DOI: 10.2298/SARH1404178A
UDC: 611.718

Contribution to the Method for Determining Femoral Neck Axis

Zoran Andjelković[1], Desimir Mladenović[2,3], Zoran Vukašinović[4,5], Stojanka Arsić[3], Milorad Mitković[2,3], Ivan Micić[2,3], Marko Mladenović[2]

[1]Department of Orthopedics and Traumatology, General Hospital, Leskovac, Serbia;
[2]Clinic of Orthopedics and Traumatology, Clinical Center of Niš, Niš, Serbia;
[3]Faculty of Medicine, University of Niš, Niš, Serbia;
[4]Institute of Orthopedic Surgery "Banjica", Belgrade, Serbia;
[5]Faculty of Medicine, University of Belgrade, Belgrade, Serbia

SUMMARY

Introduction Femoral neck axis plotting is of great significance in measuring parameters that define femoral head-neck junction sphericity in the group of patients with the femoroacetabular impingement. Literature methods of femoral neck axis determination have weaknesses associated with the risk of obtaining inaccurate values of certain parameters.

Objective Method of plotting of the femoral neck axis by two parallel lines that belong to the medial quarter of the femoral neck is proposed. Method was tested on the anatomic specimens and the respective radiograms.

Methods A total of 31 anatomic specimens of the proximal femur and respective radiographs were used, on which three axes of the femoral neck were plotted; accordingly, alpha angle value was determined and tested with corresponding parametric tests, with the measurement error of less than 5% and the strength of the applied tests of 80%.

Results Alpha angle values obtained by plotting femoral neck axis using the literature and methods we have proposed were not significantly different in our series, and, in more than a half of the specimens, the two axes overlapped each other.

Conclusion The advantage of the proposed method does not depend on the position of the femoral head rotation center in relation to the femoral neck, which favors proposed method for measuring the angles of femoral head sphericity in patients with the femoral head translation. Disadvantage of the study is a small sample size for valid conclusions about the applicability of this method in clinical practice.
Keywords: hip; femoral neck axis; new method; angle alpha

INTRODUCTION

Osteoarthritis of the hip was classified as secondary (congenital or developmental disease of the hip) or primary [1-7]. The concept of femoroacetabular impingement (FAI), created by Ganza et al. [5, 6], has contributed to a better understanding of etiology of hip osteoarthritis where the small bone changes of the hip, with FAI mechanism, cause damages of the hip soft tissue structures indicated as early signs of osteoarthritis [8-14]. Several diagnostic tools for measuring changes in the acetabulum and proximal femur in patients with FAI have been described, such as an offset index of the femoral head and neck, alpha angle and triangular index [14-23]. The baseline for all of them is a femoral neck axis determination, as a line that connects the center of the femoral head rotation with the middle of the line that connects the narrowest portion of the femoral neck.

Murray [3] determined the femoral neck axis on anteroposterior radiograms of the hips, plotting the line that connects the middle of the line of the narrowest part of femoral neck and the middle of the line that connects superolateral edge of the tip of the greater trochanter with the lesser trochanter. He used this method to determine the level of translation of the femoral head in relation to the femoral neck axis, considering that the femoral head translation ("tilt deformity") was a cause of hip osteoarthritis. Goodman et al. [19] plotted femoral neck axis on the cadaveric proximal femur specimens and respective radiograms, without specifying the method of plotting, and also pointed that the translatory displacement of femoral head deviated the center of the femoral head rotation from the femoral neck axis. The most commonly used and widely accepted method for femoral neck axis determination [20] assumes that the line joining the center of the femoral head rotation and the narrowest part of the femoral neck is the neck axis (Figure 1a). Alpha angle, offset index and triangular index were measured on this line in patients with cam and mixed form of FAI [10, 14, 19-27]. We think that plotted femoral neck axis in femoral head translational pathology is not the same as it would have been if the femoral head had not been translated (Figure 2). Therefore, we believe that the weakness of these literature methods in determining the femoral neck axis is that the axis of the femoral neck is deter-

Correspondence to:
Zoran ANĐELKOVIĆ
Dubočica 13, 16000 Leskovac
Serbia
zoa8@ptt.rs

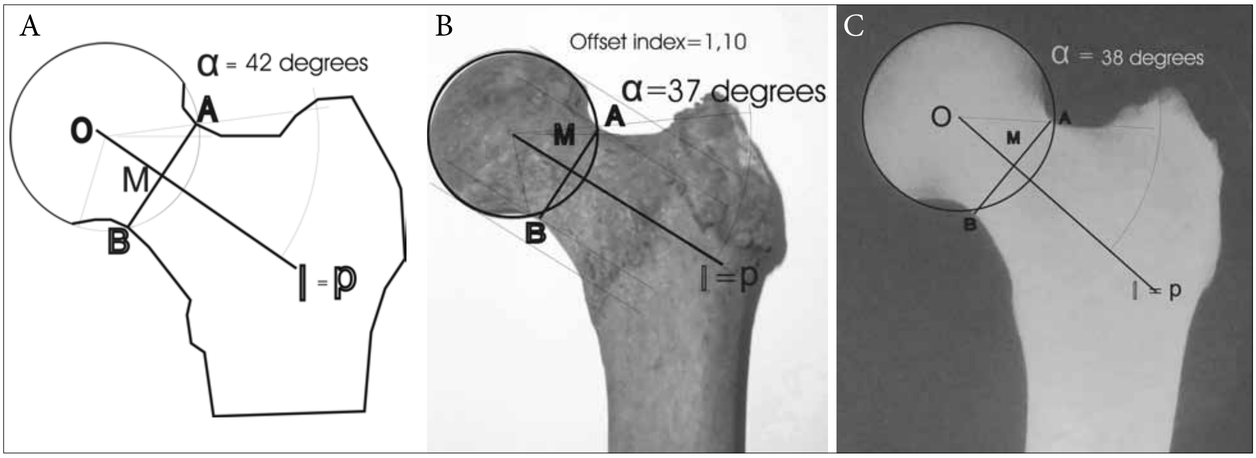

Figure 1. A) Sketch; B) Anatomical specimen; C) Radiograph of the anatomical specimen B, from pathological unchanged proximal femor. Determining the axis of the femoral neck by methods that are commonly used in the literature (line l), which is in these pictures matched with determination of the femoral neck axis we propose in this paper, line p (l = p). Determination of the angle alpha (alpha-l = alpha -p) by the method which was adopted in the literature as the "gold standard", known as a method of Nötzly (explanation given in the text).

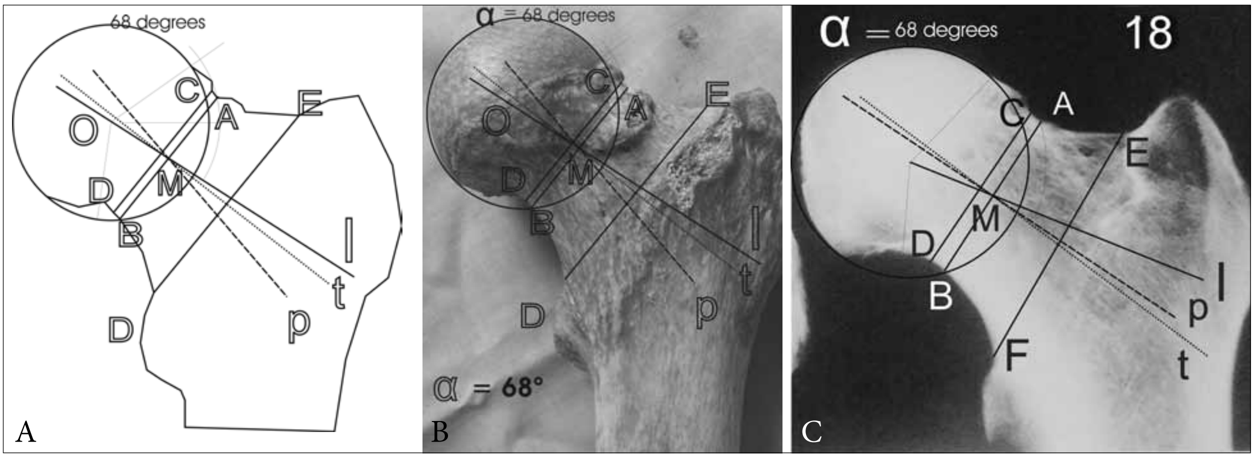

Figure 2. A) Sketch; B) Anatomical specimen; C) Radiograph of the anatomical specimen with osteocartilaginous cam at the femoral head and neck junction: overview of the method of determining axes l, p,t, those determining the angle of alpha-l by the method of Nötzly (explanation in the text).

mined on the basis of two points, one point at the site of the femoral neck and the second one at the center of the femoral head rotation or intertrochanteric line.

Using the anatomical specimens of the upper femur, two separated parts on the anterior side of the femoral neck were observed: an irregular parallelogram-shaped inner quarter of the femoral neck, directly related to the femoral head, and an irregular trapezoid-shaped, outer three-quarters of the femoral neck, which ends with its base at the trochanteric massif (Figure 3). On these two parts of the femoral neck, two different axes of the femoral neck can be plotted (Figure 2).

Our query was whether plotted femoral neck axis were identical, and whether they could be used in clinical practice as a femoral neck axis, then which plotting was not dependent on the position of the center of the femoral head rotation, and whether there was a match of these axes, with the most frequently used method of femoral neck axis determination.

Our hypothesis was that all plotted femoral neck axes and determined values of alpha angle and offset index were matched.

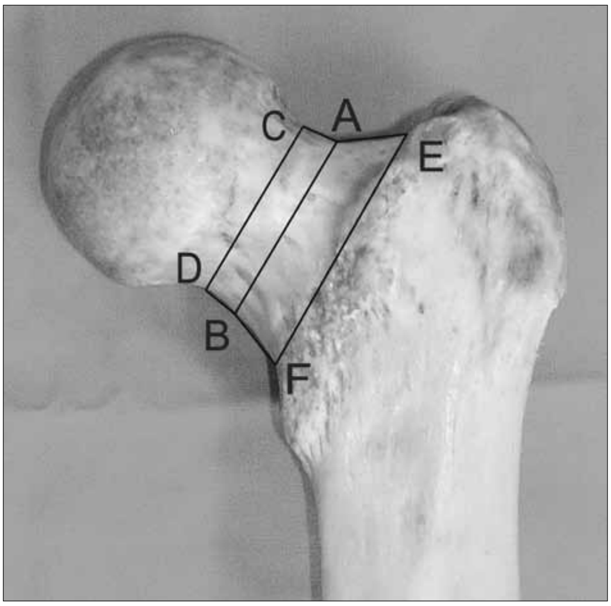

Figure 3. The two anatomical parts of the femoral neck, which could be extracted on the anterior side of the anatomical specimens: first, parallelogram shape of the neck of the femur (ABCD), and irregular trapezoid shape of the neck of femur (ABEF).

OBJECTIVE

The aim was to present two methods of determining true femoral neck axes, which do not depend on the position of the center of the femoral head rotation, and the angle alpha values obtained by these two methods compared with the values of literature methods.

METHODS

The study used 50 cadaveric specimens of the femur obtained from the Institute of Anatomy of the Faculty of Medicine in Nis: 20 right and 30 left specimens. Two of them were immediately excluded because of the mechanical damage. Digital photos were taken for the proximal femur, and other specimens were in the anteroposterior position with the internal rotation of 15-20° to correct the femoral anteversion. All these specimens were radiographed in the same positions, and all images were digitized and processed by the computer program Corel Draw 12 for Windows. Digital images were used to determine the upper and lower offset of the femoral neck and head to obtain the value of offset indexes [10, 15, 22]. Pathological values of offset index were found in 17 specimens (lower than 0.80 and higher than 1.20), and they were excluded from the study, too. The remaining 31 specimens, with the spherical femoral head-neck junction and normal range of offset indexes, were used in the study: 18 and 13 were left and right, respectively. Sample size was determined by the method of Lehr [28]: at least 25 specimens were needed to avoid type II error of study. The following parameters were plotted and measured on each digitized image:

1. Literature "gold standard" method of femoral neck axis was marked with the letter l (Figure 1). At the narrowest part of the femoral neck, line AB that connects the upper and lower edge of the femoral neck has been plotted. The middle point M on that line has been inscribed and used in all three methods of the femoral neck axis determination. Using the Mose concentric circle [29], the center of the femoral head rotation O has been defined and connected with the point M, to get the femoral neck axis.

2. The second femoral neck axis, p, was plotted to the inner quarter of the femoral neck (Figures 2 and 3). Second line, CD, was plotted parallel to the plotted line AB, going to the femoral head at a distance of at least 3 mm or more. The axis of the inner femoral neck quarters was obtained merging the middle of CD line with the point M of the line AB.

3. The third axis of the lateral three-quarters of the femoral neck was marked with the letter t (Figure 2). Line EF parallel to the intertrochanteric line was used to connect the most lateral point of the upper edge of the femoral neck (point E) and the bottom of it (point F). The middle of the line EF was merged with the point M of the line AB to plot the third line of the femoral neck axis.

4. The angles lMp, lMt and pMt were measured at point M in all cases of l, p, t axis discrepancy (Figure 2).

5. Angle alpha was determined by method proposed from Nötzly [14], who measured this angle on MRI images. One arm of the angle was femoral neck axis (l, p or t), and another arm was the line that merges the femoral head rotation center and the point at the intersection of the femoral head circumference with the upper edge of the femoral neck. Values of the angle alpha were marked as angle alpha-l, alpha-p and alpha-t, depending on the plotted axis on the femoral neck where the angle alpha was measured.

6. Femoral head-neck offset indexes were determined by methods defined in the literature [10, 15, 22], where normal range is 0.80 up to 1.20 (Figure 1b).

7. The length of the lines AB and CD was measured on the anatomic specimens and their radiographs, and the resulting values of these lines were divided by the measured value of the femoral head radius. Measurement errors were avoided by obtaining the index values of the lines AB and CD.

Normality of distribution of the parametric data was checked using the Kolmogorov-Smirnov test. Analysis of variance was used for intergroup variation of data, and between group data variation was checked by Fischer's least significant difference. Paired two-way t-test was used to test the significance difference of arithmetic means. The strength of correlation and percentage data interconnectivity were measured by Pearson's linear correlation coefficient and the coefficient of determination. Strength of the statistical tests was set at 80% with possible beta error of 0.20, and the level of significance of the test with a margin of error in the conclusion of less than 5%, so that the null hypothesis was rejected if $p<0.05$. All obtained data were analyzed by the computer program for statistical data analysis, SPSS 8 for Windows.

RESULTS

Indices of lines AB and CD (Figure 3), whose middle points built femoral neck axis (line p), were not significantly different ($p=0.055$), with high degree of correlation, $P=0.861$, which means that as much as 74% of indices were closely related to each other.

Offset indices measured along the lines l and p on the anatomic specimens did not differ, $p=0.862$ (95% CI= 0.603 to 1.283 of) with low degree of correlation, $P=0.458$. Radiographs of the anatomical specimens showed similar results, $p=0.395$ (95% CI=0.705 to 1.172). There were no significant intergroup and intragroup differences of the offset index values, measured along the line-l and p, on specimens and respective radiographs.

Plotted lines l and p were matched (p=l) in 16 (51.6%) specimens, line l was matched with the line t (t=l) in only two specimens (6.45%), while all three axes were matched (l=p=t) in 3 specimens (9.7%). In 9 specimens (29%), line p went beyond the center of the femoral head rotation, forming the angle pMl of 2.2° (range: 1-5°) with line l. In 4 specimens, line t went beyond the center of the femoral head rotation forming the angle tMl of 7.4° (3-14°) with

doi: 10.2298/SARH1404178A

Table 1. Summary of calculated statistical values of specimens and respective radiographic images

Parameter		Kol.-Smir.	$\bar{X}$	SD	$\bar{X}$±2SD	SEx	CI_{SEX} (95%)
Anatomical specimens	Alpha-l	0.660	46.26	4.19	37.88-54.64	0.75	44.76-47.76
	Alpha-p	0.651	46.77	4.90	36.97-56.57	0.88	45.01-48.53
	Alpha-t	0.510	41.87	8.01	25.85-57.89	1.44	38.99-44.75
Radiographic images of anatomical specimens	Alpha-l	0.824	45.48	3.12	39.24-51.27	0.56	44.36-46.6
	Alpha-p	0.493	45.81	3.59	38.63-52.99	0.64	44.53-47.09
	Alpha-t	0.742	40.35	8.12	24.11-56.59	1.46	37.43-43.27

Kol.-Smir. – Kolmogorov-Smirnov nonparametric test for assessing the normality of data distribution; $\bar{X}$ – mean value; SD – standard deviation; SEx – standard error of mean; CI_{SEX} (95%) – confidence interval of the mean at the probability level of 95%

Table 2. Statistic values of anatomical specimens and radiographic images of anatomical specimens

Anatomical specimens			Radiographic images of anatomical specimens		
P=r/r^2×100 (%)	Alpha-l	Alpha-p	XR of Alpha-l	XR of Alpha-p	XR of Alpha-t
Alpha-l			0.073	0.447	0.00065
			0.839/70.39	0.658/43.29	0.351/12.32
Alpha-p	0.111		0.034	0.178	0.00037
	0.938/87.98		0.762/58.06	0.616/37.95	0.028/0.07
Alpha-t	0.0089	0.00515	0.005	0.008	0.432
	0.742/55.05	0.646/44	0.614/37.69	0.303/9	0.459/21.06
XR of Alpha-l				0.315	0.00057
				0.872/76.02	0.555/30.80
XR of Alpha p					0.0002
					0.735/54.02

p – level of significance; r – value of Pearson's correlation coefficient for the angle alpha of specimens and radiographs; r^2 – coefficient of determination, expressed as percentage; XR – radiograph-angle values for alpha-l, alpha-p and alpha-t

line l, and in 23 specimens (74.2%), line t went below the center of the femoral head rotation at an angle tMl of 6.7° (3-16°) to the line l. On the radiographs of the specimens, line p and l were matched in 12 (39%) radiographs (p=l), and in one case, all three axes (l=p=t) were matched. On 12 (39%) radiographs, line p went beyond the center of the femoral head rotation at an angle pMl of 1.8° (1-4°) to the line l, and on two radiographs, line p went below the center of the femoral head rotation forming the angle pMl of 2° with the line l. On 25 radiographs (80.6 %), line t went below the center of the femoral head rotation at an angle lMt of 8.26° (2-19°) to the line l. On 26 (83.9%) radiographs, line t went below the line p forming the angle pMt of 8.30° (2-20°).

All values of alpha angle were normally distributed (Table 1), and we grouped them in three groups: the first one consisted of alpha angle values obtained from digital recordings of anatomical specimens, the second one consisted of alpha angle values obtained from radiographic images and the third group consisted of alpha-l and alpha-p angle values from the anatomical specimens and their radiographic images. One-way analysis of variance for the first and second group of values of the angle alpha demonstrated significant inter-group data variation, and Fischer's least significant difference test showed that the value of angle alpha-t significantly differed from the values of angles alpha-l and alpha-p of the specimens and respective radiograms. Testing of the angles alpha-l and alpha-p in the third group of data also showed significant intergroup variation of the alpha-p angle values measured on specimens in relation to the radiographic values of angle alpha-l and alpha-p. Mean values of the angles alpha-l and alpha-p on specimens and their radiographs were not significantly different and varied within the literature value range [14, 21, 22] (Table 2). Conversely, the values of alpha-t angle significantly differed from the values of alpha-l and alpha-p angles, on specimens and their radiographs. The alpha-l and alpha-p angle values of specimens were not significantly different (p=0.111, 95% CI=37.88-54.64° for the angle alpha-l and 36.97-56.57° for the angle alpha-p) with high degree of correlation, r=0.938 (p=0.001) and 88% of matched values (Table 2). Due to the absence of significant difference between the angles alpha-l and alpha-p on specimens and their radiographs, post-hoc statistical test power analysis was carried out and statistical sample size was evaluated. The power test for 31 specimens and respective radiographs was far below pre-study defined value (P=43%), what meant that 532 specimens and 532 radiographic images of the same measurements had to be taken for valid statistical inference. This explains why significant intra-group differences and the absence of significant correlation between the measured values of angles alpha-l and alpha-p on specimens and respective radiograms were herein achieved.

DISCUSSION

The concept of hip osteoarthritis developing through the FAI mechanism has been attracting attention of orthopedists more than 20 years [7, 10, 14]. There are conflicting opinions about the femoral head translation in the adolescence, as one of the etiological factors [9, 11, 12, 21-26, 30] because of the lack of so called "gold standard" in determination of the femoral neck axis, plotted in the same manner in patients with objective finding of femoral head translation and without it.

Murray's [3] proposal of femoral neck axis plotting has not been not widely accepted due to the inconsistency of method, i.e. applicability in the anteroposterior radiographs of the hips only, difficulty in determining the most superior point of the greater trochanter, thereby losing precision of the method, and one of the points used for femoral neck axis plotting does not belong to the femoral neck but intertrochanteric line. Goodman et al. [19] did not describe the plotting method of the femoral neck axis and Southwick [23] wisely avoided plotting of the femoral neck axis in measuring the femoral head epiphysis slip in adolescents, because his method is hardly applicable in closed growth zone of the femoral head in adults. The most common used method reported in literature connects the center of the narrowest part of the femoral neck with the center of the femoral head rotation, losing precision in determination of the diagnostic parameters in pathological conditions such as translation of the femoral head [9, 10, 11, 17, 20, 25, 26]. Method for determining femoral neck axis with two almost equal and parallel lines on the medial quarter of the femoral neck has been proven to be a possible method of choice because it is compatible with the method in literature; in addition, the angle alpha values, obtained by this method, are not significantly different from the values reported in literature. Plotting the femoral neck axis, by this method, does not depend on the position of the center of the femoral head rotation [14, 26, 27]. Disadvantage of this method is that the plotted line does not represent the axis of the entire femoral neck, but its inner quarters where the femur head is situated, in the zone in which clinically important pathological processes occur: femoral head translation and cam deformity in patients with FAI. However, the main disadvantage is statistically small sample size (only 31 specimens and their radiographs compared with 532 required in post hoc analysis), with consequent low statistical power and low validity of statistical conclusions about the applicability of this method in clinical practice.

CONCLUSION

Our attempt to use femoral neck axis of the lateral three quarters of the neck showed that this axis was situated, in most of the specimens, out of the femoral head rotation center, with significant difference of alpha-t angle from the literature values; in our opinion, this was the reason why the plotting of the femoral neck axis on the line t had no practical significance. The drawback of this study, as a whole, is proposing the method of plotting the femoral neck axis only in the anteroposterior plane. We have not found any published paper studying the validity of any methods of determining the femoral neck axis on the femoral specimens and respective radiograms.

Proposed method of femoral neck axis plotting, presented in this paper, is a good method with its advantages and disadvantages presented herein. This method should not be excluded *a priori* as an imprecise technique, but accepted as a method that require further verification on the anatomical specimens and respective radiograms, as well as on the clinical material, and with sufficient number of samples for valid statistical inference.

ACKNOWLEDGMENT

This paper was supported by the Ministry of Education, Science and Technological Development, Republic of Serbia, grants No III 107 and III 41004.

REFERENCES

1. Harris WH. Etiology of osteoarthritis of the hip. Clin Orthop Relat Res. 1986; 213:20-33.
2. Solomon L. Patterns of osteoarthritis of the hip. J Bone Joint Surg Br. 1976; 58:176-83.
3. Murray RO. The etiology of primary osteoarthritis of the hip. Br J Radiol. 1965; 38:810-824.
4. Tonnis D, Heinecke A. Acetabular and femoral anteversion: relationship with osteoarthritis of the hip. J Bone Joint Surg Am. 1999; 81:1747-00.
5. Ganz R, Parvizi J, Beck M, Leunig M, Notzli H, Siebenrock KA. Femoroacetabular impingement: a cause for osteoarthritis of the hip. Clin Orthop Relat Res. 2003; 417:112-20.
6. Ganz R, Leunig M, Leunig-Ganz K, Harris WH. The etiology of osteoarthritis of the hip: an integrated mechanical concept. Clin Orthop Relat Res. 2008; 466:264-72.
7. Wagner S, Hofstetter W, Chiquet M, Mainil-Varlet P, Stauffer E, Ganz R, et al. Early osteoarthritic changes of human femoral head cartilage subsequent to femoroacetabular impingement. Osteoarthritis Cartilage. 2003; 11:508-18.
8. Tonnis D, Heinecke A, Nienhaus R, Thiele J. Predetermination of arthrosis, pain and limitation of movement in congenital hip dysplasia (author transl). Z Orthop Ihre Grenzgeb. 1979; 117:808-15.
9. Stulberg SD, Cordell LD, Harris WH, et al. Unrecognized childhood hip disease: a major cause of idiopathic osteoarthritis of the hip. In: Amstutz HC, editor. The hip: Proceedings of the Third Open Scientific Meeting of the Hip Society. St. Louis: CV Mosby; 1975. p.212-228.
10. Ito K, Minka MA, Leunig M, Werlen S, Ganz R. Femoroacetabular impingement and the cam-effect: a MRI-based quantitative anatomical study of the femoral head-neck offset. J Bone Joint Surg Br. 2001; 83:171-6.
11. Beck M, Kalhor M, Leunig M, Ganz R. Hip morphology influences the pattern of damage to the acetabular cartilage: femoroacetabular impingement as a cause of early osteoarthritis of the hip. J Bone Joint Surg Br. 2005; 87:1012-8.
12. Tanzer M, Noiseux N. Osseous abnormalities and early osteoarthritis: the role of hip impingement. Clin Orthop Relat Res. 2004; 429:170-7.
13. Reynolds D, Lucas J, Klaue K. Retroversion of the acetabulum. A cause of hip pain. J Bone Joint Surg Br. 1999; 81:281-8.
14. Notzli HP, Wyss TF, Stoecklin CH, Schmid MR, Treiber K, Hodler J. The contour of the femoral head-neck junction as a predictor for the risk of anterior impingement. J Bone Joint Surg Br. 2002; 84:556-60.
15. Siebenrock KA, Kalbermatten DF, Ganz R. Effect of pelvic tilt on acetabular retroversion: a study of pelves from cadavers. Clin Orthop. 2003; 407:241-8.
16. Meunier P, Lefevre C, Le Saout J. A simple method for measuring anteversion of the acetabulum from a frontal radiograph of the hip. J Radiol. 1987; 68:799-804.
17. Gosvig K, Jacobsen S, Magnusson E, Palm H, Sonne Holm S. A new and accurate radiologic index for assessment of femoral head asphericity in cam impingement. J Bone Joint Surg Br. 2007; 89(10):1309-16.

18. Beaule PE, Zaragoza E, Motamedi K, Copelan N, Dorey FJ. Three-dimensional computed tomography of the hip in the assessment of femoroacetabular impingement. J Orthop Res. 2005; 23:1286-92.
19. Goodman DA, Feighan JE, Smith AD, Latimer B, Buly RL, Cooperman DR. Subclinical slipped capital femoral epiphysis. J Bone Joint Surg Am. 1997; 79:1489-97.
20. Tönnis D. Normal values of the hip joint for the evaluation of x-rays in children and adults. Clin Orthop. 1976; 119:39-47.
21. Meyer DC, Beck M, Ellis T, Ganz R, Leunig M. Comparison of six radiographic projections to assess femoral head/neck asphericity. Clin Orthop Relat Res. 2006; 445:181-5.
22. Toogood PA, Skalak A, Cooperman DR. Proximal femoral anatomy in the normal human population. Clin Orthop Relat Res. 2009; 467:876-85.
23. Southwick WO. Osteotomy through the lesser trochanter for slipped capital femoral epiphysis. J Bone Joint Surg Am. 1967; 49:807-35.
24. Slavković N, Vukašinović Z, Slavković S. Factors influencing the development of avascular necrosis in non-operative treatment of the acute slipped capital femoral epiphysis. Srp Arh Celok Lek. 2007; 135:54-60.
25. Vukašinović Z, Spasovski D, Živković Z. Femoroacetabular impingement related to Legg-Calvé-Perthes disease. Srp Arh Celok Lek. 2011; 139(11-12):834-7.
26. Siebenrock KA, Wahab KHA, Werlen S, Kalhor M, Leunig M, Ganz R. Abnormal extension of the femoral head epiphysis as a cause of cam impingement. Clin Orthop. 2004; 418:54-60.
27. Andjelković A, Mladenvić D. Measuring of the osteochondral connection of the femoral head and neck in patients with impingement femoroacetabular determining the angle of 2alpha on lateral and anteroposterior hip radiographic images. Vojnosanit Pregl. 2013; 70(3):259-66.
28. Lehr R. Sixteen S-squared over D-squared: a relation for crude sample size estimates. Stat Med. 1992; 11:1099-102.
29. Mose K. Methods of measuring in Legg-Calve-Perthes disease with special regard to the prognosis. Clin Orthop Relat Res. 1980; (150):103-9.
30. Resnick D. The "tilt deformity" of the femoral head in osteoarthritis of the hip: a poor indicator of previous epiphysiolysis. Clin Radiol. 1976; 27:355-63.

Допринос методи одређивања осовине врата бутне кости

Зоран Анђелковић[1], Десимир Младеновић[2,3], Зоран Вукашиновић[4,5], Стојанка Арсић[3], Милорад Митковић[2,3], Иван Мицић[2,3], Марко Младеновић[2]

[1]Одељење за ортопедску хирургију и трауматологију, Општа болница, Лесковац, Србија;
[2]Клиника за ортопедску хирургију и трауматологију, Клинички центар, Ниш, Србија;
[3]Медицински факултет, Универзитет у Нишу, Ниш, Србија;
[4]Институт за ортопедску хирургију и трауматологију „Бањица", Београд, Србија;
[5]Медицински факултет, Универзитет у Београду, Београд, Србија

КРАТАК САДРЖАЈ

Увод Уцртавање осовине врата бутне кости има велики значај у мерењу параметара којима се дефинише сферичност главе фемура, на споју главе фемура с вратом, код болесника с фемороацетабуларним сударом (енгл. *impingement*). Методе одређивања осовине врата бутне кости коришћене у литератури имају своје слабости које прате ризик добијања непрецизних вредности измерених параметара.

Циљ рада Предлаже се метода мерења осовине врата бутне кости помоћу две паралелне линије које припадају медијалној четвртини врата бутне кости. Метода је тестирана на одговарајућим анатомским препаратима и радиографским снимцима.

Методе рада За потребе овога рада користили смо 31 анатомски препарат бутне кости и њихове радиографске снимке на којима смо уцртавали три осовине врата бутне кости. Да би се утврдила валидност уцртаних осовина, одређиване су вредности угла алфа, које су испитане одговарајућим параметријским тестовима са грешком у мерењу мањом од 5% и снагом примењених тестова од 80%.

Резултат Вредности угла алфа добијене предложеном методом за одређивање осовине врата бутне кости и вредности наведене у литератури не разликују се значајно, а у више од половине препарата ове две осовине се међусобно преклапају.

Закључак Уцртавање осовине врата бутне кости предложеном методом не зависи од положаја центра ротације главе у односу на врат бутне кости, што истиче значај ове методе код мерења угла сферичности главе бутне кости код болесника с транслацијом главе бутне кости. Недостатак рада је мали узорак за валидно доношење закључака о примењивости методе у клиничком раду.

Кључне речи: кук; осовина врата бутне кости; нова метода; угао алфа

Примљен • Received: 14/09/2012 **Прихваћен • Accepted:** 13/11/2012