

The Importance of Ultrasonographic Examination in the Diagnosis of Developmental Hip Dysplasia: A Preliminary Study of 95 Newborns

GELİŞİMSEL KALÇA DİSPLAZİSİ TANISINDA ULTRASONOGRAFİ MUAYENESİNİN ÖNEMİ: 95 YENİDOĞANLI ÖN ÇALIŞMA

Abtullah MİLCAN, MD,^a Altan YILDIZ, MD,^b İrfan AYAN, MD,^a
Volkan ÖZTUNA, MD,^a Fehmi KUYURTAR, MD^a

^aDepartment of Orthopedics and Traumatology, ^bDepartment of Radiology, Mersin University School of Medicine, MERSİN

Abstract

Objective: To evaluate the importance of ultrasonography in the diagnosis of developmental hip dysplasia.

Material and Methods: Ultrasonographic examination of 190 hips of 95 newborns was conducted between October 2002 and March 2003. Clinical examination performed by an orthopaedic surgeon following the ultrasonographic examination, which was accomplished by a radiologist in a specially designed positioning apparatus.

Results: There were 45 males, and 50 females in the series. Of the hips, 177 were classified as Graf Type 1a and 1b (93.2%), 10 (5.3%) Graf Type 2a, 2 (1%) Graf Type 2c and 1 (0.5%) Graf Type 3a. Alpha values of right and left hips in Graf Type 1a and Type 1b hips were significantly higher than the values in Graf Type 2a ($p=0.0001$), but with respect to beta values, there was no significant difference. Number of hips in Graf Type 2c and Graf Type 3a were not significant to be compared. There was a significant correlation between the clinical and ultrasonographic findings in each hip type ($p=0.0001$).

Conclusion: Newborns should be routinely examined ultrasonographically for developmental dysplasia of the hip. However, when the social and economical conditions of our Country are taken into consideration, at least the newborns belonging to high-risk groups should be examined ultrasonographically.

Key Words: Developmental hip dysplasia, ultrasonographic examination, newborn screening

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Özet

Amaç: Doğumsal kalça displazisinin tanısında ultrasonografinin önemini değerlendirmek.

Gereç ve Yöntemler: Ultrasonografik olarak 95 yenidoğanın 190 kalçası Ekim 2002- Mart 2003 tarihleri arasında incelendi. Radyolog tarafından yapılan ultrasonografik muayene sonrası hastalar ortopedi kliniğince değerlendirildi.

Bulgular: Seri, 45 erkek, 50 kız yenidoğandan oluşturuldu. Ultrasonografik tetkik yapılan 190 kalçanın 177'si (%93.2) Graf Tip 1a ve Tip 1b, 10 u Graf Tip 2a (%5.3), 2 si (%1) Graf Tip 2c ve 1'i (%0.5) Graf Tip 3a olarak sınıflandırıldı. Graf Tip 1a ve Tip 1b kalçaların sağ ve sol alfa değerleri Graf Tip 2a'nın değerlerinden anlamlı yüksek bulundu ($p=0.0001$). Ancak sağ ve sol beta değerleri bakımından bu iki grup arasında anlamlı bir fark bulunmadı. Graf Tip 2c ve Graf 3a'da kalça sayısı istatistikî önem taşımadığından karşılaştırma yapılmadı. Klinik muayene bulguları ile kalça tipleri arasında anlamlı bir ilişki bulundu ($p=0.0001$).

Sonuç: Yenidoğan döneminde rutin olarak kalçanın ultrasonografik tetkiği yapılmalı, ancak ülkemiz koşullarında rutin olarak yapılamadığında en azından riskli yenidoğanlarda zorunlu olmalıdır.

Anahtar Kelimeler: Gelişimsel kalça displazisi, ultrasonografik muayene, yenidoğan taraması

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Developmental dysplasia of the hip designates an abnormal relation between the femoral head and the acetabulum. It encompasses dislocation, subluxation, instability,

and all of the anomalies pertaining to insufficient acetabular development.¹ Ultrasonography is a superior diagnostic and follow up tool especially in the first four months of life.² Ultrasonography of the hip can be performed by the dynamic method or the static method of Graf.^{1,2} In the latter method two angles are calculated (Figure 1). The α angle represents the bony acetabulum. It is formed by the intersection of the line parallel to the osseous acetabulum, and the line parallel to the lateral wall of the ilium. The lower limit of normal value is 60

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Yazışma Adresi/Correspondence: Dr. Abtullah MİLCAN
Mersin Üniversitesi Tıp Fakültesi
Ortopedi ve Travmatoloji AD, MERSİN
amilcan@mersin.edu.tr

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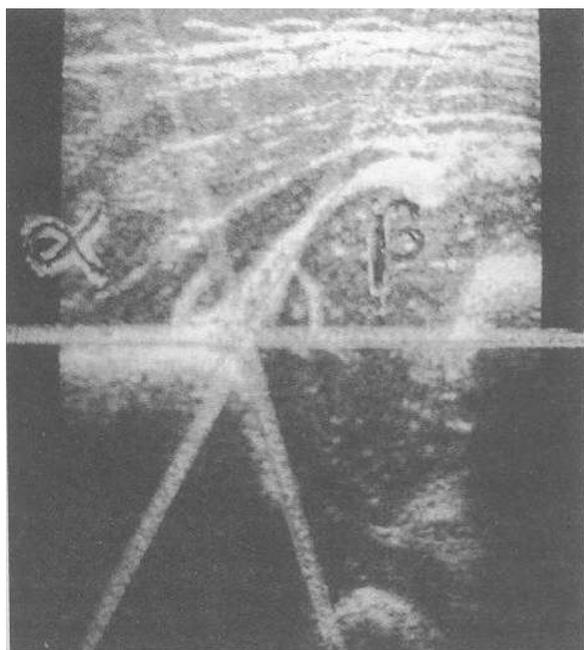


Figure 1. The ultrasonographic image of the hip depicting the α and the β angle.

degrees. The β angle reflects the cartilaginous roof. It is formed by the intersection of the line parallel to the lateral wall of the ilium, and the line parallel to the roof of the cartilage acetabulum. A β

angle greater than 77 degrees represents eversion of the labrum, and subluxation of the hip.^{1,2} The hip is classified into one of four main types according to Graf's classification¹ (Table 1).

Ultrasonography is a frequently used method of examination with proven reliability. In this study we aimed to demonstrate the importance of ultrasonographic examination in the routine diagnosis of developmental dysplasia of the hip.

Material and Methods

Clinical and ultrasonographic examination of 190 hips of 95 newborns that enrolled to our out patient clinics were performed between October 2002 and March 2003 in accordance with the Helsinki Declaration Principles with approval from ethical board of the institute. The risk factors were determined, and the hips were classified according to Graff. Clinical examination performed by an orthopaedic surgeon followed the ultrasonographic examination accomplished by a radiologist. Ultrasonographic examination was performed with Toshiba Power Vision 8000, multifrequency linear probe (8-15 mHz). Ultrasonographic examination was carried out in a special positioning ap-

Table 1. Ultrasonographic hip types according to Graf

Hip Type	Osseous Rim	Cartilaginous Rim	α angle	β angle
1a: fully mature	angular	narrow, covers femoral head	≥ 60	< 55
1b: fully mature	blunt	wide based, covers femoral head	≥ 60	> 55
2a+: physiological delay of ossification before age of 3 months	round	wide, covers femoral head	50-59	> 55
2a-: physiological delay of ossification with maturity deficit before age of 3 months	round	wide, covers femoral head	50-59	
2b: delay of ossification after age of 3 months	round	wide, covers femoral head	50-59	> 55
2c: critical range	round to flat	wide, covers femoral head	43-49	70-77
D: decentering	round to flat	displaced	43-49	> 77
3a	flat	displaced, without structural alteration	< 43	> 77
3b	flat	displaced, with structural alteration	< 43	> 77
4	flat	displaced inferomedially	< 43	> 77

paratus. Gel was applied to the skin of the newborn, and the probe was held perpendicular to the greater trochanter region while the examined hip was kept in semiflexion. The probe was shifted in the antero-posterior, and cranio-caudal direction until a standard image was obtained. A reproducible frontal plane section depicting the inferior iliac margin, the osseous acetabular promontory, and the acetabular labrum is appropriate in defining the landmarks, and making measurements. Thus, a standard plane for obtaining angular measurements was defined as strictly frontal plane of section through the acetabular fossa (1).

Statistical Analysis

Statistical analysis was accomplished utilising SPSS 9.0 for Windows. Alpha and beta values in each hip type were compared using independent t-test. Correlation between clinical findings and hip type was performed by chi-square test. A value of $p < 0.05$ was considered significant.

Results

Of the newborns 45 were males, and 50 females. There were 73 vaginal deliveries including one breech presentation, and 22 caesarean sections. According to the classification of Graf, 177 (93.2%) of 190 hips were Graf Type Ia and Type Ib, 10 (5.3%) Graf Type 2a, 2 (1%) Graf Type 2c and 1 (0.5%) Graf Type 3a. Alpha values of right and left hips in Graf Type Ia and Type Ib hips were significantly higher than the values in Graf Type 2a ($p=0.0001$), but with respect to beta values there was no significant difference. Number of hips in Graf Type 2c and Graf Type 3a were not of significant importance. There was a significant correlation between the clinical and ultrasonographic findings in each hip type ($p=0.0001$) (Table 2).

One patient had pes calcaneovalgus deformity, and another had torticollis. Treatment with Pavlic harness was initiated in Graf type 2c and 3a hips.^{2,3}

Discussion

The clinical tests of Barlow and Ortoloni play an important role in the diagnosis of developmental hip dysplasia in new borns.^{2,3} The place of radiography in this period is limited.¹ There are several indirect radiological measurement methods. Nevertheless, the position of the newborn, or the method of radiological examination affects the results.² Arthrography is an invasive method that requires sterile conditions and general anesthesia. Computerized tomography and magnetic resonance imaging are advanced, and expensive diagnostic tools that require sedation.^{2,3} The use of ultrasonography to examine the neonatal hip was founded, and developed by Graf.¹ Ultrasonography can provide images of the soft tissue components of the hip, that is, the joint capsule, the labrum, and the cartilaginous parts of the femoral head and the acetabulum. It carries no risk of radiation, and it is a safe and prompt diagnostic tool when combined with clinical examination.^{1,2,4,6} Stability, subluxation and dislocability can be determined by the dynamic method. The technique of ultrasonographic examination and the interpretation of the image affect the result.⁷ Opinions vary with regard to ultrasonographic screening of newborns for developmental hip dysplasia. Bialik et al⁸ recommended that ultrasonographic examination be performed for all newborns. Tönnis et al⁹ concluded that all newborns should be screened with ultrasonography so that disorders that might be missed when only clinical examination was employed could be detected. Clarke et al¹⁰ performed a selective screening program in which high risk new borns were

Table 2. Cross tabulation of clinical findings and hip types

Hip Type		Ortoloni positive	Ortoloni negative	Total
1A, 1B	Count within %	177 (100%)		177 (100%)
2A	Count within %	4 (40%)	6 (60%)	10 (100%)
2C	Count within %	2 (100%)		2 (100%)
3A	Count within %	1 (100%)		1 (100%)
Total	Count within %	184 (96.8%)	6 (3.2%)	190 (100%)

examined both clinically and ultrasonographically. They concluded that the approach did not reduce or eliminate the number cases diagnosed late

Marks et al¹¹ reported that 90% of the 847 infants diagnosed as having abnormal ultrasonographic findings in the series of 14050 newborns had normal ultrasonographic examination at the final follow up visit after nine months. Gardiner et al¹² stated that the anomalies detected in the neonatal period resolved rapidly, and questioned the place of ultrasonography in the neonatal period. Rosendhal et al¹³ reported that ultrasonographic examination of newborns did not reduce the rate of late subluxation and dislocation.

The timing of ultrasonographic examination is also debatable. Although screening of infants who are six weeks old detects persistent anomalies early, but allows minor anomalies to resolve during the period after birth, it has the drawback of not ensuring that all of the population is examined.¹ Wientroubet et al¹ emphasized that since immature newborn hips resolved during the four to six week period following birth, screening should be done during that period. On the other hand Graf et al³ stated that the ultrasonographic examination should be performed during the newborn period and should be repeated when the infant was three or four months old regardless of the pathology detected.

Our clinical findings were similar with Ömeroğlu et al¹⁴ who stated that limitation of abduction, and asymmetrical skin folds were the most frequently encountered risk factors in developmental hip dysplasia.

Ömeroğlu et al¹⁴ reported that positive family history and breech presentation were the most common risk factors. In our study, one case that required treatment had breech presentation, and another had pes calcaneovalgus deformity and torticollis. We believe that the number of newborns screened was the limiting factor affecting the determination of the infants having risk factors.

In our study the results were in accordance with the literature. 93.2% of the hips were Graf Type 1a and 1b, and 6.3.% were Type 2.

Vedantem et al¹⁵ determined that the treatment ratio in their series of selective ultrasonographic screening was 0.39%. Clarke et al⁸ found this ratio as 0.37%. However, in our study this rate was 1.6%. We decided that this high ratio was due to the limited number of newborns in our series. Multicenter studies performed in our country could cause an increase in the number of cases, and thus more reliable results with regard to the number of cases treated could be procured.

In conclusion, ultrasonographic examination is a safe, reliable, and non invasive diagnostic tool in developmental hip dysplasia. Newborns should be routinely examined ultrasonographically for developmental dysplasia of the hip. However, when the social and economical conditions of our country are taken into consideration, at least the newborns pertaining to the high risk group should be examined ultrasonographically.

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