Early outcome of hip arthroscopy for femoroacetabular impingement

THE ROLE OF FEMORAL OSTEOPLASTY IN SYMPTOMATIC IMPROVEMENT

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There is a known association between femoroacetabular impingement and osteoarthritis of the hip. What is not known is whether arthroscopic excision of an impingement lesion can significantly improve a patient’s symptoms.

This study compares the results of hip arthroscopy for cam-type femoroacetabular impingement in two groups of patients at one year. The study group comprised 24 patients (24 hips) with cam-type femoroacetabular impingement who underwent arthroscopic debridement with excision of their impingement lesion (osteoplasty). The control group comprised 47 patients (47 hips) who had arthroscopic debridement without excision of the impingement lesion. In both groups, the presence of femoroacetabular impingement was confirmed on pre-operative plain radiographs. The modified Harris hip score was used for evaluation pre-operatively and at one-year. Non-parametric tests were used for statistical analysis.

A tendency towards a higher median post-operative modified Harris hip score was observed in the study group compared with the control group (83 vs 77, p = 0.11). There was a significantly higher proportion of patients in the osteoplasty group with excellent/good results compared with the controls (83% vs 60%, p = 0.043). Additional symptomatic improvement may be obtained after hip arthroscopy for femoroacetabular impingement by the inclusion of femoral osteoplasty.

Hip surgery has evolved greatly in recent years, perhaps no more so than in the recognition and treatment of femoroacetabular impingement (FAI). Although this was first described in 1936, it is only recently that the structural abnormalities and pathomechanics of FAI have been described and an open procedure has been popularised that corrects them safely. Meanwhile, advances in hip arthroscopy have allowed surgeons to address intra-articular pathology efficiently. Proponents of arthroscopy for the treatment of FAI cite reduced surgical trauma and morbidity as distinct advantages over the open procedures. Although techniques for treating FAI arthroscopically have been described, the long-term results are still unavailable.

Previously, treatment for labral tears or osteoarthritis was aimed primarily at the condition itself, rather than at any underlying cause such as FAI. This required the surgeon to access only the central compartment of the hip arthroscopically, the labral tear being resected back to a stable margin. However, labral injury is often secondary to the pathomechanics created by an osseous abnormality which requires correction by an osteoplasty, with removing the bump, if lasting benefit is to be expected. This requires access to the peripheral compartment of the hip, which is more technically demanding, produces greater trauma to the patient and requires a longer operating time. In addition, complications that relate specifically to osteoplasty of the femoral head/neck junction have been described, including fracture of the femoral neck and osteonecrosis of the femoral head.

Treatment of FAI, whether open or arthroscopic, should have two aims, in the short term the relief of pre-operative symptoms, with a longer term aim of prevention of repetitive injury to the articular cartilage and labrum, thereby reducing the chance of subsequently developing osteoarthritis.

The purpose of this study was to investigate whether arthroscopic surgery for FAI improves symptoms and if removing the impingement lesion was worthwhile. Our hypothesis was that arthroscopic surgery for FAI-related labral tears would improve the short-term symptoms, but we did not know whether removing the impingement lesion was of significant further benefit.
Patients and Methods

The senior author (RNV) has been performing arthroscopy of the hip for more than 20 years. However, it was only in 2004, after the value of femoral osteoplasty was substantiated,\(^3\) that he began undertaking excision of the femoral impingement lesion as part of the standard treatment for patients with intra-articular pathology secondary to FAI. Based on this change in practice, it was possible to identify patients who had undergone arthroscopic surgery for labral pathology created by FAI but who had not had their impingement lesion removed at surgery, and to compare their outcomes with those of patients who had identical pathology but who had undergone resection of the impingement lesion.

From our hip arthroscopy database we retrieved and retrospectively reviewed data and radiographs of patients who had undergone hip arthroscopy between 2000 and 2004 (control group, no osteoplasty) with a similar group performed between 2004 and 2006 (study group, osteoplasty performed). These periods were chosen in an attempt to ensure that the patients studied were all treated during a time when the senior author had established the same level of arthroscopic skill. Only patients with a minimum follow-up of one year were included.

We chose to study patients with cam impingement only with the presence of an obvious ‘pistol-grip’ deformity\(^6\) on a plain anteroposterior (AP) radiograph of the pelvis or a clearly reduced anterior head-neck offset on a cross-table lateral view\(^7\) of the affected hip. Exclusion criteria included the presence of pincer impingement, as evidenced by the presence of a cross-over sign on a plain AP pelvic radiograph,\(^18,19\) a history of hip fracture, previous surgery, dysplasia, osteonecrosis, sepsis, rheumatoid arthritis, Perthes’ disease and osteoarthritis ≥ grade 2 according to the Tönnis classification.\(^19\)

Pre- and post-operative evaluations were performed and a modified Harris hip score\(^20\) (HHS) allocated. This excluded the points allocated by the full HHS for deformity and range of movement, giving a maximum of 44 points for absence of pain and 47 for full function. Pre-operative scores were obtained on the day of surgery and post-operative scores were obtained at six weeks, six months, one year and annually thereafter, either by post or by a telephone interview conducted by a research co-ordinator (LEW). Because the modified HHS can reach a maximum value of 91, we categorised the results as excellent (81 to 91), good (71 to 80), fair (61 to 70) and poor (≤ 60).\(^20\) The pre-operative scores and those recorded one year after operation were used for this study.

Surgical technique. Under general anaesthesia, the patient was placed in the lateral decubitus position. Traction of the hip was accomplished through the use of either the McCarthy Hip Distractor (Innomed Inc., Savannah, Georgia) or, latterly, the Smith and Nephew Hip Positioning Device (Smith & Nephew Inc., Endoscopy Division, Andover, Massachusetts). The distractor was attached to the involved leg so that the hip was placed in approximately 15° of abduction, 15° of flexion, and neutral or slight external rotation. The technique for central compartment arthroscopy has been previously described.\(^21\) Briefly, this was accessed through proximal trochanteric and anterolateral portals and any areas of labral damage were resected back to a stable margin, any loose chondral flaps removed, and any exposed subchondral bone microfractured with an awl.

The traction was then released and the hip flexed to about 30° to relax the anterior capsule. Under fluoroscopic control, a third high anterior paratrochanteric portal was established proximal to the proximal trochanteric and anterolateral sites, so that the three formed the apices of an equilateral triangle. This was used to insert the arthroscope into the peripheral compartment, and operating instruments were inserted through the anterolateral portal. The fluid pump was set to maintain a pressure of 100 mmHg. As with the central compartment, a capsulotomy with either an arthroscopic knife or a radiofrequency probe was performed to enhance the manoeuvrability of the instruments.

Femoral osteoplasty was started by delineating the borders of the impingement lesion by denuding the bony prominence of all soft tissue with the use of the 90° radiofrequency probe (Vulcan Saphyre II 90° 3 mm Bipolar Ablator Probe, Smith and Nephew). Excision of the impingement lesion then followed using a 4.5 mm burr. If needed, internal rotation, with or without flexion of the limb, could be performed to improve access to the lateral edge of the lesion. At times it was necessary to exchange portals, viewing the impingement lesion from the anterolateral portal while resecting it from the high anterior paratrochanteric portal. Resection of the juxta-articular bone continued until there was no evidence of impingement by the end of the procedure. The depth of resection was usually a minimum of one diameter of the burr (about 5 mm), but could be considerably more (Fig. 1). Distally, the resection was brought flush with the anterior cortex of the femur. The radiofrequency probe was available for haemostasis during excision as required.
Rehabilitation. Although the surgery was performed as a day case, patients were enrolled in a formal physiotherapy programme once the acute post-operative pain had largely subsided, typically five to seven days after the procedure. The initial physiotherapy involved gait training, proprioception and range of movement exercises, within the arc of 0° to 90° of hip flexion. Sudden rotational movements of the hip were avoided for four weeks. Muscle strengthening exercises were allowed only after the range of movement had recovered and full weight-bearing had been initiated, typically four weeks after operation. High-impact activities were prohibited for eight to 12 weeks.

Statistical analysis. We used the SPSS for Windows version 15.0 (SPSS Inc., Chicago, Illinois) for all statistical analyses. Because of the lack of normal distribution of data, non-parametric tests were selected. For the same reason, median, rather than mean, values are reported.

Correlations were investigated with the use of Spearman’s (ρ) rank order correlation coefficient. Linear regression with testing for interaction was used to compare the correlation of age and post-operative modified HHS scores between groups. Wilcoxon’s signed-rank test was used for analysis of outcomes within groups (paired data). The Mann-Whitney U test was used for comparison between the two groups (unpaired data). Categorical data were investigated using Pearson’s chi-squared test and the linear-by-linear association chi-squared test for trend. All tests were two-sided and assessed at the 5% level of significance.

Results

The control and study groups consisted of 47 and 24 consecutive patients respectively. The basic demographic characteristics and pre-operative modified HHS values were similar in the two groups (Table I).

Control group. The post-operative modified HHS values are shown in Table II. Both pre-operative subscores and the overall score improved after operation. Pre-operatively, overall scores were rated excellent for three (7%), good for eight (18%), fair for seven (16%) and poor for 26 (59%) of 44 patients. In three patients the pre-operative scores were unavailable.

One year after surgery, there were 19 patients (40%) with excellent scores, nine (19%) with good, seven (15%) with fair and 12 (26%) with poor scores. In two patients (4%) the post-operative modified HHS was worse than before operation. Both had started off with a high pre-operative score (77 and 91, respectively), which had dropped to 32 and 45, respectively, by one year after surgery. Overall, 28 patients (60%) achieved an excellent/good outcome after one year.

Wilcoxon’s signed-rank test was conducted between pre- and post-operative scores to evaluate the impact of surgical intervention after one year. A statistically significant improvement was observed from pre- to post-operative pain (p < 0.001), function (p < 0.001) and overall modified HHS (p < 0.001). There was a negative correlation between the age of the patient and modified HHS values at one year post-operatively (p = -0.30, p = 0.038).

Study group. The post-operative modified HHS values are shown in Table II. Both pre-operative subscores and the
Discussion

Conditions causing labral tears are generally considered to fall into five categories: trauma, FAI, capsular laxity, dysplasia and degeneration. However, labral lesions associated with bony abnormalities causing FAI are now increasingly recognised. Wenger et al found that 87% of cases with a labral tear had at least one structural bony abnormality of the hip. The most commonly encountered abnormalities were coxa valga (52%), reduced ante- rior femoral head-neck offset (42%), and retroversion of the acetabulum (36%). Of these, the first two have been associated with FAI. Acetabular retroversion and paediatric hip disorders such as slipped upper femoral epiphys- is and Perthes’ disease, are also well-known causes of pincer- and cam-type FAI, respectively. It has been stated by some that a labral lesion occurs in almost all cases of FAI, and is the most common presenting finding.

FAI has been historically treated with open techniques. However, surgical advances have made it possible for FAI to be handled arthroscopically, with both soft-tissue and osseous abnormalities treatable during the procedure. Despite this, long-term outcome studies have yet to be published. Before the recognition of the FAI concept, hip arthroscopy was targeted toward the soft-tissue abnormalities only. Robertson, Kadrmas and Kelly in a recent systematic review of outcome studies of hip arthroscopy for labral tears, found that 67% of patients were satisfied after the procedure. This figure was based on the study with the largest patient group and the longest period of follow-up. Other studies were also found where patient satisfaction reached up to 91%. However, none discussed the issue of the underlying cause for the labral tears. Conceivably, each of the patient cohorts might have had a varying, yet significant, number of patients with bony impingement lesions. Although the latter had not been addressed surgically, encouraging results were still reported.

The recent literature on hip arthroscopy for intra-articular pathology has largely focused on femoral osteo- plasty as a key factor for a successful outcome. Although excision of the labrum may lead to resolution of mechanical symptoms, failure to address the impingement lesion is considered to lead to persistent pain and patient dissatisfaction. Kim et al in their study of the effect of FAI on the results of hip arthroscopy of the central compartment only, with no excision of impingement lesion, for mild (Tönnis grades 0 and 1) arthritis, found that the clinical improvement was insufficient in patients with FAI. May et al described a series of five patients with persistent symptoms after arthroscopic isolated labral debridement, whose symptoms resolved after osteoplasty of the femoral head/neck junction. However, all these patients were treated with further labral debridement in addition to the

Table III. Distribution of the categorised modified Harris hip score post-operative scores, and comparison between the control and study groups

<table>
<thead>
<tr>
<th>Group</th>
<th>Excellent (%)</th>
<th>Good (%)</th>
<th>Fair (%)</th>
<th>Poor (%)</th>
<th>Total (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control (n = 47)</td>
<td>19 (40)</td>
<td>9 (19)</td>
<td>7 (15)</td>
<td>12 (26)</td>
<td>100</td>
</tr>
<tr>
<td>Study (n = 24)</td>
<td>13 (54)</td>
<td>7 (29)</td>
<td>1 (4)</td>
<td>3 (13)</td>
<td>100</td>
</tr>
<tr>
<td>Difference (%)</td>
<td>14</td>
<td>10</td>
<td>-11</td>
<td>-13</td>
<td>p = 0.091</td>
</tr>
</tbody>
</table>

* chi-squared test for trend
osteoplasty and the osteoplasty was performed through an open approach. Philippon et al\textsuperscript{36} recently cited persistent impingement as the most common reason for patients to return for revision arthroscopy of the hip. This presumes that a residual impingement lesion is the cause of the persisting pain, but this has not been proved. There are many causes for pain in the hip other than impingement.\textsuperscript{30-36} These reports were the impetus for us to investigate our preliminary results of arthroscopic femoral osteoplasty for treatment of FAI.

The two groups did not differ in terms of age and pre-operative scores. Our results have shown that in the short term it is possible to improve a patient’s pain without removing an impingement lesion. However, we have also shown that patients do better with their impingement lesion removed rather than ignored. Although not statistically significant (p = 0.091), a tendency towards higher post-operative modified HHS category scores was demonstrated between the study and control groups. This trend was supported by the statistically significant difference in the proportion of patients in each group attaining excellent/good post-operative scores (83% for the study group, 60% for the control group, p = 0.043).

Given the proven contribution of cam impingement in the creation of chondral damage and labral tears,\textsuperscript{38} we were pleased to note that patients after osteoplasty did better after one year than those who had not undergone this procedure. In terms of relief of symptoms the procedure is worthwhile, although a significant improvement may still be gained by dealing with the labral lesion alone.

The difference between the osteoplasty and non-osteoplasty groups was significant, but not marked. This may be a reflection of the size of the sample or the possibility that the technically demanding nature of hip arthroscopy might have led to some patients undergoing an incomplete femoral osteoplasty.\textsuperscript{14} We feel the latter would be an unlikely explanation, as the senior author has considerable experience in performing hip arthroscopy and all hips were brought to the position of simulated impingement to ensure adequate resection of the cam lesion was performed. In a recent cadaver study, Sussmann et al\textsuperscript{39} confirmed by means of digital subtraction of pre-operative and post-operative CT that arthroscopic osteoplasty of the femoral head/neck junction is comparable to its open counterpart.

The contribution of associated chondral injuries to the outcome of hip arthroscopy has been clearly pointed out. Farjo et al\textsuperscript{32} found higher rates of patient satisfaction in cases without acetabular or femoral chondromalacia, compared with those who had proven chondral damage. Other studies have also described the influential role of damage to the articular cartilage on post-operative outcomes.\textsuperscript{40} As no studies on the arthroscopic treatment of labral tears at levels of evidence I, II or III exist,\textsuperscript{30} and because the two groups appeared comparable in terms of pre-operative scores and patient age, we did not include associated chondral lesions in our study.

The limitations of this study are inherent to its retrospective nature and include possible selection bias, lack of concurrent control subjects and limited sample size. However, we considered that one year after arthroscopic surgery was a reasonable time at which to assess the results, in terms of symptomatic relief, of surgery for FAI.

A final limitation is the use of the modified HHS which, although extensively used, does not constitute a validated outcome tool.\textsuperscript{36} Unfortunately, no such instrument has yet been developed for studying hip arthroscopy.\textsuperscript{30} Christensen et al\textsuperscript{41} have developed the nonarthritic hip score and described its reproducibility, internal consistency and validity. Although the overall score has been validated, its various subscores have not. Furthermore, validation was performed only on patients before operation. Assessment of the sensitivity of the nonarthritic hip score to the clinical changes imposed by surgery is still awaited.\textsuperscript{36} Ståhelin et al\textsuperscript{42} found that the reduction of the α-angle after osteoplasty did not correlate with the nonarthritic hip score in their patients. Martin and Philippon\textsuperscript{43} recently investigated the validity of the hip outcome score in a sample of 107 non-consecutive patients at a mean of three years after arthroscopy. The scores were correlated to the SF-36 scores; the authors found a high correlation of the hip outcome score with measures of physical function and a low correlation with measures of mental health.

Intuitively, it may be postulated that other factors, possibly related to each individual patient, may be more decisive in predicting the short-term outcome following arthroscopy of the hip. For example, we found that age was significantly correlated with the outcome in the control group but not with the study group (although p = 0.15 for the difference between groups). This needs to be confirmed in a larger study.

Arthroscopy for FAI is a new technique. However, whether it contributes to the prevention of arthritis will require long-term follow-up. In this study, we have demonstrated that the added morbidity of femoral osteoplasty is likely to be worthwhile in view of the enhanced symptomatic improvement it offers. Future randomised controlled trials, possibly also incorporating patient-centred quality-of-life outcome measures,\textsuperscript{44} are needed for our findings to be confirmed.

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References

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