components, %</u>** - Acetabular microfracture: 54% vs. 23%, p<0.001 - Femoral microfracture: 25% vs. 20%, p=0.442	**A vs. B** **Mean age (years)**: 41 vs. 41 **% Female**: 38% vs. 59%, p=0.010 **Mean preoperative alpha angle**: 71° vs. 70° **Joint space ≤2 mm:** 30% vs. 19% **Morphology**: Combined: 95% vs. 69% Cam: 4% vs. 27% Pincer: 1% vs. 4% p=0.001 **<u>Baseline Outcome Scores, Median (IQR)</u>**	**A vs. B** **F/U**: 10 years **Loss to F/U, % (n/N)**: 6% (9/154); 3% (5/154) vs. 3% (4/154)	**A vs. B** **<u>Primary Outcomes</u>** **Functional outcomes, <u>Median (IQR)</u>** <u>10-years</u> HOS-ADL: 96 (88 to 100) vs. 96 (89 to 100). p=0.858 HOS-sport**:** 87 (75 to 100) vs. 89 (67 to 100), p=0.969 mHHS**:** 85 (63 to 99) vs. 90 (85 to 100), p=0.173 **10-year Kaplan-Meier probability of converting to THA, % (n/N)**	**A vs. B** **Arthroscopic Revision Surgery, % (n/N)** 6.3% (5/79) vs. 2.7% (2/75) [None of these 7 patients went on to have a THA]

Author, year Study Design N ROB	Interventions	Demographics	F/U, %	Outcomes	Harms
		HOS-ADL: 71 (63 to 83) vs. 71 (57 to 81) HOS-sport: 47 (33 to 61) vs. 42 (25 to 58) mHHS: 65 (55 to 70) vs. 62 (50 to 71) SF-12 PCS: 41 (37 to 49) vs. 43 (36 to 50)		59% vs. 70%, adj. HR 1.10 (95% CI 0.59 to 2.05), p=0.762 **<u>Secondary Outcomes</u>** **QOL outcomes, Median (IQR)** <u>10-years</u> SF-12 PCS: 56 (47 to 58) vs. 56 (51 to 58), p=0.864	
Schilders 2011 Retrospective Comparative Cohort N=101 hips *Moderately high*	**A. Arthroscopic Labral Repair** (n=69 hips) - On average, two bio-absorbable suture anchors were used for a labral repair. - The tear was often extended and the labrum further detached to expose the acetabular rim for rim recession **B. Arthroscopic Labral Resection** (n=32 hips) - When the labrum was not suitable for repair, it was trimmed to a stable remnant with the shaver and a radiofrequency probe. [The decision to repair or resect the labrum was based on the type and morphology of the tear and the status and size of the labrum] **A vs. B** **<u>Surgical Components, %</u>** Trimming of the acetabular rim: 99% vs. 61% Femoral osteoplasty: 70% vs. 79% Microfracture: 7% vs. 19%	**A vs. B** **Mean age (years)**: 37 (range 15 to 71) years, all patients **% Female**: 25%, all patients **Labral tear**: 100% vs. 100% Labral detachment tear: 75% vs. 9% Flap tear: 3% vs. 69% Full thickness tear: 20% vs. 13% Midsubstance tear: 1% vs.6% Complex tear: 0% vs. 3% **Morphology**: Cam: 47.8% vs. 71.9%	**A vs. B** **Mean F/U**: 29.28 (range, 12 to 24) months **Loss to F/U:** NR	**A vs. B** **<u>Primary Outcomes</u>** **Functional outcomes, Mean (range)** <u>Post-operative</u> mHHS: 93.59 (55 to 100) vs. 88.84 (35 to 100), adj. MD 6.99 (95% CI 0.27 to 13.73), p=0.042 Unadjusted MD is 7.3 (95% CI 0.84 to 13.8) <u>Pre-post change score</u> mHHS: 33.36 (0 to 76) vs. 26.06 (0 to 61) **Conversion to THA, % (n/N)** 0% (0/69 hips) vs. 0% (0/32 hips)	NR

Author, year Study Design N ROB	Interventions	Demographics	F/U, %	Outcomes	Harms
		Retroverted acetabulum: 65% vs. 40% Coxa profunda: 20.3% vs. 15.6% [Unclear, but it appears that most patients had combination FAI] **Tönnis Grade** -0: 23% vs. 13% -1: 74% vs. 75% -2: 3% vs. 13% **<u>Baseline Outcome Scores, Mean (range)</u>** mHHS: 60.23 (24 to 85) vs. 62.78 (29 to 96)			
Arthroscopic Surgery with Labral Detachment vs. without Labral Detachment					
Redmond 2015 Retrospective Comparative Cohort N=190 hips in 174 patients *High*	**A. Acetabuloplasty + labral refixation (no labral detachment)** (n=85 hips) - If the chondrolabral junction was in satisfactory condition, and the acetabular rim resection could be performed without labral detachment, the labrum was left attached. - For this group, refixation simply means to refix the already damaged labrum. **B. Acetabuloplasty + labral detachment + labral refixation** (n=105 hips) - If the acetabular rim resection required disruption of the chondrolabral junction, the labrum was detached.	**A vs. B** **Mean age (years)**: 32.7 vs. 33 **% Female**: 71% vs. 43% **Labral tear**: 100% vs. 100% **Morphology**: All patients had pincer or combined type	**A vs. B** **Mean F/U:** NR **Loss to F/U:** NR	**A vs. B** **<u>Primary Outcomes</u>** **Functional outcomes, Mean (SD)** <u>2-years</u> mHHS: 86.6 (5.4) vs. 84.4 (15.9), p=0.45 NAHS: 83.8 (17.7) vs. 84 (14.7), p=0.91 HOS-ADL: 87.3 (17.2) vs. 86.2 (16.1), p=0.65	**A vs. B** **Arthroscopic Revision Surgery, % (n/N)** 8.2% (7/85 hips) vs. 7.6% (8/105 hips), p=0.83 [Indications for revision surgery included labral re-injury, heterotopic ossification, adhesive

Author, year Study Design N ROB	Interventions	Demographics	F/U, %	Outcomes	Harms
	[All patients did not respond to greater than 3 months of nonoperative treatment, including at least 6 weeks of physical therapy.] **A vs. B** **Surgical Components, %** Acetabuloplasty: 100% vs. 100% Labral refixation: 100% vs. 100% Labral debridement: 0% vs. 0% Femoral osteoplasty: 49% vs. 70% Microfracture: 5% vs. 10% Capsular release: 46% vs. 55% Capsular repair: 51% vs. 41% Capsular plication: 5% vs. 4%	**Mean preoperative alpha angle**: 53.5° vs. 60.5°, p<0.01 **Baseline Outcome Scores, Mean** mHHS: 64.2 vs. 61.2 NAHS: 60.6 vs. 59.1 HOS-ADL: 65.3 vs. 62.7 HOS-sport: 45.0 vs. 40.1 VAS: 5.7 vs. 6.3, p=0.04		HOS-sport: 75.1 (28) vs. 74.1 (25.4), p=0.78 Change scores (2-years – pre) mHHS: 22.4 (NR) vs. 23.2 (NR), p=0.76 NAHS: 23.3 (NR) vs. 25.0 (NR), p=0.54 HOS-ADL: 22 (NR) vs. 23.5 (NR), p=0.62 HOS-sport: 30.1 (NR) vs. 33.9 (NR), p=0.37 **Pain outcomes, Mean (SD)** Post-operative score VAS: 2.6 (2.5) vs. 2.8 (2.3), p=0.43 Pre-post change score VAS: 3.1 (NR) vs. 3.5 (NR), p=0.38 **Conversion to THA, % (n/N)** 1.2% (1/85 hips) vs. 0% (0/105 hips)	capsulitis, and chondral injury].
Webb 2019 Retrospective Comparative Cohort N=1010 hips in 950 patients	**A. Acetabuloplasty (no labral detachment)** (n=464 hips in 431 patients) - These patients did not have labral tears - Rim of the acetabulum is approached from the paralabral recess superiorly by partially releasing some of the superior capsule to gain adequate exposure to the rim. These patients had an intact labrum (i.e. no labral tear) and this approach is designed to avoid damage to the intact chondral labral	**A vs. B** **Mean age (years)**: 39 vs. 33, p=0.001 **% Female**: 54% vs. 54%	**A vs. B** **Mean F/U:** NR **Loss to F/U:** 1% (9/950)	**A vs. B** **Proportion of patients progressing to Osteoarthritis**, %: 9% vs. 0%, p=NR	**A vs. B** **Arthroscopic Revision Surgery, % (n/N)** 7.8% (36/431 patients) vs. 9.9%% (54/519 patients)

Author, year Study Design N ROB	Interventions	Demographics	F/U, %	Outcomes	Harms
High	junction. In the instance when the chondral labral junction occurred, then a repair was made. **B. Acetabuloplasty + labral detachment + labral refixation** (n=546 hips in 519 patients) - In the presence of a labral tear (73%) the tear was debrided. The labrum was then detached and the pre-existing tear was used to access the acetabular rim. The labrum was then subsequently repaired. - In the case that there was no labral tear present (27%), the labrum was incised and detached to perform the acetabuloplasty. The labrum was then subsequently repaired. **A vs. B** **Surgical Components, %** NR	**Labral tear**: 0% vs. 73% **Morphology**: All patients had pincer type FAIS			Reason for revision surgery, % of revisions: Adhesions: 17% vs. 46%, p=0.002 Non-specific synovitis: 58% vs. 35%, p=0.048 Partial ligamentum teres tear: 30% vs. 25%, p=0.598 Cam lesions: 33% vs. 4%, p=0.002 Synovitis: 0% vs. 2%, p=NR Chondral calcification: 2% vs. 0%, p=NR Labral tear: 0% vs. 2%, p=NR Chondral flap0% vs. 2%, p=NR Adductor tendon release: 0% vs. 2%, p=NR Trochanteric bursectomy: 3% vs. 2%, p=NR No abnormality detected: 6% vs. 0%, p=NR Mean time to revision: 20 months vs. 16 months, p=0.026

Author, year Study Design N ROB	Interventions	Demographics	F/U, %	Outcomes	Harms
Open Femoral Osteochondroplasty with Rim Trim vs. without Rim Trim					
Hingshammer 2015 Retrospective Comparative Cohort N=30 hips in 23 patients *High*	**A. Open Femoral osteochondroplasty + acetabular osteoplasty ("rim trim")** (n=21 hips in 14 patients) **B. Open Femoral osteochondroplasty alone** (n=9 hips in 9 patients) **Surgical Components, % (n/N)** Labral detachment then refixation: 38% (8/21 hips) vs. 0% (0/9 hips) Partial labral excision and debridement: 62% (13/21 hips) vs. 22% (2/9 hips)**	**A vs. B** **Mean age (years)**: 24.3 vs. 24.3 **% Female**: 24% vs. 22% **Labral tear**: 62% vs. 22% - Delamination depth: 2.5 mm vs. 0.2 mm, p<0.001 - Delamination length: 13.3 mm vs. 1.1 mm, p<0.001 **Morphology**: All patients had mixed type FAIS **Mean preoperative alpha angle**: 70.3° vs. 72.6° **Baseline Outcome Scores, Mean** WOMAC pain (0-20): 6.86 (4.15) vs. 6.56 (2.96), p=0.85 WOMAC stiffness (0-8): 2.43 (1.99) vs. 1.78 (1.86), p=0.41	**A vs. B** **Mean F/U:** 19.2 (7.2) vs. 20.4 (10.8) **Loss to F/U:** 0% (0/23)	**A vs. B** **Primary Outcomes** **Functional outcomes** **Final follow-up, Mean (SD)** WOMAC function: 11.0 (10.8) vs. 7.3 (12.2), p=NR WOMAC stiffness: 2.48 (1.57) vs. 0.78 (1.39), p=NR **Change scores (follow-up – pre), Mean (SD) (95% CI)** WOMAC function: -4.4 (18.4) (95% CI -12.7 to 4.0) vs. -5.6 (2.8) (95% CI -7.7 to -3.4), p=NR WOMAC stiffness: 0.5 (1.91) (95% CI -0.82 to 0.92) vs. -1.00 (95% CI -2.39 to 0.39 to 0.92), p=NR **Pain outcomes** **Final follow-up, Mean (SD)** WOMAC pain: 3.86 (3.95) vs. 2.33 (3.64), p=NR	No cases of postoperative femoral neck fracture or osteonecrosis; no other complications were reported

Author, year Study Design N ROB	Interventions	Demographics	F/U, %	Outcomes	Harms
		WOMAC function (0-68): 15.4 (20.1) vs. 12.9 (12.2), p=0.73		**Change scores (follow-up – pre), Mean (95% CI)** WOMAC pain: -3.00 (5.10) (95% CI -5.32 to -0.68) vs. -4.22 (2.82) (95% CI -6.39 to -2.06), p=NR	

*All outcomes data are for those **hips** with a minimum 10-year follow-up (n=28 vs. 17), except conversion to THA and progression to OA

†Endpoints (i.e. hip failure) defined as conversion to THA, radiographic progression of osteoarthritis, or a Merle d'Aubgine´ score of <15

‡All of these patients' preoperative Tönnis scores were Tönnis 1-2.

§Estimated from graph

**In these 2 patients, slight labral degeneration was seen and treated with labral debridement only. The extent of labral debridement was lesser than that of the debridement taking place in the "rim trim" group.

Appendix Table F6. Study characteristics, patient demographics and detailed data abstraction: Arthroscopic Surgery vs. Open Surgical Dislocation

Author, year Study Design N ROB	Interventions	Demographics	F/U, %	Outcomes	Harms
Botser 2014 Retrospective Cohort N=23 *High*	**A. Arthroscopy (n=18)** - Labral refixation/repair: 83% - Labral debridement: 17% - Femoral neck osteoplasty: 100% **B. Open dislocation (n=5)** - Labral refixation/repair: 100% - Labral debridement: 0% - Femoral neck osteoplasty: 44% [Physical therapy began for both groups on postoperative day 1, with a stationary bike for 2 hours per day or a continuous passive motion machine for 4 hours per day.]	**A vs. B** **Mean age (years)**: 20.1 vs. 18.1, p=0.001 **% Female**: 100% vs. 100% **Labral tear (yes):** 100% vs. 100% **Tönnis 0:** 100% vs. 100% **Mean preoperative alpha angle**: 62° vs. 61° **Morphology**: NR **<u>Baseline Outcome Scores, Mean (SD)</u>** mHHS: 67.8 (NR) vs. 66.2 (NR) NAHS: 66.5 (NR) vs. 66.9 (NR) HOS-ADL: 72.6 (NR) vs. 66.4 (NR) HOS-sport: 45.7 (NR) vs. 52.3 (NR)	**A vs. B** **Mean F/U:** 14.3 (12 to 24) vs. 16.2 (12 to 25) months [All patients: 14.7 (range, 12 to 25) months] **Loss to F/U:** 0% (0/23)	**A vs. B** **<u>Primary Outcomes</u>** **Functional outcomes** <u>Baseline to 3 months change score, Mean (SD)</u> mHHS: 21 vs. 11, p>0.05 NAHS: 24 vs. 2, p=0.0002 HOS-ADL: 19 vs. 11, p>0.05 HOS-sport: 22.5 vs. 12, p>0.05 <u>Baseline to 6 months change score, Mean (SD)</u> mHHS: 19 vs. 17, p=NR NAHS: 23 vs. 16, p=NR HOS-ADL: 16 vs. 14, p=NR HOS-sport: 32.5 vs. 10, p=NR <u>Baseline to 12 months change score, Mean (SD)</u> mHHS: 22 vs. 21, p>0.05	**A vs. B** **Complications, % (n/N)** No patients developed avascular necrosis, neuropraxia, heterotopic ossification, deep vein thrombosis, or deep infection. Screw removal due to persistent trochanteric pain: 0% (0/18) vs. 20% (1/5) Superficial infection (resolved with oral antibiotics): 5.5% (1/18) vs. 0% (0/5) **Re-injury requiring revision surgery, % (n/N)** 5.5% (1/18) vs. 0% (0/5)

Author, year Study Design N ROB	Interventions	Demographics	F/U, %	Outcomes	Harms
				NAHS: 25 vs. 18, p>0.05 HOS-ADL: 21 vs. 23, p>0.05 HOS-sport: 27 vs. 30, p>0.05	
Büchler 2013 Retrospective Comparative Cohort N=201 [matched from a pool of 469 patients] *High*	**A. Arthroscopy (n=66)** **B. Open dislocation (n=135)**	**A vs. B** **Mean age (years)**: 33.8 vs. 31.2 **% Female**: 74.2% vs. 32.6%, p<0.001 **Labral tear (yes):** NR **Tönnis Grade** - 0: 74.2% vs. 75.6% - I: 24.2% vs. 20.7% - II: 1.5% vs. 3.7% **Mean preoperative alpha angle**: 60.7° vs. 75.3° **Morphology**: Cam and Mixed-type, not data reported	**A vs. B** **Mean F/U:** 11.3 (range, 1.5 to 52) vs. 17.5 (range 2 to 56) months **Loss to F/U: 0**% (0/201)	NR	A vs. B **Complications (including revision surgery), % (n/N)** Overall Sink grade III or IV complications: 6.1% vs. 14%, p>0.05 Arthroscopic revision surgery of intra-articular adhesions: 6.1% (4/66) vs. 0% (0/135) Arthroscopic adhesiolysis: 0% (0/66) vs. 12% (16/135) Refixation of the greater trochanter for nonunion: 0% (0/66) vs. 2.2% (3/135)
Domb 2013† Retrospective Matched-pairs Comparative Cohort	**A. Arthroscopy (n=20)** - Labral repair: 85% - Labral debridement: 15% **B. Open dislocation (n=10)** - Labral repair: 100%	**A vs. B** **Mean age (years)**: 19.6 vs. 19 **% Female**: 80% vs. 80%	A vs. B **Mean F/U:** 25.5 (range, 21 to 34) vs. 24.8	**A vs. B** **Primary Outcomes** **Functional outcomes** **Good/Excellent result (mHHS >80 points)**:	A vs. B **Revision Surgery, % (n/N)** Revision surgery: 0% (0/20) vs. 10% (1/10)

Author, year Study Design N ROB	Interventions	Demographics	F/U, %	Outcomes	Harms
N=30 *Moderately high*	- Labral debridement: 0%	**Labral tear (yes):** 100% vs. 100% **Tönnis Grade:** NR **Mean preoperative alpha angle**: 56.93° vs. 58.44° **Morphology** - Mixed: 65% vs. 70% - Pincer: 30% vs. 30% - Cam: 5% vs. 0% **Baseline Outcome Scores, Mean (SD)** mHHS: 68.18 vs. 69.58 NAHS: 66.09 vs. 67.35 HOS-ADL: 72.17 vs. 68.59 HOS-sport: 44.34 vs. 53.76	(range, 12 to 39) months **Loss to F/U:** 0% (0/30)	95% (19/20) vs. 90% (9/10), p=0.605 Baseline to 3 months change score, Mean (SD) mHHS: 17.5 (NR) vs. 14 (NR), p=NR NAHS: 22 (NR) vs. 8 (NR), p=NR HOS-ADL: 17 (NR) vs. 12.5 (NR), p=NR HOS-sport: 31 (NR) vs. 14 (NR), p=NR Baseline to 12 months change score, Mean (SD) mHHS: 23 (NR) vs. 17 (NR), p=NR NAHS: 22 (NR) vs. 19 (NR), p=NR HOS-ADL: 20 (NR) vs. 19 (NR), p=NR HOS-sport: 40 (NR) vs. 25 (NR), p=NR Baseline to final F/U change score, Mean (SD) mHHS: 24.3 (11.2) vs. 22.5 (12.8), p=0.696	Though not considered a complication, hardware removal was performed in 80% (8/10) of the open dislocation group **Reoperation** Iliopsoas release: 5% (1/20) vs. 0% (0/10) [18 months post-operatively due to new-onset symptomatic internal snapping]

Author, year Study Design N ROB	Interventions	Demographics	F/U, %	Outcomes	Harms
				NAHS: 28.1 (16.0) vs. 18.3 (12.6), p=0.103 HOS-ADL: 23.1 (13.4) vs. 22.9 (13.9), p=0.971 HOS-sport: 42.8 (25.7) vs. 23.5 (19.7), p=0.047 <u>Scores at Final F/U, Mean (SD)</u> mHHS: 92.4 (7.13) vs. 92 (12.6), p=0.914 NAHS: 94.2 (4.5) vs. 85.7 (12.4), p=0.01 HOS-ADL: 95.3 (5.4) vs. 91.5 (7.7), p=0.129 HOS-sport: 87.1 (12.1) vs. 77.3 (22.7), p=0.131 **Pain outcomes** <u>Baseline to final F/U change score, Mean (SD)</u> VAS: 4.7 (2.0) vs. 2.1 (4.4), p=0.130 <u>Score at Final F/U, Mean (SD)</u> VAS: 2.0 (1.2) vs. 2.8 (3.1), p=0.328	
Roos 2017	**A. Arthroscopy (n=40 patients; 41 hips)** - Isolated femoral osteochondroplasty: 48.78%	**A vs. B** **Mean age (years)**: 36.12 vs. 35.76	**A vs. B**	**A vs. B** **<u>Primary Outcomes</u>** **Functional outcomes**	**A vs. B** **Complications, % (n/N)**

Author, year Study Design N ROB	Interventions	Demographics	F/U, %	Outcomes	Harms
Retrospective Comparative Cohort N=58 *High*	- Acetabular osteochondroplasty: 29.26% - Acetabular chondral microfracture: 9.75% - Labral debridement: 17.07% -Labral reattachment: 12.19% **B. Open dislocation (n=16 patients; 17 hips)** - Isolated femoral osteochondroplasty: 70.58% - Acetabular osteochondroplasty with labral refixation: 29.42%	**% Female**: 13% vs. 31% **Labral tear (yes):** NR **Tönnis Grade** - 0: 31.7% vs. 52.9% - I: 51.21% vs. 35.29% - II: 17.07% vs. 11.76% - III: 0% vs. 0% **Mean preoperative alpha angle**: 76° vs. 72° **Morphology** - Mixed: 28.27% (12 hips) vs. 29.42% (5 hips) - Cam: 70.73% (29 hips) vs. (70.58%) (12 hips) **Baseline Outcome Scores, Mean (SD)** mHHS: 65 (9.8) vs. 63 (9) NAHS: 68.8 (12.5) vs. 65 (11.3) ROM: 5° (10°) vs. 5° (10°)	**Mean F/U**: 29.1 (range, 24 to 42) vs. 52 (range, 43 to 74) months **Loss to F/U:** 3% (2/58)	**Good/Excellent clinical results (mHHS >80 points)**: 75.6% (31/41 hips) vs.70.6% (12/17 hips) Baseline to post-operative change score, Mean (SD) mHHS: 22.1 (NR) vs. 21.7 (NR) NAHS: 21.5 (NR) vs. 20.4 (NR) Score at post-operation, Mean (SD) mHHS: 88 (11) vs. 88 (22) NAHS: 92.5 (10) vs. 90 (20) **Conversion to THA** 3% (1/40) vs. 12.5% (2/16) **Secondary Outcomes** Range of Motion, Mean (SD) Internal Rotation: 20° (12.5°) vs. 25° (10°), p=NR	No major complications, such as avascular necrosis of the femoral head, femoral neck fracture, or infection were observed. Deep venous thrombosis 2.43% (1/40) vs. 0% (0/16) Heteroptopic ossification 9.8% (4/40) vs. 29.4% (5/16) -grade 1: 75% (3/4) vs. NR -grade 3: 25% (1/4) vs. NR Transient paresthesia of the pudendal nerve: 2.43% (1/40) vs. 0% (0/16) Persistent pain: 4.87% (2/40)§ vs. 23.5% (4/16) Lateral femoral cutaneous nerve injury: 0% (0/40) vs. 23.5% (4/16)

Author, year Study Design N ROB	Interventions	Demographics	F/U, %	Outcomes	Harms
Zingg 2013 N=38 Prospective Comparative Cohort *High*	**A. Arthroscopy (n=23)** - Labrum fixation: 33.3% - Labral debridement: 66.7% **B. Open dislocation (n=15)** - Labrum fixation: 60% - Labral debridement: 40% [95% of all patients had acetabular rim resection]	**A vs. B** **Mean age (years)**: 27.6 vs. 28.9 **% Female**: 35% vs. 47% **Labral tear (yes):** NR **Tönnis I:** 52% vs. 33% **Mean preoperative alpha angle**: 59° vs. 56.5° **Morphology** - Mixed: 78% vs. 73% - Cam: 0% vs. 13%% - Pincer: 22% vs. 13% **Baseline Outcome Scores, Mean (SD)** HHS: 75.2 (10.3) vs. 80.2 (8.3) WOMAC-overall: 2.3 (1.9) vs. 2.9 (2.1) WOMAC-ADL: 2.1 (1.7) vs. 2.5 (2.0) WOMAC-stiffness: 2.4 (2.7) vs. 3.1 (2.9) WOMAC-pain: 2.5 (2.1) vs. 3.0 (2.1) Pain at rest (VAS): 15 (21.9) vs. 18.3 (13.8)	**Mean F/U:** NR (Data collected at 3 weeks, 6 weeks, 3 months, and 12 months) **Loss to F/U:** 0% (0/38)	**A vs. B** **Primary Outcomes** **Function, Mean (SD)** 6 weeks (1.5 months) HHS: 81.4 (14.1) vs. 55.3 (16.7), p<0.001 WOMAC-overall: 2.0 (1.6) vs. 2.7 (1.9), p>0.05 WOMAC-ADL: 2.2 (1.6) vs. 3.2 (1.8), p>0.05 WOMAC-stiffness: 2.5 (2.3) vs. 2.5 (2.8), p>0.05 3 months HHS: 92.2 (11.1) vs. 80.6 (16.2), p=0.034 WOMAC-overall: 0.9 (1.1) vs. 2.3 (1.9), p=0.024 WOMAC-ADL: 0.8 (1.1(vs. 2.0 (2.0), p>0.05 WOMAC-stiffness: 1.2 (1.4) vs. 2.7 (2.4), p=0.041 12 months HHS: 93.4 (11.7) vs. 84.9 (14), p=0.027 WOMAC-overall: 1.1 (1.5) vs. 2.3 (2.1), p>0.05 WOMAC-ADL: 0.9 (1.8) vs. 1.9 (2.2), p>0.05 WOMAC-stiffness: 1.6 (1.9) vs. 2.6 (2.5), p>0.05	A vs. B **Complications, % (n/N)** Transient neuropraxia lateral femoral cutaneous nerve: 4.3% (1/23) vs. 0% (0/15) **Additional Surgery, % (n/N)** 0% (0/23) vs. 46.7% (7/14), p=NR

Final

Author, year Study Design N ROB	Interventions	Demographics	F/U, %	Outcomes	Harms
		Pain with ADL (VAS): 33.5 (25.3) vs. 40 (22.3) Pain at sports (VAS): 52.1 (31.2) vs. 65.9 (27)		**Pain, Mean (SD)** <u>3 weeks</u> Pain during sports (VAS): 18.7 (24) vs. 13.6 (6.3), p>0.05 <u>6 weeks (1.5 months)</u> WOMAC-pain: 1.6 (1.4) vs. 2.1 (1.8), p>0.05 Pain at rest (VAS): 6.3 (11.1) vs. 14.7 (20.7), p>0.05 Pain during ADL (VAS): 14.5 (14.5) vs. 20.1 (17.8), p>0.05 <u>3 months</u> WOMAC-pain: 0.7 (1.2) vs. 2.2 (2.0), p=0.012 Pain at rest (VAS): 2.4 (7.4) vs. 10 (13.6), p=0.021 Pain during ADL (VAS): 13.2 (17.9) vs. 24.5 (18.6), p=0.034 <u>12 months</u> WOMAC-pain: 0.9 (1.2) vs. 2.3 (1.9), p=0.011 Pain at rest (VAS): 5.5 (12.2) vs. 15 (22.8), p>0.05 Pain during ADL (VAS): vs. 10.1 (17.4) vs. 24.3 (26), p=0.042	

Author, year Study Design N ROB	Interventions	Demographics	F/U, %	Outcomes	Harms
				Pain during sports (VAS): 15.3 (24.5) vs. 16.4 (16.1), p>0.05 **ROM, Mean (SD) [°]** 3 months Internal rotation ipsilateral: 27.6 (5.6) vs. 29.4 (6.1), p>0.05 Internal rotation contralateral: 28.2 (6.5) vs. 31.5 (6.0), p>0.05 12 months Internal rotation ipsilateral: 29.6 (5.1) vs. 32.3 (5.1), p>0.05 Internal rotation contralateral: 30.6 (7.2) vs. 29.9 (5.5), p>0.05 **Time off work, days** - Due to index surgery only: 53.8 (31.1) vs. 77.1 (35.1), p=0.036 - Including revision surgery: 53.8 (31.1) vs. 108.9 (86.9), p=0.0013	
Rego 2018 Retrospective Comparative Cohort	**A. Arthroscopy (n=102 patients)** **B. Open dislocation (n=96 patients)** **A vs. B**	**A vs. B** **Mean age (years)**: 34 vs. 31 **% Female**: 53% vs. 60%	**Mean F/U (range)** All: 59 (24 to 132) months	**A vs. B** **Primary Outcomes** **Function, Mean (SD)** Post-operation	**A vs. B** **Complications, % (n/N)**

Author, year Study Design N ROB	Interventions	Demographics	F/U, %	Outcomes	Harms
N=198 *High*	**Surgical Components, %** NR	**Labral tear (yes):** NR **Tönnis Grade** -0: 51% vs. 55% -1: 31% vs. 21% -2: 17% vs. 21% -3: 1% vs. 3% **Mean preoperative alpha angle**: 68° vs. 75° **Morphology** - Cam: 100% vs. 100% **Baseline Outcome Scores, Mean (range)** NAHS: 53 (12 to 93) vs. 48 (10 to 94)	A vs. B: 44 (24 to 80) vs. 76 (25 to 132) months **Loss to F/U:** NR	NAHS: 82 (NR) vs. 83 (NR), p>0.05	Grade I Heterotopic ossification: 1% (1/102) vs. 0% (0/96) Grade I Reversible pudendal nerve paresis: 2% (2/102) vs. 0% (0/96) Grade II Deep venous thrombosis: 0% (0/102) vs. 2% (2/96) Grade II Haematoma: 1% (1/102) vs. 0% (0/96) Grade II Perineal cutaneous necrosis: 1% (1/102) vs. 0% (0/96) Grade II Superficial wound infection: 0% (0/102) vs. 1% (1/96) Grade II trochanteric osteotomy delayed consolidation: 0% (0/102) vs. 2% (2/96) Grade III Adhesive capsulitis: 1% (1/102) vs. 1% (1/96) Grade III Compartment syndrome: 1% (1/102) vs. 0% (0/96) Grade III trochanteric osteotomy pseudarthrosis: 0% (0/102) vs. 1% (1/96)

CI=confidence interval; COI=conflict of interest; F/U=follow-up; FAI=Femoroacetabular Impingement; FAIS=Femoroacetabular Impingement Syndrome; HHS=Harris Hip Score; HOS=Hip Outcome Score; HOS-ADL=Hip Outcome Score Activities of Daily Living; iHOT=international Hip Outcomes Tool; MAP=Merle d'Aubigne-Postel; MCID=Minimal clinically important difference; MCS=mental

component score; MD=mean difference; mHHS=modified Hip Harris Score; NAHS=Non-arthritic hip score; NR=not reported; A=osteoarthritis; PCS=physical component store; QOL=quality of life; ROB=risk of bias; ROM=Range of motion; SD=standard deviation; SF-12=short form 12 item health related quality of life questionaire; THA=total hip arthroplasty; VAS=visual analogue scale; WOMAC=Western Ontario and McMaster Universities Osteoarthritis Index

*All data are estimated from Figure 2, A-D

†Substantial overlap with Botser 2014 (primarily the open group).

‡3 month and 12 month change scores are estimated from Figure 1, A-D

§Both of these patients had Tönnis grade 2 arthrosis prior to surgery – THA has been indicated for one of these patients, but it is unclear as to whether or not this patient actually received THA.

APPENDIX G. Summary of Results from Case Series

Appendix Table G1. Range of frequency of complications following surgery for FAIS - adults

	# of studies*	Range of n's†	Range of follow-up	Range of % of patients (or hips) with ≥1 event
HETEROTOPIC OSSIFICATION				
	10 (arthroscopic) 2 (arthroscopic)	50 to 1870 52 to 1615 hips	13.2 to 68.7 18.7 to 84	0.5% to 5.3% of patients 0.8% to 11.5% of hips
	2 (open/mini-open) 1 (open/mini-open)	16 to 106 233 hips	24.8 to 26.4 61	25% to 33.9% of patients 34.9% of hips
BONE COMPLICATIONS				
Avascular Necrosis	6	14 to 1870	24.8 to 61	0% to 12.5% of patients
Femoral Neck Fractures	8 2	48 to 1870 1615 to 14945 hips	1.5 to 68.7 18.7	0% to 6.3% of patients 0.07% to 0.1% of hips
Pelvis Fracture	1	1870	≥ 48	0.8% of patients
Iatrogenic Chondral Injury	1 1	360 1615	≥6 18.7	5.6% of patients 1.2% of hips
Iatrogenic femoral head scuffing	1	197	28.2	2% of patients
Iatrogenic instability	2	197 to 414	28.2 to 31.2	0% of patients for all
NERVE COMPLICATIONS				
Femoral Cutaneous Nerve	2 1	45 to 197 1615 hips	28.2‡ 18.7	1% to 13.3% of patients 1.6% of hips
Pudendal Nerve	5 1	40 to 414 1615 hips	1.5 to 31.2 18.7	0.6% to 18.8% of patients 1.2% of hips
Perineum Nerve	1 1	45 1615 hips	NR 18.7	2.2% of patients 0.1% of hips
Perineum or Femoral Cutaneous Nerve	1	110	Immediately post-operation	62.7% of patients
Lateral dorsal cutaneous nerve	1	360	≥6	4.4% of patients
Other non-specific nerve complications	3 1	1615 hips	33.8 to 68.7‡ 18.7	5.4% to 13.3% of patients 0.2% of hips
THROMBOEMBOLIC EVENTS				
Deep Vein Thrombosis	2	48 to 414	26.4 to 31.2	0.2% to 2%
OTHER VASCULAR COMPLICATIONS				
Abdominal Compartment Syndrome	2	159 to 414	31.2 to 33.8	0% to 0.6% of patients
Hematoma	3 1	106 to 317 1615 hips	1.5 to 33.8 18.7	0.6% to 3.7% of patients 0.1% of hips

	# of studies*	Range of n's†	Range of follow-up	Range of % of patients (or hips) with ≥1 event
INFECTIOUS				
Superficial wound infection	4 1	48 to 414 1615 hips	26.2 to 68.7 18.7	0% to 2% of patients 1.1% of hips
Deep portal infection	1 1	48 1615 hips	26.4 18.7	0% of patients 0.1% of hips
Infection not otherwise specified	2	360 to 1870	≥6 to ≥ 48	0.2% to 0.3% of patients
SOFT TISSUE				
Iatrogenic labral punctures/perforation/tearing	1 1	197 1615 hips	28.2 18.7	1.5% of patients 0.9% of hips
Iliotibial band syndrome	2**	162 to 258	≥12 to 28.4	3.5% to 5.5% of patients
OTHER COMPLICATIONS				
Instrument breakage	3	197 to 317	1.5 to 28.2	0.6% to 2% of patients
Second degree skin burns	2	197 to 258	NR to 28.2	0.4% to 0.5% of patients
Asymptomatic snapping sounds	2	75 to 197	28.2 to 49.1	0.5% to 15% of patients
Fluid Extravasion	3	36 to 258	28.2 to NR	0% of patients for all studies
Suture anchor problem	2	185 to 197	28.2 to 61	1.1% to 1.5% of patients
REVISIONS AND REOPPERATIONS				
Revision surgery	11 1	15 to 295 233 hips	1.5 to 68.7 61	1.2% to 33.3% of patients 10.3% of hips
Additional operations	3	48 to 106	26.4 to 28.8	1.9% to 31.3% of patients
COMPLICATIONS REPORTED ON BY SINGLE STUDIES				
Includes: pulmonary edema, capsular adhesion, painful scar, hip flexor tendonitis, insufficient distraction, ankle pain, hypothermia, septic arthritis, persistent strength deficit, nonunion of the greater trochanter, superficial vein thrombosis, sciatic nerve palsy	11 1	48 to 258 1615 hips	Variable§ 18.6	0% (septic arthritis, non-union) to 6.7% (persistent strength deficit) of patients 0.1% of hips (pulmonary edema)

* Studies of arthroscopy and open/mini-open are reported on together unless there was a distinct difference in frequency of the complications between the groups of studies. In these instances the groups of studies are reported on separately.
† n value represents number of patients, unless otherwise specified.
‡ One study did not report mean F/U, but had an F/U range of 3 to 12 months.
§ Not all studies reported a mean F/U, and some outcomes were assessed during surgery (hypothermia). For those studies that provided a mean F/U, mean F/U ranged from 1.5 to 61 months (across 7 studies).
**The data for this outcome are from two by the same author/author group. Across these two studies (Sejas 2016 and 2017), there is 6 months of crossover. In both studies, 9 patients were reported to have this outcome. Therefore, it is likely that these patients are one in the same.

Appendix Table G2. Range of frequency of complications following surgery for FAIS - pediatrics

	# of studies*	Range of n's†	Range of follow-up	Range of % of patients (or hips) with ≥1 event
HETEROTOPIC OSSIFICATION				
	1 (open)	44	24	2.3% of patients
BONE COMPLICATIONS				
Avascular Necrosis	4	18 to 108	14 to 39.8	0% of patients for all
Physeal injury	4	18 to 108	14 to 39.8	0% of patients for all
Chondrolysis	1	37	28.3	0% of patients
Slipped femoral epiphysis	1	34	14	0% of patients
Femoral Neck Fracture	1	44	24	0% of patients
Non-union of the greater trochanter	1	44	24	0% of patients
Iatrogenic instability	1	108	29.8	0% of patients
NERVE COMPLICATIONS				
Femoral Cutaneous Nerve	1	24	24	8.3% of patients
Pudendal Nerve	2	37 to 104	28.3 to 38	1.9% to 2.7% of patients
Perineum Nerve	1	108	29.8	1.9% of patients
Other non-specific nerve complications	1	34	36.1	3% of patients
INFECTIOUS				
Superficial Wound Infection	3	34 to 44	14 to 28.3	0% to 2.7% of patients
OTHER COMPLICATIONS				
Growth Disturbance	2	18 to 108	29.8 to 39.8	0% of patients for all
REVISIONS AND REOPPERATIONS				
Revision Surgery	9	18 to 108	14 to 50.4	0% to 13.6% of patients
Additional Operations	3 1	24 to 44 18 hips	22 to 50.4 36	2.3% to 20.5% of patients 11.1%

* Studies of arthroscopy and open/mini-open are reported on together unless there was a distinct difference in frequency of the complications between the groups of studies. In these instances the groups of studies are reported on separately.

† n value represents number of patients, unless otherwise specified.

Appendix Table G3. Frequency of complications following surgery for FAIS - adults

	Mean follow-up (months)	Morphology Type, % (Cam/Pincer/Mixed)	Frequency % (n/N)
HETEROTOPIC OSSIFICATION			
Park 2014	28.2	4%/27%/70%	0.5% (1/197)
Rhon 2019a	≥ 48	NR/NR/NR	0.6% (12/1870)
Larson 2016	18.7	NR/NR/NR	0.8% (13/1615 hips)
Nossa 2014	≥6	45%/9%/46%	0.8% (3/360)
Perets 2019	68.7	NR/NR/NR	1% (3/295)
Hartigan 2016	38.7	NR/NR/NR	1.3% (1/78)
Seijas 2017	≥ 12	NR/NR/NR	1.6% (4/258)*
Jackson 2014	28.8	5.5%/35%/59%	1.9% (1/54)
Dutton 2016	33.8	48%/25%/27%	1.9% (3/159)
Bedi 2012	13.2	12%/15%/64%	4.7% (29/616)
Gao 2019	22.9	NR/NR/NR	5.37% (13/242)
Haefeli 2017	84	48%/25%/27%	11.5% (6/52 hips)
Chaudhary 2015§	24.8	81%/0%/19%	25% (4/16)
Chiron 2012§	26.4	58%/0%/42%	33.9% (36/106)
Naal 2012§	61	NR/NR/NR	34.9% (81/233 hips)
BONE COMPLICATIONS			
Avascular Necrosis			
Naal 2012§	61	NR/NR/NR	0% (0/185)
Rupp 2016	25	100%/0%/0%	0% (0/14)
Seijas 2017	≥ 12	NR/NR/NR	0.4% (1/258)‡
Rhon 2019a	≥ 48	NR/NR/NR	0.4% (8/1870)
Dutton 2016	33.8	48%/25%/27%	0.6% (1/159)
Chaudhary 2015§	24.8	81%/0%/19%	12.5% (2/16)
Femoral Neck Fractures			
Dutton 2016	33.8	37%/40%/26%	0% (0/159)
Cvetanovich 2018	31.2	20%/6%/74%	0% (0/414)
Kempthorne 2011§	26.4	28%/8%/64%	0% (0/48)
Merz 2015	NR	NR/NR/NR	0.7% (11/14,945 hips)
Larson 2016	18.7	NR/NR/NR	0.1% (2/1615 hips)
Perets 2019	68.7	NR/NR/NR	0.3% (1/295)
Dietrich 2014	1.5	NR/NR/NR	0.3% (1/317)
Seijas 2017	≥ 12	NR/NR/NR	0.4% (1/258)*
Rhon 2019a	≥ 48	NR/NR/NR	1% (19/1870)

	Mean follow-up (months)	Morphology Type, % (Cam/Pincer/Mixed)	Frequency % (n/N)
Zingg 2017	20	Cam and Mixed only	2% (7/357)
Chaudhary 2015§	24.8	81%/0%/19%	6.3% (1/16)
Pelvis Fracture			
Rhon 2019a	≥ 48	NR/NR/NR	0.8% (15/1870)
Iatrogenic chondral injuries			
Larson 2016	18.7	NR/NR/NR	1.2% (20/1615 hips)
Nossa 2014	≥6	45%/9%/46%	5.6% (20/360)
Iatrogenic femoral head scuffing			
Park 2014	28.2	4%/27%/70%	2% (4/197)
Iatrogenic instability			
Cvetanovich 2018	31.2	20%/6%/74%	0% (0/414)
Park 2014	28.2	4%/27%/70%	0% (0/197)
NERVE COMPLICATIONS			
Femoral Cutaneous Nerve			
Park 2014	28.2	4%/27%/70%	1% (2/197)
Hartigan 2016	38.7	NR/NR/NR	1.3% (1/78)*
Larson 2016	18.7	NR/NR/NR	1.6% (26/1615 hips)
Seijas 2017	≥ 12	NR/NR/NR	2.3% (6/258)*
Carreira 2018	Range 3 to 12	NR/NR/NR	13.3% (6/45)
Pudendal Nerve			
Dietrich 2014	1.5	NR/NR/NR	0.6% (2/317)
Seijas 2017	≥ 12	NR/NR/NR	1.2% (3/258)*
Larson 2016	18.7	NR/NR/NR	1.4% (23/1615 hips)
Park 2014	28.2	4%/27%/70%	2% (4/197)
Cvetanovich 2018	31.2	20%/6%/74%	2.2% (9/414)
Roos 2015	29.1	71%/0%/29%	2.5% (1/40)
Nossa 2014	≥6	45%/9%/46%	18.8% (68/360)
Perineum Nerve			
Larson 2016	18.7	NR/NR/NR	0.1% (0/1615 hips)
Carreira 2018	Range 3 to 12	NR/NR/NR	2.2% (1/45)
Perineum or Femoral Cutaneous Nerve			
Mas Martinez 2019	Immediately post-operation	13%/16%/71%	62.7% (69/110)
Lateral dorsal cutaneous nerve			
Nossa 2014	≥6	45%/9%/46%	4.4% (16/360)

	Mean follow-up (months)	Morphology Type, % (Cam/Pincer/Mixed)	Frequency % (n/N)
Other non-specific nerve complications			
Larson 2016	18.7	NR/NR/NR	0.2% (3/1615 hips)
Perets 2019	68.7	NR/NR/NR	5.4% (16/295)
Dutton 2016	33.8	37%/40%/26%	11.9% (19/159)
Carreira 2018	Range 3 to 12	NR/NR/NR	13.3% (6/45)
THROMBOEMBOLIC EVENTS			
Pulmonary embolism			
Dutton 2016	33.8	37%/40%/26%	0% (0/159)†
Larson 2016	18.7	NR/NR/NR	0.1% (1/1615 hips)†
Deep Vein Thrombosis			
Dutton 2016	33.8	37%/40%/26%	0% (0/159)†
Park 2014	28.2	4%/27%/70%	0% (0/197)†
Seijas 2017	≥ 12	NR/NR/NR	0% (0/258)†
Larson 2016	18.7	NR/NR/NR	0.1% (1/1615 hips)†
Cvetanovich 2018	31.2	20%/6%/74%	0.2% (1/414)
Kempthorne 2011§	26.4	28%/8%/64%	2% (1/48)**
Roos 2015	29.1	71%/0%/29%	2.5% (1/40)†
OTHER VASCULAR COMPLICATIONS			
Abdominal Compartment Syndrome			
Cvetanovich 2018	31.2	20%/6%/74%	0% (0/414)
Dutton 2016	33.8	37%/40%/26%	0.6% (1/159)
Hematoma			
Larson 2016	18.7	NR/NR/NR	0.1% (2/1615 hips)
Dutton 2016	33.8	37%/40%/26%	0.6% (1/159)
Dietrich 2014	1.5	NR/NR/NR	1.9% (6/317)
Chiron 2012§	26.4	58%/0%/42%	3.7% (4/106)
INFECTIOUS			
Superficial wound infection			
Park 2014	28.2	4%/27%/70%	0% (0/197)
Perets 2019	68.7	NR/NR/NR	1% (3/295)
Cvetanovich 2018	31.2	20%/6%/74%	1% (4/414)
Larson 2016	18.7	NR/NR/NR	1.1% (17/1615 hips)
Kempthorne 2011§	26.4	28%/8%/64%	2% (1/48)
Deep portal infection			
Kempthorne 2011§	26.4	28%/8%/64%	0% (0/48)

	Mean follow-up (months)	Morphology Type, % (Cam/Pincer/Mixed)	Frequency % (n/N)
Larson 2016	18.7	NR/NR/NR	0.1% (1/1615 hips)
Infection not otherwise specified			
Nossa 2014	≥6	45%/9%/46%	0.2% (1/360)
Rhon 2019a	≥ 48	NR/NR/NR	0.3% (5/1870)
Seijas 2017	≥ 12	NR/NR/NR	0.4% (1/258)*
SOFT TISSUE			
Iatrogenic labral punctures/perforation/tearing			
Larson 2016	18.7	NR/NR/NR	0.9% (14/1615 hips)
Park 2014	28.2	4%/27%/70%	1.5% (3/197)
Iliotibial band syndrome			
Seijas 2017	≥ 12	NR/NR/NR	3.5% (9/258)
Seijas 2016	28.4	NR/NR/NR	5.5% (9/162)
OTHER COMPLICATIONS			
Instrument Breakage			
Dietrich 2014	1.5	NR/NR/NR	0.6% (2/317)
Seijas 2017	≥ 12	NR/NR/NR	1.9% (5/258)
Park 2014	28.2	4%/27%/70%	2% (4/197)
Second degree skin burns			
Seijas 2017	≥ 12	NR/NR/NR	0.4% (1/258)
Park 2014	28.2	4%/27%/70%	0.5% (1/197)
Asymptomatic snapping sounds			
Park 2014	28.2	4%/27%/70%	0.5% (1/197)
Perets 2018	49.1	NR/NR/NR	15% (9/75)
Fluid Extravasion			
Hinzpeter 2015	NR	NR/NR/NR	0% (0/36)
Park 2014	28.2	4%/27%/70%	0% (0/197)
Seijas 2017	≥ 12	NR/NR/NR	0% (0/258)
Suture anchor problem			
Naal 2012§	61	NR/NR/NR	1.1% (2/185)
Park 2014	28.2	4%/27%/70%	1.5% (3/197)
COMPLICATIONS REPORTED ON BY SINGLE STUDIES			
Pulmonary edema			
Larson 2016	18.7	NR/NR/NR	0.1% (1/1615 hips)
Capsular Adhesion			

	Mean follow-up (months)	Morphology Type, % (Cam/Pincer/Mixed)	Frequency % (n/N)
Seijas 2017	≥ 12	NR/NR/NR	1.2% (3/258)
Painful scar			
Seijas 2017	≥ 12	NR/NR/NR	0.8% (2/258)
Hip flexor tendonitis			
Hartigan 2016	38.7	NR/NR/NR	1.3% (1/78)
Insufficient distraction			
Dietrich 2014	1.5	NR/NR/NR	1.9% (6/317)
Ankle pain			
Park 2014	28.2	4%/27%/70%	1% (2/197)
Hypothermia			
Parodi 2012	During surgery	NR/NR/NR	2.7% (2/73)
Septic Arthritis			
Dutton 2016	33.8	37%/40%/26%	0% (0/159)
Persistent strength deficit			
Carreira 2018	Range 3 to 12	NR/NR/NR	6.7% (3/45)
Non-union of the greater trochanter			
Chaudhary 2015§	24.8	81%/0%/19%	0% (0/16)
Superficial Vein Thrombosis			
Naal 2012§	61	NR/NR/NR	0.5% (1/185)
Sciatic nerve palsy			
Kempthorne 2011§	26.4	28%/8%/64%	2% (1/48)
REVISIONS AND REOPERATIONS			
Revision			
Seijas 2016	28.4	NR/NR/NR	0.6% (1/162)††
Cvetanovich 2018	31.2	20%/6%/74%	1.2% (5/414)
Dietrich 2014	1.5	NR/NR/NR	1.3% (4/317)
Seijas 2017	≥ 12	NR/NR/NR	1.5% (4/258)*
Gao 2019	22.8	NR/NR/NR	1.7% (4/242)
Park 2014	28.2	4%/27%/70%	2.5% (5/197)
Hatakeyama 2018	42.5	93.3% cam	20% (9/45)
Jackson 2014	28.8	5.5%/35%/59%	3.7% (2/54)
Chiron 2012§	26.4	58%/0%/42%	3.7% (8/106)
Rhon 2019a	≥ 48	NR/NR/NR	6.5% (122/1870)
Naal 2012§	61	NR/NR/NR	10.3% (24/233 hips)

	Mean follow-up (months)	Morphology Type, % (Cam/Pincer/Mixed)	Frequency % (n/N)
Perets 2019	68.7	NR/NR/NR	12.5% (37/295)
Perets 2018	49.1	NR/NR/NR	16.7% (10/75)
Haefeli 2017	84	48%/25%/27%	18% (9/50)*
Olach 2019	NR	100%/0%/0%	33.3% (5/15)
Additional Operations			
Jackson 2014	28.8	5.5%/35%/59%	1.9% (1/54)
Chiron 2012§	26.4	58%/0%/42%	3.7% (4/106)
Kempthorne 2011§	26.4	28%/8%/64%	31.3% (15/48)

*This study was included in the SR Riff 2019 and therefore is not represented in the condensed table.

†This study was included in the SR Bolia 2018 and therefore is not represented in the condensed table.

‡This study is included in the SR Riff 2019, but Riff 2019 reports 0 incidences of avascular necrosis (AVN), when in actuality, Seijas 2017 reports 1 case of AVN. Therefore this study has been included in the range of the condensed table.

§Evaluating open surgical dislocation or mini-open procedure.

**This deep vein thrombosis lead to a non-threatening pulmonary embolism.

††There is 6 months of crossover between Sejas 2016 and 2017, and Seijas 2017 is included in the SR Riff 2019. Therefore this study is not included in the condensed table.

‡‡An additional 15% (n=43) patients had surgery FAIS, but the side could not be confirmed so it was unclear as to if these operations were primary or revisions.

Appendix Table G4. Frequency of complications following surgery for FAIS - pediatrics

	Mean follow-up (months)	Morphology Type, % (Cam/Pincer/Mixed)	Frequency % (n/N)
HETEROTOPIC OSSIFICATION			
Sink 2013	24	NR/NR/NR	2.3% (1/44)
BONE COMPLICATIONS			
Avascular Necrosis			
Byrd 2016b	29.8	29.50%/13.90%/56.60%	0% (0/108)
Cvetanovich 2018	28.3	NR/NR/84.00%	0% (0/37)
Larson 2019	39.8	NR/NR/NR	0% (0/18)
Tran 2013	14	78%/0%/22%	0% (0/34)
Physeal (growth plate) injury			
Byrd 2016b	29.8	29.50%/13.90%/56.60%	0% (0/108)
Cvetanovich 2018	28.3	NR/NR/84.00%	0% (0/37)
Larson 2019	39.8	NR/NR/NR	0% (0/18)
Tran 2013	14	78%/0%/22%	0% (0/34)
Chondrolysis			
Cvetanovich 2018	28.3	NR/NR/84.00%	0% (0/37)
Slipped femoral epiphysis			
Tran 2013	14	78%/0%/22%	0% (0/34)
Femoral Neck Fracture			
Sink 2013	24	NR/NR/NR	0% (0/44)
Non-union of the greater trochanter			
Sink 2013	24	NR/NR/NR	0% (0/44)
Iatrogenic instability			
Byrd 2016b	29.8	29.50%/13.90%/56.60%	0% (0/108)
NERVE COMPLICATIONS			
Femoral Cutaneous Nerve			
McConkey 2019	24	25%/14%/61%	8.3% (2/24)
Pudendal Nerve			
Byrd 2016a	38	28.40%/13.80%/57.80%	1.9% (2/104)
Cvetanovich 2018	28.3	NR/NR/84.00%	2.7% (1/37)
Perineum Nerve			
Byrd 2016b	29.8	29.50%/13.90%/56.60%	1.9% (2/108)
Other non-specific nerve complications			
Degen 2017	36.1	100%/0%/0%	3% (1/34)

	Mean follow-up (months)	Morphology Type, % (Cam/Pincer/Mixed)	Frequency % (n/N)
INFECTIOUS			
Superficial wound infection			
Tran 2013	14	78%/0%/22%	0% (0/34)
Sink 2013	24	NR/NR/NR	0% (0/44)
Cvetanovich 2018	28.3	NR/NR/84.00%	2.7% (1/37)
OTHER COMPLICATIONS			
Growth disturbance			
Byrd 2016b	29.8	29.50%/13.90%/56.60%	0% (0/108)
Larson 2019	39.8	NR/NR/NR	0% (0/18)
REVISIONS AND REOPERATIONS			
Revision			
Larson 2019	39.8	NR/NR/NR	0% (0/18)
McConkey 2019	24	25%/14%/61%	0% (0/24)
Tran 2013	14	78%/0%/22%	0% (0/34)
Cvetanovich 2018	28.3	NR/NR/84.00%	0% (0/37)
Byrd 2016b*	29.8	29.50%/13.90%/56.60%	4.6% (5/108)
Litrenta 2018	50.4	NR/NR/NR	4.7% (2/43)
Degen 2017	36.1	100%/0%/0%	5.9% (2/35)
Philippon 2012	42	10%/15%/75%	12.3% (8/65 hips)†
Sink 2013	24	NR/NR/NR	13.6% (6/44)
Additional Operations			
Litrenta 2018	50.4	NR/NR/NR	2.3% (1/43)
Novais 2016	22	50%/4%/46%	4.2% (1/24)
Guindani 2017	36	NR/NR/NR	11.1% (2/18 hips)
Sink 2013	24	NR/NR/NR	20.5% (9/44)

*Byrd 2016a also reports revision – reported as 3.8% (4/104); same population as Byrd 2016b

†This study was included in the SR De Sa 2014 and therefore is not represented in the condensed table.

Appendix Table G5. THA, OA, Revision in case series with >5 years follow-up

	Mean follow-up (months)	Morphology Type, % (Cam/Pincer/Mixed)	Frequency % (n/N)
REVISION SURGERY			
Ohlin 2019	60	41.10%/1.10%/57.80%	2.2% (4/184)
Perets 2018	70.1	NR/NR/NR	4.3% (4/94)
Menge 2017	120	14.90%/2.60%/82.50%	4.5% (7/154)
Kaldau 2018	82.9	NR/NR/NR	8.2% (7/84)
Steppacher 2014/2015	132	4%/11%/85%	9% (9/97)
Naal 2012	60.7	NR/NR/NR	10% (24/240 hips)
Lee 2019	92.4	NR/NR/NR	12.2% (5/41
Perets 2019	68.7	NR/NR/NR	12.5% (37/295)
Domb 2017	70.1	NR/NR/NR	12.7% (37/292 hips)
Chen 2019	69.3	NR/NR/NR	14% (7/50)
Haefeli 2017	84	48%/25%/27%	18% (9/50)
CONVERSION TO THA			
Larson 2019*	39.8	NR/NR/NR	0% (0/28)
Chen 2019	69.3	NR/NR/NR	2% (1/50)
Lee 2019	92.4	NR/NR/NR	2.4% (1/41)
Naal 2012	60.7	NR/NR/NR	3% (7/240 hips)
Haefeli 2017	84	48%/25%/27%	4% (2/50)
Perets 2019	68.7	NR/NR/NR	7.6% (25/327 hips)
Steppacher 2014/2015	132	4%/11%/85%	11% (11/97)
Hanke 2017	132	7.10%/10.70%/82.10%	14% (9/65 hips)
Comba 2016	91	16.60%/4.70%/78.50%	16.7% (7/42)
Domb 2017	70.1	NR/NR/NR	17.1% (50/292 hips)
Kaldau 2018	82.9	NR/NR/NR	18% (15/84)
Skendzel 2014	73	NR/NR/NR	25% (117/466)
Perets 2018	70.1	NR/NR/NR	27.7% (26/94)
Menge 2017	120	14.90%/2.60%/82.50%	34% (50/154)
PROGRESSION TO OA			
Steppacher 2014/2015	132	4%/11%/85%	8% (8/97)
Hanke 2017	132	7.10%/10.70%/82.10%	8% (5/65 hips)
Haefeli 2017	84	48%/25%/27%	12% (6/50)

*This study is in pediatric patients (mean age 15.9 years) and therefore does not have a follow-up greater than 5 years.

APPENDIX H. List of on-going studies

Appendix Table H1. List of on-going trials and studies of Femoroacetabular Impingement Syndrome

NCT Number	Study Title	N	Study Type	Completion Date	Interventions/Comparators
SURGERY VS. SHAM SURGERY					
NCT02692807	Arthroscopic Surgical Procedures vs Sham Surgery for Patients With Femoroacetabular Impingement and/or Labral Tears.	140	RCT	12/1/2020	Arthroscopic surgery vs. sham surgery
SURGERY VS. CONSERVATIVE					
NCT01621360	Hip Arthroscopy Versus Conservative Management of Femoroacetabular Impingement	140	RCT	5/1/2014	Arthroscopic surgery vs. PT and activity modification
NCT03077022	Femoroacetabular Impingement (FAI): The Effectiveness of Physical Therapy	150	Comparative Cohort	2/1/2019	PT alone vs. PT + surgery
ACTRN12615001177549	Full randomised controlled trial of Arthroscopic Surgery for Hip Impingement versus best coNventional Care Australia	140	RCT	1/30/2021	PT vs. conservative care
SURGERY VS. SURGERY					
NCT01623843	Femoroacetabular Impingement RandomiSed Controlled Trial	220	RCT	12/1/2020	Arthroscopic Lavage vs. Arthroscopic Osteochondroplasty
CONSERVATIVE TREATMENT					
ACTRN12617001350314	The physiotherapy for Femoroacetabular Impingement Rehabilitation STudy (PhysioFIRST): A participant and assessor blinded randomised controlled trial of physiotherapy to reduce pain and improve function for hip impingement	164	RCT	3/15/2021	FAIS-specific Physical Therapy vs. non-specific Physical Therapy
ACTRN12617000462381	IMBRACE: Can a specialised hip BRACE alleviate symptoms of hip IMpingement? A randomised controlled trial comparing a hip brace plus usual care to usual care alone.	62	RCT	10/31/2019	Brace vs. Usual Care
NCT02368483	Conservative Treatment in Patients With Symptomatic Femoroacetabular Impingement	30	Case Series	10/1/2016	Neuromuscular training
NCT03278353	Fulfillment of Expectations for Patients With FAI Syndrome	63	Comparative Cohort	9/1/2020	Exercise vs. Manual Therapy
NCT03846817	Diagnosis and Treatment of Patients With Femoroacetabular Impingement Syndrome	110	Comparative Cohort	3/12/2021	PT + hip injection vs. PT alone
NCT03949127	Efficacy of an Exercise Program for Patients With Femoroacetabular Impingement	84	RCT	4/1/2021	Exercise vs. No Exercise

NCT Number	Study Title	N	Study Type	Completion Date	Interventions/Comparators
NATURAL HISTORY					
NCT03891563	Prospective Evaluation of Sport Activity and the Development of Femoroacetabular Impingement in the Adolescent Hip	52	Case Series	1/10/2021	NA
NCT01546493	Hip Impingement - Understanding Cartilage Damage	70	Case Series	12/1/2019	NA
NCT02408276	Longitudinal Evaluation of Hip Cartilage Degeneration: FAI	130	Case Series	12/1/2019	NA

APPENDIX I. Clinical Expert Peer Review

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