

Timely radiographic detection of developmental dysplasia of the hip in family medicine residents. Educative intervention

Detección radiográfica oportuna de displasia del desarrollo de la cadera en residentes de medicina familiar. Intervención educativa

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Abstract

Background: Developmental dysplasia of the hip (DDH) is a complex clinical entity that is usually underdiagnosed, if not detected and managed early, will turn the affected individual into a disabled being, with negative social, economic and emotional effects. **Objective:** To determine the capacity for the timely radiographic detection of DDH before and after an educational intervention. **Method:** An educational intervention is carried out in family medicine resident, where they are given training on detection in DDH radiographic projections. Preand post-training evaluation is carried out. Statistical analysis is performed using Student's *t* and χ^2 , taking $p \leq 0.05$ as significant. **Results:** 94 residents participated. In the pre-intervention evaluation, 87.2% had no knowledge of the early detection protocol ($p = 0.525$). It was observed that 98.9% incorrectly drew the Perkins line ($p = 0.427$), 96.8% the Hilgenreiner line ($p = 0.177$) and 87.2% did not consider the data of bilateral dysplasia ($p = 0.956$). After the educational intervention, 87.2% correctly drew the Perkins line ($p = 0.926$), 97.8% the Hilgenreiner line ($p = 0.325$) and 78.7% if they considered the data of bilateral dysplasia ($p = 0.826$). **Conclusions:** After this training, 80% of family medicine residents were able to detect DDH in a timely manner.

Keywords: Developmental dysplasia of the hip. Radiography. Perkins. Hilgenreiner. Hip. Infants.

Resumen

Antecedentes: La displasia del desarrollo de la cadera (DDC) constituye una entidad clínica compleja que suele ser infradiagnosticada que, de no ser precozmente detectadas y manejadas, convertirán al individuo afectado en un ser discapacitado, con efecto negativo social, económico y emocional. **Objetivo:** Determinar la capacidad para la detección radiográfica oportuna de la DDC antes y después de una intervención educativa en médicos residentes de medicina familiar. **Método:** Se realizó una intervención educativa en residentes de medicina familiar, en la que se les dio capacitación sobre detección de DDC en proyecciones radiográficas. Se realizó una evaluación previa y posterior a la capacitación. El análisis estadístico se realizó mediante pruebas *t* de Student y χ^2 , tomando como significativo un valor de $p \leq 0.05$. **Resultados:** Participaron 94 residentes. El 87.2% dijeron no conocer el protocolo radiológico de detección. En la evaluación preintervención, el 87.2% no tenían conocimiento del protocolo ($p = 0.525$). Se observó que el 98.9% trazaron de manera incorrecta la línea de Perkins ($p = 0.427$), el 96.8% la línea de Hilgenreiner ($p = 0.177$) y el 87.2% no consideraron los datos de displasia bilateral ($p = 0.956$).

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Posterior a la intervención educativa, el 87.2% trazaron de manera correcta la línea de Perkins ($p = 0.926$), el 97.8% la línea de Hilgenreiner ($p = 0.325$) y el 78.7% sí consideró los datos de displasia bilateral ($p = 0.826$). **Conclusiones:** Tras la capacitación, el 80% de los médicos residentes de medicina familiar fueron capaces de detectar oportunamente la DDC.

Palabras clave: Displasia del desarrollo de la cadera. Radiografía. Perkins. Hilgenreiner. Cadera. Infantes.

Introduction

Developmental dysplasia of the hip (DDH) constitutes a condition whose early diagnosis goes hand in hand with timely care, inferring that the functional prognosis will be good for patients; therefore, its timely detection is a priority. Family and first-contact physicians are the key link in the primary evaluation of infants, and therefore, instructing them on this condition will allow for suspicion and timely referral to assessment by the pediatric orthopedist.

The sensitivity to detect clinical signs of DDH in physical examination depends on the operator¹⁻³, so patient evaluation should be complemented with imaging modalities²⁻⁴. The reference method for imaging diagnosis worldwide is ultrasound^{3,5-12}. However, in many primary care units in our health care system, ultrasound machines are not readily available, with greater availability of x-ray machines. Therefore, we consider it feasible in our setting to perform a simple x-ray in patients older than 3 months, because at this age, the primary ossification nuclei of the femoral head are already visible, making it the most effective means to detect DDH in patients older than 3 months^{8,10}, and it is still possible to manage DDH conservatively with satisfactory outcomes, avoiding more aggressive surgical treatments¹³⁻¹⁵.

Based on former studies, an educational intervention reveals underdiagnosis of this condition, so after training, there is an improvement in screening and timely referral of patients with suspected DDH. We believe there is undervaluation of patients who may have DDH, and therefore, we consider it important to train in the observation and measurement of radiographic signs of hips in pediatric patients to screen and refer more easily and timely all patients with suspected DDH. We believe that this intervention will have a positive impact on the management of children with this condition and improve the quality of care for those younger than 6 months. The objective of our study was to determine the capacity for timely radiographic detection of DDH before and after an educational intervention in family medicine residents.

Method

We conducted an observational, prospective, cross-sectional study on graduated physicians who were undertaking the medical specialization course in family medicine at family medicine units in the city of Puebla, Mexico from July to September 2021. Physicians from all years of medical residency from four family medicine units who wished to participate voluntarily and signed the consent form to participate in the study were included.

The present study was evaluated and accepted by our hospital research and ethics committees with registration No. R-2020-2105-045.

Initially, physicians were given an informative lecture on the details of the protocol and the study's objective, in a classroom of the family medicine unit, in groups of five or six medical residents, with the relevant health measures following the health contingency measures implemented at the time. Subsequently, an exam (Annex 1) (Fig. 1) was conducted to assess their baseline knowledge of radiological diagnosis of DDH. The exam consisted of presenting a case report with two radiographic images of the hips of a patient who was younger than 5 months. The images shown were anteroposterior and frog-leg projections of both hips. They were asked if they could identify any signs of DDH and if they considered each hip. Afterwards, a lecture was given to them on the importance of timely detection of DDH projected in a Microsoft PowerPoint presentation. Six representative x-rays of normal hips of patients aged 3 to 6 months were shown, as well as representative x-rays of unilateral and bilateral DDH, and Perkins and Hilgenreiner's lines were drawn.

Subsequently, each resident physician, on a series of prints on digital x-rays, traced Perkins and Hilgenreiner's lines with a No. 2 graphite pencil and a 15 cm transparent plastic ruler. The estimated time for each educational intervention was 40 minutes.

The same exam was used to measure the final knowledge after training.

The data obtained were captured on a data collection sheet with the name, sex, year of residency, and

scores obtained from the exams, as well as the family medicine unit where the educational intervention was applied. Subsequently, the information was included in a database and analyzed using statistical software. The statistical analysis consisted of obtaining the mean for quantitative variables and applying the Student's t-test and the chi-square test. P values ≤ 0.05 were considered statistically significant.

Results

The sample included 94 medical residents, 38.3% of whom were men and 61.7%, women. The mean age was 30.6 ± 2.9 years (range, 26-38) (Table 1).

Of the total sample, 11.7% were from Clinic A, 29.8% from Clinic B, 45.7% from Clinic C, and 12.8% from Clinic D. Regarding the year of residency, 37.2% were first-year residents (R1), 46.8% were second-year residents (R2), and 16% were third-year (R3) residents (Table 1).

Among the surveyed residents, 87.2% reported not knowing the radiological protocol for timely detection of DDH, while 12.7% said they actually knew it ($p = 0.525$).

The results obtained in the pre-intervention evaluation indicated that 98.9% incorrectly traced the Perkins line ($p = 0.427$), 96.8% incorrectly traced the Hilgenreiner line ($p = 0.177$), and 87.2% did not consider the dysplasia data ($p = 0.956$). In the analysis by year of residency, 97.1% of R1 residents failed to trace the Perkins line, while 91.4% incorrectly traced the Hilgenreiner line, and 88.5% failed to identify that both hips were damaged. In contrast, 11.4% detected bilateral dysplasia promptly in the initial questionnaire. One hundred per cent of R2 residents failed to trace Perkins and Hilgenreiner's lines correctly, and 86.3% did not identify bilateral dysplasia either. One hundred per cent of R3 residents incorrectly traced Perkins and Hilgenreiner's lines, while 86.6% disregarded the dysplasia data (Table 2).

After the educational intervention, we observed that, overall, 87.2% correctly traced the Perkins line ($p = 0.926$), 97.8% correctly traced the Hilgenreiner line ($p = 0.325$), and 78.7% considered bilateral dysplasia data ($p = 0.862$). In the analysis by year of residency, among R1 residents, 85.7% correctly traced the Perkins line, 100% correctly traced the Hilgenreiner line, and 80% considered bilateral dysplasia data. Among R2 residents, 88.6% correctly traced the Perkins line, 97.7% correctly traced the Hilgenreiner line, and 77.2% identified the affected hip. Among R3 residents, 86.6%

Table 1. Sociodemographic characteristics of participants

(n = 94)	n	%
Gender		
Male	36	38.3
Female	58	61.7
Family medicine unit		
Office A	11	11.7
Office B	28	29.8
Office C	43	45.7
Office D	12	12.8
Year of residency		
R1	35	37.2
R2	44	46.8
R3	15	16

correctly traced the Perkins line, 93.3% correctly traced the Hilgenreiner line, and 80% tool bilateral dysplasia data into consideration (Table 3).

Discussion

The detection of DDH before 3 months of age based on clinical signs should be performed by trained personnel, as there is a high probability of false negatives and positives. Many authors have pointed out that clinical assessment is often conducted by unaccustomed or insufficiently trained personnel to perform the Ortolani and Barlow maneuvers, so they recommend complementing these tests with radiological studies^{1-4,6-10,12,16}.

As previously stated, ultrasound is the reference method for detecting DDH in infants younger than 4 months, as the triradiate cartilage is not observable at these ages. With simple x-rays and frog-leg positioning in patients older than 3 months old, DDH can be diagnosed with great precision,^{10,16} but training in the visualization of radiological signs is required, as most general practitioners, family physicians, and pediatricians are not used to observing these signs or tracing Perkins and Hilgenreiners' lines. We should also mention that pelvic x-rays should be acquired using the proper technique to reduce the risk of false positives for DDH. Souza et al.¹⁷ conducted a study on 186 GPs and reported that 81.1% had never establish a diagnosis of DDH in their professional or academic career. We found that 87.2% of family medicine residents did not know the radiological protocol for detecting DDH.

Based on the results prior to the educational intervention obtained from our study, 97.8% of the

Table 2. Pre-intervention assessment

Year of residency	R1 (n = 35)	R2 (n = 44)	R3 (n = 15)	Total (n = 94)	p*
Knowledge of radiological protocol					0.525
Yes	3 (8.5%)	6 (13.6%)	3 (20%)	12 (12.7%)	
No	32 (91.4%)	38 (86.3%)	12 (80%)	82 (87.2%)	
Perkins line tracing					0.427
Correct	1 (2.8%)	0	0	1	
Incorrect	34 (97.1%)	44 (100%)	15 (100%)	93 (98.9%)	
Hilgenreiner line tracing					0.177
Correct	3 (8.5%)	0	0	3	
Incorrect	32 (91.4%)	44 (100%)	15 (100%)	91 (96.8%)	
Consideration of bilateral dysplasia					0.956
Correct	4 (11.4%)	6 (13.6%)	2 (13.3%)	12 (12.7%)	
Incorrect	31 (88.5%)	38 (86.3%)	13 (86.6%)	82 (87.2%)	

*Chi-square test.

Table 3. Post-intervention assessment

Year of residency	R1 (n = 35)	R2 (n = 44)	R3 (n = 15)	Total (n = 94)	p*
Perkins line tracing					0.926
Correct	30 (85.7%)	39 (88.6%)	13 (86.6%)	82 (87.2%)	
Incorrect	5 (14.2%)	5 (11.3%)	2 (13.3%)	12 (12.7%)	
Hilgenreiner line tracing					0.325
Correct	35 (100%)	43 (97.7%)	14 (93.3%)	92 (97.8%)	
Incorrect	0	1 (2.2%)	1 (6.6%)	2 (2.1%)	
Consideration of bilateral dysplasia					0.862
Correct	28 (80%)	34 (77.2%)	12 (80%)	74 (78.7%)	
Incorrect	7 (20%)	10 (22.7%)	3 (20%)	20 (21.2%)	

*Chi-square test.

residents were unable to trace any of the requested lines. Olivo and Redón¹⁸ conducted a pre-intervention assessment on 228 physicians, 85.9% of whom did not pass the test for DDH detection. Therefore, comparing both studies, a negative response was obtained, indicating a poor knowledge of the DDH detection protocol among first-contact physicians.

In our study, in the test performed after the intervention, 92.5% of residents from all 3 years of residency were able to correctly trace the Perkins and Hilgenreiners' lines, and 78.7% correctly identified both hips as dysplastic. In the study conducted by Olivo and Redón's study, the post-course assessment was passed by 82.4% of participants. In our study the impact on family medicine residents seems obvious, which stresses the improvement in results of both tests after the educational intervention. There is still room for improvement, though, as 21.2% continued to make mistakes in their responses.

In 2017, Wright et al.¹⁹ conducted a survey on first-contact physicians in Australia to describe DDH detection practices, finding wide variability in knowledge, training, and evaluation methods among them. In this research, 76% of respondents identified the need for training and education on DDH detection, emphasizing the importance of clinical practice guidelines, training, and continuous educational updates.

In 2009, Montes et al.²⁰ conducted a questionnaire on pediatricians in Tijuana, Mexico, to assess theoretical knowledge about DDH. They observed that theoretical knowledge is deficient and that competencies to interpret pelvic X-rays are also inadequate¹². These authors propose evaluating and increasing the minimum theoretical knowledge necessary for pediatricians regarding the diagnosis and treatment of DDH.

Following the educational intervention, which covers the most important points on DDH detection, we saw a clear increase in correct answers on the applied test.



Figure 1. X-rays representative of a case.

The intervention was clear and precise, conducted in approximately 1 hour, and used very basic materials, making it widely reproducible and useful, with a positive impact on residents from different years in family medicine.

Although the use of simple x-rays yielded good results, we should work hand in hand with radiologists so that hip ultrasounds become a feasible and readily available option in our setting. This is how we would have a better chance of conservative treatment, especially in patients in their younger ages¹³⁻¹⁵.

In response to the need for improving timely detection of this condition, we propose to continue training family medicine residents pediatricians so patients can have a better chance of receiving conservative treatment, avoiding more aggressive treatments and the associated complications that can result from surgical procedures,^{14,15,21,22} as well as the evolution to premature coxarthrosis in adulthood²³.

Continuous training will go on, in addition to extending this intervention to other family medicine units in the area of influence, where this educational strategy will likely have a greater impact on the population.

We support the initiative²⁴ of including radiological screening for the prevention and timely detection of this condition in all patients younger than 6 months.

Conclusions

It is described that clinical tests (Ortolani and Barlow) are insufficient and need to be complemented by paraclinical studies. By conducting an educational intervention, in which residents are taught to trace Perkins and Hilgenreiners' lines, we proved that more than 80% of family medicine residents are capable of timely detecting DDH.

We observed that although the differences reported between the results obtained in the pre- and post-educational intervention evaluations are not statistically significant, they do indicate immediate satisfactory results. Short- and mid-term studies with more participants are needed, along with continued training, to measure the impact of this intervention in the mid- and short-term in our area of influence.

We conclude that, in our setting, radiological studies for the detection of DDH are a good diagnostic method for infants older than 3 months.

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Conflicts of interest

None declared.

Ethical disclosures

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this study.

Confidentiality of data. The authors declare that they have followed the protocols of their work center on the publication of patient data.

Right to privacy and informed consent. The authors have obtained the written informed consent of the patients or subjects mentioned in the article. The corresponding author is in possession of this document.

Supplementary data

Supplementary data is available at DOI: 10.24875/CIRUE.M23000679. This supplementary data has been provided by the corresponding author and published online for the reader's benefit. The content of the supplementary data is the authors' sole responsibility.

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