THE ACETABULAR RIM SYNDROME

A CLINICAL PRESENTATION OF DYSPLASIA OF THE HIP

K. KLAUE, C. W. DURNIN, R. GANZ

From the Inselspital, Berne

The acetabular rim syndrome is a pathological entity which we illustrate by reference to 29 cases. The syndrome is a precursor of osteoarthritis of the hip secondary to acetabular dysplasia. The symptoms are pain and impaired function.

All our cases were treated by operation which consisted in most instances of re-orientation of the acetabulum by peri-acetabular osteotomy and arthrotomy of the hip.

In all cases, the limbus was found to be detached from the bony rim of the acetabulum. In several instances there was a separated bone fragment, or 'os acetabuli' as well.

In acetabular dysplasia, the acetabular rim is subject to abnormal stress which may cause the limbus to rupture, and a fragment of bone to separate from the adjacent bone margin. Dysplastic acetabuli may be classified into two radiological types. In type I there is an incongruent shallow acetabulum. In type II the acetabulum is congruent but the coverage of the femoral head is deficient.

The term 'hip dysplasia' means an abnormality of shape or size of the acetabulum or femoral head, or of their proportions or alignment one to the other. Most often, it is the acetabulum which is dysplastic and its disproportion with the femoral head gives rise to symptoms. We will describe what we call the acetabular rim syndrome.

The nature of bone fragments about the acetabular rim has long been a subject for discussion. Anatomists have regarded these structures as remnants of secondary centres of ossification and a normal part of development of the acetabulum (Lilienthal 1909). They were described first by Albinus in 1737 and later, in 1876, by Krause who proposed the name 'os acetabuli'. The fragments, which are of varying sizes, can appear as early as six years of age, and may disappear before 20 years (Perna 1922; de Cuveland and Heuck 1957; Ponseti 1978). Persistence after this age has been explained on the hypothesis of 'hormonal disturbance' (Freedman 1934).

Radiologists and clinicians have described the

fragments as non-specific osteochondritis comparable with Perthes' disease of the femoral head (Kargus 1933). Dysplasia of the acetabulum appearing at puberty has been attributed to secondary 'absorption' of the bony acetabulum (Niethard 1984). The appearance of fragments at later ages and their persistence have been observed following trauma (Waschulewski 1967; Caudle and Crawford 1988), rickets (Fromme 1921), osteomyelitis, tuberculosis, and osteochondritis dissecans (Rühle 1921; Schinz 1922). Fragments have been ascribed to overloading of the acetabular rim in a dysplastic joint causing fracture and separation of a segment of the rim (Fiedler 1951). They are sometimes associated with cysts in the acetabular roof (Outland and Flood 1936). In a study of 1111 pelvic radiographs from an asymptomatic population, bone fragments were found in 2% to 3% (Arho 1940).

Tears of the limbus, with or without an associated bony fragment, are known to occur after traumatic dislocation of the hip (Paterson 1957; Dameron 1959; Rashleigh-Belcher and Cannon 1986; Shea, Kalamchi and Thompson 1986). Limbus tears occurring without a history of injury have been described only recently (Altenberg 1977; Currier and Fitzgerald 1988) and there has been no explanation of their cause or their relation to acetabular dysplasia.

Limbus tears have been diagnosed by arthroscopy (Suzuki et al 1986; Ikeda et al 1988), conventional arthrography (Dorrell and Catterall 1986) and CT scan

K. Klaue, MD
C. W. Durnin, MD, Clinical Research Fellow
R. Ganz, MD, Professor of Orthopaedics
Department of Orthopaedic Surgery, Inselspital, CH-3010 Berne, Switzerland.

Correspondence should be sent to Dr K. Klaue.

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(Paterson 1987). There are no previous descriptions of the use of the computerised arthrotomography, nor of magnetic resonance imaging as we employ them.

CLINICAL MATERIAL

History. The presentation in all our cases was similar. None were symptom-free. Most were young adults. They complained of knife-sharp pain in the groin and a sensation of locking of the hip. These symptoms occurred after a period of sitting, or sometimes after walking. Some patients also described episodes of 'giving way' such as an inexplicable fall. Usually the pain could be quickly relieved, often by shaking the limb, whereupon normal walking could be resumed. Some activities which predisposed to symptoms were rapid descent of stairs, use of the breast-stroke when swimming, and sports such as tennis or football. The common factor seemed to be forced movements of adduction in combination with rotation in either direction.

Questioning frequently discovered a long-forgotten incident in which the hip had been stressed particularly in rotation, causing sudden pain and the sensation of 'dead leg'. Weight-bearing was painful and a period of support with crutches had sometimes been necessary. Two patients with these symptoms had undergone inguinal or femoral herniorrhaphy; another was suspected of having entrapment of the lateral cutaneous nerve of the thigh.

Clinical signs. Between painful episodes the affected hip may be so normal to casual examination that an articular origin for the pain may be doubted. When episodes of locking occur frequently, residual pain may cause a slight limp, possibly associated with weakness of the hip abductors. However, in most cases pain can be elicited by passive movement of the thigh into full flexion, adduction and internal rotation (Fig. 1). This combination brings the proximal and anterior part of the femoral neck into contact with the rim of the acetabulum (Kapandji 1985), at exactly the point where the labrum is likely to be damaged. The test exerts a shear force on

Fig. 1

Clinical examination of the hip by passive flexion-adduction-internal rotation. A sudden sharp pain is elicited in the groin.

the limbus at its attachment to the acetabular bony margin and if a tear is present, the dislocation of the limbus may be palpable. Sometimes the opposite movements, passive hyperextension with external rotation, may also produce pain and a sensation of apprehension.

Imaging. It is not always possible to confirm the clinical diagnosis of a labrum tear by imaging. A well-centred anteroposterior radiograph, or the 'faux-profil' view of Lequesne and de Seze (1961) may demonstrate a congruent but short acetabular roof and an os acetabuli (Fig. 2). On either of these views the radius of the acetabulum may be seen to be greater than that of the

Figure 2 – Radiograph to show a well centred femoral head. The acetabular rim has a loose fragment (arrow) and the weight-bearing area is therefore reduced. Figure 3 – Radiograph to show incongruency between the femoral head and the acetabulum. No free bony fragment is visible in this instance.

Fig. 2

Fig. 3

Fig. 4

Right hip seen from the front. The limbus is detached from the bony rim over one-fifth of its circumference.

Fig. 5

CT scans. Figure 5a - Cysts in the anterior wall of the acetabulum communicate both with the joint space and with a cyst on the anterior quadrant of the capsule. Figure 5b - 6 mm below the first cut, there is a free fragment at the anterosuperior rim of the acetabulum. Operation revealed an extra-osseous ganglion, communicating with an intra-osseous cyst. The acetabular labrum was found to be detached at the same site.

femoral head (Fig. 3). On the lateral view the anterior centre-edge angle of Lequesne and de Seze (1961) and on the anteroposterior view the lateral centre-edge angle of Wiberg (1939) are reduced. Often the femoral head has migrated laterally or anteriorly or in both directions, so distorting the normal spherical shape of the acetabular mouth into an oval.

In the few cases which we have investigated by conventional arthrography and computerised arthroto-mography we have been unable to demonstrate unequivocally any tears of the limbus attachment, though we were able to show hypertrophy, displacement and truncation of the edge of the structure. Our own three-dimensional adaptation of orthodox CT scanning (Klaue, Wallin and Ganz 1988) allows a very accurate quantification of the acetabular cover for the femoral head which is not obtainable by conventional radiography. In six

cases this examination revealed the presence of cysts in the soft tissues or intra-osseous ganglia at the edge of the acetabular roof. In one case magnetic resonance imaging suggested a limbus tear, which was confirmed at operation.

Arthroscopy may permit visualisation of the limbus but is difficult to perform and we have not used it.

Operative findings. In all our cases, the diagnosis of a torn limbus made clinically was confirmed at operation. The lesion was situated at the anterosuperior quadrant of the acetabular rim and resembled a bucket-handle tear of a knee meniscus. A hook could be passed between the body of the limbus and the bone edge (Fig. 4).

Intra-osseous ganglia demonstrated by CT scans (Fig. 5) were detectable from within the joint by use of the same hook. These ganglia had a membranous lining similar to that found in other intra-osseous ganglia. Extra-osseous ganglia, when present, extruded from the joint through the defect in the limbus to emerge on the surface of the capsular structures, extending as much as 8 cm proximally.

Os acetabuli were easily identified. On their wider surfaces we found true articular cartilage.

Treatment. In all our patients the primary problem was deficiency of acetabular cover over the femoral head: the principle of surgical management was to improve this by re-orientating the acetabulum by means of a peri-acetabular osteotomy (Ganz et al 1988, Fig. 6). In 12

Fig. 6

Improved cover of the femoral head obtained by peri-acetabular osteotomy. Re-orientation of the acetabulum was achieved in three planes.

cases the tear in the limbus was repaired; in 12 others the torn limbus was resected; in the remaining five the tear was judged too small to need specific treatment.

Since our follow-up does not exceed four years it is not yet possible to recommend a definitive management, save to say that the slowest recovery was seen in those cases in which the tear was repaired. Two of these required revision to resect a re-ruptured limbus. In these patients, and in those in whom the limbus was resected primarily or left undisturbed the symptoms have all been relieved.

RESULTS

Tables I, II and III summarise the clinical and radiographic findings. The five hips in which there was radiological evidence of degenerative change have been excluded, because their radiographic measurements had become unreliable. We still consider these cases to be part of the series, since the history, examination, and surgical findings confirm a common cause.

The data show that all cases with lesions of the acetabular rim had reduced acetabular cover of the femoral head. Bone lesions occurred most frequently in hips which were congruent, that is those in which the acetabular and femoral head centres closely corresponded (Fig. 7). Soft-tissue lesions, not radiologically visible,

Fig. 7

Schematic diagram of the measurements employed to estimate joint congruency and migration of the femoral head.

Rf-ra is the difference in length between the femoral head radius and the acetabular radius.
Cf-ca is the distance between the centres of femoral head and acetabulum (this method is also valuable on the 'faux profil' image).

e lat is the distance between the vertical lateral plane of the 'tear drop' and the medial vertical tangential line touching the femoral head.

Table I. Radiographical results for 24 hips with no degenerative changes

Measurement	Mean $\pm$ SD	Normal	Source
Cover* (per cent)	48 $\pm$ 2	70	Klaue et al 1988
Lateral CE angle (degrees)	6 $\pm$ 3	> 25	Wiberg 1939
Anterior CE angle (degrees)	-1 $\pm$ 4	> 20	Lequesne and de Seze 1961
Roof angle (degrees)	23 $\pm$ 2	< 10	Tönnis 1984
e lat (mm)†	11.5 $\pm$ 1		
rf/ra (per cent)†	76 $\pm$ 3		
Cf-ca (mm)†	7.5 $\pm$ 1		

* percentage cover of the femoral head assessed by computerised graphical evaluation

† e lat, distance from tear-drop to femoral head; rf/ra, radius of the femoral head divided by radius of the acetabulum, $\times 100$ assessed on the anteroposterior radiograph; Cf-ca, distance between the centre of the femoral head and the centre of the acetabulum, assessed on the anteroposterior radiograph

Table II. Radiological results for 10 hips with bony lesions of the acetabulum (six had one or more intra-osseous ganglia; nine had a bony fragment at the acetabular rim, four of them with an intra-osseous ganglion)

Measurement	Mean $\pm$ SE	Normal
Cover (per cent)	50 $\pm$ 2	70
Lateral CE angle (degrees)	11 $\pm$ 3	> 25
Anterior CE angle (degrees)	4 $\pm$ 4	> 20
Roof angle (degrees)	17.5 $\pm$ 2	< 10
e lat (mm)	11.1 $\pm$ 1	
rf/ra (per cent)	85 $\pm$ 3	
Cf-ca (mm)	3.4 $\pm$ 1	

* see Table I

Table III. Radiological results for 14 hips with no bony lesions visible on the acetabulum (all had a limbus lesion, four with a soft-tissue ganglion)

Measurements*	Mean $\pm$ SE	Normal
Cover (per cent)	47 $\pm$ 2	70
Lateral CE angle (degrees)	2 $\pm$ 5	> 25
Anterior CE angle (degrees)	-5 $\pm$ 5	> 20
Roof angle (degrees)	27 $\pm$ 4	< 10
e lat (mm)	11.9 $\pm$ 1	
rf/ra (per cent)	70 $\pm$ 3	
Cf-ca (mm)	10.4 $\pm$ 2	

* see Table I

occurred in joints in which the radius of the acetabulum was larger than that of the femoral head. The difference between the measurements rf/ra and $Cf-Ca$ in Tables I and II is significant ($p = 0.05$). The ANOVA test shows the differences between the measurements rf/ra , $Cf-Ca$ and RA also to be significant ($p = 0.05$).

DISCUSSION

Bedouelle (1984) described many shapes of acetabulum as seen on conventional radiographs, but did not attempt a classification. We recognise two groups of radiological features associated with abnormal loading.

Type I: Hips in which the acetabulum is shallow, lies more vertical than normal, and has a radius of curvature greater than that of the femoral head. Such joints are radiologically incongruent (Fig. 3).

Type II: Hips in which the acetabulum provides less than normal cover for the femoral head ('short roof'), and has a radius of curvature similar to that of the femoral head. Such joints are congruent (Fig. 2).

A hip of type I is subject to abnormal shear force and is potentially unstable. Often the labrum is hypertrophic and the capsule thickened (Tönnis 1984). CT scans show the acetabulum elongated in the craniocaudal direction. The smallest diameter of this oval shape lies transversely and matches the diameter of the femoral head. Hypertrophy of the labrum and capsule can be interpreted as a physiological response to the shear force and an attempt to correct the bony mismatch of the joint. Eventually the overstressed labrum may become detached from the acetabular rim; in these cases the rim itself is unlikely to be overloaded (Fig. 8).

A hip of type II, which is congruent, is essentially stable. However, the relative shortness of the acetabular roof reduces the area of the loaded surface which is then subject to increased pressure, particularly at that part of the acetabular margin which lies against the upper pole of the femoral head (Greenwald and O'Connor 1971; Pauwels 1976; Bombelli 1983). The force evokes local remodelling (Stadler et al 1982; Rubin 1984; Klaue and Perren 1989) the result of which may be a fatigue fracture and separation of a rim fragment (Fig. 9). Often, there

are associated intra-osseous cysts in the acetabular roof which communicate with the joint. These are concentrated at the overloaded roof edge. By their confluence they may bring about fragmentation, and the appearance of a so-called os acetabuli.

Reports of possible acetabular fatigue fractures are few (Schmidt 1967; Maurer 1970; Kaps and Niethard 1986), and none of these authors commented on the significance of the limbus. The associated hip dysplasia is rarely mentioned (Fiedler 1951). Analysis of our own cases suggests that fatigue fractures, with or without bone cysts, only occur in congruous (type II) hips. In some of our cases early radiographs were available in which no bony fragments were visible. It is possible that some fragments may represent persistent embryological remnants which, in consequence of overload, fail to integrate. Whatever the type of dysplasia, a lesion at the acetabular rim and the consequent shear forces generated are likely eventually to cause instability and progressive degeneration of the whole joint.

Ganglia or cysts around the hip joint have been reported by many authors (Harrison, Schajowicz and Trueta 1953; Eggers et al 1963; Samuelson, Ward and Albo 1971; Margreiter, Steiner and Mikuz 1978; Garcia and Chevalley 1985; Bergenudd et al 1987).

Cysts within soft tissues are more likely to occur in the oval, unstable joints (type I) and partial detachment of the limbus may be the initiating cause. Fetal dissections have shown that a defect can occur between the labrum and the rim at a very early stage of development: this may constitute an area of potential vulnerability in the adult (Walker 1981). A valvular pumping mechanism from the joint to the cyst may play a part (Jayson and Dixon 1970). Such a mechanism would fit in with our proposition that ganglionic cysts arise through local overloading secondary to reduced acetabular cover for the femoral head. Cyst formation within the limbus may be analogous to cystic degeneration in a knee meniscus (Ueo and Hamabuchi 1984; Matsui, Ohzono and Saito 1988). No one has previously suggested that acetabular dysplasia may be an essential precursor of cysts and ganglia around the hip.

Cysts or ganglia within bone arise through splits in

Fig. 8

Fig. 9

Figure 8 – Pathophysiology of the acetabular rim in the incongruent, type I hip. In this configuration, the labrum is overloaded and may shear from the acetabular bony rim. Figure 9 – Pathophysiology of the acetabular rim in the congruent, type II hip. In this configuration, the resultant force acts upon a reduced articular surface. A 'fatigue' fracture may occur causing a bony fragment or os acetabuli.

the acetabular cartilage (Landells 1953). These develop after injury to the subarticular bone and multiple foci of such damage may allow penetration of synovial fluid deep to the subchondral bone plate to form cysts in the cancellous bone (Freund 1940). Synovial fluid may also penetrate bone through a defect between a damaged limbus and the articular cartilage (Itoigawa, Azuma and Kako 1980) which may be why such cysts were found in hips with acetabular dysplasia of type II. Intra-osseous ganglia are often visible on CT scans while remaining undetectable on conventional radiographs despite their occasionally large size. Our observations confirm the report of McBeath and Neidhart (1976) that juxtalabral intra-osseous ganglia may communicate with extra-osseous ganglia.

In the past we have treated acetabular dysplasia by the familiar techniques of shelf arthroplasty and Chiari osteotomy. However, these techniques are extra-articular and do not address the problem of the limbus tear. These operations may eliminate pain if it is caused solely by instability, but where the pain arises from the acetabular rim syndrome the causative lesion may remain hidden beneath such extra-articular cover, and may continue to give rise to symptoms and to predispose to progressive degeneration (Saito et al 1989). A better principle by which to improve both femoral head cover and joint congruency is to re-orientate the acetabulum (LeCoeur 1965; Tönnis, Behrens and Tscharrani 1981). Techniques to achieve this are, however, both major and technically demanding.

It is not clear what should be the surgical management of the damaged limbus or the detached bone fragment. The merit of refixing the limbus to the bony rim may be questionable. Conversely, limbus resection may impair joint lubrication by removing the hydrostatic function of the structure (Takechi, Nagashima and Ito 1982), and so hasten degenerative change (Butel et al 1973).

The acetabular rim syndrome is best recognised through awareness of its existence, appreciation of its symptoms and understanding of its aetiology.

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