Femoro-acetabular Impingement: A Reflection

Richard E Field PhD FRCS FRCS(Orth)
Professor of Orthopaedic Surgery, St George's University of London
Director of Research, The South West London Elective Orthopaedic Centre
Consultant Orthopaedic Surgeon, Epsom & St Helier NHS Trust

Ten years ago, a labral tear was an almost unknown diagnosis. It was certainly not recognised outside a small clique of orthopaedic surgeons. Its pathogenesis was unknown. It was not clear whether a torn labrum was a clinical problem. There were no recognised strategies for treating the condition and no-one had proven that surgical intervention would be advantageous. So how is it that, in less than ten years, an orthopaedic curiosity has developed into a major show-stopper, a condition that is familiar to the mainstream press and one that can be treated with increasing confidence?

We know that a healthy hip must satisfy the conflicting requirements for movement and stability. The forces and strains on the hip depend upon the size, shape and orientation of the articulating surfaces, the balance and strength of the surrounding soft tissue envelope, body morphology and the activities that an individual undertakes. The interplay of these variables makes every hip a unique structural and stress environment. The rim of the acetabular socket, known as the labrochondral complex, augments joint stability and helps retain synovial fluid between the bearing surfaces\(^2,3,4,5\) (Figure 1).

Over a lifetime, the human hip will be subjected to over 200 million loading and movement cycles. This equates to walking more than two circuits of the earth's equator. Any structural incongruity or instability between the femoral head and acetabular socket will stress the labrochondral rim and initiate a damage cascade that results in degenerative joint disease.

In July 2005 the British Journal of Bone and Joint Surgery published an article, from Ganz's team in Berne. The title of the article was 'Hip morphology influences the pattern of damage to the acetabular cartilage: Femoroacetabular impingement as a cause of early osteoarthritis of the hip'. If I were selecting my ten 'Desert Island' papers, it would be near the top of the list.

Publication of this article was the tipping point that disseminated the concept of femoroacetabular impingement (FAI) from a small group of hip specialists to the wider orthopaedic community and beyond. I first saw the paper a few months before its publication and subsequently wrote a 'further opinion' piece for the JBJS's online version\(^6\). Being anxious not to make a complete idiot of myself, I spent a long weekend reading papers that Ganz's team had published in the preceding few years\(^3,4,5,10,11\).

It was one of those occasions when you realise that if you'd only been a bit less lazy and read the papers being written by the thinkers of the orthopaedic world you wouldn't have missed out on one of the most important discussions to occur during your career.
I realised that Ganz’s group was creating a vocabulary that would allow us to visualise and describe mechanisms by which the hip can become damaged. Once the concepts were grasped, it seemed so obvious and somewhat bizarre that we hadn’t got it sooner. This was eight years ago. A mere blink in orthopaedic history. Yet, in just a few years, the management of pre-degenerate hip disease has been transformed. Surgeons specialising in joint preserving hip surgery have developed a range of new surgical techniques and people from all walks of life can be treated successfully, with minimal soft tissue trauma.

What is a labral tear and why do they occur?
Most orthopaedic surgeons are familiar with meniscal and labral pathology in the knee and shoulder. In the hip, ‘labral tear’ is a succinct term that is accepted by patients and the media. However, it is an oversimplification that may hamper our understanding of labral pathology. The labrochondral complex can be damaged by compression (being squashed), tension (being stretched) torsion (twisting) and shear (sliding) forces. The combination of stresses on the labrochondral complex differs for a degenerate hip, a dysplastic hip, a cam hip and a pincer hip.

Patients with degenerate hip disease are referred for orthopaedic review with a spectrum of osseous changes; ranging from relatively mild joint thinning and early subchondral changes to complete joint space obliteration, extensive marginal osteophyte formation, subchondral sclerosis and subchondral cyst formation.

While healthcare funders may deem the degree of radiological degeneration to be an appropriate criterion for joint replacement, orthopaedic surgeons recognise that any correlation between clinical symptoms, disability and radiological changes is far from linear. Indeed, patients with evidence of advanced radiological joint degeneration often report a relatively short duration of pain. Although this phenomenon is unexplained, it is interesting to note that antero-superior labral swelling and separation is usually present in such cases. It may be speculated that entrapment of the richly innervated12,13, unstable labral segment is the cause of the patients’ increased symptoms and this would also explain why some patients experience such severe symptoms in the presence of relatively mild radiological deterioration.

In dysplasia, overload of the hypertrophied labrochondral complex provides a readily understood explanation for labral separation and the poor clinical outcome of labral resection or repair is widely recognised.

Ganz’s team proposed that FAI could occur by one or more mechanisms. In cam-type impingement, the femoral head is not round. Any segment that sits proud of the surface of rotation will bump into the socket rim. As the prominent segment passes into the joint, the labrum will be levered outwards and a grinding force will be applied on the adjacent hyaline cartilage. With time, the labrochondral junction splits and the adjacent chondral tissue delaminates or breaks down (Figure 2). As damage progresses, subchondral rim cysts develop; either by repetitive trauma or pressurised synovial fluid erosion.

In pincer impingement the femoral neck impacts upon and compresses the labrum (Figure 3). This can occur if the acetabular socket is deep (cova profunda), if the front of the acetabular socket is prominent (acetabular retroversion), if the femoral neck is retroverted, if the individual has sufficient ligamentous flexibility that they are able to move their joint to an osseous limited endpoint or if the joint is forced into such position.

Figure 2 - Labral eversion, labrochondral splitting and articular cartilage damage caused by ‘cam’ type impingement

Figure 3 - Labral compression and ‘wave sign’ articular cartilage delamination caused by ‘pincer’ type impingement
What can we do about FAI?

As Personal Trainers, Physiotherapists, General Practitioners and Orthopaedic Surgeons become more attuned to the symptoms and physical signs of FAI lesions; our first priority is to identify whether patients symptoms will settle with modification of activities, physiotherapy or steroid injections. Professor Damian Griffin is currently coordinating the ‘UK FASHION’ study to determine a whether patients deemed suitable for surgical treatment can be treated by non-surgical means. If this proves to be the case, a burgeoning branch of Orthopaedic practice will be arrested. Alternatively, if the ‘UK FASHION’ study does lend support to the premise that surgical intervention can be advantageous, our task is to ensure that the appropriate intervention is undertaken in each case.

Plain radiographs usually signpost the type of impingement that a patient may be experiencing. The AP standing view provides an abundance of useful information including: joint space narrowing, saucil angle, centre-edge angle, subchondral sclerosis, marginal and saucil subchondral cyst formation, cross-over sign, ischial spine sign and labral calcification or ossification. Augmented by turned lateral and cross-table true lateral views it is usually possible predict the findings of further imaging studies such as MR, MR arthograms and CT reconstructions. Plain radiographs also enable a surgeon to provide patients with rapid feedback on the structure and condition of their hips with appropriate guidance for further investigations and treatment. The value of these simple radiographic views cannot be over emphasised.

Over the last few years, a number of research groups have developed motion analysis software using CT data to analyse the geometry of a patient’s hip and compare the potential ranges of joint movement against known population norms\textsuperscript{14,15,16} (Table 1).

Such software also enables surgeons to understand the location and quantity of bone that would need to be removed to provide impingement free movement during activities of daily life (Figures 4 and 5)\textsuperscript{17}.

Future refinements of these tools should incorporate the additional complexity of ambulation as well as the orientation and movement of adjacent and more distant joints.

Surgical treatment of FAI is increasing. When surgery works well, the patients are able to return to competitive sport, at the highest level\textsuperscript{18,19,20}. Joint replacement cannot achieve this goal. However, we do not yet know whether such individuals are being provided with a license to further damage their natural joints or the prospect of prolonged healthy joint function.

<table>
<thead>
<tr>
<th>Motion Test</th>
<th>Target</th>
<th>This Hip</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum flexion</td>
<td>120°</td>
<td>106°</td>
</tr>
<tr>
<td>Maximum abduction</td>
<td>50°</td>
<td>67°</td>
</tr>
<tr>
<td>Max internal rotation at 30° flexion</td>
<td>60°</td>
<td>87°</td>
</tr>
<tr>
<td>Max internal rotation at 60° flexion</td>
<td>40°</td>
<td>36°</td>
</tr>
<tr>
<td>Max internal rotation at 90° flexion</td>
<td>30°</td>
<td>20°</td>
</tr>
<tr>
<td>Max internal rotation at 30° flexion + 20° adduction</td>
<td>50°</td>
<td>78°</td>
</tr>
<tr>
<td>Max internal rotation at 60° flexion + 20° adduction</td>
<td>40°</td>
<td>33°</td>
</tr>
<tr>
<td>Max internal rotation at 90° flexion + 20° adduction</td>
<td>30°</td>
<td>12°</td>
</tr>
<tr>
<td>Maximum extension at 15° external</td>
<td>15°</td>
<td>16°</td>
</tr>
</tbody>
</table>

Table 1: The figures in the left column show normal ranges of hip movement. The figures in the right column are those of a patient with cam type FAI.

Figure 4 - Acetabular resection option to restore a normal ROM

Figure 5 - Femoral resection option to restore a normal ROM
There is growing evidence that open FAI surgery causes more iatrogenic morbidity than mini-open and arthroscopic procedures. However, arthroscopic FAI hip surgery is not easy. To be undertaken successfully, special equipment and new surgical skills are essential. Great strides have been made to develop a community of UK surgeons with the expertise to undertake FAI surgery and these individuals deserve our encouragement and support to ensure that they provide safe and effective interventions.

Most importantly, FAI affects the lives of young people whose ability to work, pay tax and play lives of young people whose ability to work, pay tax and play

References
3. www.bj;journal.org.uk/content/suppl/2005/06/28/87-B.7.1012.DC1/1012.pdf
16. Correspondence: Richard E Field
The South West London Elective Orthopaedic Centre
Dorking Road
Epsom
Surrey KT18 7EG
Email: richard.field@eoc.nhs.uk
17. www.clinicalgraphics.com