This study evaluates the outcome of arthroscopic femoral osteochondroplasty for cam lesions of the hip in the absence of additional pathology other than acetabular chondral lesions. We retrospectively reviewed 166 patients (170 hips) who were categorised according to three different grades of chondral damage. The outcome was assessed in each grade using the modified Harris Hip Score (MHHS) and the Non-Arthritic Hip Score (NAHS). Overall, at the last follow-up (mean 22 months, 12 to 72), the mean MHHS had improved by 15.3 points (95% confidence interval (CI), 8.9 to 21.7) and the mean NAHS by 15 points (95% CI, 9.4 to 20.5). Significantly better results were observed in hips with less severe chondral damage. Microfracture in limited chondral lesions showed superior results.

Arthroscopic femoral osteochondroplasty for cam impingement with microfracture in selected cases is beneficial. The outcome correlates with the severity of acetabular chondral damage.

Although femoro-acetabular impingement (FAI) is recognised as a precursor of osteoarthritis,1,2 this process may be very slow in some patients.3 In cam-type impingement the chondral rim of the acetabulum is vulnerable to damage, particularly at its anterolateral aspect. Repetitive injury to the chondral surface can expose the underlying bone and potentially accelerate the degenerative process. Therefore, restoration of the normal femoral head neck geometry before damage is irreversible, may be beneficial. Favourable outcomes have been reported using both open4-7 and arthroscopic8-10 approaches.

A number of pathological findings influence the outcome of mechanically compromised hips, including the degree of labral and chondral damage.10-12 Grading systems describe the degree of cartilage damage.5,13 In addition to femoral osteochondroplasty, treatment of the damage to the articular surface using chondroplasty or microfracture might also be beneficial.14,15

The purpose of this study was to evaluate the outcome of arthroscopic femoral osteochondroplasty for cam lesions in relation to the stage of acetabular chondral damage in the absence of other intra-articular pathology. Our hypothesis was that, improving the mechanical properties by femoral osteochondroplasty is beneficial in the presence of acetabular chondral damage.

Patients and Methods

The patients included had symptoms from cam lesions and associated chondral damage to their acetabula only. Those with any other intra-articular hip pathology, except for small labral lesions that required only minor debridement, were excluded. Labral lesions that required repair were excluded. No labrum was excised. Between October 2002 and March 2009, we identified 2628 hip arthroscopies in our database. Of these, 851 patients had undergone femoral osteochondroplasty and 381 fulfilled our inclusion criteria. Of these 381, 166 (170 hips) were available with a minimum of 12 months’ follow-up. The indication for surgery was pain in the hip accompanied by mechanical symptoms not responsive to non-operative treatment for at least 12 weeks. On clinical examination, all had a painful range of movement and signs of impingement. Pre-operative imaging included anteroposterior and lateral radiographs of the hip and a 3D CT scan. This was done in flexion, adduction and internal rotation16 in order to confirm the diagnosis and define the bony lesion (Fig. 1). Patients with advanced arthritis on radiography (i.e. Tönnis grade 3)17 were excluded. We found the 3D CT scan particularly useful in assessing any loss of sphericity of the femoral head or decreased femoral head-neck offset.
Informed consent was obtained from all patients.

All operations were undertaken by one surgeon (JO) who was experienced in hip arthroscopy. With the patient in the lateral decubitus position and under general anaesthesia without muscle relaxation, traction was applied as described by Mason et al.18 A proximal portal just above the tip of the greater trochanter was used for visualisation and an anterior paratrochanteric portal, approximately 2 cm anterior to the anterior margin of the greater trochanter and level with the tip of the greater trochanter, for instrumentation.

As part of the assessment of the central compartment, any acetabular chondral defect was graded. This was categorised by measuring its depth and surface area. A small partial-thickness defect was considered a grade 1 lesion. A grade 2 lesion comprised full-thickness cartilage loss with a maximum width < 30% of the distance from the acetabular edge to the fovea. A grade 3 lesion had full-thickness cartilage loss with a maximum width > 30% of the above distance. Grade 1 lesions correspond to Outerbridge19 grade 2, and grade 2 and 3 lesions correspond to Outerbridge grade 3 or 4, but are respectively smaller and larger.

Grade 1 lesions were managed by radiofrequency ablation and grades 2 and 3 by debridement of any unstable cartilage flaps. Since 2007, grade 2 and 3 lesions < 300 mm² surface area were treated by a microfracture technique,14,15 in which the defects are debrided to raw bone. This was followed by microfracture of this surface using an awl. Multiple holes are made perpendicular to the subchondral bone. To confirm that the tip of the awl had penetrated the surface, the irrigation pressure was stopped temporarily, whereupon release of fat droplets and blood from the microfracture holes was observed (Fig. 2).

After completing work in the central compartment, the traction was partially released and the femoral neck junction assessed. If a cam lesion was present, femoral osteochondroplasty was undertaken. The adequacy of the bone resection was checked both dynamically by moving the hip to 90° flexion and 30° to 40° internal rotation while watching for any
residual impingement, and by static and dynamic assessment with the image intensifier. The operation was completed by joint lavage and injection with local anaesthetic.

Post-operatively, weight-bearing was permitted as tolerated, using crutches for the first few days. The patients were also enrolled in our unit's formal physiotherapy programme, which initially includes education regarding activities of daily living to avoid hip flexion beyond 90° and guidelines for return to work that minimise prolonged sitting, standing and avoidance of lifting, thereby minimising impingement. Rehabilitation concentrates on specific retraining of quadratus femoris and the deep stabilisers of the hip. The programme also encourages early mobilisation, cycling at seven days to promote range of movement, and soft tissue work on the lumbar spine and anterior hip muscles to minimise pain. Loading was increased gradually to include global muscles to promote strength, once local muscle stability had been achieved. Jogging and running were allowed six to eight weeks post-operatively. Patients with microfracture had identical rehabilitation but impact loading was delayed until 14 to 16 weeks.

Pre- and post-operative modified Harris (MHHS) and Non Arthritic Hip Scores (NAHS) were recorded. The former is a condition-specific instrument that is widely used after hip arthroscopy. The latter is a validated, self-administered questionnaire designed to assess non-arthritic hip pain in patients with high activity demands and expectations. Post-operative scores were recorded at two, six, 26 and 52 weeks.

Statistical analysis. Results were expressed by descriptive methods (mean, range). Student’s t-test was used to compare paired samples (scores pre- and post-operatively). A one-way analysis of variance (ANOVA) was used to assess the effect of the different grades of chondral damage on the clinical outcome. Pearson’s correlation coefficient was used for analysis between chondral damage and the MHHS and NAHS scores. A p value ≤ 0.05 was considered statistically significant.

Results

The mean follow-up was 22 months (12 to 72). There were 166 patients (170 hips), 132 men and 34 women, with 73 right and 97 left hips. Their mean age was 37 years (14 to 78).

The mean overall improvement at the last follow-up was 15.3 points (95% CI 8.9 to 21.7) in the MHHS and 15 points (95% CI 9.4 to 20.5) in the NAHS. Continued improvement was seen throughout the first year (Figs 3 and 4). A statistically significant improvement after arthroscopic femoral osteochondroplasty was noticed in all grades of chondral damage (Table I). Patients with milder chondral lesions were younger, had better pre-operative scores and correlated with higher post-operative scores (Pearson’s correlation coefficient r = 0.3).

There were 29 patients with grade 2 and 3 lesions < 300 mm² who were treated by microfracture. The NAHS in particular was significantly better in those patients (Table II).

Two patients with grade 3 chondral lesions, underwent total hip replacement, one aged 65 years and the other aged 48, at 13 and 18 months, respectively, after their original hip arthroscopy. There were no infections, thromboembolic episodes or permanent nerve injuries.
Discussion

In FAI, only a few reports correlate the extent of chondral damage with the results of correction of impingement. Philippon et al., in their study of 112 patients treated arthroscopically for FAI with a mean follow-up of 2.3 years, rated the condition of the cartilage as mild, moderate or poor. Patients with poor cartilage had a significantly lower post-operative MHHS than those with moderate or mild changes. The MHHS was not affected by microfracture. The main difference from our study was their inclusion of combined cam impingement with those having mixed impingement, or poor. Patients with poor cartilage had a significantly lower post-operative MHHS than those with moderate or poor. Patients with poor cartilage had a significantly lower post-operative MHHS than those with moderate or mild changes. The MHHS was not affected by microfracture. The main difference from our study was their inclusion of combined cam impingement with those having mixed impingement, no difference was found with respect to pre-operative Tonnis grade, chondral damage, NAHS, range of movement or visual analogue scale for pain. Byrd and Jones reported a prospective assessment of 207 hips undergoing arthroscopic correction of cam impingement at a mean follow-up of 16 months. They classified and treated the articular damage according to Outerbridge. Most (190, 94%) of the cases were grade 3 or 4. Nevertheless, they achieved significant improvement in the MHHS. The main difference from our study was their inclusion of combined lesions.

The all-arthroscopic technique of femoral osteochondroplasty enables better function and patient satisfaction. We observed a continued improvement in the hip scores throughout the first year. The mean MHHS (86.1 points) and NAHS (84.8 points) scores at the last follow-up are comparable with those of previous studies. In cam impingement, although the bony prominence at the femoral neck produces mainly mechanical limitation, it is believed that the eventual chondral damage and reactive synovitis are responsible for a significant proportion of the pain. We observed the synovitis to be localised and most commonly found in the anterosuperior part of the acetabulum, which coincides with the area of chondral damage.

We differentiated between three levels of severity of acetabular cartilage lesions at the anterolateral zone. Our grading was based on a combination of those of Outerbridge and Horisberger et al. We found better scores at the last follow-up in younger patients with lower grades of articular damage. Grade 1 lesions appear to continue to improve for up to 12 months following surgery. However, with grade 2 and 3 lesions we observed the greatest improvement by eight weeks and this was maintained up to 12 months post-operatively.

The technique of microfracture is well established in the knee joint and more recently in the hip for focal full-thickness chondral lesions, namely grade 2 in our study. The perforation of subchondral bone allows the formation of a marrow clot, which provides an environment for the differentiation of stem cells into fibrocartilage. Our results are similar to those of Byrd and Jones and Philippon et al. However, our NAHS was better, which reflects improved function in high-demand activities.

Femoral osteochondroplasty should be performed gradually and cautiously to avoid the risk of fracture of the femoral neck. Conversely, insufficient bony resection is reported as a common cause for revision arthroscopy. In our study, ten patients (6%) required a second arthroscopy after an average of 12 months because of persistent symptoms. This was demonstrated by 3D CT scans and confirmed at operation, when further bone was removed. In none of these patients had the original chondral lesions deteriorated.

Two patients subsequently underwent hip replacement because of advanced osteoarthritis diagnosed at the time of their primary hip arthroscopy. We believe the outcome of

<table>
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<th>Grades</th>
<th>Hips</th>
<th>Age (range)</th>
<th>Pre-operative MHHS (range)</th>
<th>Last follow-up MHHS (range)</th>
<th>p-value</th>
<th>Pre-operative NAHS (range)</th>
<th>Last follow-up NAHS (range)</th>
<th>p-value</th>
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<td>1</td>
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<td>32.2 (14 to 78)</td>
<td>74.1 (42 to 100)</td>
<td>89.8 (62 to 100)</td>
<td>0.003</td>
<td>70.7 (49 to 100)</td>
<td>82.0 (41 to 100)</td>
<td>0.003</td>
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<tr>
<td>2</td>
<td>83</td>
<td>35.2 (18 to 63)</td>
<td>73.4 (34 to 100)</td>
<td>84.7 (41 to 100)</td>
<td>0.03</td>
<td>69.1 (25 to 100)</td>
<td>83.5 (49 to 100)</td>
<td>&lt; 0.001</td>
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<td>3</td>
<td>52</td>
<td>43.3 (23 to 65)</td>
<td>62.3 (26 to 94)</td>
<td>77.4 (36 to 100)</td>
<td>0.002</td>
<td>60.5 (31 to 93)</td>
<td>78.0 (34 to 100)</td>
<td>&lt; 0.001</td>
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<tr>
<td>Total</td>
<td>170</td>
<td>37 (14 to 78)</td>
<td>70.7 (26 to 100)</td>
<td>86.1 (36 to 100)</td>
<td>&lt; 0.001</td>
<td>69.8 (25 to 100)</td>
<td>84.8 (38 to 100)</td>
<td>&lt; 0.001</td>
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</tbody>
</table>

* Grade 1: A small partial-thickness defect; Grade 2: full-thickness cartilage loss with a maximum width < 30% of the distance from the acetabular edge to the fovea; Grade 3: full-thickness cartilage loss with a maximum width >30% of the distance from the acetabular edge to the fovea

<table>
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<th>Microfracture</th>
<th>Pre-operative MHHS</th>
<th>Last follow-up MHHS</th>
<th>p-value</th>
<th>Pre-operative NAHS</th>
<th>Last follow-up NAHS</th>
<th>p-value</th>
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<td>No</td>
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<td>67.6</td>
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<tr>
<td>Yes</td>
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<td>70.0</td>
<td>90.2</td>
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</tbody>
</table>
femoral osteochondroplasty and microfracture in this group is less favourable.

Although the strength of this study is its specific case selection of cam impingement with isolated acetabular chondral damage in the absence of other intra-articular hip pathology, it has several limitations. It lacks a control group, although all patients were initially treated non-operatively for a minimum of 12 weeks, during which none improved. Another drawback is the absence of homogeneity, such as age or level of activity, although we observed better short-term outcomes in the younger patients. Finally, the duration of follow-up is relatively short, but comparable to that of recent published studies. We believe our preliminary results will remain favourable and are conducting a longer follow-up on these patients.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

References