Hip dysplasia and the torn acetabular labrum
AN INEXACT RELATIONSHIP

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The epidemiological data and intra-operative findings from 260 consecutive arthroscopically-diagnosed acetabular labral tears seen over a ten-year period were analysed. Radiographs of 128 of these patients were assessed for dysplasia using established radiological parameters. Patients with acetabular dysplasia were then compared against those without in order to identify any differences in gender, age, the side of the tear, the pattern of the tear, the number of quadrants involved, the quadrant preference and the prevalence of intra-articular co-morbidity. Dysplasia was found in 46% (59 of 128) of the hips. No significant differences existed between the dysplastic and non-dysplastic subgroups as regards gender distribution, the side of the lesion, the number of quadrants involved or the distribution of tears among the quadrants. However, tears associated with dysplasia were diagnosed in an older age group, had a different pattern and were associated with a much higher prevalence of osteoarthritis.

It is a commonly-held view that labral tears of the acetabulum are caused by bony acetabular dysplasia.1-7 Such tears have also been attributed, in an otherwise normal hip, to trauma, femoroacetabular impingement, capsular laxity and degenerate chondral lesions.6,8,9 This paper presents an analysis of a series of arthroscopically-proven labral tears seen over a ten-year period, and shows that 48% of these hips had dysplastic acetabula. Furthermore, it appears that tears related to acetabular dysplasia can be distinguished from tears occurring as a result of other causes relating to age, the pattern of labral tear and coexistence of osteoarthritis (OA). The authors suggest that this information may be useful in planning treatment based upon the underlying cause of the tear.

Patients and Methods
A total of 260 consecutive patients with arthroscopically-diagnosed acetabular labral tears were seen in the specialist practice of the senior author (RNV) over a period of ten years.

The arthroscopies were performed under general anaesthesia in the lateral position and using a specialist hip distractor.10 A lateral supratrochanteric approach was used after the hip was distended with saline. Two or three per trochanteric portals were sufficient to evaluate the joint thoroughly.

The location and morphology of all lesions were evaluated prospectively, described and recorded by the senior author and entered into his database. All the lesions were photographed and a record was made of any other pathology seen within the joint.

The presence or absence of dysplasia of the hip was therefore determined using the standard anteroposterior (AP) pelvic radiograph which is the first radiological step in the investigation of adult hip pain and is considered the most important view for defining acetabular dysplasia.11-13 Because the radiographs had been sent from various referring centres, the lateral views were not standardised and were therefore not used for measurement.

The following subsets of patients were excluded: patients referred with radiological investigations, not including an AP view of the pelvis; obviously distorted radiological views; OA which was too severe to allow measurement; earlier corrective surgery for dysplasia which had changed the anatomy of the hip.

An appropriate AP radiograph was available for 128 patients. For each patient, the radiograph taken as close as possible in time to the arthroscopy was used for the measurements in order to better reflect the architecture of the hip at the time of arthroscopic diagnosis. Of the radiographs used for measurement, 120 of 128 (93.8%) had been taken within two years of the arthroscopy.
The assessment of dysplasia was by established radiological parameters already proven to be clinically relevant and possessing high inter- and intraobserver reliability. These were the centre-edge angle (CEA) of Wiberg, the acetabular index of the weight-bearing zone, also known as the Horizontal Toit Externe (HTE) angle, the acetabular angle of Sharp, the acetabulum-head index and the acetabular index of depth. Dysplasia was diagnosed at the following thresholds: a CEA < 20°, an HTE angle > 10°, a Sharp angle ≥ 47°, an acetabulum head index < 75% or an acetabular index of depth to width < 25%. A patient with a dysplastic value in one or more of these measurements was placed into the dysplastic group, with the other group comprising normal acetabula. Patients with proven labral tears were divided into two groups; those with evidence of acetabular dysplasia and those without.

Statistical analysis. The epidemiological and morphological assessments were compared between the two groups, with statistical analysis using SPSS Version 14 (SPSS Inc., Chicago, Illinois) to identify any differences. The features analysed were gender (2-tail Fisher’s exact test), age (Mann-Whitney rank-sum test), the side of the labral tear (2-tail Fisher’s exact test), the pattern of the tear according to the Lage classification (2-tail Fisher-Freeman-Halton test), the number of quadrants involved by the tears (2-tail chi-squared test for trend), the relative risk of tears developing in specific quadrants and the occurrence of co-morbid conditions within the joint.

Results

The epidemiological and arthroscopic data were collected without the need for reference to the radiographs and therefore reflected the population of 260 patients. The data on acetabular geometry were collected from the subgroup of 128 patients with appropriate radiographs. This was further subdivided into a dysplastic group of 59 patients and a normal group of 69 patients. We found no reason to believe that the subgroup of 128 patients differed from the overall group of 260. The findings are summarised in Table I.

No radiological measurement indicated a prevalence of dysplasia in more than 34% of hips. However, if hips with any single parameter falling within the dysplastic range are all to be considered dysplastic, 59 of 128 patients (46%) with labral tears were found to have dysplastic hips.

Of the 260 patients with arthroscopically confirmed tears, 140 (53.8%) were male and 120 (46.2%) were female. There was no gender difference between the two groups.

The age distribution of 260 patients followed a skewed curve. There was a significant (Mann-Whitney rank-sum test, p = 0.04) difference in the age at arthroscopy, with the dysplastic group presenting at a mean of 48.5 years (17 to 80) and the normal group at a mean of 35.36 years (16 to 73).

There were 153 right hips (58.8%) and 107 left hips (41.2%). No patient had a bilateral labral tear. No significant difference relating to side of lesion occurred between the dysplastic and the non-dysplastic groups (2-tail, Fisher’s exact test, p = 0.36).

The patterns of labral tear were divided into the main groups analogous to the classification system described by Lage et al. Radial flap and longitudinal peripheral tears occurred together in the same hip in only one patient who was not part of the radiological subgrouping. Of 54 tears in the dysplastic group, 27 (50%) were of the radial flap type, 13 (24%) were longitudinal peripheral and 14 (26%) radial fibrillated. Five tears in the dysplastic group were not documented as to the pattern. Of 68 tears in the non-dysplastic group, 17 (25%) were the radial flap type, 31 (46%) were longitudinal peripheral and 19 (28%) radial fibrillated, with one tear being unclassifiable. One tear in the non-dysplastic group had more longitudinal peripheral tears.

Out of 260 patients, labral tears were found in only one quadrant in 162 of 227 hips (71.4%), in two quadrants in 59 of 227 hips (26%) and in three quadrants in 6 of 227 hips (2.6%). No hip had a lesion in all four quadrants. There were no differences between the dysplastic and non-dysplastic groups in the number of quadrants involved. The most common site for a tear was the anterosuperior quadrant (183 of 298 quadrants, 61.4%), followed by the posterosuperior (62 of 298 quadrants, 20.8%), anteroinferior (44 of 298 quadrants, 14.8%) and posteroinferior (9 of 298 quadrants, 3%). Each quadrant was then compared for a significant difference in the risk of developing a tear between the dysplastic and non-dysplastic groups by analysing the proportions of tears in each quadrant and the difference between the two groups. The 95% confidence interval (CI) for each value was calculated and a p-value to test whether this difference was equal to zero. The anterosuperior quadrant was involved in 42 of 70 quadrants (60%) in the dysplastic group, and 50 of 77 quadrants (65%) in the normal group. The posterosuperior quadrant was involved in ten of 70 (14%) dysplastic hips, and in 15 of 77 (19%) normal hips. The anteroinferior quadrant was involved in 14 of 70 (20%) dysplastic hips, but in only eight of 77 (10%) of the other group. The posteroinferior quadrant was involved in four of 70 (6%) dysplastic hips and in four of 77 (5%) of normal hips. The p-value for the anterosuperior quadrant was 0.56 (2-tail chi-squared test for trend), for the posterosuperior quadrant 0.51 (2-tail chi-squared test for trend), for the anteroinferior quadrant 0.19 (two-tail chi-squared test), and for the posteroinferior quadrant 0.97 (2-tail chi-squared test). This shows a tendency in dysplastic hips to develop anteroinferior tears. This shows that the distribution of quadrants involved by labral tears does not differ between dysplastic and non-dysplastic acetabula.
Associated pathology apart from a labral tear was found in the hip joint in 163 of the 260 patients (62.7%), in 81% (56 of 69 diagnoses) of the dysplastic group, and 51% (37 of 72 diagnoses) of the normal group. The dysplastic group showed a 45% (31 of 69 diagnoses) prevalence of OA and only 10% (7 of 69 diagnoses) of chondral damage compared with the non-dysplastic group, which had a 12.5% (14 of 72 diagnoses) prevalence of OA and 19% (14 of 72 diagnoses) of chondral damage. Further associated pathology with less than a 10% prevalence in either group included osteochondral defects, synovitis, a torn ligamentum teres, loose bodies, fracture, a Hill-Sachs lesion, an acetabular cyst and chondrocalcinosis.

**Discussion**

Tears of the acetabular labrum are an acquired biomechanical cause of pain in the hip in adults. Because of the confusion regarding the relative contribution by various underlying causes to the development of a labral tear, we set out to analyse the proportion of dysplastic hips in a series of arthroscopically-proven labral tears seen over a period of ten years and to determine which morphological or epidemiological traits distinguished this group from the non-dysplastic acetabuli.

Only 48% of these patients had acetabular dysplasia, according to established radiological criteria. This differs from previous views that all hips with labral tears must display a degree of dysplasia.

We were unable to find any significant differences between the dysplastic and non-dysplastic groups as regards gender distribution, the side of lesion, the number of quadrants involved or the distribution of tears among the quadrants.

Labral tears in dysplastic hips presented at an older age than those in the normal group, although the difference was not only just statistically significant. This may reflect the practice of the senior author which has a large number of referrals of young athletes with a very high level of physical performance. Even if this leads to skewing of the patient demographics compared with a general orthopaedic practice, we feel that this is of advantage in unmasking the occurrence of labral tears in non-dysplastic acetabula, as the sample size of non-dysplastic hips in our study is greater.

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**Table I. Epidemiological and morphological findings in tears of the labrum in 59 of 128 (46%) dysplastic and 69 of 128 (54%) non-dysplastic acetabula**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Dysplastic acetabula</th>
<th>Non-dysplastic acetabula</th>
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<tr>
<td>Male:female patients (%)</td>
<td>52.5:47.5 (31:28 of 59)</td>
<td>53.6:46.4 (37:32 of 69)</td>
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<tr>
<td>Mean age (yrs) (range)</td>
<td>48.5 (17 to 80)</td>
<td>35.36 (16 to 73)</td>
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<td>Side affected (hips) (%)</td>
<td>55.9 (33 of 59)</td>
<td>65.2 (45 of 69)</td>
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<td>Pattern of labral tear (hips) (%)</td>
<td>Radial flap 50.0 (27 of 54)</td>
<td>25.0 (17 of 68)</td>
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<td></td>
<td>Longitudinal peripheral 24.0 (13 of 54)</td>
<td>46.0 (31 of 68)</td>
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<tr>
<td></td>
<td>Radial fibrillated 28.0 (14 of 54)</td>
<td>29.0 (19 of 68)</td>
</tr>
<tr>
<td></td>
<td>Not classifiable 0.0</td>
<td>1.0 (1 of 68)</td>
</tr>
<tr>
<td>Number of quadrants involved (hips) (%)</td>
<td>1 69.8 (37 of 53)</td>
<td>69.5 (41 of 59)</td>
</tr>
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<td></td>
<td>2 28.3 (15 of 53)</td>
<td>30.5 (18 of 59)</td>
</tr>
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<td></td>
<td>3 1.9 (1 of 53)</td>
<td>0.0</td>
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<td></td>
<td>4 0.0</td>
<td>0.0</td>
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<tr>
<td>Site of labral tear (%)</td>
<td>Anterosuperior 60.0 (42 of 70 quadrants involved in 53 hips)</td>
<td>64.9 (60 of 77 quadrants involved in 59 hips)</td>
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<td></td>
<td>Posterosuperior 14.3 (10 of 70 quadrants involved in 53 hips)</td>
<td>19.5 (15 of 77 quadrants involved in 59 hips)</td>
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<td></td>
<td>Anteroinferior 20.0 (14 of 70 quadrants involved in 53 hips)</td>
<td>10.4 (8 of 77 quadrants involved in 59 hips)</td>
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<tr>
<td></td>
<td>Posteroinferior 5.7 (4 of 70 quadrants involved in 53 hips)</td>
<td>5.2 (4 of 77 quadrants involved in 59 hips)</td>
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<tr>
<td>Other intra-articular diagnoses (%)</td>
<td>Nil 18.8 (13 of 69 other conditions found in 59 hips)</td>
<td>48.6 (35 of 72 other conditions found in 69 hips)</td>
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<td>Osteoarthritis 44.9 (31 of 69 other conditions found in 59 hips)</td>
<td>12.5 (9 of 72 other conditions found in 69 hips)</td>
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<td></td>
<td>Chondral damage 10.1 (7 of 69 other conditions found in 59 hips)</td>
<td>19.4 (14 of 72 other conditions found in 69 hips)</td>
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</table>
The patterns of labral tear developing in the dysplastic group were different from the non-dysplastic group. Radial flap tears predominated in patients with dysplastic acetabula, while longitudinal peripheral tears occurred more frequently in the non-dysplastic group. This may reflect different mechanisms in the development of labral tears. With acetabular dysplasia, the problem appears to arise when poor cover of the femoral head or a shallow acetabulum, or both, result in abnormal translational movement of the head within the acetabulum, producing avulsion stresses at the junction of the labrum and bony rim. This is the so-called cam impingement.\textsuperscript{19,20} Tears in non-dysplastic hips may reflect a greater incidence of rim (or pincer) impingement, which is caused by direct pinching of the labrum between the bony rim and the femoral neck.\textsuperscript{19,20}

Dysplastic acetabula showed more OA at the time of the arthroscopy. This association may simply be a reflection of the slightly older age group. However, traumatic tears or tears related to impingement may present more acutely, in keeping with the mechanism of the injury. Furthermore, a labral tear in a dysplastic acetabulum may remove the protective barrier which minimises the damaging shear forces within the joint, leading more rapidly to OA.

There are factors in this study which may have introduced error into the results. In any retrospective review of prospectively collected data, some information will be lacking, and the ability to assess more recently-discovered factors such as femoroacetabular impingement was not possible. There are well-recognised problems when measuring angles on a radiograph,\textsuperscript{16} but we believe the choice of angles outlined above minimises this risk. Plain radiological measurements may not differentiate all abnormal from normal hips morphologically, and a recent CT study\textsuperscript{21} measuring acetabular dimensions has established normal values upon which future studies may be based. However, those values will require verification before their use becomes widespread.

In spite of these shortcomings, we believe that this study shows that bony acetabular dysplasia, while still an important cause, may not be quite as dominant a factor as previously thought in the genesis of tears of the acetabular labrum. There may well be a role for undertaking arthroscopy prior to considering more major procedures for bony realignment, depending on the underlying cause of the labral tear.\textsuperscript{8,22} 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