

Correlation of Femur Head Diameters with Gestational age of Human Fetuses

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Abstract

Aims & Objectives: To determine the gestational Age with the help of transverse and vertical diameters of the femoral head in second and third trimester fetuses.

Introduction: Various parameters have been used to determine gestational age like crown rump length, bi-parietal diameter, femur length etc. But none of the parameters are reliable especially in cases like hydrocephalous, Microcephaly, Achondroplasia, dwarfism hence in such cases femur head diameter for determination of gestational age can be used.

Material & Method: 40 (22 females & 18 males) spontaneously aborted & still born fetuses were collected from the department of obs. & gynecology BRD **medical college Gorakhpur**. Dissection was done to expose the hip joint and the Transverse & vertical diameters of the head of femur were measured in full abduction of hip by **digital Vernier caliper**.

Result: The transverse and vertical diameters of the head of femur showed progressive growth with progressive increase in gestational age. Both the transverse and vertical diameters in 3rd trimester were found 2.3 times than that of the 2nd trimester

Key words: Gestational age, transverse and vertical diameters of femoral head, fetus, Developmental dysplasia of hip.

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Introduction

Since ages various parameters have been used to determine gestational age like crown rump length, bi - parietal diameter, femur length, Ultra-sonography etc. But none of the parameters are reliable specially in cases like hydrocephalous, Microcephaly, Achondroplasia, dwarfism hence in such cases femur head diameter for determination of gestational age can be relied upon. All structures of the human hip are visible at the 6th week of intrauterine life(1). At the end of 8th week, the early cartilage model of the acetabulum and the femoral head appear and at the 11th week (approximately at the end of 1st trimester) all the components of the hip can be observed early. Following birth, the acetabulum and the proximal part of the femur continue to grow (4-6).

Knowledge of anatomy hip joint and the early development of the hip joint is necessary to understand correctly the developmental dysplasia and dislocation of the hip joint(5). Very few studies has been done by walker et al (1981) and Uysal et al (2004) in relation to femoral head diameters and gestational age but nobody reported this parameters according to gestational age.

Material & Method

40 (22 females & 18 males) spontaneously aborted & still born fetuses were collected from the department of obs. & gynecology BRD **medical college Gorakhpur**. These feature had no apparent pathologic features. Legal consent of the respective parents along with permission from the ethical research committee of the college was taken. These fetuses were fixed with 10% formalin solution using immersion.

Fetuses were divided into 7 groups based on gestational age at the interval of four weeks. The gestational age of the fetus was confirmed by LMP.

Dissection of gluteal region of both sides of each fetus was done to expose the hip joint. A linear curved skin incision was given in the upper part of the gluteal region. Skin and superficial fascia reflected laterally. Gluteus Maximus was cut at right angle to its long axis and reflected towards the sites of attachment. After cutting, the sciatic nerve was reflected laterally thus exposing the posterior surface of acetabulum. The thigh was partially flexed, laterally rotated & was abducted to cut the capsule and labrum of hip joint Ligament of head of femur was detached from the acetabulum & head of femur was dislocated from the joint. Transverse & vertical diameters of the head of femur were measured in full abduction of hip by **digital Vernier caliper** as shown in fig.No-1 & 2.



Fig. 1: Measurement of Vertical Diameter of Femur Head



Fig. 2: Measurement of Transverse Diameter of Femur Head

Table 1

Gestational age category (weeks)	No of Foetus	Right transverse Mean \pm SD	Right vertical Mean \pm SD	Left transverse Mean \pm SD	Left vertical Mean \pm SD
13- 16	5	3.17 \pm 0.62	3.28 \pm 0.56	3.16 \pm 0.58	3.30 \pm 0.53
17-20	6	4.50 \pm 0.50	4.70 \pm 0.44	4.51 \pm 0.54	4.70 \pm 0.54
21-24	7	6.79 \pm 0.46	7.07 \pm 0.59	6.81 \pm 0.40	7.17 \pm 0.50
25-28	3	8.53 \pm 0.58	8.83 \pm 0.73	8.59 \pm 0.54	8.82 \pm 0.70
29-32	5	10.90 \pm 0.53	11.11 \pm 0.55	10.90 \pm 0.61	11.15 \pm 0.58
33-36	7	12.53 \pm 0.72	12.96 \pm 0.54	12.79 \pm 0.62	13.05 \pm 0.60
37-40	6	13.90 \pm 0.41	14.30 \pm 0.68	14.17 \pm 0.63	14.56 \pm 0.62

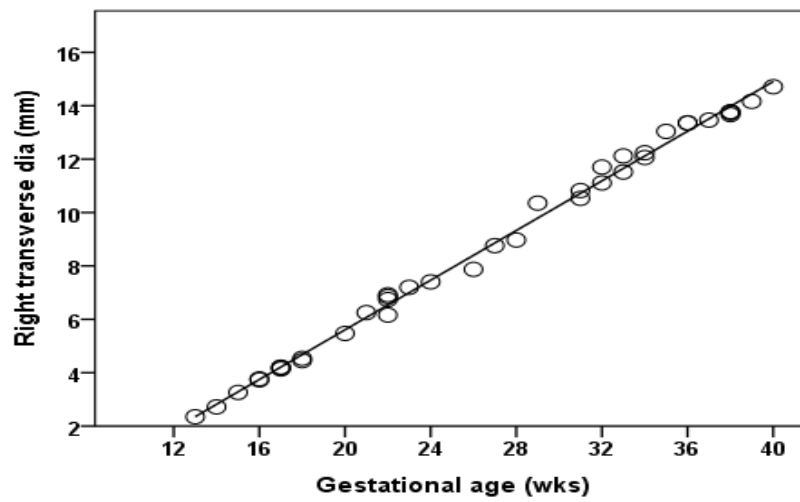
Table 2

	Right Transverse diameter	Right Vertical diameter	Left Transverse diameter	Left Vertical diameter
2 rd Trimester	5.35 \pm 1.84	5.56 \pm 1.90	5.37 \pm 1.86	5.60 \pm 1.91
3 rd Trimester	12.42 \pm 1.52	12.78 \pm 1.57	12.65 \pm 1.70	12.97 \pm 1.65
Ratio of Mean	2.32	2.30	2.35	2.31

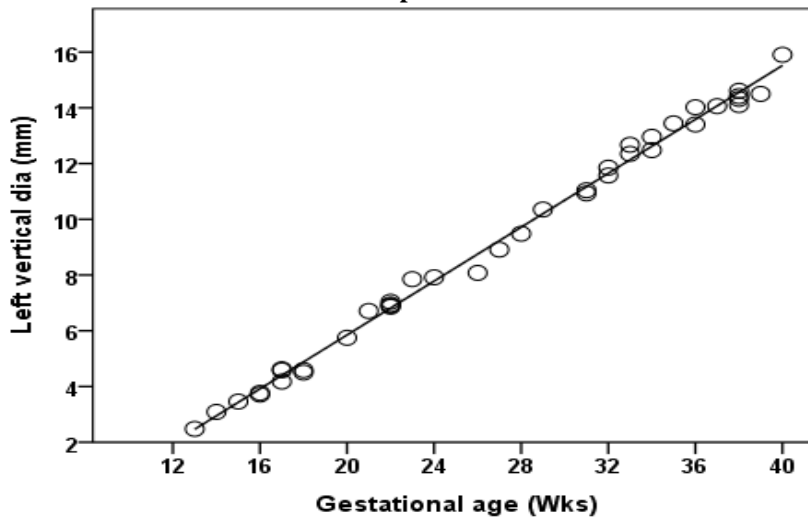
Graph-1



Graph -2



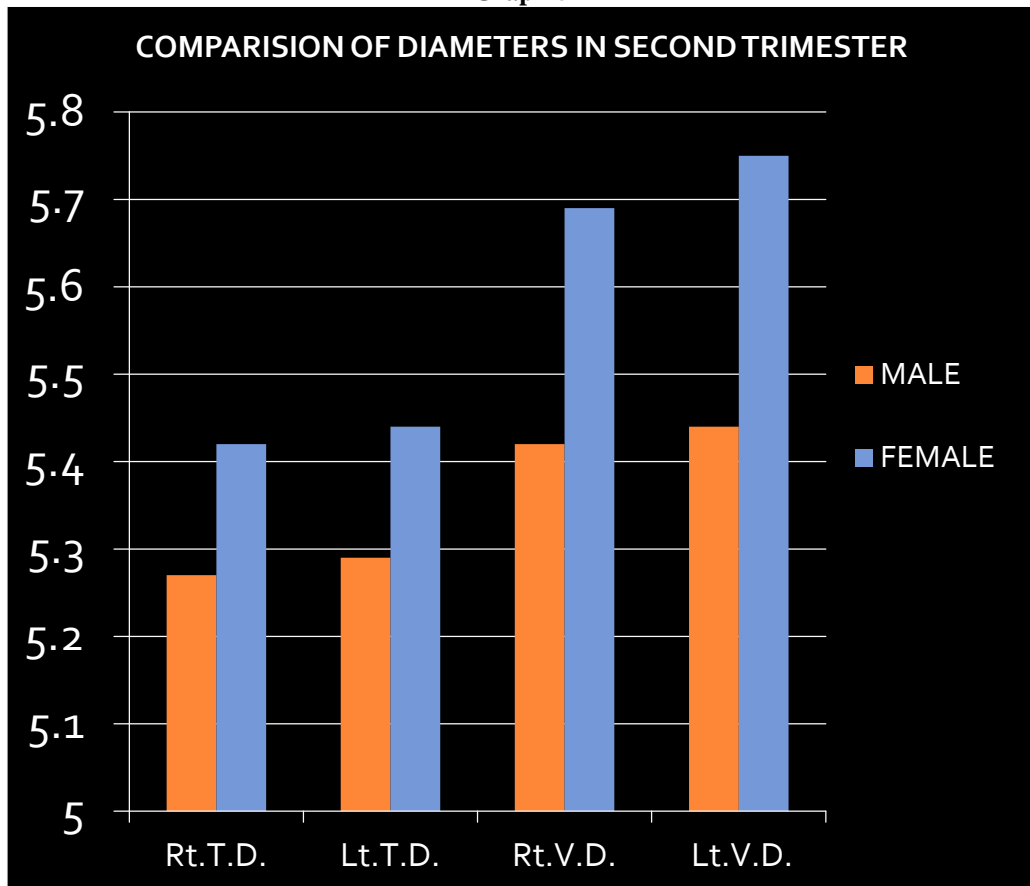
Graph -3

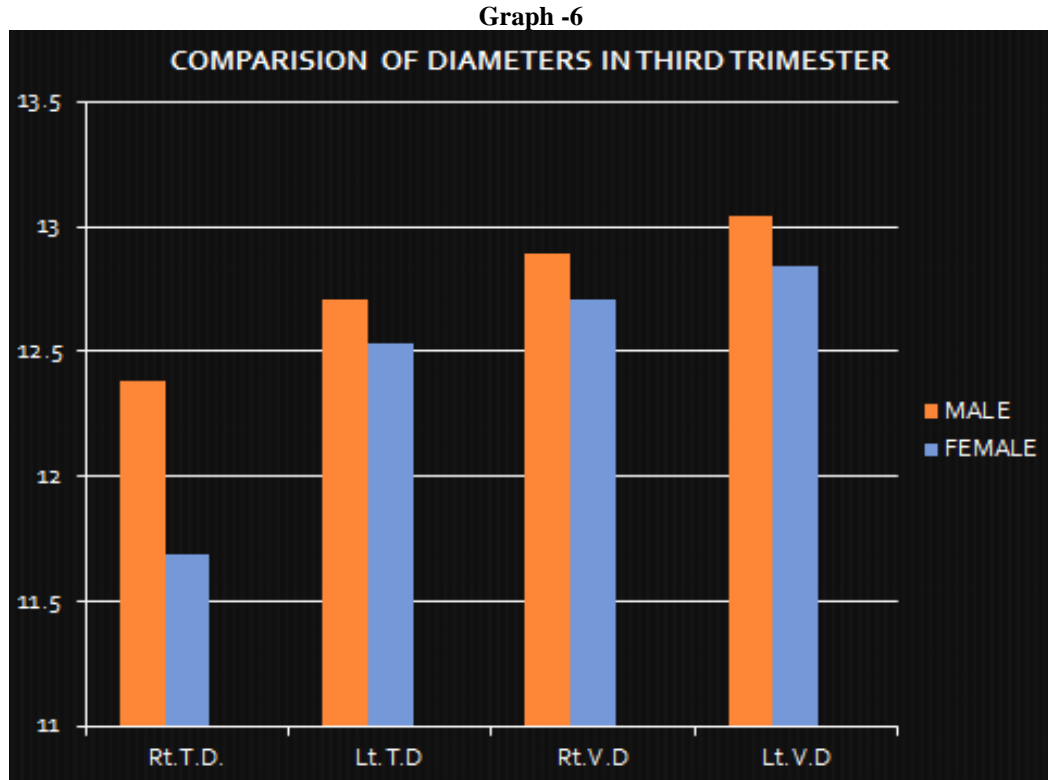


Graph -4



Graph-5





Result

- According to the graph (1-4) both the transverse and vertical diameters of the head of femur showed progressive growth with progressive increase in gestational age. They show strong correlation with gestational age (Pearson correlation index $r=0.998$).
- The vertical diameter of head of femur on both the sides i.e. right & left side was found more than the transverse diameter (table - 1).
- Both diameters were found more on left side than that of right side (table - 1).
- Both the transverse and vertical diameters in 3rd trimester were found 2.3 times than that of the 2nd trimester (table-2).
- In 2nd trimester both diameters were more in female in comparison to male, while in 3rd trimester it was found greater in male (graph 5 & 6).

Discussion

Walker & Gold Smith (1981) measured the diameter of the femoral head but could not find any differences between males & females and left or right side (8).

According to Beata Baroti et al, The morphological examinations have been done to monitor the intrauterine development of the hip joint between 3rd & 6th weeks of pregnancy. According to them the vertical and horizontal diameters of the femoral head did not differ statistically. The shape of femoral head was considered a circle (6). Based on an ultrasonographic study of the prenatal hip joint by Ianakova OM et al, the

most intensive growth of the head occurs at 26-38 weeks of gestation (7).

Other authors using magnetic resonance imaging and fetal hip joint ultrasound observed that until the 20th week the diameter of the femoral head and the depth of acetabulum showed a slight increase, but after 20 weeks they increase exponentially (9,10).

According to I. I. UYSAL (2004) the mean height of the femoral head in females was greater than that in males in the third trimester on both sides. Also they found a highly positive correlation between the transverse diameter of the acetabulum and the femoral head (11).

However in our study we found that the diameters in most of the fetuses on the left side were more than that of the right side.

The mean diameters of the femoral head in females were greater than that in males in the second trimester. While the mean diameters of the femoral head in males were greater than that in females in the third trimester.

Conclusion

The Data provided in our study i.e., a correlation of femur head diameters with the gestational age could be beneficial for the clinicians not only for the assessment of gestational age of the fetus but also will help them for early diagnosis of any malformation of hip joint since the success of treatment in developmental dysplasia or dislocation of hip depends on early diagnosis. The present study might stimulate future research such as the use of high resolution pre-natal

ultrasound to measure femur head diameters in utero & to examine whether ultrasound measurements are correlated with clinical instability or dysplasia.

Conflict of Interest: None

Source of Support: Nil

References

1. Uththoff HK, Jarvis J. Embryology of human hip orthopedic 26:2-6, 1997.
2. Tachdjian MO, editor. Congenital dysplasia of the hip. Pediatric Orthopedics. Volume 1, 2nd ed. W.B. Saunders, Philadelphia, 1990 PP:297-312.
3. Weinstein SL. Developmental hip dysplasia and dislocation. In: Morrissy RT, Weinstein SL, editors. Lovell and Winter's Pediatric orthopedics. Volume 2, 4th ed. Lippincott-Raven. Philadelphia 1996 PP:903-7.
4. Avisse C, Gomes H, Delvinquiere V et al. Anatomic study of the pre and neonatal hip. Physiopathologic considerations on dysplasia and congenital dislocation of the hip. Surg. Radial Anat 19:155-9, 1997.
5. Graf R. The acetabular labrum in infants. Orthopade 27:670-4, 1998.
6. Beata Baroti, Zsursanna Pap et al, Morphometric and ultrasonographic study of the human fetal hip joint during intrauterine development, Rom J Morphol Embryol 2013, 54 (4): 977-981.
7. Ianakova OM, demidov vi, Gashimova SA, Use of ultrasound in the study of the hip joint of fetuses during different periods of intrauterine development, Ortop Travmatol Protez, 1990, 10: 14-18.
8. Walkers JM, Goldsmith CH. Morphometric study of the fetal development of the human hip joint: Significance for congenital hip disease. Yale J Biol Med 54:411-37, 1981.
9. Lee J, Jarvis J, Uththoff HK et al. The fetal acetabulum. A histomorphometric study of acetabular anteversion. Clin Orthop 281: 48-55, 1992.
10. Whitby EH, Bell MJ, Rigby AS, Burton M. Measuring hip development using magnetic resonance imaging. J Pediatr Orthop. 2007;27 (8):898-902.
11. Uysal I.I., Salbacak, Kapicioglu I.S., Buyukmumcu M., Seker M., Cicekcibasi A.E. Turk J Med Sci 34: 301-307 2004.