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Original Article

Clinical evaluation of hip joint in sagittal plane using pelvifemoral angle

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ABSTRACT

Background: Pelvifemoral angle has been described in early literature but the values have not been validated and no mention of distal bony point has been made.

Methods: Patients attending the Orthopaedic Outpatient in our hospital with complaints not related to the hip or knee were included in this study. Exclusion criteria included patients with history of hip pathology (Unilateral or Bilateral) and patients with Pelvis or Lower Limb fractures (Unilateral or Bilateral). Measurements were taken using a measuring tape, and angles were measured using a Goniometer. Authors describe two clinical measurements of the hip joint in sagittal plane using Nelaton's line as reference for pelvis and line joining greater trochanter to 1. Superolateral pole of patella (α angle) and 2. Fibular head (β angle). Three hundred normal hips of 150 individuals were included in this study and angles were measured in supine and standing position.

Results: Mean values of these angles (in supine and standing) were $67 \pm 1^\circ$ (α angle) and $51 \pm 1^\circ$ (β angle) in males and $72 \pm 2^\circ$ (α angle) and $58 \pm 2^\circ$ (β angle) in females. These angles are independent of age, height, weight and hence, the body mass index of a person.

Conclusion: Authors are describing a simple yet accurate method of quantifying the clinical pelvifemoral angle which will reflect upon the fixed flexion deformity at the hip in unilateral/bilateral pathological hip cases where other conventional methods are either unreliable or painful to perform.

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1. Introduction

In most pathological conditions of the hip, the first movement to be lost is extension. Thereafter, the hip goes in for increasing flexion deformity with progress of disease.¹ Measurement of the degree of flexion deformity at the hip joint is

one of the most elementary of orthopaedic procedures. No satisfactory clinical method has been devised for determining this with accuracy.² Thomas test is commonly done to determine the fixed flexion deformity of hip. Painful hip, obese individuals, bilateral deformities and anterior tilting of pelvis during the test can give false results.^{3,4} This prompted us to

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search for a clinical test that can measure the flexion at hip which is reliable and can be used independent of other hip involvement and patient's profile.

2. Methods

Patients attending the Orthopaedic Outpatient in our hospital with complaints not related to the hip or knee were included in this study. Exclusion criteria included patients with history of 1. Hip pathology (Unilateral or Bilateral). 2. Pelvis or Lower Limb fractures (Unilateral or Bilateral). Informed consent was obtained and their height, weight and waist circumference were recorded. Measurements were taken using a measuring tape, and angles were measured using a Goniometer.

Pelvifemoral angle was measured by two methods with hip in full extension in neutral rotation. Alpha angle (α angle) is measured as the acute angle between a line is drawn connecting anterior superior iliac spine (ASIS) with the ipsilateral ischial tuberosity (Nelaton's line) and another line connecting the greater trochanter with superolateral pole of patella (Fig. 1). Beta angle (β angle) is measured as the angle between the Nelaton's line and the line connecting the greater trochanter with the most prominent part of fibular head (Fig. 2).

These angles were measured on both sides and in supine and standing position. Four sets of α and β angles were obtained. Alpha angle in supine position on right side (SUR α), supine position left side (SUL α), and while standing on right and left side (STR α) and (STL α) were measured. Similarly beta angles in supine right (SUR β), supine left (SUL β), standing right (STR β) and standing left (STL β) were obtained. Statistical analysis was done using students unpaired t test and ANOVA using SPSS 11.5 and p value less than 0.05 was considered as significant.

3. Results

A total of 76 females and 74 males were a part of this study. There were 22 males and 25 females of age less than 20 years while 24 males and 23 females were more than 40 years old.

Fig. 1 – Figure showing method one of obtaining alpha angle between Nelaton's line and line joining greater trochanter to superolateral pole of patella.

Fig. 2 – Figure showing method two of obtaining beta angle between Nelaton's line and line joining greater trochanter to fibular head.

Remaining 56 individuals were in their third or fourth decade. Mean height and weight in the <20 years category was 158.7 cm and 54.4 kg in males and 131.7 cm and 35.6 kg in females. Others had the mean height of 173.9 cm and 163.2 cm in males and females respectively. Mean weight of males in 20–40 yrs age group was 69.4 kg and >40 yrs was 67.8 kg. Mean weight of females in 20–40 yrs age group was 57.4 kg and >40 yrs was 61.3 kg. Waist circumference (measured at the level of ASIS) in males (Mean in cm) in <20 yrs, 20–40 yrs, >40 yrs were 72.4, 81.7 and 80.2. Mean circumference (cm) in females in <20 yrs, 20–40 yrs, >40 yrs were 58.9, 76.7 and 75.1 respectively. The body mass index (BMI) was also calculated.

The pelvifemoral angle measurement showed that the alpha angle was more than the beta angle. It was also noted that these angles were comparable on both sides and there was no significant variation with the position of individual. Mean values (in degrees) are represented in the following table (Table 1).

The range of these angles (in supine and standing) were 66–68° (α angle) and 50–52° (β angle) in males and 70–74° (α angle) and 55–60° (β angle) in females. Mean values of these angles (in supine and standing) were $67.4 \pm 1^\circ$ (α angle) and $51.0 \pm 1^\circ$ (β angle) in males and $72.2 \pm 2^\circ$ (α angle) and $57.7 \pm 2^\circ$ (β angle) in females. There was no association between the anthropometric parameters and α and β angles, in supine as well as standing positions.

4. Discussion

The clinical test to determine the amount of flexion deformity at the hip was described by H.O. Thomas in 1865 and is popularly known as the Thomas test.⁵ Henry Milch⁶ pointed out the limitations and other authors^{3,4} also described the deficiencies of this test. Pelvifemoral angle was described in 1942 to determine the true relationship of femur with pelvis in the sagittal plane.⁷ It was the angle between Nelaton's line and the shaft of femur in maximum flexion and maximum extension. A study done by Salmore⁸ measured this angle in 100 normal hips in maximum extension and found the mean

Table 1 – Mean pelvifemoral angle in supine and standing position.

Angle	<20 years		20–40		>40 years	
	Male	Female	Male	Female	Male	Female
SUR α	67.4	70.1	67.3	73.6	68.3	74.5
SUL α	67.7	70.1	66.9	72.7	67.8	74.2
STR α	67.5	70.2	67.4	73.5	68.1	74.3
STL α	67.6	70.1	66.8	72.4	67.8	73.9
SUR β	50.5	55.3	51.3	58.2	52.0	60.2
SUL β	50.5	55.8	51.0	57.9	51.5	59.6
STR β	50.6	55.4	51.3	58.4	52.0	59.9
STL β	50.5	55.8	51.0	57.9	51.5	59.6

SUR α – Alpha angle in supine position on right side.
 SUL α – Alpha angle in supine position on left side.
 STR α – Alpha angle in standing position on right side.
 STL α – Alpha angle in standing position on left side.
 SUR β – Beta angle in supine position on right side.
 SUL β – Beta angle in supine position on left side.
 STR β – Beta angle in standing position on right side.
 STL β – Beta angle in standing position on left side.

to be equal to 52° with no gender variation. No distal bony point was used in this study and the author also established that this measurement doesn't vary with height and weight of a person and are equal on both sides. Similar findings were seen in our study.

Our study was done on 300 normal hips. We observed that the pelvifemoral angles are almost equal in either limbs in both supine and standing positions. This was the first time where distal bony prominence was used to obtain the second line with accuracy. Two different angles were measured for the first time for establishing this sagittal relationship. No association with waist circumference was also established in this study. In our study, we found that the females have a higher pelvifemoral angle as compared to males. The measurement using superolateral pole (α angle) of patella had consistently higher values than using fibula (β angle). The range of these angles (in supine and standing) were 66–68° (α angle) and 50–52° (β angle) in males and 70–74° (α angle) and 55–60° (β angle) in females. Two different values were established in order to overcome the anatomical and acquired variations in either of the bony landmarks.

There is a theoretical drawback in the method of determining the clinical pelvifemoral angle described by the authors. The α and β angle determination may vary with the rotation of the lower limb as these angles subtended may increase or decrease with internal or external rotation respectively. This discrepancy is minimal and clinically insignificant. However the subtle variations can be quantified by knowing the length of the second line (which can be considered as radius of a circle with greater trochanter as a centre point) and the arc of the circumference of this circle moved due to change in rotation of the lower limb.

Further scope of this study is to determine these angles in substantial number of unilateral hip disorders, followed by cases with bilateral and spinal involvement.

Conflicts of interest

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

REFERENCES

1. Greidanus N, Cibere J, Thorne A, et al. Reliability and standardization of the hip examination in osteoarthritis. *J Bone Joint Surg Br.* 2008;90-B(suppl 1):131.
2. Milch H. The pelvifemoral angle of flexion and extension at the hip joint. *Clin Orthop Relat Res.* 1963;31:58–64.
3. Peeler J, Anderson J. Reliability of the Thomas test for assessing range of motion about the hip. *Phys Ther Sports.* 2007;8:14–21.
4. Thurston A. Assessment of fixed flexion deformity of hip. *Clin Orthop Relat Res.* 1982;169:186–189.
5. Thomas HO. *Diseases of the Hip, Knee, and Ankle Joints with Their Deformities, Treated by a New and Efficient Method.* 2nd ed. Liverpool (UK): Dobb and Co; 1876.
6. Milch H. The measurement of hip motion in the sagittal and Coronal plane. *J Bone Joint Surg Am.* 1959;41:731–736.
7. Milch H. The pelvifemoral angle. *J Bone Joint Surg Am.* 1942;24:148–153.
8. Salmore W. The pelvifemoral angle. *J Bone Joint Surg Am.* 1944;26:392–393.