Anterior acetabular head index of the hip on false-profile views

NEW INDEX OF ANTERIOR ACETABULAR COVER

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The vertical-centre-anterior margin (VCA) angle quantifies the anterior cover of the femoral head. However, when the femoral head is deformed it may be difficult to identify its centre. We have therefore created a new index, the anterior acetabular head index (AAHI) which is measured on the false-profile radiograph. We measured the VCA and AAHI angles in 312 hips in which the centre-edge angle was $>25^\circ$. There were 250 patients, 86 men and 164 women, whose ages ranged from 20 to 65 years. The mean AAHI was 84.1% (81.7% in women and 88.5% in men). There was a correlation between the AAHI and VCA angles. Our data suggest that the AAHI is useful in the evaluation of anterior acetabular cover and that it is higher in men than in women.

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In patients with dysplasia of the hip it is necessary to estimate the degree of anterior as well as lateral cover.^{1,2} For this, the ventral-centre-acetabulum or vertical-centre-anterior margin (VCA) angle as determined from the false-profile radiograph are used³ in addition to Wiberg's centre-edge (CE) angle¹ and the Sharp angle² as measured on plain anteroposterior (AP) radiographs of the hip. However, deformity of the femoral head or progressive arthropathy may be seen after congenital dislocation, dysplasia or in Legg-Calvé-Perthes' disease (LCPD). In such patients, it is sometimes difficult to identify the centre of the femoral head and lateral cover is often assessed by using Heyman's acetabulum head quotient (AHQ) or the acetabular head index (AHI).⁴ Although the VCA angle is used as an index

Fig. 1

Diagram showing the position of the pelvis for the Lequesne projection.

of the degree of anterior cover, it cannot be used in patients with deformity of the femoral head or advanced arthropathy. In order to solve this problem, we proposed a new index, the anterior acetabular head index (AAHI), and our aim in this study was to assess its value.

Patients and Methods

AP and false-profile radiographs of the hip were taken in 250 patients, 86 men and 164 women who ranged in age from 20 to 65 years. The upper limit of normal for the CE angle was taken as 25° . Out of the 500 hips, 312 (108 in men and 204 in women) were identified with a CE angle $>25^\circ$ and these formed the study group.

False-profile radiographs were taken in the standing position at an angle of 65° between the pelvis and the film as described by Lequesne.³ The ipsilateral second metatarsal axis was parallel to the surface of the film and the bulb was at right angles to it. The tube-film distance was 100 cm so that the femoral head was positioned at the centre (Fig. 1). The ventral centre acetabulum or vertical-centre-anterior

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Fig. 2

Diagram showing the false-profile view (V, vertical line from the centre of the femoral head; C, centre of the femoral head; A, anterior edge of the dense shadow of the subchondral bone slightly posterior to the anterior edge of the acetabulum).

Fig. 3

Diagram showing the anterior acetabular head index $((A/B) \times 100)$.

margin (VCA) angle was measured (Fig. 2). The new index, the anterior acetabular head index (AAHI), was measured on the false-profile view (Fig. 3). Anterior cover is determined from three vertical lines. The first (1) passes through the most posterior aspect of the femoral head, the second (2) through the anterior aspect of the acetabulum, and the third (3) through the most anterior aspect of the head. The distance between the first and second lines (A) is divided by the distance between the first and third (B) and the A/B ratio is finally converted to a percentage $((A/B) \times 100)$.

Statistical analysis. We used SPSS 8.0 for Windows (SPSS Japan Inc, Tokyo, Japan). Comparisons were performed by an independent sample Student's *t*-test. Correlations were evaluated by using Pearson's coefficient.

Results

Normal AAHI range. The data were of normal distribution. The mean AAHI for all hips was $84.1 \pm 6.2\%$. For women it was $81.7 \pm 4.6\%$ (69 to 96) and for men $88.5 \pm 6.6\%$ (74 to 99). This difference was statistically significant ($p < 0.001$).

Correlation between the AAHI and VCA angles. There was a positive correlation between the AAHI and VCA angles (Fig. 4).

Fig. 4

The correlation between the vertical-centre-anterior margin (VCA) angle and the anterior acetabular head index (AAHI) ($p < 0.001$; $Y = 0.56X + 62.3$; $r = 0.72$).

Fig. 5a

Fig. 5b

Radiographs showing a) the AP and b) the false-profile views of the left hip in a 41-year-old woman with hip dysplasia and associated arthropathy. It was difficult to determine the centre of the femoral head because of the deformity. The AHI was 68% and the AAHI 74%.

Fig. 6a

Fig. 6b

Radiographs showing a) the AP and b) the false-profile views of the right hip in a 24-year-old man with deformity of the femoral head after Legg-Calvé-Perthes' disease. It was difficult to determine the centre of the femoral head. The AHI was 62% and the AAHI 77%.

Discussion

Wiberg's CE angle¹ has been used as an index of hip dysplasia since it was first reported. Cooperman, Wallensten and Stulberg⁵ reported that degenerative changes were observed

in most patients with an abnormal CE angle but that the degree of dysplasia did not correlate with the onset of these changes. Sharp² indicated that it was difficult to measure the CE angle accurately in patients with subluxation and deformity of the femoral head and described the value of the

Sharp angle.² We have previously reported that since there is both lateral and anterior dysplasia it is necessary to use both the VCA and CE angles to demonstrate the progression of degenerative changes.^{6,7} Crockarell, Trousdale and Guyton⁸ also suggested that the anterior centre-edge angle should be measured when counselling patients with asymptomatic acetabular dysplasia. In our earlier study,⁶ we measured the VCA angle in 283 patients and regarded a value of more than 24° as normal, in agreement with the range reported by Lequesne. Since it is difficult to measure the VCA and CE angles in patients with dysplasia and deformity of the femoral head or in those with advanced arthropathy, we have introduced and evaluated the AAHI (Figs 5 and 6). The mean AAHI for all hips was 84%. Any value over 72% was normal, which is similar to the AHI measured on AP views of the hip. The AAHI was higher in men than in women.

AP and Lauenstein views are conventionally used for the assessment of patients with a flat femoral head after Perthes' disease. Unfortunately, the degree of anterior cover cannot be assessed using these views alone and it is necessary to undertake false-profile views. Since it is difficult to determine the centre of the femoral head, the AAHI may be used to assess anterior cover. There is a significant correlation between the VCA angle and AAHI.

In conclusion, the AAHI is useful in the assessment of anterior cover in dysplastic hips, particularly in those with a deformity of the femoral head or those with degenerative changes.

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