Arch. Biol. Sci., Belgrade, 63 (1), 137-143, 2011 DOI:10.2298/ABS1101137J

SEX DIMORPHISM OF POSTURAL PARAMETERS OF THE HUMAN ACETABULUM

D. JEREMIĆ[1], B. JOVANOVIĆ[2], IVANA ŽIVANOVIĆ-MAČUŽIĆ[1], GORDANA ĐORĐEVIĆ[3], MAJA SAZDANOVIĆ[4], M. ĐORĐEVIĆ[2], P. SAZDANOVIĆ[1], MAJA VULOVIĆ[1] and J. TOŠEVSKI[1]

[1] *Department of Anatomy, Faculty of Medicine, University of Kragujevac,* 34000 Kragujevac, Serbia
[2] *Obstetrics and Gynecological Clinic, Clinical Center Kragujevac,* 34000 Kragujevac, Serbia
[3] *Department of Epidemiology, Medical Faculty, University of Kragujevac,* 34000 Kragujevac, Serbia
[4] *Department of Histology, Faculty of Medicine, University of Kragujevac,* 34000 Kragujevac, Serbia

Abstract - The aim of this investigation was to examine normal acetabular morphometry, its sex dimorphism and the acetabular dysplasia rate in Serbian adults. For each hip, the centre-edge angle of Wiberg, the acetabular angle of Sharp, acetabular depth and acetabular roof obliquity were measured. The center-edge angle of Wiberg correlated negatively with the acetabular angle of Sharp and acetabular roof obliquity, but positively correlated with acetabular depth. Our results suggest that the prevalence of acetabular dysplasia in the Serbian population is lower than in Western countries. We confirmed the existence of significant gender differences in acetabular morphology among the subjects of our study. These sex-related differences in acetabular morphology were the cause for more dysplastic female acetabula compared with male acetabula.

Key words: Sex dimorphism, posture, acetabulum, acetabular dysplasia

UDC 595.76:591.139:59

INTRODUCTION

The erect posture assumed by humans is unique among primates. The maintenance of trunk balance and improved stability in the upright posture of man are achieved with the help of the large muscles of the vertebral column, gluteal and abdominal muscles, and changes that have occurred on the vertebral column, hip, pelvis and blood vessels (Conroy, 1990, Toševski, Lečić Toševski, 2006, Abitbol, 1995, 1988, Schimpf, Tulikangas, 2005). The center of gravity in humans lies near the hip joint and the line of gravity falls slightly anterior to the ankle joint (Conroy, 1990, Toševski, Lečić Toševski, 2006). It seems that only human bipedalism was successful, even though the upright posture of modern man was a direct cause of several inefficient biomechanical solutions and diseases that are entirely human (low back pain, sciatica, acetabular dysplasia, coxarthrosis, gonarthrosis, varicose veins, etc.) (Toševski, Lečić Toševski, 2006).

More information is needed about the postural parameters of the acetabulum of a normal hip joint, including its shape, its depth at precise locations, and the influence of age, sex and congenital morphology (Goker et al., 2003; Lanyon et al., 2003). As race, clime, heredity and geographical areas have strong influences over the anthropometric parameters of bones, the present study was undertaken to note the average anatomical parameters of the acetabulum, as part of the hip joint, in the Serbian population. Knowledge of the anatomical parameters of the bony components of the hip joint is very essential as it will enable a better understanding of the etiopathogenesis of diseases like primary osteoarthrosis of hip joint. Also, knowledge of the various bony components of the hip joint will not only help the radiologist but will also be of immense importance to orthopaedicians and prosthetists in constructing suitable prostheses (Shiramizu et al., 2003, Rejholec, 2007). Awareness of the average dimensions of the hip joint bones in both sexes will also help in early detection of disputed sex by forensic expert.

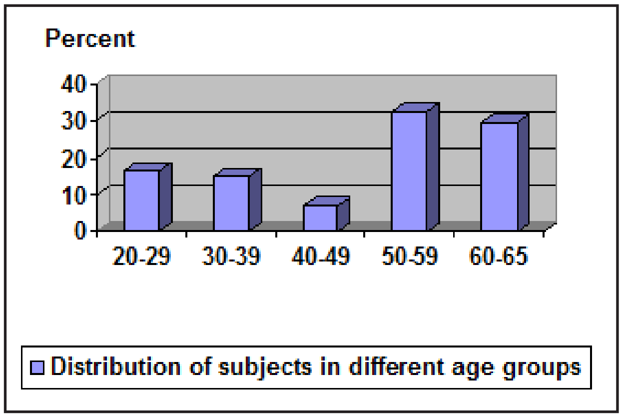
The purpose of this study was to examine normal acetabular morphometry, to determine sex differences in the anatomical parameters of the acetabulum among asymptomatic subjects without structural change, and finally to evaluate the rate of acetabular dysplasia in the Serbian population compared with those values from other countries.

MATERIALS AND METHODS

We evaluated the hip joints of 370 individuals who were over the age of 20; 32 of them had been treated with physical procedures for fractures of the femoral neck and 338 had clinically normal hip joints. They were 60.0% males (222) and 40.0% females (148). The average age was 50.8 years (from 21 to 65); broken down by decades, the twenties 16.2% (60), thirties 14.8% (55), forties 6.7% (25), fifties 32.4% (120) and over-sixties 29.7% (110) (Table 1, His. 1).

Table 1. Age groups of evaluated population

Age (yrs)	No. of males	No. of females	Total no.
20-29	56	4	60
30-39	42	13	55
40-49	19	6	25
50-59	55	65	120
60-65	50	60	110
Total	222	148	370



His.1. Distribution of subjects in different age groups

Patients with a known hip disease or pain located in the hip region, including ambiguous pain probably of lumbar origin but irradiating to the region of the greater trochanter, groin or thigh, were excluded from this study. We also excluded patients with bone disorders such as Paget's disease, femoral head disease, acquired deformities, unequivocal osteoarthritis of the hip, and evident osteophytes or cysts adjacent to the hip joint cavity. Films with incorrect patient positioning (misalignment of the sacrum-pubic symphysis vertical axis ≥1.5 cm) were also excluded.

An antero-posterior (AP) radiograph was used to measure the radiography of a hip joint. Patients were placed in a supine position with legs extended and internally rotated 15°, with a distance of 100,.0 cm between the x-ray source and the radiographic film. The central radiographic ray was aligned to be perpendicular to the cassette, entering 5.00 cm superior to the pubic symphysis. All measurements were made using a new Plexiglass instrument, the arthrometer, which is comprised of a ruler and protractor for measuring hip architectural angles (Lequesne, Morvan, 2002). Interpretations were performed by a physiatrist trained in the radiographic appearance of acetabular morphology and acetabular dysplasia.

A retrospective study was performed for the radiography of patients treated by physical procedures and a prospective study was done for all the radiography of clinically normal hip joints.

To measure the morphology of the acetabulum, the anatomical structure of the hip joint was assessed by measurement of the acetabular angle of Sharp,

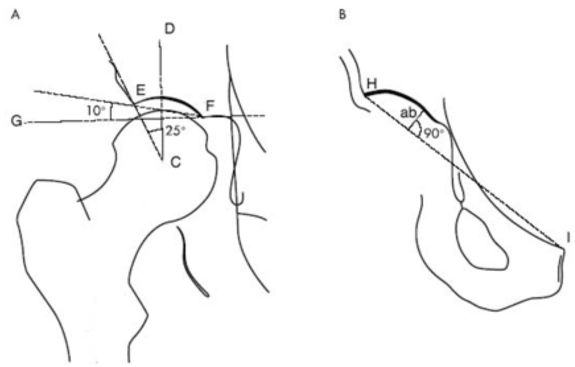


Fig. 1. (A) The center-edge angle of Wiberg - DCE, acetabular roof obliquity - GFE; (B) Acetabular depth – segment ″ab″

center-edge angle of Wiberg, acetabular depth and acetabular roof obliquity (Fig. 1).

The acetabular angle is formed by the angle between a line connecting the left and right sides of the pelvic tear drop and a line joining the lateral edge of the acetabular roof and the inferior tip of the pelvic tear drop (Fig. 1A), (Cooperman et al., 1983; Delaunay et al., 1997).

The Wiberg angle is formed by the angle between a line connecting the center of the femoral head and lateral margin on the acetabular roof and a perpendicular line joining the center of the two femoral heads (Fig. 1B), (Smith et al., 1995). The center of the femoral head was determined with the aid of a transparent plastic sheet marked with concentric circles.

The acetabular depth is the longest vertical distance between a line joining the lateral acetabular margin and the upper margin of the symphysis pubis on the same side and the acetabular roof (Fig. 1B), (Smith et al., 1995).

The acetabular roof obliquity is defined as the angle between a line connecting the lateral edge of the acetabular roof and the lower iliac tip of the acetabular surface and a line parallel to the pelvic tear drop (Fig. 1A), (Delaunay et al., 1997).

All measurements of the anatomical parameters of the acetabulum were performed by a single reader.

Statistic analysis

Sex related differences of the anatomical parameters of the acetabulum were assessed by paired samples t-test, and Pearson's correlation coefficient was used to measure the relationship between the various measurement and age. SPSS statistical software for Windows version 15.0 was used for all calculations. A p value of <0.5 is considered significant.

RESULTS

The acetabular angle was 38.3±3.6° in the group of patients in their twenties, 38.0±3.4° in their thirties, 37.8±5.5° in their forties, 38.0±4.5° in their fifties and 38.5±3.2° in the over-sixties. The average acetabular angle was 38.0±3.8° (37.5±3.6° in males, 38.5±3.9° in females).

The Wiberg angle was 32.9±5.5° in the group of patients in their twenties, 33.4±6.5° in the thirties, 32.2±6.9° in the forties, 33.8±7.2° in the fifties and 32.8±6.3° in the over-sixties. The average Wiberg angle was 33.5±6.5° (33.6±5.8° in males, 33.3±6.9° in females).

The acetabular depth was 12.8±2.6 mm in the group of patients in their twenties, 12.4±2.6 mm in the thirties, 11.9±2.7 mm in the forties, 11.6±2.8 mm in the fifties and 11.1±2.6 mm in the over-sixties. The mean acetabular depth was 11.9±2.8 mm (12.5±2.7 mm in males, 11.2±2.7 mm in females).

The acetabular roof obliquity was 5.5±4.4° in the group of patients in their twenties, 6.9±5.7° in the thirties, 8.2±5.5° in the forties, 8.1±6.0° in the fifties and 9.3±6.0° in the over-sixties. The mean acetabular roof obliquity was 7.6±5.7° (6.2±4.9° in males, 9.0±6.0° in females).

There were significant differences in the acetabular depth and acetabular roof obliquity (p<0.01), whereas no significant differences were found in the Wiberg angle and acetabular angle related to age (p>0.05). The acetabular angle, acetabular depth and acetabular roof obliquity differed significantly by gender, while no significant differences were observed in the Wiberg angle related to gender (Tables 2, 3).

To understand the relationship between the Wiberg angle, acetabular angle, acetabular depth and acetabular roof obliquity, we compared the data using the Pearson correlation coefficient. Therefore, the acetabular depth (r =0.60, p<0.01), was significantly increased compared with the Wiberg angle, whereas the acetabular angle (r = -0.65, p<0.01) and acetabular roof obliquity (r = -0.66, p<0.01), were significantly decreased. The values between two standard deviations from the mean represented a normal range (95% confidence).

Following the approach used in previous studies, an abnormal Wiberg angle indicating acetabular dysplasia, was defined as less than 25 degrees, an abnormal acetabular depth as less than 9 mm (Delaunay et al., 1997; Lequesne, Morvan, 2002; Wiberg, 1939), an acetabular angle of more than 45° (44° in males; 45° in females). Low values of acetabular depth and Wiberg angle, reflecting an abnormally shallow and abnormally laterally displaced acetabulum, characterize acetabular dysplasia (Tan et al., 2001). The dysplasia was categorized as severe (a lateral center-edge angle-Wiberg angle of ≤ 5°), moderate (a lateral center-edge angle of 6° to 15°), or absent or mild (a lateral center-edge angle of >15°).

The proportion of acetabular dysplasia was 2.9% overall (2.2% in males; 3.6% in females).

DISCUSSION

The center-edge angle, as described by Wiberg, is the most important measurement on the AP view of the pelvis, because an abnormal center-edge angle

Table 2. Value of each parameter of the acetabulum by age-decades of evaluated subjects

Age	20-29	30-39	40-49	50-59	60-65	p value
Wiberg angle	32,9±5,5	33,4±6,5	32,2±6,9	33,8±7,2	32,8±6,3	>0,05
AA	38,3±3,6	38,0±3,4	37,8±5,5	38,0±4,5	38,5±3,2	>0,05
AD	12,8±2,6	12,4±2,6	11,9±2,7	11,6±2,8	11,1±2,6	<0,01*
ARO	5,5±4,4	6,9±5,7	8,2±5,5	8,1±6,0	9,3±6,0	<0,01*

* Significant difference
The values are mean ± standard deviation.
Wiberg angle (degree), AA: Acetabular angle (degree), AD: Acetabular depth (mm), ARO: Acetabular roof obliquity (degree)

Table 3. Values of each parameter of acetabulum by gender of evaluated subjects

Acetabular parameters	Male	Female	p value	Total
Wiberg angle	33,6±5,8	33,3±6,9	>0,05	33,5±6,5
AA	37,5±3,6	38,5±3,9	<0,01*	38,0±3,8
AD	12,5±2,7	11,2±2,7	<0,01*	11,9±2,8
ARO	6,2±4,9	9,0±6,0	<0,01*	7,6±5,7

* Significant difference
The values are mean±one standard deviation.
Wiberg angle (degree), AA: Acetabular angle of Sharp (degree), AD: Acetabular depth (mm), ARO: Acetabular roof obliquity (degree)

is diagnostic of acetabular dysplasia. This angle is used to assess the superior and lateral coverage of the femoral head by the bony acetabulum. Wiberg reports normal values above 25°, values between 20° and 25° are considered to be borderline, and a center-edge angle of less than 20° is considered diagnostic of acetabular dysplasia (Delaunay et al., 1997). The center-edge angle of Wiberg may not provide an accurate measurement for the following reasons: 1) the center point of a deformed femoral head cannot be located accurately, 2) subluxation, or simple loss of joint space alters the Wiberg angle, and 3) subluxation of the contralateral hip affects the Wiberg angle. Therefore, the acetabular angle and acetabular depth were used for the diagnosis of acetabular dysplasia to compensate for the limitation of the Wiberg angle. Nakamura et al. reported that the average Wiberg angle in the population of Japan was 32.2±6.4° (32.2±6.9° in males, 32.1±6.0° in females), and Yoshimura et al. reported the following values of Wiberg angle: 30.9±6.4° in males, 31.5±7.9° in females (Nakamura et al., 1989; Yoshimura et al., 1994). Lau et al. reported that the average Wiberg angle in the Chinese population was 35.5±6.4° and Croft *et al.* reported that the average in England was 36.2±6.9° (Lau et al. 1995; Croft et al., 1991). Umer *et al.* reported that the mean center-edge angle in the Singaporean population was 31.2±7.9° (range 5-52 degrees) (Umer et al., 2006). Jacobsen et al. reported that the mean Wiberg angle in Denmark of the right and left hips was 35.0±7.3° and 34.0±7.4° in males and 35.0±7.4° and 35.0±7.8° in females (Jacobsen et al., 2005). Goker et al. presented that the mean Wiberg angle in the Turkish population was 34.5±7.4° in males and 35.0±7.0° in females (Goker et al., 2005). Saikia et al. reported that the mean center-edge angle in the Indian population was 32.7° (Saikia et al., 2008). Our study showed that the average center-edge angle was 33.5±6.5° (33.6±5.8° in males, 33.3±6.9° in females). Therefore, we found that the degree of center-edge angle in our study was less than that in the study of the hip joint of the Chinese, English, Danish and Turkish populations, and was greater than that in the study of the hip joint of the Japanese, Singaporean and Indian populations.

Based on Nakamura's report, the average acetabular angle of Sharp in Japan was 38.0±3.6° (37.3±3.7° in males, 38.6±3.4° in females) (Nakamura et al., 1989). Lavy *et al.* reported that the average acetabular angle in Malawi (sub-Saharan Africa) was 36.9±4.0° in males and 38.6±4.9° in females (Lavy et al., 2003). From these results it can be seen that Malawian female acetabulae in their study population are more dysplastic than that of males. Umer et al. reported that the mean acetabular angle in the Singaporean population was 39.5±6.0° (range 10-58 degrees) (Umer et al., 2006). Jacobsen et al. reported that the mean acetabular angle in the Danish population of the right and left hips was 37.0±3.5° and 37.0±3.5° in males and 39.1±3.7° and 38.0±3.8° in females (Jacobsen et al., 2005). Our study showed that the average acetabular angle was 38.0±3.8° (37.5±3.6° in males, 38.5±3.9° in females). No significant differences in age and gender were observed. Therefore, we found that the average acetabular angle in our study was similar to those of Japan, Denmark and Malawian females and different from those of Singaporean population and Malawian males.

The acetabular index of depth to width evaluates the depth of the acetabulum. In a comparison between normal and dysplastic hips with osteoarthritis, all normal hips were shown to have acetabular index values over 38° (Delaunay et al., 1997). Murray reported another method, acetabular depth to compensate for the inaccuracy of the Wiberg angle which was caused by the formation of a bony spur on the lateral margin of the acetabulum and displacement of the femoral head (Murray, 1965). If the acetabular depth is less than 9 mm this is considered to be acetabular dysplasia. Lau et al. presented that the mean acetabular depth in the Chinese population was 11.8 mm and Croft *et al.* presented that it was 14.4 mm in the English population (Lau et al. 1995; Croft et al., 1991). The depth value of our study was 11.9±2.8 mm (12.5±2.7 mm in males, 11.2±2.7 mm in females). Therefore, we found that the average acetabular depth in our study was similar to that of the Chinese population and different from that of the English population. However, since the value of acetabular depth decreased with an increase in age, and the value for females was less than that for males, acetabular depth may not be a good measure of acetabular dysplasia.

Acetabular roof obliquity is used to evaluate the orientation of the acetabular roof in a coronal plane and the superior lateral coverage of the femoral head. Normal values are 10° and under; values above 10° are frequently found in acetabular dysplasia (Delaunay et al., 1997). Acetabular roof obliquity was normal if the angle was less than 30° under one year of age, if the angle was less than 25° between the age of 1 and 3, and if the angle was less than 20° from the age of 3 to adulthood (Massie, Howorth, 1950). The report of Nakamura et al. showed that the Japanese average acetabular roof obliquity was 4.4±5.1° (4.6±4.1° in males, 5.4±4.5° in females) (Nakamura et al., 1989). Umer et al. reported that the mean acetabular angle in the Singaporean population was 7.9±6.5° (7.8±6.5° in males, 7.8±6.8° in females) (Umer et al., 2006), whereas our study indicated the average was 7.6±5.7° (6.2±4.9° in males, 9.0±6.0° in females). Interestingly, we observed the values of males were significantly lower than those of females and a discrepancy was observed between different ages. However, it may not be a good diagnostic method for acetabular dysplasia because of the differences between ages and sex and its high standard deviation.

The prevalence of acetabular dysplasia has been reported as 1.1% in Hong Kong (Lau et al. 1995), 3.3% in Nigerian men (Ali-Gombe et al., 1996), 3.4% in white females in Britain (Lane et al., 1997), 3.8% in another British population (Cooperman et al., 1983), 1.8% in the Korean population (Han et al., 1998), 2.4% in the Turkish population (Aktas et al., 2000) and 1.44% in the Saudi Arabian population (Moussa, Alomran, 2007). In our study, the prevalence was 2.9% (2.2% in males; 3.6% in females). This suggests the prevalence of acetabular dysplasia is higher in the Serbian than in the Asian population and less than in Western countries.

In summary, we analyzed the radiological characteristics of the center-edge angle of Wiberg, acetabular angle of Sharp, acetabular depth, acetabular roof obliquity and their correlation to acetabular dysplasia. We confirmed the existence of significant gender differences among the subjects of our study. These sex-related differences in acetabular morphology were the cause for more dysplastic female acetabulae, compared with male acetabulae. Our data suggest that the prevalence of acetabular dysplasia is lower in the Serbian population than in Western countries.

REFERENCES

Abitbol, M.M. (1988). Evolution of the ischial spine and of the pelvic floor in the hominoidea. *American Journal of Physical Anthropology*, **75**(1), 53-67.

Abitbol, M.M. (1995). Speculation on posture, locomotion, energy consumption and blood flow in early hominids. *Gait & Posture*, **3**(1), 29-37.

Aktas, S., Pekindil, G., Ercan, S., and *Y. Pekindil* (2000). Acetabular dysplasia in normal Turkish adults. *Bull Hosp Jt Dis*, **59**, 158-162.

Ali-Gombe, A., Croft, P.R., and *A.J. Silman* (1996). Osteoarthritis of the hip and acetabular dysplasia in Nigerian men. *J Rheumatol*, **23**, 512-515.

Conroy, C.G. (1990). Primate Evolution, 332–333. W W Norton & Company, New York.

Cooperman, D.R., Wallensten, R., and *S.D. Stulberg* (1983). Acetabular dysplasia in the adult. *Clin Orthop*, **175**, 79- 85.

Croft, P., Cooper, C., Wickham, C., and *D. Coggon* (1991). Osteoarthritis of the hip and acetabular dysplasia. *Ann Rheum Dis*, **50**, 308-310.

Delaunay, S., Dussault, R.G., Kaplan, P.A., and *B.A. Alford* (1997). Radiographic measurements of dysplastic adult hips. *Skeletal Radiol*, **26**, 75-81.

Goker, B., Sancak, A., Arac, M., Shott, S., and *J.A. Block* (2003). The radiographic joint space width in clinically normal hips: effects of age, gender and physical parameters. *Osteoarthritis Cartilage*, **11**, 328-334.

Goker, B., Sancak, A., and *S. Haznedaroglu* (2005). Radiographic hip osteoarthritis and acetabular dysplasia in Turkish men and women. *Rheumatol Int*, **25**, 419-422.

Han, C.D., Yoo, J.H., Lee, W.S., and *W.S. Choe* (1998). Radiographic parameters of acetabular dysplasia in Korean adults. *Yonsei Med J*, **39**, 404-408.

Jacobsen, S., Sonne-Holm, S., Soballe, K., Gebuhr, P., and *B. Lund* (2005). Hip dysplasia and osteoarthritis. *Acta Orthopaedica*, **76**(2), 149-158.

Lane, N.E., Nevitt, M.C., Cooper, C., Pressman, A., Gore, R., and *M. Hochberg* (1997). Acetabular dysplasia and osteoarthritis of the hip in elderly white women. *Ann Rheum Dis*, **56**, 627-630.

Lanyon, P., Muir, K., Doherty, S., and *M. Doherty* (2003). Age and sex differences in hip joint space among asymptomatic subjects without structural change: implications for epidemiological studies. *Arthritis Rheum*, **48**, 1041-1046.

Lau, E.M.C., Lin, F., Lam, D., Silman, A., and *P. Croft* (1995). Hip osteoarthritis and dysplasia in Chinese men. *Ann Rheum Dis*, **54L**, 965-969.

Lavy, C.B.D., Msamati B.C., and *P.S. Igbigbi* (2003). Racial and gender variation in adult hip morphology. *International Orthopaedics* (SICOT), **27**, 331-333.

Lequesne, M., and *G. Morvan* (2002). Description of the potential of an arthrometer for standard and reduced radiographs suitable to measurement of angles and segments of hip, knee, foot and joint space widths. *Joint Bone Spine*, **69**, 282-92.

Massiem W.K., and *M.B. Howorth* (1950). Congenital dislocation of the hip. *J Bone Joint Surg*, **32**-A, 519-531.

Moussa, M., and *A. Alomran* (2007). Acetabular dysplasia in adult hips of a Saudi population. *Saudi Med J*, **28**(7), 1059-1061.

Murray, R.O. (1965). The etiology of primary osteoarthritis of the hip. *Br J Radiol*, 38, 810-824.

Nakamura, S., Ninomiya, S., and *T. Nakamura* (1989). Primary osteoarthritis of the hip joint in Japan. *Clin Orthop*, **241**, 190-196.

Rejholec, M. (2007). Combined pelvic osteotomy for deformed dysplastic acetabula: a 5 year prospective study. *Journal of Orthopaedic Surgery*, **3**, 347-351

Saikia, K.C., Bhuyan, S.K., and *R. Rongphar* (2008). Anthropometric study of the hip joint in Northeastern region population with computed tomography scan. *Indian J Orthop*, **42**(3), 260-266.

Schimpf, M., and *P. Tulikangas* (2005). Evolution of the female pelvis and relationships to pelvic organe prolapse. *International Urogynecology Journal*, **16**(4), 315–320.

Shiramizu, K., Naito, M., and *M. Yatsunami* (2003). Quantitative anatomic characterisation of the pelvic brim to facilitate internal fixation through an anterior approach. *Journal of Orthopaedic Surgery*, **11**(2), 137-140.

Smith, P.W., Coggon, D., Cawley, M.I.D., and *C. Cooper* (1995). Osteoarthritis of the hip joint and acetabular dysplasia in women. *Ann Rheum Dis*, **54**, 179-181.

Tan, L., Aktas, S., Copuroglu, C., Ozcan, M., and M. *Ture* (2001). Reliability of radiological parameters measured on anteroposterior pelvis radiographs of patients with developmental dysplasia of the hip. *Acta Ortpodedica Belgica*, **67**(4), 374 - 379.

Toševski, J., and *D. Lečić Toševski* (2006). Concealed female external genitals: Possible morpho-psychological clue to unique emotional and cognitive evolutionary matrix of man. *Med Sci Monit*, **12**(5), 11-19.

Umer, M., Thambyah, A., Tan, W.T.J., and *S. Das De* (2006). Acetabular morphometry for determining hip dysplasia in the Singaporean population. *Journal of Orthopaedic Surgery*, **14**(1), 27-31.

Wiberg, G. (1939). Studies on dysplastic acetabulae and congenital subluxation of the hip joint. *Acta Orthop Scand* (Suppl), **58**, 1-132.

Yoshimura, N., Campbell, L., Hashimoto, T., Kinoshita, H., Okayasu, T., Egger, P., Coggon, D., Croft, P., and *C. Cooper* (1994). Acetabular dysplasia in Britain and Japan. *Br J Rheumatol*, **33** (suppl.), 102.