RESEARCH ARTICLE

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Diagnostic Yield of Routine Imaging Follow-up after Normal Hip Ultrasonography in Children with a Family History of Developmental Dysplasia of the Hip

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Abstract

Objectives: Developmental dysplasia of the hip (DDH) is an important disorder in which delayed diagnosis may lead to persistent deformity, functional impairment, and premature osteoarthritis. Although a positive family history is a recognized risk factor and commonly prompts early ultrasonographic screening, the need for imaging follow-up after a normal initial ultrasound remains uncertain.

Methods: In this retrospective study, records of 842 children screened ultrasonographically for DDH were reviewed. Children with bilateral Graf type I hips, a positive family history of DDH, and at least one subsequent imaging examination were included. The final cohort comprised 243 children. Follow-up consisted of repeat ultrasonography or anteroposterior pelvic radiography. Radiographs were assessed using Hilgenreiner, Perkin, and Shenton lines and acetabular angle measurements.

Results: The mean age was 10.3 months, and 172 children (70.8%) were female. Eighty-nine patients underwent repeat ultrasonography, and none showed abnormal ultrasonographic or physical examination findings. The remaining 154 patients underwent follow-up pelvic radiography; the Shenton line was preserved and the upper femoral epiphysis remained within the expected inferomedial quadrant in all cases. The mean acetabular angle was 25.4±0.7°. In seven patients with serial radiographs, initially higher acetabular angles decreased to below 21°. Nine patients had multiple risk factors, with no significant difference in mean acetabular angle compared with the overall cohort.

Conclusion: A positive family history appears important for initial DDH risk stratification but, in isolation, may not justify repeated imaging after a normal early ultrasound. Selective, individualized follow-up may reduce unnecessary examinations, radiation exposure, and parental anxiety.

Keywords: Developmental dysplasia of the hip, family history, ultrasonography, pelvic radiography, follow-up imaging, acetabular angle

Introduction

Developmental dysplasia of the hip (DDH) encompasses a broad spectrum of abnormalities, ranging from mild acetabular dysplasia and transient instability to fixed subluxation or complete dislocation. Because the disorder may be clinically subtle during early infancy, delayed recognition can result in persistent biomechanical impairment, gait disturbance, chronic pain, premature osteoarthritis, and the need for complex reconstructive surgery later in life.[1,2] Nevertheless, the natural history of DDH is heterogeneous: some mild forms of neonatal instability or sonographic immaturity resolve spontaneously, whereas clinically relevant dysplasia may persist or become apparent later. This variability continues to complicate decisions regarding whom to image, when to image, and how long surveillance should be maintained.[1,2]

Physical examination remains the cornerstone of early detection, but imaging plays a critical complementary role when examination findings are equivocal or when recognized risk factors are present. Ultrasonography is particularly valuable during the first months of life, when the femoral head is predominantly cartilaginous, whereas anteroposterior (AP) pelvic radiography becomes increasingly informative with progressive ossification.[3] Despite decades of screening experience, the optimal screening strategy remains a matter of debate.

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Universal ultrasonographic screening may increase early case detection but can also identify transient abnormalities and increase follow-up and treatment burden, whereas selective screening seeks to concentrate imaging on infants with abnormal physical findings or predefined risk factors.[2,4] Accordingly, contemporary practice generally favors an age-adapted and risk-based approach rather than indiscriminate repeated imaging.[1,3]

Among the established risk factors for DDH, breech presentation, female sex, and a positive family history are consistently emphasized, and meta-analytic evidence supports the association between family history and an increased probability of DDH.[5] However, the presence of a risk factor at the time of initial screening is not equivalent to evidence that the same factor should, by itself, mandate prolonged radiologic surveillance after a normal early examination. This distinction is particularly relevant for infants who have an isolated positive family history because clinical practice varies substantially after a normal screening ultrasound. In some centers, these infants undergo routine repeat ultrasonography or a pelvic radiograph after 4-6 months of age, whereas other pathways allow discharge from imaging follow-up when the initial clinical and sonographic assessment is normal.[3,6-8]

Several studies have, therefore, examined the diagnostic yield of secondary imaging in children with a family history of DDH. Arumilli et al.[6] and Osarumwense et al.[7] questioned the necessity of routine radiographic follow-up in infants with a positive family history after reassuring early assessment. Tafazal and Flowers[8] similarly evaluated whether an early normal ultrasound should routinely be followed by later pelvic radiography and found limited support for indiscriminate secondary imaging. In a two-center cohort of 205 children with a positive family history and normal initial ultrasonographic findings, Aydin and Fatihoglu[9] reported no late DDH on repeat ultrasonography or follow-up radiography, suggesting that family history alone may have limited value as an automatic indication for continued imaging after a normal screening study. Consistent with this broader evidence base, Price et al.[10] demonstrated a very low yield of abnormal radiographs after a normal initial ultrasound within a selective screening program.

Taken together, the available literature supports family history as a meaningful marker for initial risk stratification, but provides less consistent evidence that an isolated family history should trigger routine late imaging once early clinical and ultrasonographic findings are normal. This unresolved distinction has practical implications because unnecessary follow-up can increase healthcare utilization, expose infants to avoidable ionizing radiation when radiography is used, prolong surveillance, and amplify parental concern without a commensurate diagnostic benefit.[3,9] A more precise definition of which infants truly benefit from secondary imaging is, therefore, essential to balance prevention of missed late dysplasia against over-investigation. Further evidence, focused specifically on outcomes after normal early ultrasonography, is needed to refine risk-based follow-up pathways and reduce unwarranted variation in DDH screening practice.

Methods

Ethics Approval

Ethical approval for this study was obtained from the Erzincan Binali Yıldırım University Clinical Research Ethics Committee (approval no: EBYU-KAEK-2025-21/16, date: 27.11.2025).

Study Design and Participants

This retrospective study was conducted following approval by the relevant institutional ethics committee. The medical records and imaging data of 842 children who underwent ultrasonographic screening for DDH were retrospectively reviewed.

Children were eligible for inclusion if the initial hip ultrasonography demonstrated bilateral Graf type I morphology, there was a documented positive family history of DDH, and at least one subsequent imaging examination was available. Patients with ultrasonographic findings other than Graf type I hips, those without a documented positive family history of DDH, and those without follow-up imaging were excluded. After applying the predefined eligibility criteria, 243 children constituted the final study population.

Physical Examination

Clinical hip examinations were performed by family physicians and pediatricians as part of routine clinical assessment. The examination included assessment of hip stability using the Barlow and Ortolani maneuvers, and evaluation of asymmetry in the gluteal and thigh skin folds. Galeazzi sign, limitation of hip abduction, and limb-length discrepancy were not systematically documented in the available medical records and were therefore not included as predefined clinical assessment parameters in this retrospective analysis.

Ultrasonographic and Radiographic Equipment

Ultrasonographic examinations were performed using high-resolution ultrasound systems equipped with high-frequency linear transducers. Ultrasound systems included Samsung RS85 Prestige with an LA3-16A linear transducer (Samsung Medison Co., Ltd., Seoul, Republic of Korea), Mindray Resona R9 and Resona R7 with an LM16-4U linear transducer (Shenzhen Mindray Bio-Medical Electronics Co., Ltd., Shenzhen, China), Toshiba Aplio 300 with a PLT-805AT (12-6.2 MHz) linear transducer (Canon Medical Systems Corporation, Otawara, Japan), and GE Logiq Fortis R4 with an ML6-15-D linear transducer (GE HealthCare, Chicago, IL, USA).

Standardized AP pelvic radiographs were obtained using digital radiography systems equipped with automatic exposure control, including the DR-Rad X3-C and DR-Rad X4-C systems (DRGEM Corporation, Gwangmyeong-si, Republic of Korea) and the Jumong digital radiography system (SG HealthCare Co., Ltd., Goyang-si, Republic of Korea). All radiographic examinations were performed using a standardized pediatric low-dose imaging protocol in accordance with institutional imaging procedures to minimize radiation exposure while maintaining diagnostic image quality.

Ultrasonographic Evaluation

Hip ultrasonography was performed according to the standardized Graf method by two specialist radiologists, who had 5 and 7 years of radiology experience, respectively, and were working at two different institutions. The radiologists were not blinded to clinical information provided by referring clinicians, including documented DDH-related risk factors. Previous imaging findings were also available to the radiologists at the time of image interpretation. Examinations were performed with the infant positioned in the lateral decubitus position and the hip maintained in a neutral position. A high-frequency linear transducer

(7.5-12 MHz) was oriented to obtain the standard coronal Graf plane, with appropriate visualization of the straight iliac line, acetabular roof, bony acetabular rim, labrum, and femoral head.

The alpha (α) and beta (β) angles were assessed on technically adequate standard coronal images, and hip morphology was classified according to the Graf classification system. Graf type I morphology was defined by an α angle of ≥60°. In the present cohort, the minimum measured α angle was 61°. Graf type Ia and Ib hips were not analyzed separately because beta-angle-based subclassification was not considered clinically relevant to the primary objective of the present study; therefore, both subtypes were categorized as Graf type I.

Both hips were evaluated independently. Dynamic ultrasonographic stability assessment with posterior stress or other provocative maneuvers was not performed; all measurements were obtained without the application of stress. Measurements were performed only on images fulfilling the standard anatomical and technical criteria of the Graf method.

Radiographic Examination

An AP pelvic radiograph was obtained with the infant in the supine position. Both lower extremities were positioned symmetrically with the hips in a neutral position and the patellae oriented anteriorly to minimize rotational error. Care was taken to ensure pelvic symmetry by aligning the iliac wings and obturator foramina. Radiographic technical adequacy was assessed before acetabular measurements were performed. Pelvic positioning was considered acceptable when the obturator foramina and iliac wings were approximately symmetric, the sacrum and coccyx were aligned with the pubic symphysis, and pelvic inclination permitted appropriate visualization of the acetabular landmarks. Radiographs demonstrating substantial pelvic rotation, pelvic obliquity, excessive lordosis, abnormal pelvic inclination, or other positioning errors that could interfere with reliable identification of the Hilgenreiner line, the acetabular roof, or the lateral acetabular margin were considered technically inadequate for quantitative assessment. No predefined numerical cutoff for the sacrococcygeal-pubic symphysis distance was used. No radiographs were excluded for inadequate positioning, nor did any examinations require repeat acquisition for technical inadequacy. The radiograph, which included the entire pelvis and proximal femora, was acquired using a standardized pediatric low-dose imaging protocol appropriate for infants. Pelvic radiographs were evaluated using the Hilgenreiner, Perkin, and Shenton reference lines. The acetabular angle was measured separately for the right and left hips. For patient-level statistical analysis, the higher of the two measurements was used to represent the individual patient. The acetabular angle was also measured to provide a quantitative assessment of acetabular development. Demographic characteristics, including age and sex, were recorded. In addition, the presence of established DDH-related risk factors other than family history was documented.

Radiographic Definition of Dysplasia

Radiographic assessment was based on the acetabular angle, the relationship of the femoral head to the Hilgenreiner and Perkin lines, and the continuity of the Shenton line. Because acetabular development is age dependent, acetabular angle measurements were interpreted according to published age-appropriate reference values rather than a single fixed threshold. Age-, sex-, and side-specific normative values reported for the pediatric population (CIs) were used as the reference for interpretation.[11]

For radiographic classification, isolated acetabular dysplasia was defined as an acetabular angle exceeding the age-appropriate reference range, with a concentrically positioned femoral head and a preserved Shenton line. Subluxation was defined as partial displacement of the femoral head from its expected relationship with the acetabulum, accompanied by abnormal femoral head position and/or disruption of the Shenton line without complete dislocation. Dislocation was defined as a complete loss of the normal femoral head-acetabular relationship, with displacement from the expected inferomedial quadrant, as defined by the Hilgenreiner and Perkin lines.

Femoral head position was assessed using the Hilgenreiner and Perkin reference lines and the Shenton line; a separate quantitative femoral head coverage measurement was not performed. Symmetry of the ossific nucleus was not used as a predefined quantitative diagnostic criterion.

Methods-Risk-Factor Classification

In addition to a positive family history, other documented DDH-related factors were recorded, including female sex, breech presentation, first-born status, multiple pregnancy, and associated musculoskeletal or anatomical abnormalities such as torticollis. Because positive family history was an inclusion criterion, all children in the study had this baseline risk factor. Patients with multiple additional documented DDH-related factors were evaluated separately as a higher-risk subgroup.

Primary Outcome

The primary outcome was the detection of any DDH-related abnormality on follow-up imaging during the available follow-up period. On follow-up ultrasonography, an abnormal finding was defined as a hip morphology other than Graf type I. On pelvic radiography, an abnormal finding was defined as one or more of the following: an acetabular angle exceeding the age-appropriate reference range, disruption of the Shenton line, or abnormal femoral head position relative to the Hilgenreiner and Perkin lines. Radiographic abnormalities were further categorized, when applicable, as isolated acetabular dysplasia, subluxation, or dislocation according to these predefined radiographic criteria. Physical examination findings were recorded as complementary clinical data but not included as a separate component of the primary imaging outcome.

Sample Size and Precision Analysis

Because the study was retrospective, no a priori sample size calculation was performed. All patients who met the predefined eligibility criteria during the study period and had available follow-up imaging were included. To quantify the precision of the zero-event outcome, an exact 95% binomial confidence interval was calculated for the observed event proportion.

Statistical Analysis

All study variables were initially recorded on standardized data collection forms and subsequently transferred to a Microsoft Excel database. Data entries were rechecked to minimize potential transcription errors. Statistical analyses were performed using IBM SPSS Statistics for Windows, version 20.0.

The distribution of continuous variables was assessed using the Kolmogorov-Smirnov test. Normally distributed numerical variables were presented as mean ± standard deviation, whereas non-normally distributed variables were summarized as median and interquartile range. Comparisons of continuous variables between groups were performed using the independent-samples Student's t test for normally distributed data and the Mann-Whitney U test for non-normally distributed variables.

Exact binomial 95% confidence intervals were calculated for the principal proportions reported in the study.

Results

The medical records and imaging data of 842 children who underwent ultrasonographic screening for DDH were retrospectively reviewed. After applying the predefined eligibility criteria, 243 children constituted the final study population (Figure 1).

The mean age of the study population was 10.3 months ±3.1 weeks. The cohort consisted of 172 girls (70.8%) and 71 boys (29.2%). The repeat-ultrasonography group included 60 girls (67.4%) and 29 boys (32.6%); the radiography group included 112 girls (72.7%) and 42 boys (27.3%). There was no significant difference in sex distribution between the two groups (p=0.380).

Initial ultrasonographic examinations were performed at a median age of 8.6 weeks (range, 6.5-12.4 weeks).

A total of 89 patients (36.6%) underwent repeat ultrasonography at a median age of 7.2 months (range, 6.2-12.4 months). None of these patients demonstrated abnormal findings on ultrasonography or physical examination during follow-up; all were considered normal (Figure 2).

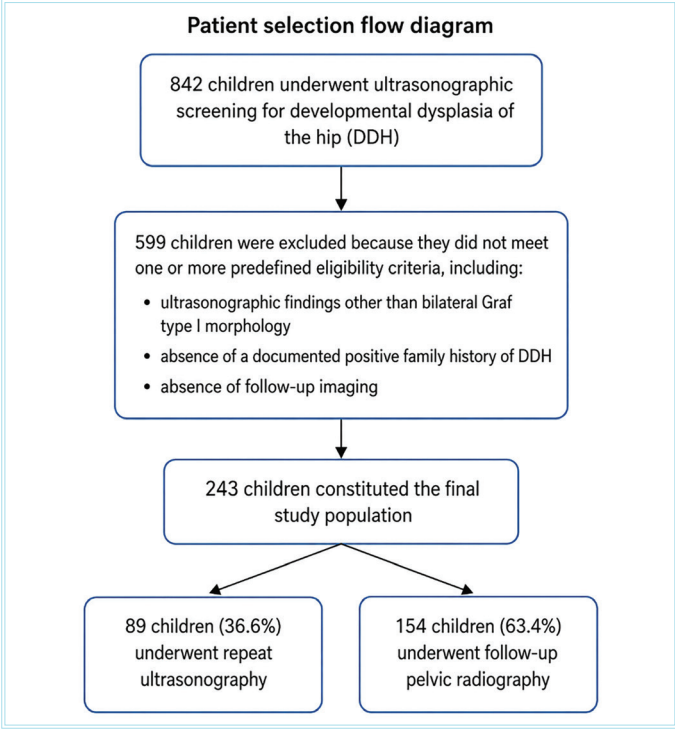

Figure 1. Patient-selection/STROBE flowchart

DDH: Developmental dysplasia of the hip

The remaining 154 patients (63.4%) underwent follow-up pelvic radiography at a median age of 8.5 months (range, 6.2-22.0 months). In all patients, the Shenton line was preserved, and the upper femoral epiphysis was located within the inferomedial quadrant defined by the Hilgenreiner and Perkin lines.

No cases meeting the predefined criteria for DDH were identified during the available follow-up period (0/243, 0%; 95% CI: 0%-1.51%).

The mean acetabular angle in the overall study population was 25.4±0.7°.

A representative AP pelvic radiograph demonstrating the radiographic landmarks and measurements used in the study, including the Hilgenreiner and Perkin lines, the preservation of the Shenton lines, the femoral head position within the inferomedial quadrants, and the bilateral acetabular angle measurements, is shown in Figure 3.

Seven patients (2.9%) underwent two follow-up radiographic examinations. Among these patients, five had multiple DDH-related risk factors. The acetabular angles measured on the first radiographs were relatively higher than those in the overall cohort but remained within the expected range for age. On subsequent examinations, all acetabular angles decreased, with final measurements below 21° (Table 1). None of the seven patients who underwent serial radiographic follow-up received an abduction brace or other orthopedic treatment; all were managed with observation.

Nine patients had multiple DDH-related risk factors (Table 2). Among these patients, five underwent more than one follow-up radiographic

Table 1. Patients who underwent two follow-up radiographic examinations

Patient no	1st acetabular angle (°)	2nd acetabular angle (°)
1	27.7	20.8
2	28.5	20.8
3	28.0	19.1
4	28.3	20.0
5	28.0	19.9
6	28.5	20.4
7	28.3	20.7

Table 2. Patients with multiple risk factors

Patient no	Risk factors	Acetabular angle (°)
1	BP, F	26.1
2	BP, F	24.8
3	BP, F, DB	28.5
4	F, BP	24.2
5	BP, F, DB	28.3
6	BP, F	26.2
7	F, BP, DB	24.9
8	BP, F	28.4
9	BP, F, DB	24.1

It referred to a complicated delivery requiring additional obstetric intervention, defined as a delivery in which mechanical or fetal factors, such as fetal macrosomia, cephalopelvic disproportion, or shoulder dystocia, necessitated additional obstetric intervention, including vacuum- or forceps-assisted delivery or cesarean delivery
BP: Breech presentation, F: Female sex, DB: Difficult birth

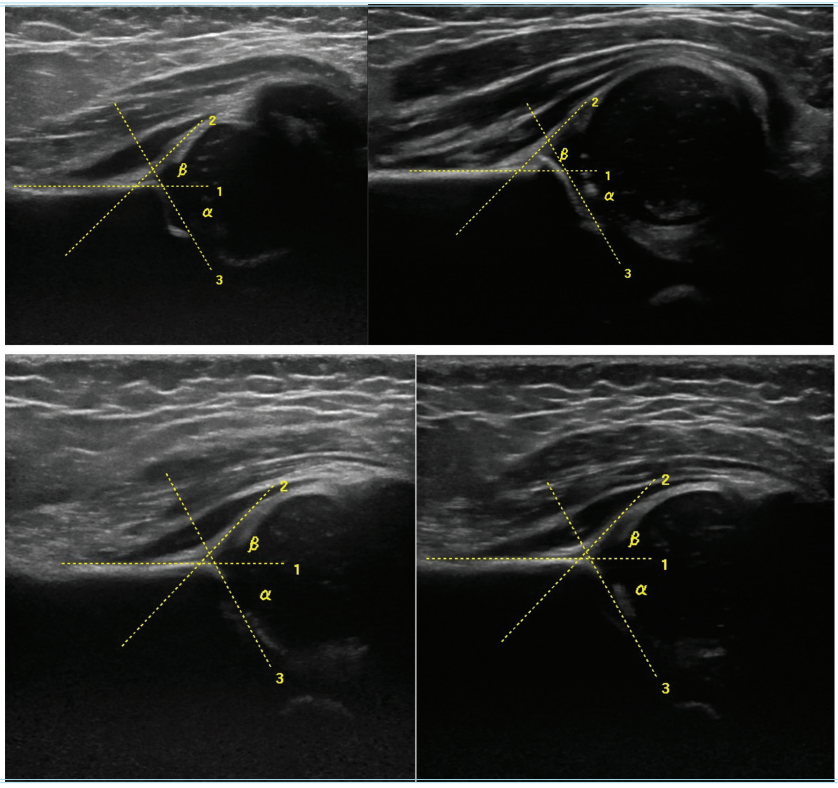

Figure 2. The alpha and beta angles were measured using the Graf method in the different patient groups presented above. The alpha angle values were greater than 60° in all groups

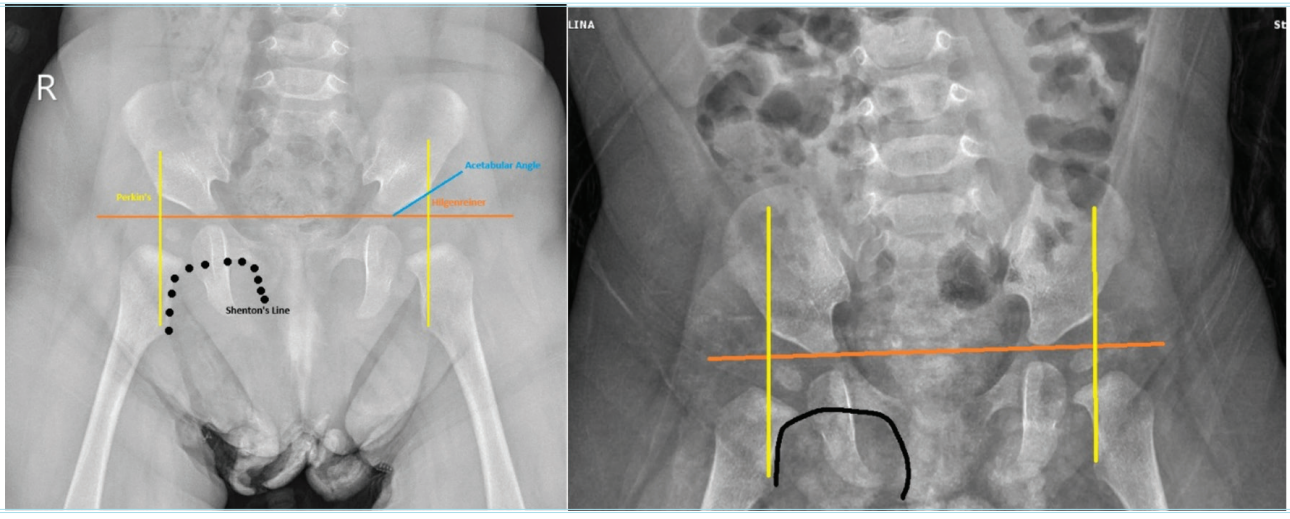

Figure 3. Representative anteroposterior pelvic radiograph demonstrating the radiographic assessment performed in the study. Anteroposterior pelvic radiograph of a a certain month-old child showing the Hilgenreiner lines, Perkin lines, and the inferomedial quadrants used to evaluate femoral head position. The Shenton lines are preserved bilaterally. The right and left acetabular angles are measured between the Hilgenreiner line and the acetabular roof line extending from the triradiate cartilage to the lateral acetabular margin. The anatomical landmarks and measurement lines used for calculation of the acetabular angles are indicated

examination. The mean acetabular angle in patients with multiple risk factors was slightly higher than that of the overall study population (26.2±1.8° vs. 25.4±0.7°); however, this difference was not statistically significant (p>0.05).

No cases meeting the predefined criteria for DDH were identified during the available follow-up period (0/243, 0%); the exact binomial 95% CI for the event rate was 0% to 1.51%.

Discussion

The principal finding of the present study was the absence of DDH-related abnormalities during the available follow-up period among children with a positive family history who had normal initial ultrasonographic findingsthat, among children with a positive family history and normal initial ultrasonographic findings, no DDH-related

abnormalities were detected during the available follow-up period. None of the patients who underwent repeat ultrasonography demonstrated abnormal imaging or physical examination findings, and no pathologic hip configuration was identified among those evaluated with follow-up pelvic radiography. In addition, the Shenton line was preserved, and the upper femoral epiphysis was located within the expected inferomedial quadrant in all radiographically assessed patients. These findings suggest that, although a positive family history is clinically relevant during initial risk stratification, its isolated presence may have limited value as an indication for routine repeated imaging after a technically adequate and normal early ultrasonographic examination.

Family history is a well-established risk factor for DDH and remains an important component of selective screening strategies.[1,5] Meta-analytic evidence has demonstrated a significant association between positive family history and DDH, while earlier ultrasonographic studies have also reported an increased frequency of abnormal neonatal hip findings among infants with recognized risk factors.[5,12] However, a distinction should be made between factors that increase the pretest probability of DDH at initial screening and those that independently predict late dysplasia after normal early imaging. The latter association appears considerably less certain. Arumilli et al.[6] found little support for routine secondary radiologic surveillance solely on the basis of family history after reassuring early assessment, and similar conclusions were reported by Osarumwense et al.[7] and Tafazal and Flowers.[8] Our findings are consistent with these studies and reinforce the concept that family history may be more informative in determining who should undergo initial imaging than in identifying who requires indefinite follow-up after a normal examination.

The present findings are also consistent with our previous study, in which no late DDH was detected among 205 children with a positive family history and normal initial ultrasonographic findings.[9] The current cohort, comprising a larger study population, provides further support for that observation and demonstrates a similarly low diagnostic yield of repeated imaging. This consistency is clinically relevant because the available literature remains heterogeneous regarding follow-up schedules, imaging modalities, and definitions of radiographic dysplasia. Price et al.,[10] in a large selective screening program, also reported a very low yield of abnormal radiographic findings following normal initial ultrasonography. Taken together, these findings argue against an automatic policy in which every infant with a family history undergoes repeated ultrasonography or pelvic radiography, irrespective of the quality and result of the initial examination. Nevertheless, this interpretation should not be extended indiscriminately to all high-risk infants, particularly because different risk factors may not carry equivalent prognostic implications.

The predominance of girls in our cohort is consistent with the recognized epidemiologic profile of DDH. Female sex has repeatedly been associated with an increased risk of abnormal hip development and is frequently included among the major variables used for selective screening.[5,12] In the present study, girls constituted 70.8% of the population. This distribution may reflect both the underlying biological association and referral patterns in clinical practice. However, the predominance of female patients did not translate into detectable late DDH after a normal initial ultrasonography. This observation further illustrates that the presence of an established epidemiologic risk factor does not necessarily indicate persistent structural abnormality when early imaging demonstrates normal hip morphology. Clinical and ultrasonographic assessments are complementary rather than interchangeable, and discrepancies between them have previously been documented in neonatal screening cohorts.[13] Therefore, the reassuring implications of a normal ultrasound depend on technically appropriate image acquisition and interpretation.

Another important finding was the radiographic behavior of the acetabular angle. The mean acetabular angle in the overall cohort was 25.4±0.7°, while patients with multiple risk factors demonstrated a slightly higher mean value of 26.2±1.8°. However, this difference was not statistically significant. Moreover, among patients who underwent more than one radiographic examination, the initially higher acetabular angles decreased on subsequent imaging, reaching final values below 21°. This pattern is compatible with progressive acetabular maturation rather than persistent dysplasia. Interpretation of such measurements requires caution because acetabular parameters change with age and can be influenced by pelvic positioning, rotation, landmark identification, and measurement technique.[14] Consequently, a relatively high acetabular angle on a single examination—particularly when other radiographic relationships remain normal—should not automatically be interpreted as evidence of progressive DDH.

The spontaneous decrease in acetabular angles observed on serial radiographs also raises an important issue regarding over-surveillance. Minor or borderline radiographic deviations may prompt repeated examinations even when the overall hip configuration is normal. In our cohort, seven children underwent two follow-up radiographic examinations; despite relatively higher initial values, subsequent measurements showed improvement rather than deterioration. Similar concerns have been raised in previous studies evaluating later radiography after normal ultrasonography.[8-10] Radiography remains valuable after progressive ossification and provides a robust assessment of osseous acetabular development, whereas ultrasonography offers direct evaluation of cartilaginous structures during early infancy.[3,15] These modalities should therefore be regarded as age-dependent and complementary tools, rather than tests that must routinely be performed sequentially on every at-risk infant. The low diagnostic yield observed in our cohort supports a more selective imaging strategy, particularly when early ultrasonography is normal and serial clinical examinations remain reassuring.

The subgroup with multiple risk factors deserves specific consideration. Nine patients in our cohort had more than one DDH-related risk factor, and their mean acetabular angle was numerically higher than that of the overall population, although the difference did not reach statistical significance. This finding may indicate either a true but small cumulative effect or simply random variation resulting from the limited size of this subgroup. Previous literature supports the importance of risk-based assessment but does not establish that all combinations of risk factors confer the same probability of persistent or late dysplasia.[5,12] Accordingly, our data do not justify routine prolonged surveillance for every child with multiple risk factors, but they also do not exclude the possibility that selected combinations—particularly those involving stronger mechanical risk factors—may warrant individualized follow-up. Larger cohorts with sufficient numbers in each risk-factor combination are required to determine whether cumulative risk models outperform single-factor approaches.

From a practical perspective, the present findings support a distinction between indications for initial screening and indications for post-screening surveillance. Family history is a reasonable indication

for careful clinical assessment and early ultrasonography,[1,5] but the persistence of this historical risk factor after a normal high-quality scan does not necessarily imply continued structural risk. Such a distinction could reduce unnecessary repeat appointments, radiographic exposure, healthcare utilization, and parental anxiety. This concept is also aligned with the broader movement toward selective ultrasound-first imaging pathways in which radiography is reserved for cases with persistent uncertainty or specific clinical indications, rather than being applied automatically to all screened infants. Recent technical research has explored selective escalation of imaging from ultrasonography to radiography as a radiation-sparing strategy, although such approaches still require clinical validation before routine implementation.

Study Limitations

The present study has several limitations. First, its retrospective design introduces the possibility of selection bias and limits control over imaging intervals and follow-up protocols. The study did not include a control group of children without a positive family history of DDH nor comparison groups of children with other isolated DDH-related risk factors. Therefore, the present findings cannot determine whether the observed follow-up outcomes differ from those of the general screened population or from those of children with alternative individual risk profiles. Second, follow-up was not uniform: some children underwent repeat ultrasonography, whereas others were assessed with pelvic radiography. Although this reflects real-world clinical practice, modality heterogeneity complicates direct comparison between follow-up pathways. Third, the subgroup with multiple risk factors was small, limiting statistical power to detect modest differences in acetabular angle. Fourth, interobserver and intraobserver agreements for ultrasonographic classification and radiographic measurements were not assessed. This is relevant because both Graf classification and acetabular measurements may be affected by image acquisition, landmark selection, and observer experience.[13,14,16] Fifth, the duration of follow-up may not be sufficient to exclude all forms of very late acetabular dysplasia. Therefore, the absence of detected late DDH should not be interpreted as proof of zero lifetime risk. Finally, the degree of familial relationship and the severity of DDH in affected relatives were not stratified; these variables may modify hereditary risk and should be addressed in future studies.

Despite these limitations, the study has clinically relevant implications. The relatively large cohort of children with a positive family history, the inclusion of both ultrasonographic and radiographic follow-up data, and the assessment of acetabular development provide a pragmatic evaluation of a common surveillance dilemma. Our findings indicate that routine, repeated imaging after a normal initial ultrasound has a very low diagnostic yield in children whose principal risk factor is a family history. Accordingly, follow-up decisions should be individualized and incorporate the quality of the initial examination, serial physical findings, the presence and combination of additional risk factors, and any emerging clinical concern, rather than family history alone.

Conclusions

The findings of the present study suggest that a positive family history is an important criterion for initial DDH risk assessment but may not, in isolation, justify routine, repeated ultrasonography or pelvic radiography after a normal early ultrasonographic examination. The absence of detected DDH-related abnormalities during the available follow-up period, together with the progressive normalization of relatively high acetabular angles on serial imaging, supports a more selective follow-up strategy. Prospective studies with standardized imaging intervals, predefined radiographic thresholds, longer follow-up periods, and adequately powered subgroups defined by combined risk factors are needed to identify the small subset of children who may genuinely benefit from continued surveillance.

Ethics

Ethics Committee Approval: Ethical approval for this study was obtained from the Erzincan Binali Yıldırım University Clinical Research Ethics Committee (approval no: EBYU-KAEK-2025-21/16, date: 27.11.2025).

Informed Consent: Since the study was a retrospective study, informed consent was not required by the ethics committee.

Footnotes

Authorship Contributions

Concept: O.A., Design: E.A., B.A.E., Data Collection or Processing: O.A., Analysis or Interpretation: E.A., Literature Search: E.A., Writing: E.A.

Conflict of Interest: No conflict of interest was declared by the authors.

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