A systematic review of DDH screening practices in the UK

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Abstract

Background: The United Kingdom (UK) currently employs a selective screening system for developmental dysplasia of the hip (DDH). Despite this, late presentation rates remain high. The aim of this study was to systematically review the available literature to gain an understanding of screening practices throughout the UK.

Methods: A systematic review was conducted. Studies reporting DDH screening methods from the UK were included. The primary outcome measure was the method of ultrasound and clinical screening. Secondary outcomes were the treatment rate and late presentation rate. A narrative analysis was undertaken, as meta-analysis was felt to be inappropriate due to the differences between included studies.

Results: Nine studies were eligible and included. There was significant variability in practice, with a variety of ultrasound techniques being used and a variety of staff members performing clinical screening. Treatment rate ranged from 16.4/1,000 to 0.8/1,000. Late presentation rate ranged from 1.28/1,000 to 0.27/1,000.

Discussion: In spite of a national consensus statement, there is no standardised approach to clinical or ultrasound screening in the UK. A variety of different methods are used, which may explain the persistently high late presentation rate. A national system of quality control and a standardised screening process is recommended, with specialised training in the Graf method of ultrasound.

Keywords

DDH, screening, ultrasound, clinical screening

Introduction

Rationale

Developmental dysplasia of the hip (DDH) is the most common orthopaedic disorder in newborns and is the leading cause of early-onset arthritis and total hip arthroplasty in young patients [1, 2]. Early detection and treatment of DDH can reduce the need for invasive surgical intervention and reduce long-term disability. Effective DDH screening is therefore essential to identify and treat cases as early as possible.

At present, the United Kingdom (UK) uses a selective screening model, with children with specific risk factors (breech presentation, multiple births, family history) or an abnormal clinical examination being invited for ultrasound screening. Clinical examination is performed at birth and repeated at 6–8 weeks in a primary care setting [3].

In 2022 the British Society for Children's Orthopaedic Surgery (BSCOS) released a consensus statement regarding the management of DDH in the first three months of life [4]. They advocate for universal screening, but they also gave recommendations for selective screening within the current UK system. They recommend that the current risk factors be increased to include non congenital talipes equinovarus (CTEV) foot deformities and packaging disorders. They recommend that ultrasound should take place in a one-stop clinic, and that the Graf criteria of quality assurance should be adhered to. Those with clinical abnormalities on examination should have a scan within 2 weeks, and the examination itself should be performed by "expert" examiners with robust methods of quality assurance in place.

Objectives

This paper aims to evaluate screening in the UK by performing a systematic review of the relevant literature. This will provide an overview of the screening methodologies used. It can then be evaluated whether UK practice reflects that of the BSCOS consensus statement.

Materials and methods

A Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) compliant systematic review was conducted to gain an overview of current screening practice in the UK [5]. The Embase and Medlin databases were searched, along with the Cochrane Library.

Eligibility criteria

Study designs

Unpublished studies, guidelines, protocols, and editorials were not considered. Previous systematic reviews were also excluded. All other study designs were considered.

Types of participants

Exclusion criteria included studies with either serious or critical risk of bias.
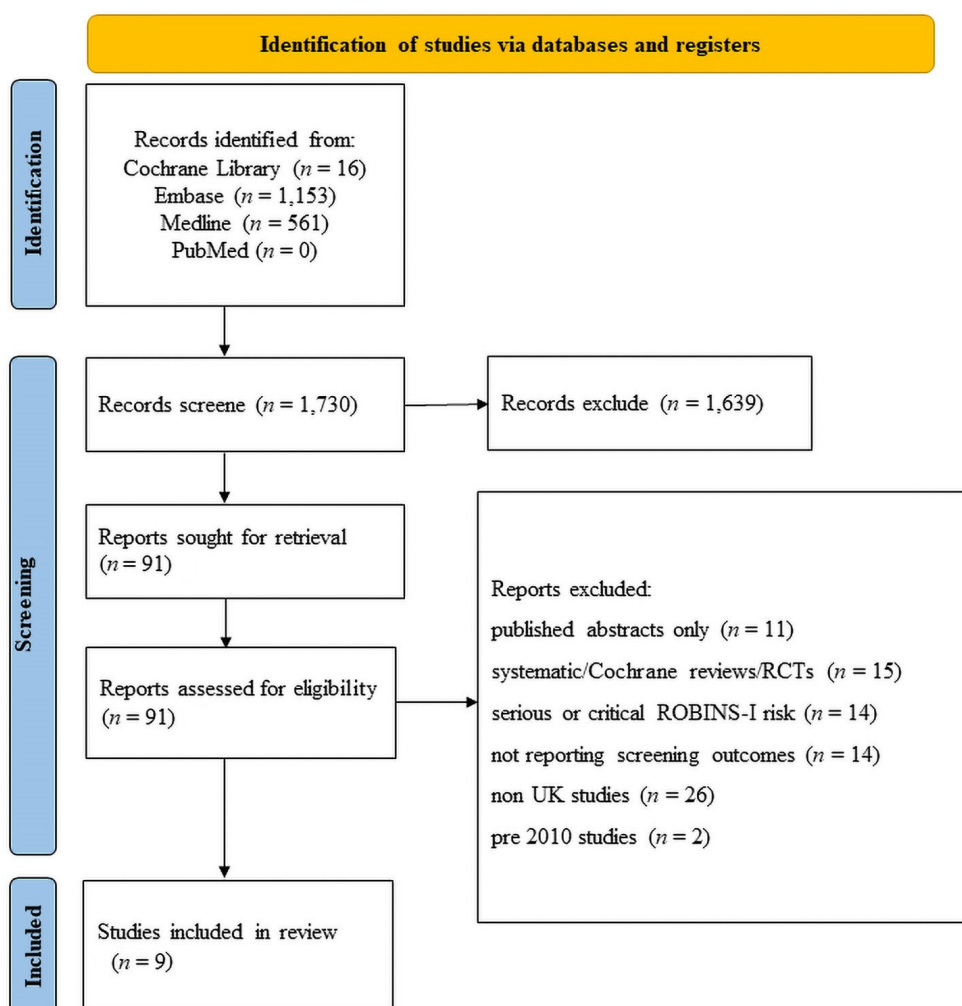
Interventions

Interventions eligible for consideration were children who had undergone ultrasound screening for DDH in the UK. A full list of inclusion and exclusion criteria is detailed in Table 1.

Table 1. Full inclusion and exclusion criteria

Selection criteria	Inclusion criteria	Exclusion criteria
Language	English language	Non-English studies
Study type	All study designs	Systematic reviews
Population	Newborn population	Children older than newborn
	Human studies	Cadaveric or animal studies
	UK based study	Non-UK study
Intervention	DDH screening	Not relevant to screening
Date	Studies after 2009	Studies prior to 2010
Quality	Clearly reported methodology	Serious or critical risk of bias
Availability	Full text available	Abstract only available
		Unpublished studies
		Editorials

Outcomes of interest

The primary outcome measures of interest were the methods of ultrasound and clinical screening used. Secondary outcomes were the treatment rate and late presentation rate. The search strategy is detailed in Figure 1.

Figure 1. PRISMA flow diagram illustrating literature search. *n*: number. RCTs: randomized controlled trials; ROBINS-I: risk of bias in non-randomized studies of interventions

Search strategy

A systematic literature search was performed. The Embase, Medline, and PubMed databases, along with the Cochrane Library were searched. The search strategies and results are presented in Figure 1.

Selection process

The resulting papers were then manually searched to determine whether they met the inclusion criteria (Table 1). This was performed independently by 2 authors (Nicholas Birkett and Edward Karam). In the case of only one author including a paper, it was included in the review nonetheless.

Data collection process and synthesis methods

The methodologies and data extracted were reviewed. Meta-analysis was felt to be inappropriate due to the heterogeneity in both treatment modalities and outcome measurements. A narrative review was conducted to best answer the research question.

Risk of bias assessment

The ROBINS-I critical appraisal tool was used to evaluate the included studies for risk of bias [6]. The studies were then categorised as either low, moderate, serious, or critical risk.

Results

Study selection

A total of 1,730 studies were identified from the literature search (Medline, Embase, PubMed, and Cochrane Library). Ninety one studies were selected for full-text review following assessment of their abstracts. Of these, 9 met the inclusion criteria and were deemed eligible for this review. The full results of the literature search are presented in Figure 1.

Risk of bias in studies

The critical appraisal is summarised in Table 2, assessed using the ROBINS-I tool. The studies were all low or moderate risk.

Table 2. Assessed risk of bias of included studies using the ROBINS-I tool

Study	Type of bias							Overall bias risk
	Confounding	Selection of participants	Classification of intervention	Deviations from intended interventions	Missing data	Measurement of outcomes	Selection of reported results	
Afaq et al. [7]	Moderate	Moderate	Moderate	Low	Moderate	Low	Low	Moderate
Broadhurst et al. [8]	Low	Low	Low	Low	Low	Low	Low	Low
Choudry et al. [9]	Low	Low	Low	Low	Moderate	Low	Low	Moderate
Clarke et al. [10]	Low	Low	Moderate	Low	Low	Moderate	Low	Moderate
Donnelly et al. [11]	Low	Low	Low	Low	Low	Low	Low	Low
McAllister et al. [12]	Low	Low	Low	Low	Low	Low	Low	Low
Talbot et al. [13]	Low	Low	Moderate	Low	Low	Low	Low	Low
Tyagi et al. [14]	Low	Moderate	Low	Low	Low	Low	Low	Moderate
Westacott et al. [15]	Low	Low	Low	Moderate	Moderate	Moderate	Low	Low

Findings

The included studies highlighted the variability in screening practice throughout the UK, with a variety of reported clinical and ultrasound screening methods. All papers reported on selective screening, except for Westacott et al. [15], whose study compared universal with selective screening.

Primary outcome—ultrasound and clinical screening method

The ultrasound screening method was reported in 7/9 (78%) of papers. Five studies used either the Graf technique or a modification of it. Other methods used were Harcke, Terjesen, and Clarke. Often, these methods were combined and modified.

There was significant variability in the healthcare professional performing the ultrasound screening. Four studies did not report who performed the ultrasound screening. Other papers reported screening being performed by orthopaedic consultants, radiologists, sonographers, and physiotherapists. It is unclear from the papers whether these staff members had specific training or not.

Table 3. A summary of included studies and result

Study	Number of patients	US method	Professional performing US	Professional performing clinical exam	Criteria for referral	Treatment rate	Late presentation rate
Afaq et al. [7]	200	Harcke method with Terjesen measurements	Consultant radiologist or sonographer	Junior doctor or midwife	Family history, breech, syndromic children, spinal or foot deformities, abnormal examination	Not reported	Not reported
Broadhurst et al. [8]	3,635	Not reported	Not reported	Not reported	Family history, breech presentation	Not reported	1.28/1,000
Choudry et al. [9]	124	Graf & Harcke	Orthopaedic consultant	Variable—junior doctor/midwife/advanced nurse practitioner	Family history, breech presentation, abnormal examination	0.8/1,000	0.78/1,000
Clarke et al. [10]	20,344	Clarke	Not reported	Paediatrician	Family history, breech presentation, foot deformities, abnormal examination	7.2/1,000	0.34/1,000
Donnelly et al. [11]	75,856	Graf	Not reported	Health visitors	Family history, breech presentation, abnormal examination	8.5/1,000	0.42/1,000
McAllister et al. [12]	896,594	Not reported	Physiotherapist/Physician	Physiotherapist/Physician	Family history, breech presentation, moulding abnormality, abnormal examination	Not reported	Not reported
Talbot et al. [13]	2,984	Modified Harcke (dynamic) & modified Graf (static)	Not reported	Orthopaedic surgeon	Family history, abnormal examination	16.4/1,000	Not reported
Tyagi et al. [14]	3,618	Graf	Consultant radiologist/radiographer	Maternity care professional	Family history, breech, multiple pregnancies, CTEV, high bodyweight females, abnormal examination	3.31/1,000	0.27/1,000
Westacott et al. [15] (selective group)	18,053	Graf	Radiographer or orthopaedic consultant	Junior doctor or general practitioner	Family history, breech presentation, multiple pregnancies, increased birth weight, non-CTEV foot deformities, packaging disorders	2.3/1,000	0.28/1,000
Westacott et al. [15] (universal group)	10,015	Graf	Radiographer or orthopaedic consultant	N/A—US screening alone	N/A—universal	7.9/1,000	0.5/1,000

N/A: not applicable; US: ultrasound

Clinical examination was performed by a wide variety of staff. Most commonly, the examination was performed by either midwives or junior doctors in paediatrics. Other studies reported examinations by orthopaedic surgeons, physiotherapists, paediatricians, and health visitors.

Risk factors that prompted screening generally conformed with the UK newborn and infant physical examination (NIPE) guidelines [3]. Westacott et al. [15] included packaging disorders and non-CTEV foot disorders as risk factors.

Secondary outcomes

Treatment rates ranged from 16.4/1,000 to 0.8/1,000. The highest treatment rate was seen in the universal screening group in Westacott et al. [15], which is to be expected. Late presentation rates were poorly reported but ranged from 1.28/1,000 to 0.27/1,000. The definition of late presentation varied by study which made direct comparison difficult. It is worth noting that Westacott et al. [15] found 5 cases of delayed presentation in both their universal and selective screening groups, but all the cases in the universal group were due to administrative errors.

A summary of all the studies' findings can be found in Table 3.

Discussion

The included studies highlight the variability in DDH screening practice throughout the UK. Criteria for screening appear relatively similar and in keeping with NIPE guidelines, but work is required to expand the indications to include foot deformities and packaging disorders as per the BSCOS consensus statement. Most variability was noticed in ultrasound methodology and in the seniority or experience of those carrying out clinical examinations. It is clear from many of the studies that the important task of clinical examination is often carried out by a relatively inexperienced member of the team.

The late presentation rate of DDH in the UK has been estimated at 1.2/1,000 [16]. Countries with universal screening have reported late presentation rates ranging from 0 to 0.16/1,000 [17, 18]. The introduction of selective screening in the UK did not have any effect on late presentation rates, highlighting inconsistency in practice [8]. If the current system of selective screening in the UK is to continue for the foreseeable future, consistency and quality control are required at all levels of the process, from the initial assessment of the newborn to the ultrasound screening itself.

One essential area for improvement is education and training in the Graf method of ultrasound. The method is recommended but is often implemented in a modified fashion. The Graf method is successful when performed with the correct technique and the strict reporting criteria are adhered to. Modifications of the Graf method invalidate its efficacy, therefore widespread training in how to properly apply the method is required.

In conclusion, despite a national consensus statement, the UK literature demonstrates significant variability in practice. Significant change is required at a national level to standardise screening processes, with a national level of quality control to ensure that the highest quality care is being delivered. Specific training in the Graf ultrasound method is recommended, to ensure it is delivered correctly without modification.

Abbreviations

BSCOS: British Society for Children's Orthopaedic Surgery

CTEV: congenital talipes equinovarus

DDH: developmental dysplasia of the hip

ROBINS-I: risk of bias in non-randomized studies of interventions

Declarations

Author contributions

NB: Conceptualisation, investigation, writing—original draft preparation, Writing—review & editing. EK: Conceptualisation, investigation, Writing—review & editing. DF and DP: Investigation, Writing—review & editing. CM: Conceptualisation, supervision, Writing—review & editing. All authors read and approved the submitted version.

Conflicts of interest

The authors declare that they have no conflicts of interest.

Ethical approval

Not Applicable.

Consent to participate

Not Applicable.

Consent to publication

Not Applicable.

Availability of data and materials

All data is from studies referenced in the manuscript.

Funding

Not Applicable.

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