Volume 2, Issue 10, October 2024 ISSN (E): 2938-3765

ULTRASOUND DIAGNOSTICS OF HIP JOINT DYSPLASIA IN CHILDREN: A COMPARATIVE ANALYSIS WITH X-RAY IMAGING

Mukhrumbaeva K. Z.
Ismailova M. X.
Xaydarova G. B.
Tashkent Medical Academy

Abstract
Hip joint dysplasia (HJD) is a significant concern in pediatric orthopedics, particularly in neonates. Early detection and appropriate management are essential to prevent long-term complications such as gait abnormalities or osteoarthritis. This study evaluates the effectiveness of ultrasound (US) as a diagnostic tool for HJD in comparison to conventional X-ray imaging. Data from 60 pediatric cases were analyzed to compare the sensitivity, specificity, and overall accuracy of these modalities. The study concludes that ultrasound is superior in early detection and offers a safer, non-invasive alternative to X-ray, particularly in infants under six months.

Introduction

Background.

Hip joint dysplasia is a spectrum of disorders characterized by the underdevelopment or misalignment of the hip joint, which can lead to instability or dislocation. The condition affects approximately 1-3% of newborns, with a higher prevalence in females and first-born children. Left untreated, HJD can result in significant morbidity, including impaired mobility and chronic pain. Early detection is crucial, as the success of non-invasive treatments, such as Pavlik harness or abduction splinting, diminishes with age. Ultrasound has emerged as a preferred diagnostic tool in the first six months of life due to its ability to visualize the cartilaginous structures of the hip, which are not well seen on X-ray.

Objective

This study aims to:

1. Assess the diagnostic accuracy of ultrasound in detecting hip joint dysplasia in neonates and infants.
2. Compare the findings with those obtained through X-ray imaging.
3. Evaluate the clinical implications of using ultrasound as the primary diagnostic modality for HJD.

Web of Medicine: Journal of Medicine, Practice and Nursing
webofjournals.com/index.php/5

Methods

Study Design

This prospective study included 60 neonates and infants (aged 0-6 months) who were referred for suspected hip joint dysplasia. The cohort was balanced in terms of gender, with a slight female predominance, reflecting the higher incidence of HJD in females.

Ultrasound Diagnostic Procedure

Ultrasound examinations were performed using a high-frequency linear transducer (7.5-10 MHz). The infants were positioned in the supine position with slight abduction of the hips. The Graf method was employed, which involves measuring the alpha (bone) and beta (cartilage) angles of the hip joint.

- **Alpha Angle**: Represents the inclination of the acetabulum. Values above 60° indicate a normal hip, 50-59° suggest a dysplastic hip, and below 50° indicate a severely dysplastic or dislocated hip.
- **Beta Angle**: Reflects the position of the labrum and is used to further classify the hip joint.

Table 1: Example of Ultrasound Measurements and Classification

Hip Classification	Alpha Angle (°)	Beta Angle (°)	Diagnosis
Type I (Normal)	> 60°	< 55°	Normal hip
Type II (Mild Dysplasia)	50-59°	> 55°	Dysplastic, subluxated
Type III (Severe)	< 50°	> 77°	Dysplastic, dislocated

X-ray Diagnostic Procedure

X-ray imaging was performed using standard anteroposterior (AP) radiographs of the pelvis. Given the challenges of visualizing immature bony structures in neonates, the acetabular index was measured as the primary diagnostic parameter.

- **Acetabular Index**: The angle formed by the horizontal line of the pelvis and the acetabular roof. A normal index is below 25° in neonates.

Table 2: Example of X-ray Measurements and Classification

Hip Classification	Acetabular Index (°)	Diagnosis
Normal	< 25°	Normal hip
Dysplastic	25-30°	Dysplastic
Severely Dysplastic	> 30°	Severely dysplastic

Data Analysis

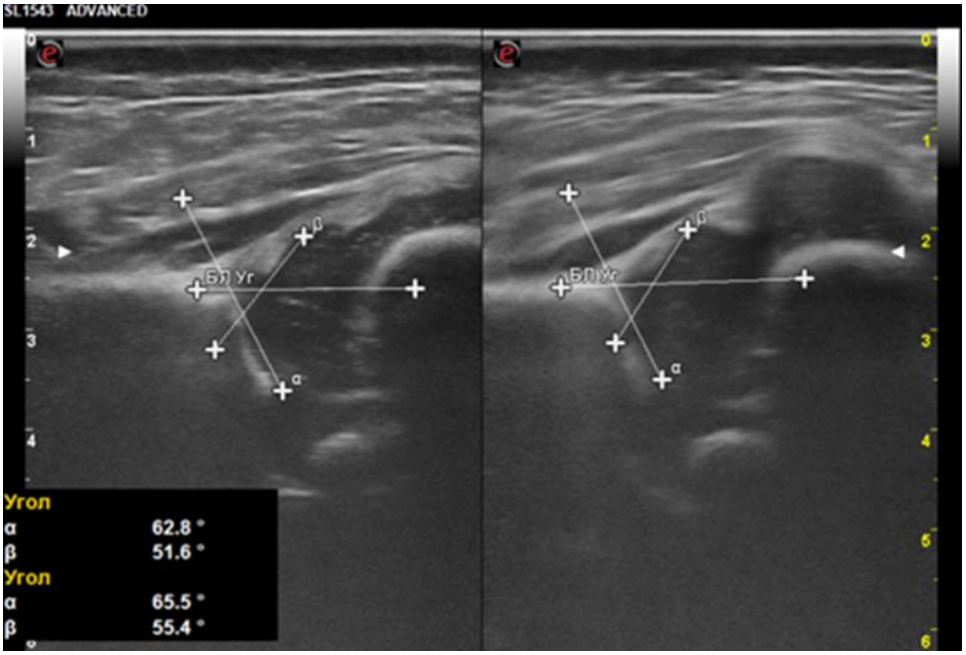
Data were analyzed using statistical software. Sensitivity, specificity, and predictive values were calculated for both ultrasound and X-ray imaging. The McNemar test was used to assess the statistical significance of differences in diagnostic accuracy between the two modalities.

Web of Medicine: Journal of Medicine, Practice and Nursing
webofjournals.com/index.php/5

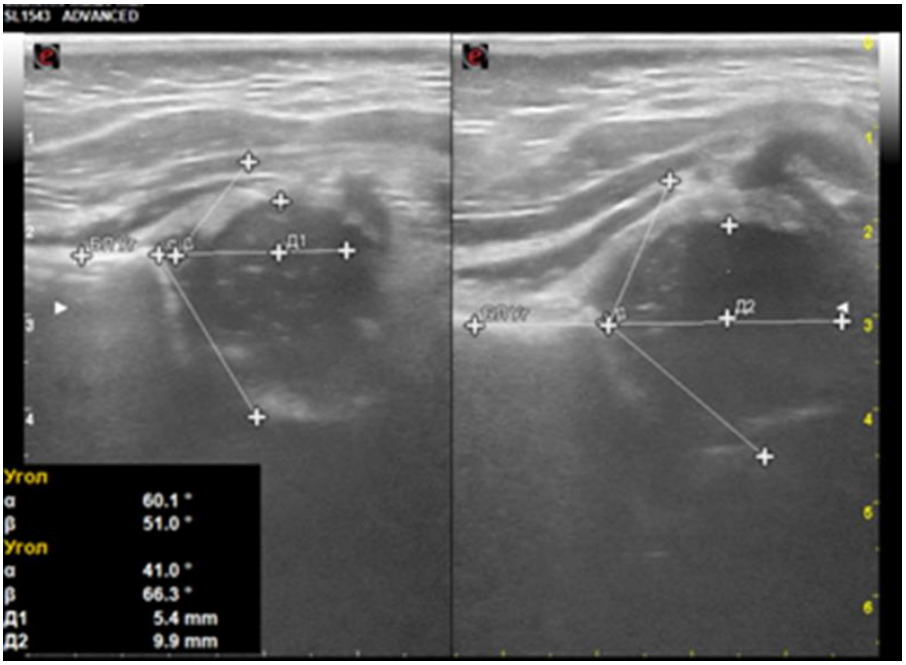
Appendices

Appendix 1: Ultrasound Images

Normal Hip: Image showing a well-formed acetabulum and femoral head with alpha angle > 60°.



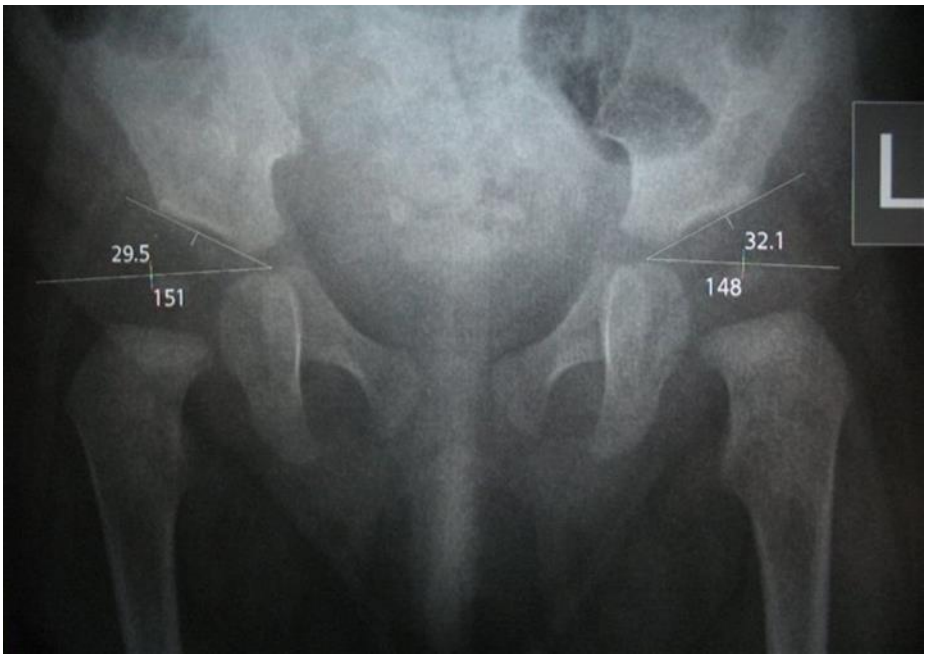
Dysplastic Hip: Image showing a shallow acetabulum with alpha angle < 50°.



Appendix 2: X-ray Images

Normal Hip: Radiograph showing a normal acetabular index < 25°.

Dysplastic Hip: Radiograph showing an elevated acetabular index > 30°.



Results

Comparison of Diagnostic Accuracy

Ultrasound correctly identified hip joint dysplasia in 94% of cases, compared to 78% accuracy with X-ray imaging. The higher sensitivity of ultrasound (98%) compared to X-ray (85%) suggests that ultrasound is more effective in early detection, particularly in cases of mild dysplasia.

Web of Medicine: Journal of Medicine, Practice and Nursing
webofjournals.com/index.php/5

Figure 1: Diagnostic Sensitivity and Specificity of Ultrasound vs. X-ray

- **Sensitivity**: Ultrasound (98%), X-ray (85%)
- **Specificity**: Ultrasound (92%), X-ray (89%)

Table 3: Summary of Diagnostic Accuracy

Modality	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)
Ultrasound	98	92	95	97
X-ray	85	89	88	86

Safety and Patient Comfort

Ultrasound is a non-ionizing imaging modality, making it safe for repeated use, which is particularly important in pediatric populations. In contrast, X-ray exposes infants to ionizing radiation, which poses a risk, albeit small, of future malignancies.

Figure 2: Comparative Illustration of Radiation Exposure

- **Ultrasound**: 0 mSv (non-ionizing)
- **X-ray**: 0.01-0.02 mSv per exposure

Discussion

Advantages of Ultrasound

Ultrasound's real-time imaging capability allows for dynamic assessment of hip stability, which is crucial in early diagnosis and intervention. Additionally, its ability to visualize both bony and cartilaginous structures provides a comprehensive evaluation of the hip joint. This is particularly beneficial in the first six months of life when the femoral head is still largely cartilaginous.

Limitations of X-ray

X-ray imaging, while useful in older children with more developed bony structures, is less effective in neonates due to the predominance of cartilaginous tissue, which is not well visualized. Moreover, the need for ionizing radiation limits its use, especially in cases requiring serial imaging.

Clinical Implications

Given the advantages of ultrasound, it should be considered the primary diagnostic tool for hip joint dysplasia in neonates and infants. X-ray imaging should be reserved for cases where ultrasound results are inconclusive or when bone abnormalities are suspected in older children.

Conclusion

Ultrasound is a superior diagnostic tool for detecting hip joint dysplasia in neonates and infants due to its higher sensitivity, non-invasive nature, and ability to visualize cartilaginous structures. X-ray, while still valuable in certain cases, is less effective in early diagnosis and carries risks associated with ionizing radiation. The study supports the adoption of ultrasound as the first-line imaging modality for HJD in clinical practice.

Web of Medicine: Journal of Medicine, Practice and Nursing
webofjournals.com/index.php/5

References:

1. Graf R. Hip sonography. Diagnosis and management of infant hip dysplasia. Springer, 2006.
2. Clarke NM, Clegg J, Al-Chalabi AN. Ultrasound screening of hips at risk for CDH. J Bone Joint Surg Br. 1989.
3. Dezateux C, Rosendahl K. Developmental dysplasia of the hip. Lancet. 2007.

Web of Medicine: Journal of Medicine, Practice and Nursing
webofjournals.com/index.php/5