NATIONAL INSTITUTE FOR HEALTH AND CLINICAL EXCELLENCE

INTERVENTIONAL PROCEDURES PROGRAMME

Interventional procedure overview of arthroscopic femoro–acetabular surgery for hip impingement syndrome

Treating hip impingement syndrome with arthroscopic femoro-acetabular surgery

Hip impingement syndrome is caused by unwanted contact between abnormally shaped parts of the head of the thigh bone and the hip socket. This results in limited hip movement and pain.

The aim of femoro-acetabular surgery is to improve range of movement and reduce pain. It is believed that it may also help prevent hip arthritis in later life. With the patient under general anaesthesia, a special camera (called an arthroscope) is inserted into the hip joint through a small incision. Using instruments inserted through one or two additional incisions, the surgeon removes some of the cartilage or bone, with the aim of reshaping the joint surface. Unlike open surgery, in arthroscopic surgery the hip joint does not need to be dislocated, and recovery is thought to be quicker.

Introduction

The National Institute for Health and Clinical Excellence (NICE) has prepared this overview to help members of the Interventional Procedures Advisory Committee (IPAC) make recommendations about the safety and efficacy of an interventional procedure. It is based on a rapid review of the medical literature and specialist opinion. It should not be regarded as a definitive assessment of the procedure.

Date prepared

This overview was prepared in May 2011.

Procedure name

- Arthroscopic femoro-acetabular surgery for hip impingement syndrome

Specialty societies

- British Hip Society

Description

Indications and current treatment

Hip or femoro-acetabular impingement results from abnormally shaped (non-spherical) parts of the femoral head, the acetabulum, or both. The understanding of the pathophysiological mechanisms implicated is evolving, but it is believed that the condition results from (often unrecognised or subtle) injury – particularly during adolescence. Sporting activities involving weight training or loading are believed to be risk factors. Currently, it is believed that femoro-acetabular impingement is a common cause of 'groin pain syndrome' among elite athletes. Impingement is usually caused by jamming of an abnormally shaped femoral head into the acetabulum during forceful motion (especially during flexion) – often called the 'cam' lesion. Impingement can also be caused by contact between the acetabular rim and the femoral head–neck junction – often called the 'pincer' lesion.

Symptoms include restriction of movement, 'clicking' of the hip joint, and pain. Symptoms may occur or be exacerbated during hip flexion activities resulting from sporting activity, or after prolonged sitting. It is also believed that femoro-acetabular impingement leads to osteoarthritis later in life, although the epidemiological evidence for this association is limited. Diagnosis is typically based on history, clinical examination and (usually magnetic resonance) imaging. However, often the presence of impingement and its extent are confirmed endoscopically (intra-operatively).

Appropriate management may begin with a trial of conservative measures, including activity modification to reduce excessive motion and loading on the hip. Non-steroidal anti-inflammatory drugs may be useful in patients with acute onset. In patients who are refractory to conservative treatment arthroscopic or open surgery to reshape the femoroacetabular joint may be required.

Hip pain scores

There are two commonly employed methods for assessing hip function – the Harris hip score and the Merle d'Aubigné scale. The Harris hip score rates the hip based on the 4 criteria of pain, function, range of motion and deformity, scoring 0 to 100 points (higher scores better) with more weighting towards function and pain. The Merle d'Aubigné scale rates pain, walking, range of motion, and clinical grade scoring 4 to 18 points (higher scores better). 18 points is considered an excellent clinical grade, 15 to 17 points good, 13 or 14 points fair, and less than 13 points poor.

What the procedure involves

Arthroscopic surgery for femoro-acetabular impingement aims to relieve pain and improve the range of movement of the hip joint.

The procedure is carried out with the patient under general anaesthesia. The hip is subluxed using leg traction against a perineal padded post, in order to widen the intra-articular space. Fluoroscopic guidance may be used. An arthroscope and surgical instruments are inserted into the hip through 2 or 3 lateral and anterior portals. Non-spherical sections of the femoral head and prominent sections of the anterior femoral neck are resected to improve the offset of the femoral neck and increase clearance in the joint. Labral lesions are debrided using a shaver or radiothermal device. Alternatively, if suitable, the labrum may be reattached. Femoral and acetabular osteoplasties are achieved where necessary with a burr. The range of motion and any residual impingement are evaluated. Additional access via a small incision may be required to reach or visualise parts of the joint. A period of physiotherapy rehabilitation is required after the procedure.

Literature review

Rapid review of literature

The medical literature was searched to identify studies and reviews relevant to arthroscopic femoro-acetabular surgery for hip impingement syndrome. Searches were conducted of the following databases, covering the period from their commencement to 31 August 2010 and updated to 30 March 2011: MEDLINE, PREMEDLINE, EMBASE, Cochrane Library and other databases. Trial registries and the Internet were also searched. No language restriction was applied to the searches (see appendix C for details of search strategy). Relevant published studies identified during consultation or resolution that are published after this date may also be considered for inclusion.

The following selection criteria (table 1) were applied to the abstracts identified by the literature search. Where selection criteria could not be determined from the abstracts the full paper was retrieved.

Table 1 Inclusion criteria for identification of relevant studies

Characteristic	Criteria
Publication type	Clinical studies were included. Emphasis was placed on identifying good quality studies. Abstracts were excluded where no clinical outcomes were reported, or where the paper was a review, editorial, or a laboratory or animal study. Conference abstracts were also excluded because of the difficulty of appraising study methodology, unless they reported specific adverse events that were not available in the published literature.
Patient	Patients with hip impingement syndrome.
Intervention/test	Arthroscopic femoro-acetabular surgery.
Outcome	Articles were retrieved if the abstract contained information relevant to the safety and/or efficacy.
Language	Non-English-language articles were excluded unless they were thought to add substantively to the English-language evidence base.

List of studies included in the overview

This overview is based on approximately 1126 patients from 3 non-randomised controlled studies[1,2, 3], 5 case series[4,5,6,7,8], and 1 case report[9].

Other studies that were considered to be relevant to the procedure but were not included in the main extraction table (table 2) have been listed in appendix A.

Table 2 Summary of key efficacy and safety findings on arthroscopic femoro-acetabular surgery for hip impingement syndrome

Abbreviations used: HHS, Harris hip score; OA, osteoarthritis; NSAID, no steroidal anti-Inflammatory drug

Study details	Key efficacy findings	Key safety findings	Comments
Larson C M (2009)[1] **Non-randomised controlled study** USA Recruitment period: 2004 to 2007 Study population: patients with radiographic and intraoperative evidence of pincer, or cam and pincer hip impingement. Tönnis grade 0 = 56 hips, grade 1 = 16 hips, grade 2 = 3 hips. **n = 75 hips (36 labral debridement, 39 labral refixation) – both arms also had additional femoro-acetabular surgery as required** Age: 29 years Sex: 64% male Patient selection criteria: patients without radiographic evidence of complex tearing, intralabral ossification or calcification, or degenerative changes. Technique: arthroscopic treatment of impingement with fluoroscopic guidance. Correction of the pincer lesion and cam impingement where present. With labral debridement along the area of impingement vs labral refixation with suture anchors after acetabular rim trimming. Follow-up: **1 year minimum, 19 months (mean)** Conflict of interest/source of funding: none	Number of patients analysed: **75 (36 debridement, 39 refixation)** **Clinical outcomes** The group mean HHS was significantly better in the labral refixation group (94.3 points) than in the debridement group (88.9 points) at 1-year follow-up (p = 0.029). At baseline there was no statically significant difference in HHS between the groups (≈ 63 points in both groups – read from figure) Significantly more hips in the refixation group 89.7% (35/39) than in the debridement group 66.7% (24/36) reported a HHS of > 80 points (a good or excellent outcome) at 19-month follow-up. **Requirement for further surgery** Debridement / Refixation Revision osteochondroplasty: 5.6% (2/36) / 0% (0/39) Total hip athroplasty: 0% (0/36) / 2.6% (1/39) Re-injury during sport arthroscopic debridement: 0% (0/36) / 2.6% (1/39) **Quality of life** There was no statistically significant difference between the groups in Short Form-12 score or pain score at any time during follow-up. **Radiographic assessment** There was no significant difference in offset angle between the groups following labral debridement or refixation. Also there was no statistically significant difference in degenerative changes between the groups.	**Complications** Rate of outcome per hip Outcome / Debridement / Refixation Heterotopic bone development (revision arthroscopy in 2 patients): 8.3% (3/36) / 0% (0/39)	**Follow-up issues**: Prospective follow-up. With yearly radiographic assessment. Patient accrual method not reported, 143 patients (149 hips) were treated but not all fulfilled the inclusion criteria. **Study design issues**: All procedures performed by the same clinician. Historical control group – before the development of the refixation technique Postoperative rehabilitation was different for the 2 groups with the labral refixation group instructed to limit to toe-touch weight bearing for 2 weeks. **Study population issues**: No comparison between groups at baseline. **Other issues**: Probably some of the same patients reported in Larson (2008). Authors state that there is a steep learning curve for arthroscopic surgery for hip impingement. Improvements in the refixation group could be affected by better technique.

Abbreviations used: HHS, Harris hip score; OA, osteoarthritis; NSAID, no steroidal anti-Inflammatory drug

Study details	Key efficacy findings	Key safety findings	Comments
Nepple J J (2009)[2] **Non-randomised controlled study** USA Recruitment period: not reported Study population: patients with isolated cam impingement. Tönnis grade 0 = 33 hips, grade 1 = 14 hips, grade 2 = 1 hip. n = **48 hips (23 arthroscopic, 25 combined)** Age: 35 years Sex: 60% male Patient selection criteria: not reported Technique: arthroscopic treatment of impingement with with partial Labral resection and chondroplasty vs arthroscopic treatment of impingement wit with partial labral resection and chondroplasty with limited open osteochondroplasty. No labral repair/fixation in either group. Follow-up: **2 years (mean)** Conflict of interest/source of funding: supported by charitable fund and manufacturer	Number of patients analysed: **48 (23 arthroscopic, 25 combined) at 1 year (11 arthroscopic, 15 combined) at 2-year follow-up.** **Clinical outcomes** Group median HHS (points) Arthroscopic / Combined / p = Baseline 61.6 / 66.0 / 0.179 1 year 84.7 / 95.7 / 0.019 2 year 82.5 / 93.5 / 0.056 p = < 0.001 / < 0.001 An improvement in HHS of 10 or more points was reported more frequently in the combined group 96.0% (24/25), than in the arthroscopic group 65.2% (15/23) (p = 0.009) (length of follow-up not reported). There were 5 clinical failures in the arthroscopic group (2 total hip arthroplasties at 0.8 and 2.7 years, 1 open head-neck osteochondroplasty at 1.8 years, 1 repeat arthroscopy at 1.6 years, and 1 combined procedure at 3.9 years). No failures were reported in the combined group.	**Complications** Adverse events were not reported on.	**Follow-up issues**: Retrospective follow-up. **Study design issues**: Historical control group – before the development of the combined technique with limited open osteochondroplasty. The mean follow-up was significantly longer in the arthroscopic group (p = 0.014) **Study population issues**: There we no statistically significant differences between groups at baseline in terms of clinical or demographic characteristics, except that a higher proportion patients in the combined group had grade 3-4 acetabular chondromalacia (p = 0.036). **Other issues**: Study is comparing different degrees of intervention.

Abbreviations used: HHS, Harris hip score; OA, osteoarthritis; NSAID, no steroidal anti-Inflammatory drug

Study details	Key efficacy findings	Key safety findings	Comments
Randelli F (2010)[3] **Non-randomised controlled study** Italy Recruitment period: 2006 to 2009 Study population: patients with femoro-acetabular impingement n = **300 (n = 285 NSAID, 15 no NSAID)** Age: 37 years Sex: 60 % male Patient selection criteria: Not reported. Technique: arthroscopic treatment of impingement with 2 or 3 port entry, traction, and capsulotomy with NSADI prophylaxis for 7 days vs. no NSAIDs Follow-up: **18 months (mean)** Conflict of interest/source of funding: None	Number of patients analysed: **300 (n = 285 NSAID, 15 no NSAID)** Efficacy outcomes were not reported on.	**Complications** **Heterotopic ossification.** Overall rate of heterotopic ossification was 1.7% (5/300) NSAID: 0% (0/285); No NSAID: 33.3% (5/15); p = < 0.001 Heterotopic ossification occurred between 2 and 12 months follow up following arthroscopic femoro–acetabular surgery.	**Follow-up issues**: Consecutive patients treated. Retrospective study, patients with medical records unavailable were excluded. **Study design issues**: Two centre study All procedures performed by surgeons experienced in arthroscopy. **Study population issues**: There were no statistically significant differences between the groups in terms of demographic characteristics at baseline or surgical technique used (rim trimming, or osteoplasty). **Other issues**: No further details are provided regarding surgical technique/extensiveness of revision surgery.

Abbreviations used: HHS, Harris hip score; OA, osteoarthritis; NSAID, no steroidal anti-Inflammatory drug

Study details	Key efficacy findings	Key safety findings	Comments
Byrd J W T (2009)[4] **Case series** USA Recruitment period: 2003 to 2007 Study population: patients with refractory hip pain with imaging evidence or clinical findings of persistent hip symptoms unresponsive to non-operative measures. Mean period from onset of symptoms = 23 months. Cam impingement n = 163, cam-pincer impingement n = 44. n = **200 (207 hips)** Age: bimodal peak at 20 and 43 years, Sex: not reported. Patient selection criteria: patients without disease stage to advanced to reasonably benefit from arthroscopic intervention, or bone-on-bone contact. Technique: arthroscopic surgery with articular damage treated by chondroplasty and microfracture. Labrum conservatively debrided. Recountouring of the cam lesion with a spherical burr. **Follow-up: 16 months (mean)** Conflict of interest/source of funding: supported by manufacturer	Number of patients analysed: **200 (207 hips) at 1 year follow-up.** **Clinical outcomes** The mean change in HHS from baseline to 16 months follow-up was 20 points (range −17 to 60 points). 83% of patients reported an improvement in score (absolute figures not reported). The scores were similar for patients with pure cam impingement (mean 20 points range −17 to 60 points), and those with combined cam-pincer impingement (mean 19 points range −15 to 49 points). 1 out of 200 patients (a patient with grade IV articular loss of both the acetabular and femoral surfaces) underwent total hip arthroplasty at 8 month follow-up due to continued pain. 1.5% (3/200) of patients underwent a second arthroscopic procedure due to mechanical symptoms.	**Complications** Outcome — Rate per hip Transient neuropraxia of pudendal nerve resolved at 2-week follow-up — 1 out of 207 Partial neuropraxia of lateral femoral cutaneous nerve resolved at 1-month follow-up — 1 out of 207 Heterotopic ossification — 1 out of 207	**Follow-up issues**: Prospective follow-up; 100% follow-up to 1 year. **Study design issues**: No details of independent outcome assessment. The HHS may have a ceiling effect in patients with a high level of function. **Study population issues**: Selected patient cohort without advanced hip degeneration. **Other issues**: None

Abbreviations used: HHS, Harris hip score; OA, osteoarthritis; NSAID, no steroidal anti-Inflammatory drug

Study details	Key efficacy findings	Key safety findings	Comments
Sampson (2006)[5] **Case series** USA Recruitment period: 2002 to 2006 Study population: patients with hip impingement syndrome length of symptoms: 3 months to 25 years. n = **183 (194 hips)** Age: range 14 to 73 years Sex: not reported Patient selection criteria: all patients had a positive impingement clinical sign, and a small pop at point of maximal pain when the flexed hip is rolled from maximal internal rotation into extension. Technique: arthroscopic treatment using 3 portals. Labral lesions were debrided with a shaver or radio-thermal device; articular cartilage was debrided or smoothed. Resection osteoplasty was undertaken where needed with a rounded burr. Patients used crutches for 2–4 weeks postoperatively. Follow-up: **29 months (maximum)** Conflict of interest/source of funding: not reported	Number of patients analysed: **183 (194 hips)** **Clinical outcomes** 94% of patients' impingement sign-on test was eliminated (absolute numbers not reported). There was a 'high degree' of satisfaction with the surgical outcome. More extensive damage to the articular surface at baseline resulted in poorer outcomes and / or longer recovery time. In 'most patients' pain decreased by 50% at 2 to 5 weeks follow-up, 75% by 5 months, and 95% by one year (absolute figures not reported). 3.3% (6/183) of patients had subsequent total hip arthroplasty.	**Complications** Outcome — rate Pathological fracture (not otherwise described)(length of follow-up not reported) — 1.1% (2/183) No other complications were reported.	**Follow-up issues**: No details of case selection were provided. **Study design issues**: All procedures were undertaken by two surgeons. Qualitative evaluation of outcomes only. Outcomes used in pain reduction assessment and measurement is not clear in the study report **Study population issues**: None **Other issues**: Authors state that these early results are similar to those reported using the open procedure.

Abbreviations used: HHS, Harris hip score; OA, osteoarthritis; NSAID, no steroidal anti-Inflammatory drug

Study details	Key efficacy findings	Key safety findings	Comments
Philippon M J (2009)[6] **Case series** USA Recruitment period: 2005 Study population: patients with hip impingement with associated labral and chondral pathology. Mean time since injury = 34 months. Cam impingement n = 23, pincer impingement n = 3, mixed impingement n = 86. n = **112** Age: 41 years Sex: 45% male Patient selection criteria: patients without bilateral surgery, avascular necrosis, or previous hip surgery. Technique: with the patient under general anaesthesia, lumber plexus block, and traction; 2 ports inserted. Arthroscopic removal of pincer and or cam impingement with round burr. Other pathologies of the articular cartilage and labarum also treated with debridement using thermal or shaving techniques or repair. A standard postoperative protocol used with restricted weight bearing followed by physiotherapy. Follow-up: **2.3 years (mean)** Conflict of interest/source of funding: supported by manufacturer	Number of patients analysed: n = **112 completed follow-up questionnaires and were analysed; n = 90 at 2 years.** **Clinical outcomes** Group mean scores Baseline 2.3 years p= HHS 58.0 84.3 <0.001 Baseline HHS score (p = 0.017), joint space > 2mm (p = 0.002), and labral repair rather than debridement (p = 0.03) were independent predictors of follow-up HHS. 8.9% (10/112) of patients underwent total hip arthroplasty at a mean follow-up of 16 months. Patient age, reduced joint space, and worse degenerative cartilage changes were all independent predictors of requirement for athroplasty (p=0.001 for each). **Quality of life** Group mean scores Baseline 2.3 years p = Activities of daily living 70.0 87.8 < 0.001 Sport activities 43.0 69.0 < 0.001 Of the 90 patients followed up 26.7% (24/90) were at school or had retired 73.3% (66/90) were in work.	**Complications** There we no reports of infection, pulmonary embolism, deep vein thrombosis, fracture, or paraesthesia following the procedure.	**Follow-up issues**: 122 of 209 patients treated met the inclusion criteria, 10 were lost to follow-up and 112 were analysed. Consecutive patient accrual. **Study design issues**: Quality of life outcome assessment tools not described. **Study population issues**: Patients with unilateral hip impingement. **Other issues**: Authors state that it is unclear how this procedure will affect the long-term outcome of the hip joint.

Abbreviations used: HHS, Harris hip score; OA, osteoarthritis; NSAID, no steroidal anti-Inflammatory drug

Study details	Key efficacy findings	Key safety findings	Comments
Laude F (2009)[7] **Case series** France Recruitment period: 1999 to 2004 Study population: patients with hip impingement and persistent pain. n = 5 patients had undergone previous hip surgery. n = **97 (100 hips)** Age: 33 years Sex: 52% male Patient selection criteria: patients with a positive hip impingement test. Technique: Procedure carried out without fluoroscopy and under traction. Arthroscopy through 1 port plus 2 to 4 cm anterolateral incision and capsulotomy for instrumentation. Osteochondroplasty of the femoral head-neck junction. Labral refixation in 40 hips. Follow-up: **58 months** Conflict of interest/source of funding: none	Number of patients analysed: **91 (94 hips) at final follow-up.** **Clinical outcomes** Clinical function assessed using the non-arthritic hip score based on four domains (pain, mechanical symptoms, physical function, and level of activities) scored 0 to 100, higher scores better. Group mean (and Standard deviation) points 		Baseline	58 months	p =
Hip score	54.8 ± 12	83.9 ± 16	< 0.000001 | At final follow-up (58 months) |	Refixation	Debridement	p =
Hip score	86 ± 11	82 ± 19	< 0.13 | 13.4% (13/97) of patients underwent a revision procedure (arthroscopic debridement and osteochondroplasty where necessary) for persistent pain at mean follow-up of 30 months. In 61.5% (8/13) of these the refixed labrum had failed and it was removed. 11% (11/100) of hips developed OA and underwent total hip arthroplasty (2 had hip resurfacing).	**Complications** | Outcome	rate
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Femoral neck fracture at 23-week follow-up – healed without surgery but slight varus malunion.	1 out of 97
Deep wound infection – surgical debridement	2.1% (2/97)
Heterotopic ossification at 33 months – revision	1 out of 97	 There were no reports of avascular necrosis.	**Follow-up issues**: Retrospective follow-up. 6 patients lost to follow-up. **Study design issues**: All procedures undertaken by the same clinician. **Study population issues**: Patients were highly selected. **Other issues**: Only study not to use the HHS for outcome assessment, which makes comparison with other studies difficult.

Abbreviations used: HHS, Harris hip score; OA, osteoarthritis; NSAID, no steroidal anti-Inflammatory drug

Study details	Key efficacy findings	Key safety findings	Comments
Gedouin JE (2010)[8] **Case series** European Recruitment period: 2008 to 2009 Study population: patients with disabling femoro–acetabular impingement for > 6 months duration. Mean interval from onset of symptoms to surgery = 2.5 years. **n = 110 (111 hips)** Age: 31 years Sex: 71 % male Patient selection criteria: femoro–acetabular impingement with clinical and radiographic assessment, with osteoarthritis Tönnis grade > 2. Technique: arthroscopic treatment of impingement with capsulectomy, and osteoplasty with motorised burr. Acetubuloplasty in patients with pincer-type impingement (n = 5). Labral suturing where deeply torn (n = 14). **Follow-up: 10 months (mean)** Conflict of interest/source of funding: None	Number of patients analysed: **n = 110 (111 hips)** **Clinical outcomes** Clinical function assessed by the Western Ontario and McMaster Universities Osteoarthritis index at baseline and at 10-month follow-up (group mean and standard deviation) | | Baseline | 10months | p = | | --- | --- | --- | --- | | Clinical score | 60.3 ± 14.8 | 83.0 ± 16.4 | < 0.001 | There was no statistically significant difference in functional score between patients having labral debridement (82.7 points) or labral refixation (86.3 points) (p=0.4) | Patient satisfaction | Proportion | | --- | --- | | Very satisfied/satisfied | 77.3% (85/110) | | Moderately satisfied | 27.3% (25/110) | | Disappointed | 12%* | * absolute numbers not reported Totals sum to > 100% **Radiographic assessment** There were no cases of worsening osteoarthritis, including patients requiring revision surgery. | | Baseline | 10 months | p = | | --- | --- | --- | --- | | α angle | 64.6 ± 12.0° | 50.6 ± 6.3° | < 0.001 | **Operative characteristics** 99.1% (110/111) of hips had arthroscopic surgery performed as intended.	**Complications** **Revision surgery** 4.5% (5/110) of patients required revision surgery with hip replacement at a mean follow-up of 1 year following arthroscopic femoro–acetabular impingement surgery, where grade 1 osteoarthritis was not relived by the procedure. | Outcome | Rate – per hip | | --- | --- | | Heterotopic ossification | 2.7% (3/111) | | Femoral neurapraxia* | 0.9% (1/111) | | Pudendal neurapraxia* | 0.9% (1/111) | | Labium majus skin necrosis* | 0.9% (1/111) | | Non displaced stress fracture of femoral head neck junction (conservative management) | 0.9% (1/111) | * resolved without sequelae in a few months	**Follow-up issues**: Consecutive patients treated. No loss to follow-up. **Study design issues**: Multicentre study Operative technique not standardised across all centres. **Study population issues**: Patient clinical characteristics were homogenous across participating sites. **Other issues**: Authors state that follow-up may be too short, with functional results stabilising at between 6 and 12 months.

Abbreviations used: HHS, Harris hip score; OA, osteoarthritis; NSAID, no steroidal anti-Inflammatory drug			
Study details	**Key efficacy findings**	**Key safety findings**	**Comments**
Scher D L (2010)[9] **Case report** USA Recruitment period: not reported Study population: patient with disabling femoro–acetabular impingement. **n = 1 (1 hip)** Age: 24 years Sex: 100 % male Patient selection criteria: femoro–acetabular impingement with clinical and radiographic assessment, with osteoarthritis Tönnis grade > 2. Technique: arthroscopic treatment of impingement. Under general anaesthetic, and with traction against a padded perineal post with fluoroscopic guidance until 10 mm of distraction noted. 2-port access, debridement of the torn labrum, and resection of the pincer lesion with an arthroscopic burr. . **Follow-up: 3 months** Conflict of interest/source of funding: none	Patient had hip pain refractory to physiotherapy and NSAIDs, which was worse after prolonged sitting. Physical examination showed impingement sign, and limited internal rotation of the hip. Radiographs were suggestive of pincer-type lesion. There was no abnormal bleeding during the procedure and traction removed after 90 minutes. At 2-week follow-up, the patients walked independently without crutches but had mild pain on range of motion examination. At 3-month follow-up, the patient had increasing pain and a mild antalgic gait. Magnetic resonance imaging demonstrated femoral head osteonecrosis. The patient underwent repeat athroscopy with core decompression and autologous bone marrow graft. At 12-month follow-up (9 months after revision surgery) the patient continued to have pain and decreased range of motion, but no evidence of articular collapse.		**Follow-up issues**: None. **Study design issues**: Not clear how many patients treated at the centre (denominator). **Study population issues**: Patient was an active duty soldier requiring aerobic and strength training as part of their job. **Other issues**: No discussion of potential cause of osteonecrosis.

Efficacy

Clinical outcome

A non randomised controlled study of 75 hips reported that mean Harris hip score (HHS) was significantly better in patients treated by arthroscopic femoro–acetabular surgery with labral refixation (94.3 points) than in patients treated by arthroscopic femoro–acetabular surgery with labral debridement (88.9 points) at 1-year follow-up ($p = 0.029$)[1].

A non-randomised controlled study of 48 hips reported that a significantly higher proportion of patients recorded an improvement in HHS of 10 or more points following combined arthroscopic and limited open surgery 96% (24/25) than following totally arthroscopic surgery 65% (15/23) ($p = 0.009$) (length of follow-up not reported)[2].

A case series of 200 patients (207 hips) reported that there was a mean improvement in HHS of 20 points (range −17 to 60 points) from baseline to 16-month follow-up (measurement of significance not reported)[4]. In the same study, 1 out of 200 patients required total hip arthroplasty at 8-month follow-up due to persistent pain. A case series of 112 patients reported that mean HHS improved significantly from 58.0 points at baseline to 84.3 points at 2.3-year follow-up after arthroscopic femoro–acetabular surgery ($p < 0.001$)[6]. However, 9% (10/112) of patients underwent total hip arthroplasty at a mean follow-up of 16 months.

A case series of 97 patients (100 hips) reported that mean 'non-arthritic hip score' improved significantly from 54.8 points at baseline to 83.9 points at 58-month follow-up ($p < 0.000001$)[7]. 11% (11/100) of hips developed osteoarthritis and underwent total hip arthroplasty (or hip resurfacing) (length of follow-up not reported).

Quality of life

The case series of 112 patients reported a significant improvement in mean activities of daily living score from 70.0 points at baseline to 87.8 points at 2.3-year follow-up ($p < 0.001$)[6]. Similarly, mean sport activity score improved from 43.0 points at baseline to 69.0 points at 2.3-year follow-up ($p<0.001$).

A case series of 110 patients reported that 77% (85/110) of patients were satisfied or very satisfied with their treatment at 10-month follow-up[8].

Radiographic evaluation

The case series of 110 patients reported that there was a significant improvement in femoral head–neck offset angle from 64.6° at baseline to 50.6° at 10-month follow-up ($p < 0.001$)[8].

Safety

Fracture

A case series of 183 patients reported pathological fracture (not otherwise described) in 1% (2/183) patients (length of follow-up not reported)[5]. A case series of 97 patients (100 hips) reported that femoral neck fracture (healed without surgery) in 1 patient[7].

Lower limb nerve neuropraxia (traction-related)

The case series of 200 patients (207 hips) reported partial neuropraxia of the lateral femoral cutaneous nerve (resolved at 1-month follow-up) in 1 out of 207 hips[4]. The case series of 112 patients reported that there were no cases of paraesthesia following the procedure[6]. The case series of 110 patients reported femoral neuropraxia in 1% (1/111) of hips treated which resolved within a 'few months'[8].

Avascular necrosis

The case series of 97 patients (100 hips)[7] reported that there were no occurrences of avascular necrosis following the procedure.

A case report describes osteonecrosis of the femoral head following arthroscopic femoro–acetabular surgery for pincer impingement, which required arthroscopic decompression and bone marrow graft.

Soft tissue ossification

The non-randomised controlled series of 75 hips reported that heterotopic bone development occurred in 8% (3/36) of patients treated with labral debridement and in 0% (0/39) of patients undergoing labral refixation at 19-month follow-up (measurement of significance not reported)[1]. Heterotopic ossification was reported in 1 out of 207 hips in the case series of 200 patients with a mean follow-up of 16 months[4].

Validity and generalisability of the studies

- Little controlled data are available comparing the procedure with other interventions or against natural history.
- A range of outcome assessment scales are used; validation of these scales is often not reported.
- The description of hip impingement pathology/lesions is not well defined in all studies.

- The intervention required is usually individualised to each patient, making comparison between studies difficult.
- Study quality is generally poor, with little prospective data collection in case series.

Existing assessments of this procedure

There were no published assessments from other organisations identified at the time of the literature search.

Related NICE guidance

Below is a list of NICE guidance related to this procedure. Appendix B gives details of the recommendations made in each piece of guidance listed.

Interventional procedures

- Open femoro–acetabular surgery for hip impingement syndrome. NICE interventional procedures guidance 203 (2007). Available from www.nice.org.uk/guidance/IPG203

Specialist Advisers' opinions

Specialist advice was sought from consultants who have been nominated or ratified by their Specialist Society or Royal College. The advice received is their individual opinion and does not represent the view of the society.

Prof. D Griffin, Mr F Haddad, Mr J Timperley, Mr R Villar, Mr J Witt (British Hip Society).

- Four Specialist Advisers classified the procedure as established and no longer new, while one considered it to be novel and of uncertain safety and efficacy.
- The main comparator with this procedure is conservative management, or open femoro–acetabular surgery
- Adverse events seen or reported in the literature include genital trauma from traction post, neurological damage (sometimes related to traction), infection, fracture, post-operative hip dislocation, haemorrhage, pressure injuries to the perineum and instrument breakage.

- Additional theoretical adverse events might include avascular necrosis, deep vein thrombosis or pulmonary embolism, and iatrogenic articular cartilage damage.
- The key efficacy outcomes for this procedure include pain relief and delayed progression to osteoarthritis.
- One Specialist Adviser commented that they had limited exposure to open femoro–acetabular impingement (FAI) surgery because arthroscopic treatments have now largely taken over in their practice.
- Minimum requirements should be proper cadaveric lab training and mentoring of individuals wishing to start a service by more experienced/established surgeons. There is a well recognised, significant learning curve to the procedure.
- The treatment remains relatively specialised and the arthroscopic approach to treatment has made a major difference in terms of the morbidity associated with surgical correction. The concern remains about surgeons receiving adequate training and performing sufficient numbers of cases of this type of procedure to reach a level of adequate proficiency.
- There is presently discussion as to whether arthroscopic FAI surgery can adequately emulate open FAI surgery. It appears that it can do so in properly trained hands. However, it is likely that open FAI surgery will disappear as arthroscopic FAI surgery expands, so this question may eventually be irrelevant.
- There is no proof yet that this procedure is efficacious, but the technique may have a place in preventing the development of osteoarthritis of the hip in some patients.
- Use of this procedure will become much more widespread, but should remain within the remit of the specialist dealing with hip disorders in young adults.

Patient Commentators' opinions

NICE's Patient and Public Involvement Programme was unable to gather patient commentary for this procedure.

Issues for consideration by IPAC

- The committee is also being asked to consider open hip impingement treatment at the same meeting. There are no studies comparing the two different approaches.
- There is no other operative comparative treatment to this procedure; it may be considered a stopgap before total hip athroplasty, although a small proportion of patients in these series who were considered failures subsequently required arthroplasty during relatively short follow-up.
- Many studies are published within the last 2 years.

References

1. Larson CM and Giveans MR. (2009) Arthroscopic debridement versus refixation of the acetabular labrum associated with femoroacetabular impingement. Arthroscopy 25: 369–76.

2. Nepple JJ, Zebala LP, and Clohisy JC. (2009) Labral disease associated with femoroacetabular impingement: do we need to correct the structural deformity? Journal of Arthroplasty 24: Suppl-9.

3. Randelli F, Pierannunzii L, Banci L et al. (2010) Heterotopic ossifications after arthroscopic management of femoroacetabular impingement: the role of NSAID prophylaxis. Journal of Orthopaedics and Traumatology 11: 245–50.

4. Byrd JW and Jones KS. (2009) Arthroscopic femoroplasty in the management of cam-type femoroacetabular impingement. Clinical Orthopaedics and Related Research 467: 739–46.

5. Sampson TG. (2006) Arthroscopic treatment of femoroacetabular impingement: a proposed technique with clinical experience. Instructional Course Lectures 55: 337–46.

6. Philippon MJ, Briggs KK, Yen YM et al. (2009) Outcomes following hip arthroscopy for femoroacetabular impingement with associated chondrolabral dysfunction: minimum two-year follow-up. Journal of Bone and Joint Surgery - British Volume 91: 16–23.

7. Laude F, Sariali E, and Nogier A. (2009) Femoroacetabular impingement treatment using arthroscopy and anterior approach. Clinical Orthopaedics and Related Research 467: 747–52.

8. Gedouin J-E, May O, Bonin N et al. (2010) Assessment of arthroscopic management of femoroacetabular impingement. A prospective multicenter study. Orthopaedics and Traumatology: Surgery and Research 96: S59–S67.

9. Scher DL, Belmont PJ, Jr., and Owens BD. (2010) Case report: Osteonecrosis of the femoral head after hip arthroscopy. Clinical Orthopaedics and Related Research 468: 3121–5.

Appendix A: Additional papers on arthroscopic femoro–acetabular surgery for hip impingement syndrome

The following table outlines the studies that are considered potentially relevant to the overview but were not included in the main data extraction table (table 2). It is by no means an exhaustive list of potentially relevant studies.

Article	Number of patients / follow-up	Direction of conclusions	Reasons for non-inclusion in table 2
Baldwin KD, Harrison RA, Namdari S, et al (2009) Outcomes of hip arthroscopy for treatment of femoroacetabular impingement: a systematic review. Current Orthopaedic Practice 20 (6) 669-674	n = 274 FU = 1 to 2.5 years	Although hip arthroscopy seems to be a promising alternative to open surgical dislocation techniques, currently there is insufficient literature to support this modality as superior to open techniques.	Descriptive systematic review studies included are in table 2 or appendix A of this overview.
Bardakos NV, Vasconcelos JC, and Villar RN et al. (2010) Early outcome of hip arthroscopy for femoroacetabular impingement: the role of femoral osteoplasty in symptomatic improvement. Journal of Bone and Joint Surgery - British Volume 90 (12) 1570–5	n = 24 FU = 1 year	Additional symptomatic improvement may be obtained after hip arthroscopy for femoroacetabular impingement by the inclusion of femoral osteoplasty.	Larger studies are included in table 2
Barton C, Banga K, and Beaule PE. (2009) Anterior Hueter approach in the treatment of femoro–acetabular impingement: rationale and technique. Orthopedic Clinics of North America 40 (3) 389–95.	n = 23 FU = 22 months	This article discusses the indications and diagnostic criteria and the surgical technique and early clinical results for the combined arthroscopic/Hueter approach.	Larger studies are included in table 2
Botser IB, Smith TW Jr, Nasser R et al (2011) Open surgical dislocation versus arthroscopy for femoroacetabular impingement: a comparison of clinical outcomes. Arthroscopy 27 (2) 270-278	n = 1409 FU = N/R	All 3 surgical approaches led to consistent improvements in patient outcomes. Because a wide variety of subjective hip questionnaires were used, direct comparisons could not be made in many cases, and none of the approaches could be clearly shown to be superior to the others. However, it seems that, overall, the arthroscopic method had the lowest complication and fastest rehabilitation rate	The same studies summarised as included in table 2 with no pooling of data
Brunner A, Horisberger M, and Herzog RF. (2008) Evaluation of a computed tomography-based navigation system prototype for hip arthroscopy in the treatment of femoroacetabular cam impingement. Arthroscopy 25 (4): 382–91	n = 50 FU = 2.2 years	A significant percentage of patients (24%) showed an insufficient correction of the alpha angle after hip arthroscopy for cam FAI.	Larger studies are included in table 2 Probably the same patients as reported in Brunner (2009)
Brunner A, Horisberger M, and Herzog R F (2009) Sports and recreation activity of patients with femoroacetabular	n = 53 FU = 2.4 years	Arthroscopic osteoplasty can significantly improve the rate and level of popular sports activities in patients with FAI. The level of postoperative sports activity	Larger studies are included in table 2

impingement before and after arthroscopic osteoplasty. American Journal of Sports Medicine 37 (5): 917–22		directly correlates with the clinical outcome in terms of pain and function.	
Clohisy JC, Zebala LP, Nepple JJ et al (2010) Combined hip arthroscopy and limited open osteochondroplasty for anterior femoroacetabular impingement. Journal of Bone and Joint Surgery – American Volume 92 (8): 1697–1706	n = 35 FU = 2 years	Early results indicate that combined hip arthroscopy and limited open osteochondroplasty of the femoral head-neck junction is a safe and effective treatment for femoroacetabular impingement. In our small series, most patients had symptomatic relief, improved hip function, and enhanced activity after two years of follow-up.	Larger studies are included in table 2
Fowler J. and Owens BD. (2010) Abdominal Compartment Syndrome After Hip Arthroscopy. arthroscopy 26(1): 128–130	n = 1 FU = 6 days	A distended abdomen was noted on drape removal, and the patient required a decompressive laparotomy for abdominal compartment syndrome.	Larger studies are included in table 2
Fritz AT, Reddy D, Meehan JP et al. (2010) Femoral neck exostosis, a manifestation of cam/pincer combined femoroacetabular impingement. Arthroscopy 26 (1): 121–7	n = 2 FU = not reported	We recommend that the presence of these exostoses be carefully noted by the arthroscopic hip surgeon and that they be a geographic marker of the zone of contact between the head-neck junction and the acetabular rim and a guide for the area of head osteochondroplasty in combination with appropriate treatment of the acetabular rim	Larger studies are included in table 2
Gedouin JE, Duperron D, Langlais F et al. (2010) Update to femoroacetabular impingement arthroscopic management. Orthopaedics and traumatology, surgery and research 96 (3): 222–7	n = 38 FU = 1.3 years	Arthroscopic treatment of FAI is a safe technique which can be achieved without perineal complications. Limited anterior-superior capsulectomy and cephalic bone resection represent the first operative step, allowing acetabular trimming, labral reattachment and FAI relief. It is effective in terms of early clinical results.	Larger studies are included in table 2
Guanche CA and Bare AA. (2006) Arthroscopic treatment of femoroacetabular impingement. Arthroscopy 22: 95–106	n = 10 FU = 16 months	Mean non-arthritic score on the McCarthy scale improved from 75 points to 95 points at 14 months follow-up.	Larger studies are included in table 2
Hartmann A and Gunther K-P (2009) Arthroscopically assisted anterior decompression for femoroacetabular impingement: Technique and early clinical results. Archives of Orthopaedic and Trauma Surgery 129 (8): 1001–9.	n = 33 FU = 15 months	Treatment of anterior femoroacetabular impingement through an arthroscopically assisted mini-open anterior approach can reduce pain and improve function in a short-term observation period. Femoral osteochondroplasty as well as surgical treatment of acetabular cartilage and labrum lesions are possible, but the access is limited to the anterior and anterolateral	Larger studies are included in table 2

		part of the hip joint.	
Haviv B. and O'Donnell J. (2010) Arthroscopic treatment for symptomatic bilateral cam-type femoroacetabular impingement. Orthopedics 33 (12) 874	n = 82 FU = 12 months	Our results suggest that symptomatic patients with cam-type femoroacetabular impingement have similar accompanied pathologies on both sides and can benefit from sequential arthroscopic osteochondroplasty.	Larger studies are included in table 2
Horisberger M, Brunner A, and Herzog RF. (2010) Arthroscopic treatment of femoroacetabular impingement of the hip: a new technique to access the joint. Clinical Orthopaedics and Related Research 468 (1): 182–90.	n = 88 FU = 2.3 years	The outcome measures after arthroscopic therapy for femoroacetabular impingement seem comparable to those reported after open procedures.	Larger studies are included in table 2
Horisberger M, Brunner A, and Herzog RF. (2010) Arthroscopic treatment of femoral acetabular impingement in patients with preoperative generalized degenerative changes. Arthroscopy 26 (5): 623–9	n = 20 FU = 3 years	In patients with already marked generalized chondral lesions, arthroscopy does not have any effect beyond the short-term pain relief resulting from debridement. The study underlines the fact that FAI with advanced osteoarthrosis, particularly Tönnis grade 3, is not an indication for arthroscopic FAI correction	Larger studies are included in table 2 Possibly same patients as reported in Horisberger (2010)
Ilizaliturri Jr, Orozco-Rodriguez L, Acosta-Rodriguez E et al. (2008) Arthroscopic treatment of cam-type femoroacetabular impingement. Preliminary report at 2 years minimum follow-up. Journal of Arthroplasty 23 (2): 226–34.	n = 19 FU = 2 years	Hip arthroscopy can be successfully used to treat cam impingement. The precautions used in open surgery to preserve femoral neck bone stock and hip vascularity should be followed.	Larger studies are included in table 2
Ilizaliturri VM Jr, Nossa-Barrera JM, Acosta-Rodriguez E et al. (2007) Arthroscopic treatment of femoroacetabular impingement secondary to paediatric hip disorders. Journal of Bone and Joint Surgery, British Volume 89B (8): 1025–31.	n = 13 FU = 2.5 years	N/R	Larger studies are included in table 2 Atypical patient population.
Javed A and O'Donnell JM. (2011) Arthroscopic femoral osteochondroplasty for cam femoroacetabular impingement in patients over 60 years of age. Journal of Bone and Joint Surgery – British Volume 93 (3) 326–31	n = 40 FU = 30 months	Arthroscopic femoral osteochondroplasty performed in selected patients over 60 years of age, who have hip pain and mechanical symptoms resulting from cam femoroacetabular impingement, is beneficial with a minimal risk of complications at a mean follow-up of 30 months.	Larger studies are included in table 2

Larson CM and Giveans MR. (2008) Arthroscopic management of femoroacetabular impingement: early outcomes measures. Arthroscopy 24 (5) 540–6.	n = 96 FU = 10 months	Arthroscopic management of patients with femoro–acetabular impingement results in significant improvement in outcomes measures, with good to excellent results being observed in 75% of hips at a minimum 1-year follow-up. Alteration in the natural progression to osteoarthritis and sustained pain relief as a result of arthroscopic management of FAI remain to be seen.	Larger studies are included in table 2
Lincoln M, Johnston K, Muldoon M et al. (2009) Combined arthroscopic and modified open approach for cam femoroacetabular impingement: a preliminary experience. Arthroscopy 25 (4): 392–9.	n = 14 FU = 2 years	The combination of hip arthroscopy with a limited anterior approach (Heuter) is a useful technique for patients with cam or cam-dominant FAI lesions. We believe the limited anterior approach with open osteoplasty presents a reasonable alternative to arthroscopic methods of osteoplasty with minimal drawbacks in the event that total hip arthroplasty is indicated in the future.	Larger studies are included in table 2
Matsuda DK. (2009) Acute iatrogenic dislocation following hip impingement arthroscopic surgery. Arthroscopy 25 (4): 400–4.	n = 1 FU = 1 year	Lessons learned are discussed in hopes of minimizing the occurrence of this rare but dramatic complication.	Larger studies are included in table 2
Matsuda DK, Carlisle JC, Arthurs SC et al. (2011) Comparative systematic review of the open dislocation, mini-open, and arthroscopic surgeries for femoroacetabular impingement. Arthroscopy 27 (2) 252–69	n = N/R FU = N/R	The arthroscopic method had surgical outcomes equal to or better than the other methods with a lower rate of major complications when performed by experienced surgeons	The same studies summarised as included in table 2 with no pooling of data
Philippon MJ, Yen YM, Briggs, KK et al. (2008) Early outcomes after hip arthroscopy for femoroacetabular impingement in the athletic adolescent patient: a preliminary report. Journal of Pediatric Orthopedics 28 (7): 705–10	n = 16 FU = 1.4 years	Hip arthroscopy for FAI in the adolescent population produces excellent improvement in function and a high level of patient satisfaction in the short-term.	Larger studies are included in table 2
Philippon M, Schenker M, Briggs K et al. (2007) Femoroacetabular impingement in 45 professional athletes: associated pathologies and return to sport following arthroscopic decompression. Knee Surgery, Sports Traumatology, Arthroscopy 15	n = 45 FU = 1.6 years	Three athletes did not return to play; however, all had diffuse osteoarthritis at the time of arthroscopy. Thirty-five athletes (78%) remain active in professional sport at an average follow-up of 1.6 years. Arthroscopic treatment of FAI allows professional athletes to return to professional sport	Larger studies are included in table 2

(7) 908–14.			
Philippon MJ, Weiss DR, Kuppersmith DA et al. (2010) Arthroscopic labral repair and treatment of femoroacetabular impingement in professional hockey players. American Journal of Sports Medicine 38 (1): 99–104	n = 28 FU = 2 years	Treatment of femoroacetabular impingement and labral lesions in professional hockey players resulted in successful outcomes, with high patient satisfaction and prompt return to sport	Larger studies are included in table 2
Sampson, Thomas GM. (2005) Arthroscopic Treatment of Femoroacetabular Impingement. Techniques in Orthopaedics 20 (1): 56–62	n = 120 FU = 1 year	The early results are favorable and may be comparable to the open technique	Larger studies are included in table 2 Probably the same patients as reported in Sampson (2006) in table 2
Sekiya JK, Martin RL and Lesniak BP. (2009) Arthroscopic repair of delaminated acetabular articular cartilage in femoroacetabular impingement. Orthopedics 32 (9): 692	n = 1 FU = not reported	The direct cartilage repair, in addition to osteoplasty, anterior superior labral repair, iliofemoral capsular plication, and psoas lengthening, produced an excellent outcome in this young, active patient.	Larger studies are included in table 2
Stahelin L, Stahelin T, Jolles BM et al. (2008) Arthroscopic offset restoration in femoroacetabular cam impingement: accuracy and early clinical outcome. Arthroscopy 24 (1): 51–7	n = 22 FU = 6 months	The femoral offset can be precisely restored via an arthroscopic technique in the treatment of femoroacetabular cam impingement. The early clinical outcome of arthroscopic offset restoration and debridement is good in patients with no or only mild osteoarthritis.	Larger studies are included in table 2

Appendix B: Related NICE guidance for arthroscopic femoro–acetabular surgery for hip impingement syndrome

Guidance	Recommendations
Interventional procedures	**Open femoro–acetabular surgery for hip impingement syndrome. NICE interventional procedures guidance 203 (2007)** This guidance is currently under review and is expected to be updated in 2011. For more information, see www.nice.org.uk/guidance/IPG203 1.1 Current evidence on the safety and efficacy of open femoro–acetabular surgery for hip impingement syndrome does not appear adequate for this procedure to be used without special arrangements for consent and for audit or research. 1.2 Clinicians wishing to undertake open femoro–acetabular surgery for hip impingement syndrome should take the following actions. • Inform the clinical governance leads in their Trusts. • Ensure that patients understand the uncertainty about the safety and efficacy of the procedure in both the short and long term, and provide them with clear written information. Use of the Institute's information for patients ('Understanding NICE guidance') is recommended. • Audit and review clinical outcomes of all patients having open femoro–acetabular surgery for hip impingement syndrome (see section 3.1). 1.3 Publication of safety and efficacy outcomes will be useful. The Institute may review the procedure upon publication of further evidence.

Appendix C: Literature search for arthroscopic femoro–acetabular surgery for hip impingement syndrome

Database	Date searched	Version/files
Cochrane Database of Systematic Reviews – CDSR (Cochrane Library)	31 8 2010	Aug 2010
Database of Abstracts of Reviews of Effects – DARE (CRD website)	31 8 2010	Aug 2010
HTA database (CRD website)	31 8 2010	Aug 2010
Cochrane Central Database of Controlled Trials – CENTRAL (Cochrane Library)	31 8 2010	Aug 2010
MEDLINE (Ovid)	31 8 2010	1950 to August Week 3 2010
MEDLINE In-Process (Ovid)	31 8 2010	
EMBASE (Ovid)	31 8 2010	1980 to 2010 Week 34
CINAHL (NLH Search 2.0)	31 8 2010	Aug 2010
BLIC (Dialog DataStar)	23/8/2010	Aug 2010

The following search strategy was used to identify papers in MEDLINE. A similar strategy was used to identify papers in other databases.

1	Arthroscopy/
2	arthroscop*.tw.
3	keyhole*.tw.
4	(key* adj3 hole*).tw.
5	(Resection* adj3 osteoplasty*).tw.
6	1 or 2 or 3 or 4 or 5
7	Acetabulum/
8	acetab*.tw.

9	7 or 8
10	Femur/
11	Femur Head/
12	(femur* or femor*).tw.
13	Hip/
14	hip*.tw.
15	10 or 11 or 12 or 13 or 14
16	6 and 9 and 15
17	(Femoroacetabular* or femoro-acetabular*).tw.
18	6 and 17
19	16 or 18
20	Animals/ not Humans/
21	19 not 20