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ORIGINAL ARTICLE

HIP ULTRASOUND IN DEVELOPMENTAL HIP DYSPLASIA: AN INITIAL EXPERIENCE AT A TERTIARY SPECIALIZED TEACHING HOSPITAL IN ADDIS ABABA

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ABSTRACT

Introduction: *Developmental dysplasia of the hip is a congenital anomaly. Clinical assessment is not effective and efficient as assumed previously, and the role of ultrasound imaging has increased over time and is now employed for screening of neonates. The local literature lacks information. The purpose of this article was, therefore, to do a preliminary ultrasound assessment of its status among infants.*

Methods: *A cross-sectional study was conducted in the pediatric unit of the Department of Radiology at Tikur Anbessa Specialized Hospital from August 2018- to February 2019.Participants were selected based on recommended age (4-24 weeks) Hip ultrasound was performed using the Graf static method to measure alpha and beta angles of both hips and measurements were grouped according to the Graf classification. Mean values of alpha and beta angles of both hip sides and types were analyzed. Independent sample T test was used for analysis where appropriate.*

Result: *Over the specified period, 65 neonates within the age group 4-24 weeks* were scanned. *40(61.5%) were males and 25 (38.5%) females. Graf type II (immature and dysplastic) hips comprised 4.61% for the right hip and 10.7% for the left in males and 4.61% each for both hips in females).Type IV(dislocated) hips comprised 4.61% for the right hip and 1.5% for the left in males and was not identified in females.*

Conclusion: *The proportion of abnormal hips identified in the study warrants the need for a much larger and more comprehensive study and the use of ultrasound for a wider clinical application or a potential screening strategy is recommended.*

Key Words: *developmental hip dysplasia, Ultrasound, hip angles*

INTRODUCTION

Developmental dysplasia of the hip (DDH) which was previously addressed in the literature as congenital dislocation of the hip does not have an established etiology. The condition encompasses a wide spectrum of conditions from mild, clinically insignificant acetabular dysplasia in the adult to irreducible, total dislocation of the hip in neonates (1). It was first reported as hip instability by Roser in 1879. Le Damny and Seiget, were the first people to describe clinical tests for the condition in 1910. This was further developed in 1937. Later on Palmer in 1961 and Barlow in 1962 expanded on these clinical tests for identifying subluxation and dislocation (2).The incidence of the disease, as described in the literature, tremendously shows a wide range of variations.

A systematic medical literature review by Randal T Loder *et al* came up with incidence ranges of 0.06 per 1000 live births in Africans to 76.1 in native Americans showing a significant variability within racial groups and across geographic locations (3).

Vivek Gulet showed an overall incidence ranging from 1.5- 2.5 per 1000 live births (1). Yet another Australian study showed a rather higher incidence of 7.3 per 1000 live births (4). In a similar manner, the prevalence of DDH shows variations across studies where a range of 0.15-4% was the reported prevalence in one study (5); while another showed a 0.07-0.16% (6). The local literature does not have any information regarding incidence in Ethiopia apart from sporadic clinical encounters in routine practice. The only study found was one conducted in the Ethiopian Jewish community in Israel which showed an incidence of 0.44% compared to 5.9% in white Jewish neonates (7)

Contemporary evidence in the literature shows that DDH is associated with certain risk factors such as breech presentation, positive family history, and gender (female).Some human leucocyte antigens (HLA) A, B, and D gene types demonstrate an increase in DDH.

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Chromosome17q21 is very much associated with DDH. Lax ligaments and abnormalities in collagen metabolism, estrogen metabolism, and pregnancy-associated pelvic instability have associations with DDH. On the other hand, children born premature, with low birth weights, or to multi-fetal pregnancies are somewhat protected from DDH (8).

Clinical assessment of DDH is not always as effective and efficient as assumed previously, and the role of ultrasound imaging has increased over the years and is now extensively employed for screening of neonates with clinical evidence of hip instability and those at risk (7,8). The wide spread use of ultrasound began after Graf developed and published a static method of assessment, and later in 1985, Harcke *et al* introduced a dynamic method of examination(9)

Currently, there is no consensus as to whether ultrasound should be used as a universal screening or in selective situations before the age 6 weeks to minimize late detection of DDH. The age definition of late cases ranges from 4 to 24 weeks. However, studies have also shown that positive ultrasound examinations in the universal plan have resulted in insignificant reduction in the rate of late complication of DDH while increasing the rate of intervention compared to the selective approach; although the difference was not statistically significant.(5): while other studies recommend universal screening of newborns(10).

The two methods of ultrasound exam- Graf's static method of ά and β acetabular angle measurement and Harcke's dynamic method are mostly used in conjunction, but there are some authors who recommend Graf's method as a more reliable one and advocate its separate use (6). The author of this article has employed Graf's method (Figure 1) as it is easier to use since it does not employ clinical maneuvers such as Barlow's dislocation test. (11, 12).

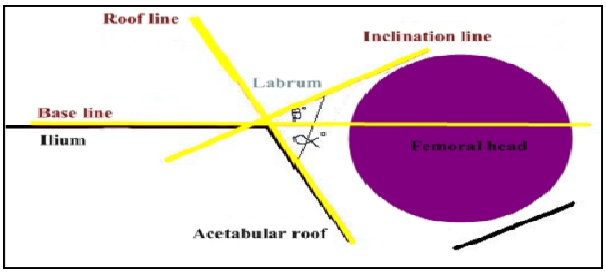
The purpose of this article is to do a preliminary assessment of the incidence of late DDH in infants between the ages of 4 and 24 weeks visiting our pediatric ultrasound unit within the specified study period and generate information for a more focused large scale study which may help develop future national screening strategies which are currently non-existent.

PATIENTS AND METHODS

This was a cross-sectional study conducted in the pediatric unit of the Department of Radiology at Tikur Anbessa Specialized Hospital from August 2018- to February 2019 after approval by the departmental research and ethics committee. The source population was all pediatric patients presenting at the teaching hospital in the specified study period.

A non-random convenience sampling method was used. The sample size obtained was 59 with a 10% contingency added, totaling 65, and this was estimated, using a higher range prevalence of 4% taken from the literature and cited in a joint Norwegian and British study (5) as a baseline, and employing a single population proportion formula with a level of significance at 5% a confidence interval (Z) of 95% and an absolute precision (margin of error) at 5%(ά-0.05). Infants with known hip pathology were excluded.

Hip US exam was performed after informed consent was obtained from parents. Data were collected in a data collection format. A Sonoace US machine with a 7 MHz linear probe was used. The Graf method of static scan was employed to measure the alpha and beta angles of both hips. Measurements were grouped according to the Graf angle classification shown below on Table 1 (11,12). Subjects were stratified by gender and age (4-10 weeks, 11-17 weeks and 18-24 weeks of age). All collected data were then checked for clarity and completeness and analyzed using SPSS statistical software version 20 at 5% precision level. Percentage, mean and standard deviation of alpha and beta angles of both hip sides as well as hip types were analyzed using the Graf classification. Associations between variables were checked with independent samples T test at a P value of <0.05 taken as statistically significant.



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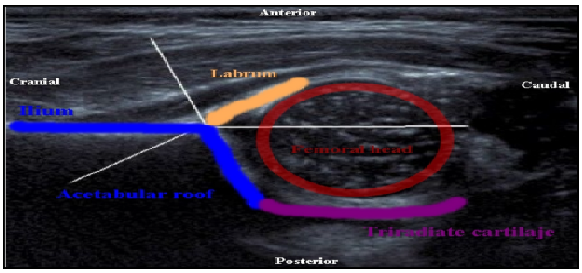

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Figure 1: Schematic demonstration of alpha and beta angle measurements used in this study (17)

Table 1: Graf Classification of hip angles used - (12)

All types Alpha angle > 60 degrees	
Type 1a	Beta angle < 55 degrees
Type 1b	Beta angle > 55 degrees
(Normal)	
All type II	
Type 2a	Alpha angle 50-59 degrees (< 3 months)
Type 2b	Alpha angle 50-59 degrees (> 3 months) Beta angle 55-77
Type 2c	Alpha angle 43-49 degrees Beta angle < 77 degrees
Type 2d	Alpha angle 43-49 degrees Beta angle > 77 degrees ("about to decenter")
I mmature/Dysplatic	
Type 3	Alpha angle < 43 degrees
(	(Type 3a and 3b distinguished on
t	he grounds of structural alteration of the cartilaginous roof)
Deficient/Subluxed	
Type 4	Alpha angle < 43 degrees (dislocated with labruminterposed between femoral head and acetabulum)
Dislocated, highly deficient	

RESULTS

US scan of the hips was performed in 65 neonates of whom 40(61.5%) were males and 25 (38.5%) females. The mean age was 12 weeks. In the female babies, the mean alpha angles were 63.08 (±4.30) degrees for the right hip and 64.20(±5.45) for the left; whereas in the male babies, the mean alpha angles were 64.65(±4.35) for the right hip and 63.63(± 7.16) for the left (figure 2). :The mean beta angles were 44.4 (±10.7) for the right hip and 45.36(±11.0) for the left in females; while the mean beta angles were47.05(± 14) for the right hip and 47.12(± 11.65) for the left in males (figure 3).

Differences in both mean alpha and beta angles between males and females were not statistically significant (t=1.421, df=63, P=.160 for right alpha angle, t= .465, df=63, P=-.644 for the left alpha angle and t=.808 df= 63 P= .422 for right beta angle and t= .606, df=63, P=.547 for the left).

Hip types were grouped according to a modified Graf classification for both sexes. Type I hips (all subtypes lumped together) were the predominant ones in both gender groups and on both sides with 34 (85%) for the right hip, and 32(80%) out of the 40 for the left hip in males and 22(88%) out of the 25 females each for the right and left hips, (Table 2).

Type II hips (with all subtypes included) were seen in 3 (7.5%) of our cases for the right hip and 7 (17.5%) for the left out of the 40 males. Out of the 25 females scanned, 3(12%) showed type II hips equally for both hips.(Table 2). There were no Graf type III hips identified in both genders. Graf type IV hip was found in 3(7.5%) for the right hip and 1(2.5%) for the left, of the 40 males. It was not identified in females.

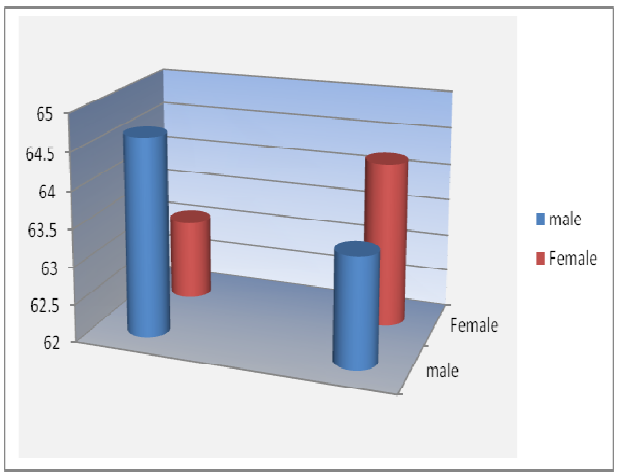

Figure 2: Mean ά angles by gender among infants scanned at Tikur Anbessa Specialized Hospital: August 2018- February 2019.

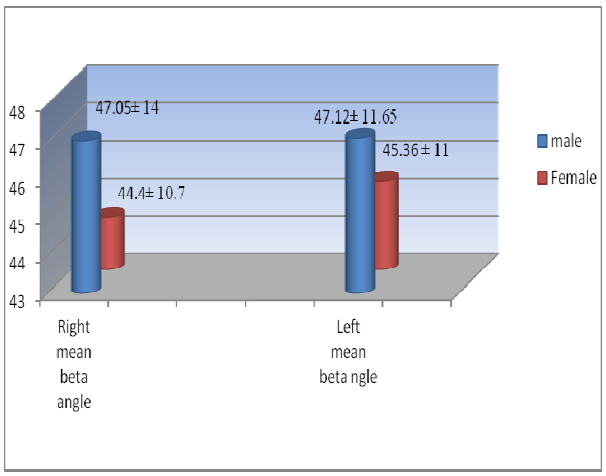

Figure 3: Mean beta angles by gender among infants scanned at Tikur Anbessa Specialized Hospital: August 2018- February 2019.

Table 2: Distribution of hip types (as determined by the Graf classification) by gender with group percentage among infants scanned at Tikur Anbessa Specialized Hospital: August 2018- February 2019.

Graf hip type	Gender							
	Male				Female			
	Right		Left		Right		Left	
	(n)	(%)	(n)	(%)	(n)	(%)	(n)	%
Type I	34	85	32	80	22	88	22	88
Type II	3	7.5	7	17.5	3	12	3	12
Type III	0	0	0	0	0	0	0	0
Type IV	3	7.5	1	2.5	0	0	0	0
Total	40	100	40	100	25	100	25	100

Table 3: Distribution of hip types (as determined by the Graf classification) by laterality with both sexes combined among infants scanned at Tikur Anbessa Specialized Hospital: August 2018- February 2019.

Graf hip type	Laterality			
	Right		Left	
	(n)	(%)	(n)	(%)
Type I	56	86.2	54	83.1
Type II	6	9.2	10	15.4
Type III	0	0	0 0	00
Type IV	3	4.6	1	1.6
Total	65	100	65	100

Among the study subjects, 62 of them had cephalic presentation and 3 had breech at delivery. Of the 62 cephalic presentations, 54 (83%) had type I hips, 5 (7.7%) had type II hips and 3(4.61%) had type IV hips. Of the 3 breech presentations, 2 had type I hips and 1 had type II. 57 babies were delivered vaginally, and 8 by Cesarean section. Forty nine of those delivered vaginally had type I hips, 5 had type II and 3 had type IV. From the 8 Cesarean section deliveries, 7 had type I and 1 had type II hips. There were 26 first born and 39 non-firstborn babies. Twenty two of the first born babies had type I, 3 had type II, and 1 type IV hips whereas 34 of the non-first born babies had type I, 3 type II and 2 type IV hips (tables not shown). Two of our subjects had evidence of torticollis and were in the type II hip group.

DISCUSSION

In this study, mean alpha and beta angles were computed for both genders and both sides. The slight variations observed in mean alpha angle values between male and female groups (higher in males on the right side and higher in females on the left side) were not statistically significant in contrast to the findings of other studies in the literature which showed higher values for males(6). Mean beta angles also showed slightly higher values in males, but the difference again was not statistically significant as were differences of values with regard to laterality These findings were in agreement with those of other similar studies in the literature (6, 13).

Further analysis of data showed that type I (mature and normal) hips were the most predominant group occurring in 56(86.2%) regardless of gender. The same predominance of occurrence was corroborated in other studies (6, 14). Type II hips (immature and dysplastic) were seen in 16 (24.6%).This figure was higher than values obtained by Sernic (12.4%) (13), and slightly lower than figures by Bruno (6). Yet another study by Garedaghi (15) revealed a figure which was around 49.9%.

With regard to laterality, type II hips occurred more on the left side compared to the right and this is in agreement with the findings of the previous studies (6, 13). Type III hips (subluxed type) were not identified in the study subjects; whereas type IV hips (dislocated) were identified in only three males on right hip and one on the left as compared to the much lower figure by Gharedaghi(15).

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Although various studies in the literature describe the occurrence of immature, dysplastic, subluxed or dislocated hips more in females and on the left side, this study did not show the same except for type II hip which was observed in 10 of the subjects on the left side; but again the small sample size and the study design pose a significant limitation to provide a solid explanation, and a more comprehensive study is needed to provide a reasonable answer in the future.

The literature has documented studies which state breech lie and presentation as common predisposing factors in the development of DDH (3, 4, and 8). There were only 3 breech presentations with 1 dysplastic hip documented out the 65 study subjects and as such; no significant inference could be made. By the same token, differences observed in modes of delivery (vaginal Vs Cesarean section) were not worth reasonable inference owing to the small number of Cesarean sections observed in the study. Dysplastic hips (type II) were equally seen in both first-born and non -first-born babies; while only 1 dislocated hip (type IV) in the first-born group and 2 in the non-first-born group were seen, respectively, but differences in observation were not statistically significant. There were two cases of torticollis found with type II hip dysplasia in this study, but it is very difficult to assume whether this observation was accidental or indicates association; although such association between DDH and torticollis has been established in the literature (16).

Variations in the values among different studies might be affected by various factors such as study designs, population types, and experience and observer variation of ultrasound examination.

The immature/dysplastic (type II) and dislocated/ deficient (type IV) hips identified in the study, portray a clear need for a more comprehensive longitudinal study design across health institutions nation-wide to investigate the incidence and prevalence of DDH and all the predisposing factors mentioned above. This study had limitations in terms of study design, scarcity of adequate high end ultrasound equipment and study subjects coming from a single hospital population.

Conclusion and recommendation

In this study, although the majority of our study subjects had normal hip types, the proportion of abnormal hips that were picked by ultrasound herald the need for a more comprehensive longitudinal study design addressing associated risk factors, and the effects of early and late diagnosis of DDH and the role of ultrasound with the recommended protocols including dynamic methods should be considered for a wider clinical application.

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