
Validity of visual examination for femoral neck anteversion between (1-10 years old) Husham A. S. Alkattan MBChB, DO, MSc.*

ABSTRACT:

Background: Femoral Anteversion is a condition in which the femoral neck leans forward with respect to the rest of the femur. This causes the lower extremity on the affected side to rotate internally. Because some degrees of rotation of the femur is always presented during children's growth, it is considered abnormal only if it is significantly different from the average value of a patient of the same age.

Aim: To investigate the validity of visual angles estimation of hip joint.

Study design: case series study in the Al-Jumhorei teaching hospital. Total 121 patients have been examined (51 males and 70 females), ages varies between 1 year -10 years.

Study period: 1st June 2010-1st Dec 2010

Methodology: Visual femoral neck examination has been carried for determination of hip joint motion in the internal position carried by the first examiner, and the second proved the femoral neck position by application of Goniometer, comparison of both reading has been recorded and analysis carried on.

Results: Specificity of visual determinations for femoral neck anteversion of females appeared to be 90% for the right hips, males left hips appeared to be 100% ,while in studying both groups appeared to be 95% ,92% for each right and left hips respectively, with highly significant $P \leq 0.000$.

Conclusion: Visual determination of femoral neck anteversion proved to be an easy, quick, safe, valid and accurate method for screening hip joint alignment.

Key word: Femoral neck anteversion, visual examination, reliability and validity

Introduction:

Femoral neck anteversion is defined as the angle between an imaginary transverse line that runs medially to laterally through the knee joint and an imaginary transverse line passing through the center of the femoral head and neck¹⁻³

Femoral neck anteversion usually diminishes with age, by 1-2° per year until skeletal maturity. Reaching adult life with a value close to 16°⁴⁻⁶. femoral neck anteversion is very common and can occur up to 10 - 30% of children. It is twice as common in girls as in boys. It is nearly always symmetrical, and it is often familial^(3,7).

Patients and methods:

The study was conducted through the period 1st June 2010-1st Dec 2010 in aljumhorei hospital outpatient clinic. Where, 121 patients have been examined (51 males and 70 females), their ages varies between 1-10 years (average around 3.4 years). Patients have been examined in position traced back to a doctoral thesis by Netter, which described the estimation of femoral anteversion by palpation of the maximum lateral prominence of the greater trochanter.

With the patient lying supine on the examination table and the knees flexed 90 degrees over the edge, the hip is internally rotated until the maximum prominence of the greater trochanter is felt. Femoral anteversion is represented by the measured arc through which

the tibia moves from the original position to the position where the maximum prominence of the greater trochanter is felt laterally (fig 1).

Fig (1): Method of application of the Goniometer during determination of the femoral neck angle.



The angle subtended between the tibia and true vertical line is measured with a Goniometer, the device is usually made of transparent material and consists of a protractor with two connecting arms (fig 2).

One arm remains stationary with the proximal part of the joint, whereas the other arm moves with the distal part of the joint to determine the arc of motion that has been occurred across the joint measurement scales, which were located on the body (0-180 or 0-360)^(2,8).

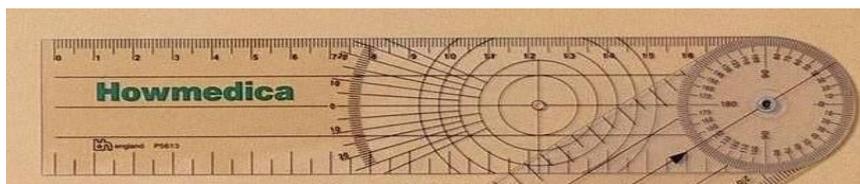


Fig 2: The Goniometer with 2 arms used for measuring joint angles.

The chi – squared test was used for statistical analysis of associations between discrete variables, P-values <0.05 were considered significant⁽⁹⁾.

Sensitivity and specificity, positive and negative predictive values, positive and negative likelihood ratios were estimated for each clinical criterion⁽¹⁰⁾.

Results:

During the study period of examination, (121 patients) had been examined (51 males and 70 females), their ages varies between 1-10 years (average around 3.4 years).

Table (1) demonstrates that the sensitivity for females was (85% and 83%) for both right and left hip respectively. Regarding the specificity, it

is found to be 90% and 80% for both right and left hip respectively.

The probability of detecting the femoral neck anteversion for the right and left hips was (98%, 98%) respectively, on the other hand the probability of inability to determine the femoral neck anteversion for females was (50%, 26%) respectively.

The positive likelihood for femoral neck anteversion examination in- females for both sides was (8.50, 4.15) compared to (0.17, 0.212) in females with inability to determine femoral neck anteversion. P- value appeared to be highly significant (0.000, 0.006) respectively.

Reproducibility for females (0.563,0.328) right and left respectively.

Table (1): Positive and negative predictive values and likelihood ratios for females.

Sex and laterality	Kappa (repeatability)	Sensitivity %	Specificity %	Positive Predictive value%	Negative Predictive value%	Positive Likelihood Ratio	Negative Likelihood Ratio
Female RT	0.563	85%	90	98	50	8.50	0.17
Female Lt	0.328	83%	80	98	26	4.154	0.212

χ^2 21.46, P ≤ 0.000, χ^2 7.545, P ≤ 0.006

Table (2) depicts the sensitivity (80%, 76%) for both right and left hips respectively for male child. The specificity looks to be (81%) for right hips, while (100%) for the left hips.

The probability of determination femoral neck anteversion in males (94%) for right hips, (100%) for left hips. the probability of inability to determine the femoral neck anteversion for males (52%, 44%).

The likelihood for a positive test result for determination femoral neck anteversion in- males both sides (4.4, INF) respectively with clear infinity for the left hips, compared to (0.17, 0.233) in males with inability to determine femoral neck anteversion. P_ value proved to be highly significant (0.000, 0.000) respectively.

Repeatability varies between 0.516, 0.509 for right and left sides for males.

Table2: Validity, positive, negative predictive values and likelihood ratios for males.

Sex and laterality	Kappa (repeatability)	Sensitivity %	Specificity %	Positive Predictive value%	Negative Predictive value%	Positive Likelihood Ratio	Negative Likelihood Ratio
Male RT	0.516	80%	81%	94%	52%	4.4	0.174
Male LT	0.509	76%	100%	100%	44%	INF	0.233

χ^2 12.185, P <0.0001 χ^2 14.197, P < 0.0001

Table (3) indicates Sensitivity for both females and males showed (85%, 80%).

Regarding specificity femoral neck examination both females and males showed high (95%, 92%) respectively.

The probability of determination femoral neck anteversion in for both groups (98%, 98%) respectively for right and left hips. the probability of inability to determine the femoral neck anteversion for both females and males right and left hips (57%, 36% respectively).

The likelihood for a positive test result for determination femoral neck anteversion for both groups (17.85, 10.472) respectively, compared to negative likelihood ratio (0.158, 0.211) in males and females for right and left hips respectively with inability to determine femoral neck anteversion. P-value proved to be highly significant (<0.0001).

Repeatability varies between 0.635, 0.435 all males and females for right and left respectively.

Table3. Validity, positive, negative predictive values and likely hood ratios for both males and all females.

Sex and laterality	Kappa (repeatability)	Sensitivity %	Specificity %	Positive Predictive value%	Negative Predictive value%	Positive Likelihood Ratio	Negative Likelihood Ratio
ALL Male and Female RT	0.635	85%	95%	98%	57%	17.85	0.158
ALL Male and Female LT	0.435	80%	92%	98%	36%	10.472	0.211

χ^2 50.517, P<0.0001 χ^2 27.493, P< 0.0001

Table (4) revealed average (mean) and standard deviation for both right and left hips females, visual and Goniometer examinations varies between (69.43,72.86,71.14,73.86), (25.02, 21.84, 23.73, 20.86) respectively.

While males, readings varies between (58.43, 60.63, 61.27, 62.55), (22.48, 21.02, 23.57, 21.57) means and standard deviations respectively for

right and left hips, visual and Goniometer examinations.

Groups, means and standard deviations varies between (64.79, 67.60, 66.90, 69.09), (24.59, 22.36, 24.13, 21.88) respectively for right and left hips, visual and Goniometer examinations hips respectively.

Table 4: Reading for an average (means), standard deviations for right and left hips females, males, and both groups respectively.

SEX	Statistical reading	Visual examination right hip	Goniometer examination right hip	visual examination left hip	Goniometer examination left hip
FEAMLES	AVERAGE	69.43	72.86	71.14	73.86
	SDV	25.02	21.84	23.73	20.86
MALES	AVERAGE	58.43	60.63	61.27	62.55
	SDV	22.48	21.02	23.57	21.57
BOTH GROUPS	AVERAGE	64.79	67.60	66.90	69.09
	SDV	24.59	22.36	24.13	21.88

Table 5 exhibit the average for both males and females (59.85,70.29), standard deviation less than 2 (0.77,0.92) for males and females respectively.

Table 5: Comparison males and females patients for an average and SDV for femoral neck ante version.

Statistic	Males	Females
Average	59.85	70.29
SDV	0.77	0.92

Discussion:

The significance of the angle of anteversion of the femur is widely recognized, especially in persistent upper femoral torsion, cerebral palsy Perthes' disease and sometimes can be associated with many clinical problems ranging from harmless intoeing gait in the early childhood, to disabling osteoarthritis of the hip and the knee in the adults. (7,11-12).

It must be recognized that, as with any other objective scientific measurement, the range-of-motion determinations should be reliable, valid, accurate, simple, and relatively inexpensive. Reliability indicates how well a certain procedure or instrument is able to produce the same result under the same conditions. Validity Establishes how well a method or device measures what it is intended to measure. Validity requires reliability, but reliability does not ensure validity. Passive motion has also been suggested to be a more valid indicator of actual changes within the periarticular connective tissues of the joint (8,13).

Measurements of passive ROM are difficult to perform by a single tester because fixation, moving the limb and reading the results must be done at the same time. In clinical practice, it is not often possible for a patient to measure by the same therapist from time to time. It is important to consider possible sources of error when measuring hip ROM. One factor is the tester.

One way to eliminate error related to this different experience was to practice the procedure and standardize it in a manual. The manual consisted of directives for placement of the goniometer, subject position, fixation and verbal instructions. Literature emphasizes standardization of the procedure in order to gain reliable results error could occur if the subjects do not fully understand their role in the measurement procedure. , the measurements were taken with a 15_20-min pause in between, during which the subjects were not allowed to exercise or receive

treatment, a higher reliability is expected if the second test is made within an hour instead of days or weeks later (14).

In this study we do agree and we had performed the clinical evaluations by 2 examiners. We practiced the test before application to adjust the reading in accurate manner more over the test has been applied within 5 minute of time.

Phyllis A C et al added if two clinicians can reproduce similar results when obtaining various tests and measures, it would validate findings between clinicians and give them confidence in the data collected (15).

Richard mentioned, it has been shown that hip rotation in extension does not provide an accurate measure of femoral neck in the clinical determination of femoral anteversion. In flexion, the anterior capsular and soft-tissue structures are relaxed; permitting a greater range of lateral rotation and it is found that hip rotation as measured in extension to be a poor predictor of femoral anteversion (16).

While Chin, said the trochanteric prominence angle test that showed excellent validity and reliability (17).

The previous statements go in consistence with this work, and we do apply the same procedure of clinical assessment which exhibits a highly significant difference and revealed that visual estimation for the femoral neck anteversion was highly significant ($P \leq 0.000$) as in Table (3). The specificity appeared to be high, ranging between (92%, 95%) for both females and males for right and left hip respectively. Regarding the repeatability appeared to be higher (0.635, 0.435), particularly for the right hips as far as compared to the left hips. The validity makes no much difference for each group separately.

Studies done by Michael T C, confirmed that, intra-operatively the TPAT (trochanteric prominence angle test) predicted the FNA, measured, more accurately than either the CT or Magilligan method (1).

While Lea R D concluded that visual estimation of range of motion is as good as or better than goniometric measurement (8).

Clinical technique offers clinicians the ability to determine, accurately and quickly, values of femoral anteversion for diagnostic and therapeutic purposes, while minimizing expenses and limiting the exposure of these young patients to radiation, more over many modern methods are not much more accurate than clinical methods, and they are expensive. (2,7).

On the contrary to this work James et al exhibits that clinical measurement of joints movement and particularly of cervical spine motion are the least accurate of the common measurements of the mobility of the body's joints.

He attributed this lack of accuracy to the lack of bony landmarks on the head and to the thickness of soft tissues overlying segments of the cervical spine⁽¹⁸⁾.

While Banskota B et al found that the number of years in training this led in conclusion that the reliability of visually estimating joint angles is poor as far as the long period of experience play role for accurate decision for the visual estimation of the passive joint motions⁽¹²⁾.

Collette Menadue et al explained that although visual estimation is commonly used in the clinic, it is unlikely to be sufficiently reliable to enable clinicians to confidently monitor progress between treatment sessions, or compare measurements between clinicians. It is therefore recommended that objective measurements be made⁽¹⁹⁾.

Concerning sex Relation and Laterality:

The range of motion of the extremities tends to be greater in female subjects but again, there are exceptions and controversies. However, studies have shown no difference between gender with regard to the total rotation of the hip. Others found more flexion in male than in female subjects". More flexion of the knee, external rotation of the hip and dorsiflexion of the ankle were observed in Saudi men than in Scandinavian men⁽⁸⁾.

Ankur et al in his study mentioned that, statistically significant differences were found between male and female-type bones, right and left-sided bones. The male bone showed about 2.7° less anteversion than the female one⁽²⁰⁾.

Jain et al added, racial variation is expected to exist because of different social needs of the different races. Since Indians are more apt to floor level activities, the mean value of the male type was 7.5° (SD 6.6°) and of female type was 10.5° (SD 6.1°).

The mean value of right side was 7.3° (SD 6.7°) and of left side was 8.9° (SD 6.5°). The mean of the female type bone was significantly higher than the male type bone by 3° ($p \leq 0.002$). Also the mean of left sided bone was significantly higher than the right sided bone by 1.6° ($p \leq 0.04$)⁽²¹⁾.

This study showed, the mean difference for FNA appeared males (59.85), females (70.29) as in (Tab 4, 5) with significance difference which is

valuable in estimation of femoral neck anteversion, for comparison between males and females.

Michael T C confirmed that differences in hip rotation between the left and right side rarely exceed 10 degrees⁽¹⁾.

While significant differences reported between the right and left sides with regard to several different ranges of joint motion⁽²²⁾.

Conclusion:

Clinical determination of femoral neck anteversion proved to be an easy, quick, safe, accurate method for determination hip joint motions

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