
Significance of radiological appearance of ossific femoral nucleus in diagnosis of developmental hip dysplasia

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Abstract:

The aim of the study to determine the benefit of delaying appearance of femoral head ossific nucleus in diagnosis of developmental hip dysplasia.

This case control study has been carried in Mosul teaching hospital orthopedic department, and private clinic through the period March 2006-March 2008. One hundred seventy six (176 infants with developmental hip dysplasia) and one hundred seventy six (176 normal infants), ages between (3-8) months with mean age 5.3 months.

Highly significant difference being developmental hip dysplasia ($P = 0.009$) compared with controls particularly for ages between (3-5 months). Computation of the odds ratio showed that developmental hip dysplasia cases could be a factor in delaying ossification femoral head centre three times ($OR=3$) in comparison to normal.

Key word: femoral head, ossific nucleus appearance, DDH.

Introduction:

Developmental dysplasia of the hip (DDH) is defined as a deformity of the acetabulum of different degrees in which the head of the femur may be properly located or displaced (partially or completely). Novacheck 1996^[1], Eugenio 1997^[2]

Williamson 1972^[3] mentioned that the clinical examination in the maternity department has revealed several practical difficulties, the behaviors of the baby may affect the tests of hip examinations, the importance of complete relaxation cannot be over stressed, it may be impossible to demonstrate a known dislocation if the baby is crying or kicking, difficult breech deliveries may cause much bruising and a negative examination may not be valid.

Diagnosis in the first few months of life allows conservative treatment with complete resolution in most cases. Suspicion of developmental hip dysplasia (DDH) is based on ethnic, family, and pregnancy history, and on physical examination of the newborn. Imaging assists in the diagnosis and follows the treatment. When the abnormal relationship between the femoral head and the acetabulum occurs, the relative proportion of ossified to cartilaginous portions of the acetabular roof is shifted in favor of the structurally weaker cartilage Eugenio 1997^[2].

Roentgen discovered X-rays in 1895 and in the medical setting X-rays developed pari passu with surgery with an explosive expansion in the last two decades^{Peter [4]}.

Douglas 2004^[5] added since the discovery of radiography, imaging studies has become the

central component for the diagnosis and treatment in medicine in general, and especially in orthopedic conditions. Radiological imaging can be a valuable adjunct to the physical examination for hip dysplasia, particularly after 4-6 months, ultrasonography is no longer useful and radiographic imaging is the modality of choice, moreover used as a means of monitoring treatment Janet^[6].

The aim of the study to confirm the significance of radiological appearance of ossific nucleus in diagnosis of DDH cases.

Patient & Methods:

This case control study has been carried in Mosul teaching hospital orthopedic department, and the private clinic through the period March 2006-March 2008. Infants ages between (3-8) months mean ages 5.3 months, for all (151 males) and (239 females). Clinical examinations done by Ortolani's test which is essential to detect hip instability or dislocation Wedge 1993^[7].

Radiological examinations of the infants done through anteroposterior view in supine positions, radiography of the pelvis obtained with hips in neutral position. Studying of the hip with demonstration presence or absence of the ossific nucleus (**Fig 1**),

For the infants between (3-8 months), **tab (1)** (176) normal infants as a controls, and (176) for cases with developmental hip dysplasia.

Various statistical methods were used to analyze data. Chi-squared (X^2) test for contingency tables to find the statistical association or difference between cases and controls regarding the presence or absence of

risk factors^[8]. Computation of the odds ratio also

done, this is calculated as follows: $\frac{a/c}{b/d}$ [9, 10].



Fig: (1) radiological examination for a female infant (6 months) anteroposterior view in supine position. Revealed delay in the appearance of the left femoral ossific nucleus with positive left hip ortolani test in comparison for the right hip.

Results:

Table (1) Describes sex distribution of infants with developmental hip dysplasia as (cases) and their normal infants as a (controls) between (3-8months) of age. There is a (71%) female infant for cases. **Table (2)** shows the percentage of distribution for state of femoral ossific nucleus for each right and left hips respectively. Right

hips there is about (55%) for cases with DDH, while normal infants (60%) in relation for delaying appearance of the femoral ossific nucleus.

Left hip (57%) for DDH cases, (58%) for control in relation of the delaying appearance of ossific femoral nucleus.

Table (1) the distribution of the study populations according to sex.

Sex	No. of DDH infants	%	No. of normal infants	%
Males	51	29	84	48
Females	125	71	92	52
Total	176	100	176	100

Table (2): Percentage distribution for state of femoral ossific nucleus for both right and left hips between infants with developmental hip dysplasia and normal infants.

Side	State of femoral ossific nucleus	Infants with DDH	%	Normal infants	%
Right	Normal	79	45	70	40
	Delay	97	55	106	60
	Total	176	100	176	100
Left	Normal	76	43	74	42
	Delay	100	57	102	58
	Total	176	100	176	100

Table (3) Exhibits no significant difference ($P_{\text{value}} = 0.5$) of DDH cases compared with controls for all ages between (3-8 months). Computation of the OR = 1.

Table (4) showed that about (60%) for infant of DDH with delaying appearance of

ossific nucleus in comparison for normal infants (80%). With significant P-value (0.009). While computation odds ratio about 3 times in favor of delaying ossification nucleus being developmental hip dysplasia.

Table (3). The association of appearance of femoral ossific nucleus as a risk factor in DDH in comparison with normal infants for all ages.

Ages 3-8 Months				
State of ossific femoral head	No. Infants with DDH	%	No. Normal infants	%
Normal Ossific femoral head	77	44	72	41
Delayed ossific femoral head	99	56	104	59
Total numbers	176	100	176	100

$\chi^2 = 0.2$, $P\text{-value} = 0.5$
OR= 1

Table (4) the association of appearance of femoral ossific nucleus as a risk factor in DDH in comparison with normal infants between (3-5 months) ages.

Age Months 3-5				
State of ossific femoral head	No. Infants with DDH	%	No. Normal infants	%
Normal ossific femoral head	38	40	17	20
Delayed ossific femoral head	62	60	67	80
Total numbers	100	100	84	100

$$\chi^2 = 6.8$$

$$OR = 3$$

$$P_value = 0.009$$

Table (5) for ages between 6-8 months , exhibit about (49%) for infants with developmental hip dysplasia in comparison with (37%) normal infants in relation for delaying femoral ossification nucleus , with no significant P_ value = 0.1, computation of odds ratio(OR = <1) which is of no significance.

Table (6) for all ages between (3-8 months) in relation for the effect of sex on delaying the appearance of femoral ossific nucleus .No statistical association with no significance P-value. Computation odds ratio (OR= <1), no additional risk factor for males in DDH.

Females analysis, with no statistical effect .computation odds ratio (OR= <1). With no significance P-value.

Table (5) the association of appearance of femoral ossific nucleus as a risk factor in DDH in comparison with normal infants between (6-8 months).

Age Months 6-8				
State of ossific femoral head	No. Infants with DDH	%	No. Normal infants	%
Normal ossific femoral head	39	51	58	63
Delayed ossific femoral head	37	49	34	37
Total numbers	76	100	92	100

$$\chi^2 = 2.3$$

$$OR = < 1$$

$$P_value = 0.1$$

Table (6) the association of appearance of femoral ossific nucleus as a risk factor for DDH cases in comparison with normal infants for both sex's males and females.

Ages 3-8 Months					
Sex	State of ossific femoral head	No. Infants with DDH	%	No. Normal infants	%
Males	Normal	15	28	32	37
	Ossific femoral head				
	Delayed ossific femoral head	37	72	54	63
	Total numbers	52	100	86	100
Females	Normal	63	51	44	49
	Ossific femoral head				
	Delayed ossific femoral head	61	49	46	51
	Total numbers	124	100	90	100

Males

$$\chi^2 = 1.009$$

$$P\text{-value}=0.3$$

OR=<1

Females

$$\chi^2 = 0.070$$

$$P\text{-value}=0.7$$

OR= <1

Discussion:

The most appreciable change in the vascular arrangement occurring before the fourth month is the disappearance of the penetrating vessels from the ligamentum teres. This coincides approximately with the time when the secondary ossification center is first seen in the middle of the femoral head. Usually the ossicle is single, but on occasions it begins with several nuclei, the largest of which is in the middle from four to eight months the ossifying center has grown to occupy the middle third^[11].

Stewart 1986^[12], Boniforti 1997^[13], Peter 2004^[14] discussed that radiographic parameters are an important factor and extremely useful in following the development of the hip, evaluating hip dysplasia, diagnosis and management of DDH. There is little information regarding qualitative signs in the literature. A precise analysis of the radiological appearance of the hip is needed to assess DDH in infancy. The most

popular and relatively often observed parameter of this kind is the appearance of the ossification center of the femoral head.

Stewart 1986^[12] in his study had reviewed radiographs of the normal hips of 277 children aged under 12 months. Results showed no difference in ossification was found between left and right sides. This is goes with our series in which there is no significance in percentile distributions between both sides for normal infants and DDH cases (tab 2).

Radiographs of the pelvis and hips have historically been used to assess an infant with suspected DDH. During the first few months of life when the femoral heads are composed entirely of cartilage, radiographs have limited value. By 4 to 6 months of age, radiographs become more reliable (**Fig 2, 3**), particularly when the ossification center develops in the femoral head^[15].



Fig: (2) anteroposterior view of the pelvis for female infant (6 months). Clear evidence of bilateral hip dislocation.



Fig: (3) female infant (4 months) with clear evidence right hip dislocation with delay appearance of the ossific nucleus of the hip in comparison for the left hip.

Bertol 1982^[16] mentioned, that the use of radiographs as an aid in the diagnosis of neonatal congenital dislocation of the hip is controversial. There is a trend towards delay in the appearance of the epiphysial ossific center on the clinically abnormal side, and hence the center is smaller than that on the contralateral side for some

months after it becomes visible. He added the age at which the upper femoral epiphysis appeared radiographically was four months for the clinically normal side in unilateral cases of dislocation, five months for the contralateral dislocated side, and six months for the bilateral cases.

Jones 2000^[17] and Gunderman 2005^[18] respectively added that, in the first month of life when the femoral heads are composed entirely of cartilage, radiographs are of limited value unless a dislocation is present. By 4 to 6 months of age, radiographs become more reliable. In DDH, often there is a delay in the appearance and growth of the ossific nucleus of the femoral head, as compared to the normal hip.

This goes with our series finding (**tab3-5**) particularly for the ages between (3-5 months) with an effect three times more for DDH case in comparison with normal, while not for those ages between (6-8) .In addition we agree about the nucleus of the femoral head ossifies at approximately 4 months (50th percentile), with a normal range of 2 to 8 months.

Garvey 1992^[19] stated that infants at risk should be radiographed at four to six months of age to diagnose DDH missed earlier and thus increase the chance of successful treatment.

D'souza 1996^[20] added that in some centers, it has become routine to take radiographs of these

infants at four to seven months of age. While Luhmann 1998^[21] explained, some investigators have suggested that the presence of the ossific nucleus of the femoral head at the time of closed or open reduction is associated with a lower rate of ischemic necrosis. This finding if verified could lead to a delay in the treatment of a dislocated hip until ossification of the femoral head has begun.

We disagree about infant at risk with DDH should delayed to setting diagnosis depending on the presence of ossific nucleus (Fig 4)and for those planed for closed or open reduction which lead to an increase the risk of neglecting infants with DDH .

Our finding confirm the routine 3-5 months age radiography in a service with a well developed screening program which is beneficial to determine the presence DDH .Sex difference has limited value for determination presence of delaying femoral ossific nucleus (**tab 6**).



Fig: (4) anteroposterior view in supine for male infant age (8 months) revealing absent ossific nucleus in both hips with clear right hip dislocation proved by clinical ortolani test.

Conclusion:

Being a case of DDH could be considered as a risk factor for delaying appearance of femoral ossific nucleus, this is goes with the idea of other researchers particularly between 3-5 months

References:

1. Novacheck T F. Common orthopedic problems developmental dysplasia of the hip. *Pediat Clin of North America*. 1996; 43(4): 829-848.
2. Eugenio O G, A radiologist's guide to the imaging in the diagnosis and treatment of developmental dysplasia of the hip. *Skeletal Radiol*. 1997; 26:386-397.
3. Williamson J. Difficulties of early diagnosis and treatment of congenital dislocation of the hip in Northern Ireland. *J Bone Joint Surge* .1972; 54-B (1): 13-17.
4. Peter D, Stame G, Angus G. Ionising radiation and Orthopaedic. *Current Orthopaedics*. 2005 ;(19):1-12.
5. Douglas R P, Colleen A L, Lori A D, Heather M R, Stuart L W, and Jose A M . Radiographic Measurements in Developmental Dysplasia of the Hip Reliability and Validity of a Digitizing Program. *J Pediatr Orthop* .2004; 2 (24): 156-160.
6. Janet C M, Susanna L. Radiology Rounds Department of Radiology .2004; 4:819-827 [Online]. [Cited 2007 June 10]. Available From:URLhttp://www.massgeneralimaging.org/newsletter/april_2004.
7. Wedge J H. Lower extremity. Hip Pediatric Aspect in: Orthopedic knowledge update 4 home study syllabus .1st Ed, American academy of orthopedic surgeons, Rosemont, St Louis, USA. 1993: 505-507.
8. Kirkwood B R. Essentials of medical statistics. For Confidence Interval.1st Ed. Black-Well Scientific Publications, Oxford UK. (1988):234.
9. MacMahon B, Pugh TF: Case control studies. Epidemiology principles and methods. Little Brown Company. Boston. USA. (1970):241-282.
10. Gordis L.: Epidemiology. WB Saunders Company. Philadelphia USA (For design of case control). 1996:124-140.
11. Trueta J. The normal vascular anatomy of the human femoral head during growth. *JBJS* 1957; 39 –B: 358-394.
12. Stewart R J, Patterson C C, Mollan R A B. Ossification of the normal femoral capital epiphysis brief reports. *JBJS*. 1986; 68 –B: 653.
13. Boniforti F G, Fujii G, Angliss R D, Benson M. K. D. The reliability of measurements of pelvic radiographs in infants *JBJS* 1997; 79-B: 570-575.
14. Peter T T. Sillinger J K, Bellyei A R. Radiographic parameters of the hip joint from birth to adolescence. *Pediatr Radiol*. 2004; (34): 237-244.
15. American Academy Of Pediatric. Clinical Practice Guideline: Early Detection of Developmental Dysplasia of the Hip . *Pediatrics* Vol 105, No 4; 2000: 896-905
16. Bertol P, Macnicol M F, Mitchellg P. Radiographic features of neonatal congenital dislocation of the hip. *JBJS* .1982; 64-B: 176-179.
17. Jones D. Sonographic assessment of pediatric hip. Imaging update. 2000; I s s u e 5.
18. Gunderman R, Strain JD, Cohen HL, Fordham L, McAlister WH, Slovis TL, Smith WL, Tosi L, Expert Panel on Pediatric Imaging. Developmental dysplasia of the hip. [Online publication]. Reston (VA): American College of Radiology (ACR); 2005. [Online]. [Cited 2007 June 10]. Available From: URL <http://www.guideline.gov/summary/summary.aspx?doc-id=860>.
19. Garvey M, Donoghue V B , Gorman W A, O'Brien N , Murphy J F A . Radiographic Screening at Four Months of Infants at Risk for Congenital Hip Dislocation .*JBJS* ;1992: 74-B: 704-707.
20. D'souza L, Hynes D, McManus F. Brief reports. Radiological screening for congenital hip dislocation in the infant "at risk". *J B J S*. 1996; (78-B): 319-320.
21. Luhmann S J ,Schoenecker P L,Anderson A M , and Bassett G S .The prognostic importance of the ossific nucleus in the treatment of congenital dysplasia of the hip .*J B J S* .1998;(80-A):1719-1727.

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