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# Association between Sub-clinical Acetabular Dysplasia and a Younger Age at Hip Arthroplasty in Idiopathic Osteoarthritis

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**This retrospective study was designed to investigate whether sub-clinical acetabular dysplasia, defined by a reduced centre-edge angle of Wiberg, was associated with a younger age at hip arthroplasty in patients with idiopathic osteoarthritis (OA). Fifty-four patients with 69 performed arthroplasties and no previous referral for hip dysplasia were selected from a list of consecutive recipients of hip endoprostheses due to idiopathic OA. The centre-edge angle was measured from standard pelvic radiographs taken a mean of 5.1 years prior to the endoprosthesis operation when there were minimal signs of hip OA. The age at which hip arthroplasty was carried out was compared between those patients with low (20° – 35°) and those with high (≥ 35°) centre-edge angles. The mean age at hip arthroplasty was significantly younger in the group with centre-edge angles of 20° – 35° (65.6 years) compared with those with centre-edge angles ≥ 35° (69.2 years). These results suggest that sub-clinical acetabular dysplasia was associated with a younger age at hip arthroplasty in idiopathic OA.**

KEY WORDS: Osteoarthritis (OA); Idiopathic; Hip dysplasia; Arthroplasty; Centre-edge angle; Wiberg angle; Contact stress

## Introduction

Osteoarthritis (OA) of the hip, with its increased prevalence and morbidity among the ageing population, has become a substantial economic burden in developed countries.[1] It develops most commonly in the absence of a known cause and is, thereafter, referred to as idiopathic or primary OA. Efforts to prevent the disease or slow its progression have been unsuccessful.[1] In addition to increased age, epidemiological studies have suggested several other risk factors for hip OA, including obesity,[2] heavy lifting[3] and mild anatomical abnormalities of the hip joint,[4] all of which are presumed to act through increased contact stress on the articular surface.[5] Although the first two of these additional risk factors might be responsive to personal intervention, the latter is not. The most common deformity of

the hip joint is caused by congenital hip subluxation and is referred to as developmental dysplasia of the hip.[4] Studies have consistently implicated increased hip joint contact stress due to marked acetabular dysplasia in the development of hip OA.[6] In a study comparing populations of healthy and dysplastic hips, higher cumulative hip stress was suggested to be responsible for faster occurrence of OA in hips with developmental dysplasia.[7]

Different surgical procedures have been devised in an effort to decrease contact stress and slow down the progressive joint degeneration.[8] Considering the lack of prospective clinical studies demonstrating long-term benefits in treating OA, caution when performing prophylactic osteotomies remains mandatory. Not all anatomical abnormalities, however, present themselves as severe conditions. Mild deformity of an otherwise healthy hip might go unnoticed in the clinical setting, hence the term sub-clinical acetabular dysplasia.[9] Defined by a decrease in the centre-edge angle of Wiberg, acetabular dysplasia has been shown to be associated with an increased risk of incident hip OA,[10] but there is no general consensus on its importance in idiopathic hip OA development. To the authors' knowledge, the present study is the first to address this issue by analysing the association between centre-edge angle and age at hip arthroplasty in patients with idiopathic OA.

# Patients and methods

## STUDY POPULATION

In this retrospective study, the central archives of the University Hospital Maribor, Maribor, Slovenia, were searched for pelvic radiographs from consecutive female recipients of primary hip endoprosthesis, who were operated on during a 2-year period from January 2004 to December 2005. The pelvic radiographs suitable for inclusion in the study were those taken in the supine position as routine clinical images prior to the operation. All operations were performed at the Department of Orthopaedic Surgery, University Hospital Maribor. The study was approved by the National Ethics Committee of Slovenia. All patients with radiographs selected for inclusion in the final analysis were contacted and provided written informed consent for the use of their data in the study.

Only female patients were considered for evaluation in this study because of the higher prevalence of idiopathic OA in women.[1] Secondary causes of hip OA, which were established through medical records and an interview, were used as exclusion criteria for participation in the study. Patients previously treated for developmental dysplasia of the hip, rheumatoid or psoriatic arthritis, avascular necrosis of the femoral head, slipped capital femoral epiphysis or previous hip/femur fracture were excluded.

## RADIOGRAPH ASSESSMENT

Standard anterior–posterior pelvic radiographs with both hips and pelvis clearly visible and that showed spherical femoral heads were recovered from the hospital archives. Centre-edge angle was measured as the angle between the vertical through the centre of the femoral head and the line that connects the centre of the femoral head with the lateral margin of the acetabular rim (Fig. 1). The width of the hip joint space was measured at the lateral margin of the sub-chondral sclerotic line, at the apical transection of the weight-bearing surface by a vertical line through the centre of the femoral head, and at the medial margin of the weight-bearing surface bordering on the fovea. The minimum joint space width was defined as the smallest of

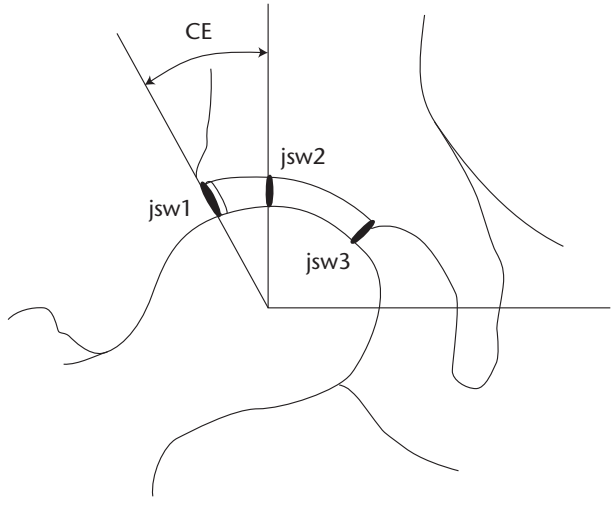


**FIGURE 1:** Measurement of the centre-edge angle of Wiberg (CE) and joint space width (jsw) in the hip joint: joint space width was measured at the lateral margin of the sub-chondral sclerotic line (jsw 1), at the apical transection of the weight-bearing surface by a vertical line through the centre of the femoral head (jsw 2), and at the medial margin of the weight-bearing surface bordering on the fovea (jsw 3)

the three measurements. Radiographs with considerable joint space narrowing (minimum joint space width < 3 mm), marked acetabular dysplasia, large osteophytes, or acetabular protrusion were further excluded from the study. The cut-off point for marked acetabular dysplasia was set as a centre-edge angle < 20°, as previously used by Jacobsen *et al.*,[11] hence radiographs showing a centre-edge angle < 20° were excluded.

### STATISTICAL ANALYSIS

The hips were divided into two equally sized groups according to the mean centre-edge angle: hips with a low centre-edge angle (20° – 35°) and hips with a high centre-edge angle (≥ 35°). The mean age at the time of hip arthroplasty was compared between the two groups with the two-tailed independent sample *t*-test for unequal variances. Statistical significance was determined at a *P*-value of < 0.05. The trend line for the dependence between age at the time of hip arthroplasty and centre-edge angle was computed using linear regression. All statistical analyses were performed using the SPSS® statistical package, version 12.0 (SPSS Inc., Chicago, IL, USA) for Windows®.

## Results

The central archives search identified pelvic radiographs from 431 consecutive female patients that had been taken as routine clinical images at a mean of 5.1 years (range 18 months to 15 years) before patients had undergone primary hip endoprosthesis. Ninety-two patients were excluded because they had secondary causes of hip OA. From the remaining patients, there were 90 standard anterior–posterior pelvic radiographs with both hips and pelvis clearly visible and that showed spherical femoral heads. Of these, 27 radiographs

showed considerable joint space narrowing (minimum joint space width < 3 mm), marked acetabular dysplasia, large osteophytes, or acetabular protrusion and were excluded from the analysis. Three patients could not be located, two had died by the time of the study and four were unwilling to give informed consent. Accordingly, the study sample consisted of 54 patients with idiopathic OA who had undergone 69 hip arthroplasties (39 unilateral and 15 bilateral).

Centre-edge angle measurements of the hips ranged from 20° to 50° (mean ± SD 35.0° ± 7.6°). The 69 hips were divided into two equally sized groups with regard to the mean centre-edge angle: 34 hips had a centre-edge angle of 20° – 35° and 35 hips had a centre-edge angle ≥ 35°.

Mean ± SD age at the time of hip arthroplasty was 65.6 ± 6.6 years in the group with a low centre-edge angle (20° – 35°) and 69.2 ± 7.5 years in the group with a high centre-edge angle (≥ 35°) (Table 1). This difference was statistically significant ($P = 0.041$).

Figure 2 shows the correlation between age at hip arthroplasty and centre-edge angle. The depicted trend line shows that a young age at the time of hip arthroplasty was associated with a low centre-edge angle. The standardized β coefficient for linear regression was 0.271 ($r^2 = 0.073$; $P = 0.024$).

# Discussion

The present study demonstrated a significant difference in patient age at hip arthroplasty between the two groups based on their centre-edge angles; a low centre-edge angle (20° – 35°) was significantly associated with a young age at hip arthroplasty ($P = 0.041$). As the centre-edge angle measured in the present study (mean 35.0°) was similar to that found in a larger population of healthy hips,[11] the sample may be considered as representative of the general population in Slovenia. A decrease in the centre-edge angle has previously been shown to result in increased contact hip stress,[12] which is believed to be aetiologically related to early degeneration of the cartilage in dysplastic hips.[6] The results of the present study suggested that, in addition to dysplastic values (centre-edge angle < 20°), low centre-edge angles in hips with sub-clinical acetabular dysplasia (20° – 35°) might also be related to faster development of hip OA in a similar manner, i.e. through increased contact stress. A previous biomechanical study, where centre-edge angle and contact stress were compared between both hips of a pelvis, further supports this claim.[13] A low centre-edge angle and high peak contact hip stress values were found on the side where earlier idiopathic hip OA had occurred.[13]

No reciprocal validation exists between onset of OA of the hip and age at the time of

**TABLE 1:**
**Comparison of age at the time hip arthroplasty for the hips of females with a low (20° – 35°) or a high (≥ 35°) centre-edge angle of Wiberg in pelvic radiographs taken several years (mean 5.1 years) prior to surgery**

| Sample group | No. of hips | Mean age ± SD (years) | Statistical significance[a] |
|---|---|---|---|
| Centre-edge angle 20° – 35° | 34 | 65.6 ± 6.6 | $P = 0.041$ |
| Centre-edge angle ≥ 35° | 35 | 69.2 ± 7.5 | |

[a]Independent sample *t*-test.

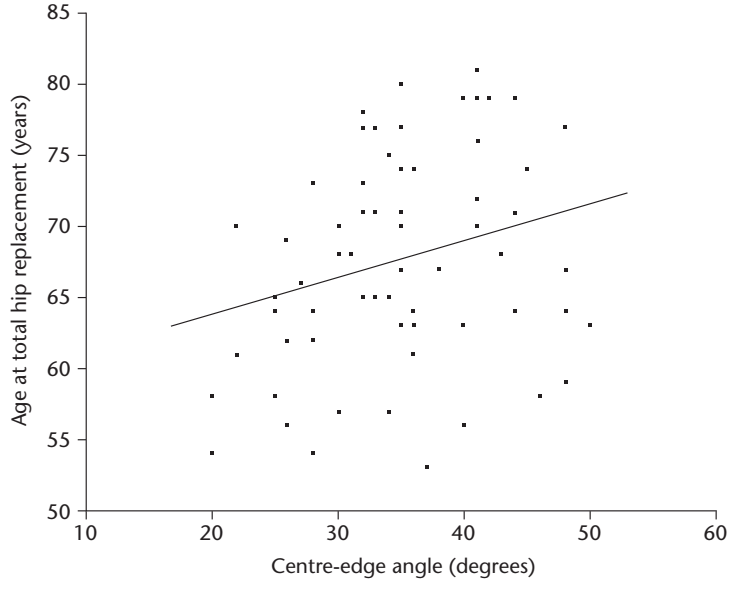


**FIGURE 2:** Correlation between age at the time of hip arthroplasty and centre-edge angle of Wiberg for 69 hips in 54 female patients with idiopathic osteoarthritis who had undergone hip arthroplasty (39 unilateral and 15 bilateral): standardized β coefficient for linear regression was 0.271 ($r^2$ = 0.073; $P$ = 0.024)

hip arthroplasty, which presents a limitation for the present study. As it is not possible to pinpoint the exact time at which OA occurs and as timing of the operation is influenced by clinical as well as socio-economic factors,[14] no such validation is possible. By defining rigorous radiographic exclusion criteria, the patient sample in the present study might have been biased towards the selection of young patients with few radiographic signs of OA. Hypothetically, these young patients might have presented with more severe pain than older patients, necessitating earlier operative intervention. Unfortunately, clinical symptoms were not assessed and this is a limitation of the present study. The small population size and the retrospective nature of the study design are further limitations. Performing a prospective study with a larger sample would help to ameliorate these limitations.

Despite its limitations, the present study exhibits several strengths. The University Hospital Maribor is the only institution in the Podravje and Pomurje regions of Slovenia where hip arthroplasty is performed. As patients were selected from a group of consecutive recipients of hip endoprosthesis and their centre-edge angle measurements reflect population characteristics,[11] the sample could be considered to be representative for the 250 000 women living in these two regions. By excluding hips with centre-edge angles < 20°, any negative effect that developmental dysplasia of the hip might have had on the study findings was minimized. The threshold for marked acetabular dysplasia could have been raised even higher to 25° or 30°,[10] but since none of the hips included in the present study was treated or clinically evaluated prior to the onset of OA, to do this would seem arbitrary.

In conclusion, the present study demonstrated that, among women with idiopathic hip OA, a younger age at hip arthroplasty was associated with a decreased centre-edge angle. These data suggest that acetabular dysplasia might not only be an important predictor of secondary hip OA when presented as developmental dysplasia of the hip, but also of idiopathic hip OA. In the latter case, acetabular dysplasia could persist clinically and unnoticed in an apparently healthy hip until symptoms of OA develop. Further studies are required to elucidate the role of sub-clinical acetabular dysplasia in the development of idiopathic hip OA.

## Conflicts of interest

The authors had no conflicts of interest to declare in relation to this article.

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