

Diagnostic and treatment preferences for developmental dysplasia of the hip: a survey of EPOS and POSNA members

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Abstract

Purpose The aim of this study was to elucidate developmental dysplasia of the hip (DDH) diagnosis and treatment preferences among members of the Pediatric Orthopaedic Society of North America (POSNA) and European Paediatric Orthopaedic Society (EPOS).

Methods A 54-question survey on DDH diagnosis and treatment preferences was distributed to POSNA and EPOS members. Descriptive statistics were performed.

Results A total of 459 responses were analyzed. Ultrasound was the preferred modality for diagnosing DDH in infants less than six months old; few surgeons preferred radiographs. In all, 57% of POSNA members had radiology technicians perform ultrasounds, only 7% of EPOS members did. The percent coverage defining a dislocated hip varied greatly, the most frequent response being < 20% for POSNA and < 40% for EPOS members. Pavlik harnesses were the most popular harness/brace, used by 90% of POSNA and 71% of EPOS members. POSNA members were more likely than EPOS members to use a rigid abduction brace following initial harness/brace failure. For residual acetabular dysplasia, POSNA members were twice as likely as EPOS members to institute hip abduction bracing. Most surgeons would not perform closed reduction at less than three months of age or open reduction at less than six months of age. Most EPOS members

used traction prior to reduction; few POSNA members did. Few POSNA and EPOS members believed that reduction should be delayed until the ossific nucleus was visible.

Conclusion There is great variation in the preferred methods for diagnosing and treating DDH. This survey is the largest transcontinental survey to compile diagnostic and treatment preferences for DDH. With wide variations in practice, there is room for quality improvement.

Level of Evidence II

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Introduction

Evidence-based guidelines for the treatment of developmental dysplasia of the hip (DDH) have been published,¹ but only low to moderate quality evidence supports these recommendations. Consequently, continued variations in diagnosis²⁻⁵ and treatment^{2,4} regimens have been documented. These previous studies primarily evaluated differences within national societies,^{2,5} although, one study did evaluate diagnostic criteria for surgeons from across Europe.³ Only one study was transcontinental and included surgeons from select centres in five countries; this study looked at the demographics and initial treatment of children with DDH, demonstrating regional variations in treatment.⁴

The goal of this study was to quantify surgeon preferences – from the two largest paediatric orthopaedic professional societies in the world – for the diagnosis, treatment and follow-up of DDH. A few topics of particular interest were: risk factors surgeons feel require an ultrasound, details of bracing protocols, surveillance during and after treatment and how surgeons determine when to discontinue bracing and initiate alternative treatment. The goal of this survey was to obtain input from practising surgeons on a comprehensive list of factors

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related to the diagnosis and treatment of DDH. Areas of discordance may represent opportunities for further research and collaboration to determine optimal diagnostic and treatment regimens and ultimately improve patient outcomes.

Materials and methods

A survey was distributed to 1371 Pediatric Orthopaedic Society of North America (POSNA) and 447 European Paediatric Orthopaedic Society (EPOS) members. The survey and study protocol were approved by the POSNA Evidence Based Practice Committee and by the EPOS Research and Scientific Committee and EPOS Board. An email with a link to the survey, hosted by <https://www.surveymonkey.com>, was sent from the respective societies to their memberships. At least one reminder email was sent by each society.

The 54-question survey focused on diagnosis, treatment decisions and follow-up of DDH in various clinical scenarios (supplementary material). At the request of the EPOS Board, the survey sent out to EPOS members included an additional question asking if the respondent wished to be acknowledged by name for their participation. The survey included binary yes/no, multiple choice, select all that apply and open textbox questions. If members were part of both EPOS and POSNA, they were categorized based on whether they responded to the survey invitation from EPOS or POSNA. To assess diagnostic variation, respondents were asked about preferred modality of diagnosis, clinical signs that would prompt imaging and methodology used for quantifying the severity of the dysplasia. Regarding treatment, respondents were asked about harness/brace use and other management in various clinical scenarios as well as preferences for subsequent follow-up; this included treatment practices in older infants and patients who previously failed harness/brace treatment.

Data analysis consisted of descriptive statistics. Depending on the format of the answers, means with SD, proportions, medians or modes with ranges were reported.

Results

A total of 523 surgeons from 52 different countries responded to the survey. In all, 331 POSNA members (24%) and 192 EPOS members (43%) responded. Of responding surgeons, 38 indicated they were members of both societies. The top responding country was the United States, followed by Italy and Canada. The average number of fellowships completed by all surgeons was 1.1, with 94% of POSNA members and 80% of EPOS members having completed at least one paediatric orthopaedic

fellowship. The median number of years in practice was 15 for POSNA respondents and 20 for EPOS respondents (0 to 48). A total of 21 surgeons did not treat DDH and did not complete the rest of the survey. Nine surgeons responded that they did treat DDH, but preferred not to complete the survey and 34 surgeons agreed to participate but did not answer any treatment questions, leaving 459 surgeons whose responses were eligible for analysis (Fig. 1). Each percentage reported is the proportion of the 459 responding surgeons who selected that response, although for each question a certain percentage of respondents left the answer blank. Over half of all respondents from both societies treated between 11 to 50 DDH infants per year, with an additional 12% and 28% of POSNA and EPOS members, respectively, treating over 50 infants per year.

Diagnosis and imaging

When diagnosing DDH in infants less than six months old, 89% of POSNA members and 93% of EPOS members preferred ultrasound, with 13% of POSNA members and 27% of EPOS members obtaining a follow-up radiograph if the ultrasound results were not clear. Radiograph was preferred over ultrasound as the primary method to diagnose DDH in this age group by only 4% of POSNA members and 2% of EPOS members. Surgeons reported that they would order an ultrasound to assess for DDH with various history and physical exam findings; responses are presented in Table 1. The majority of surgeons from both societies believed that imaging should be undertaken to assess hips in infants less than six months old presenting with instability or a history of breech positioning. The greatest disparity existed between POSNA and EPOS members ordering ultrasound imaging when an infant presents with torticollis (POSNA 32%, EPOS 72%) or club-foot (POSNA 17%, EPOS 69%).

In all, 57% of POSNA members and 7% of EPOS members responded that they had a radiology technician perform ultrasounds. Only 14% of POSNA members performed their own ultrasounds, compared with 47% of EPOS members, while 77% of POSNA members and 85% of EPOS members interpreted ultrasounds themselves. In all, 70% of POSNA members and only 44% of EPOS members noted that a radiologist was also involved in ultrasound interpretation. The majority of surgeons in both societies used the Graf Classification to determine treatment for DDH (POSNA 75% and EPOS 86%). The majority of POSNA and EPOS members measured alpha angles on ultrasounds to inform their decision making, but differed with other ultrasound measurements, as more POSNA members used percent coverage and more EPOS members used the beta angle (Table 2). When asked what percentage coverage is considered a dislocation, the most

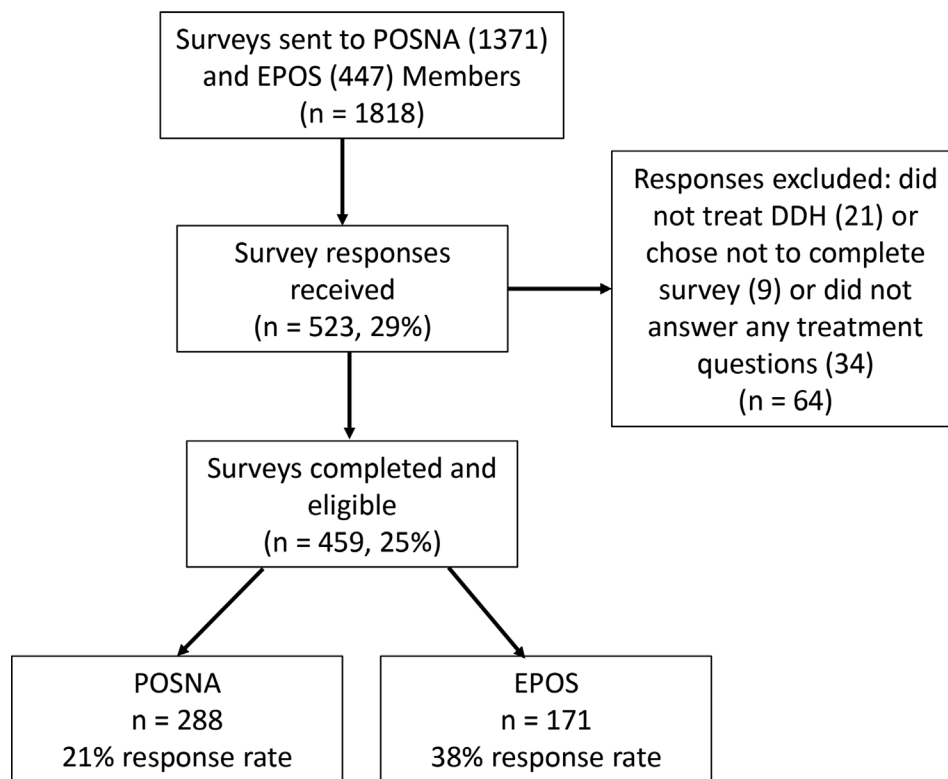


Fig. 1 Flowchart of survey respondents (POSNA, Pediatric Orthopaedic Society of North America; EPOS, European Paediatric Orthopaedic Society; DDH, developmental dysplasia of the hip).

Table 1 Proportion of surgeons who would order an initial/diagnostic ultrasound in the following situations when treating a patient less than six months of age

	Pediatric Orthopaedic Society of North America (%)	European Paediatric Orthopaedic Society (%)
Reducible dislocated hip	75	92
Irreducible dislocated hip	80	89
Barlow positive hips	79	93
reduced at rest		
Sensation of unstable or loose hips	90	93
Breech position	76	89
Asymmetric thigh folds	39	65
Hip click	40	72
Torticollis	32	72
Clubfoot	17	69
Metatarsus adductus	18	61
Signs of hypermobility	16	50

Respondents selected all that apply

frequent response was < 20% from POSNA members and < 40% from EPOS members, with the definition of dislocation ranging from no articulation (0% coverage) to anything less than 50% coverage.

Treatment and follow-up imaging

The preferred bracing modalities are presented in Figure 2. The Pavlik harness was the most popular brace amongst both POSNA and EPOS members. In all, 39% of POSNA

Table 2 Which of the following ultrasound metrics do you use in decision making?

	Pediatric Orthopaedic Society of North America (%)	European Paediatric Orthopaedic Society (%)
Alpha angle	85	83
Percentage coverage	80	46
Beta angle	17	53
Dynamic instability/stress exam	75	54
Transverse imaging	27	9
Coronal imaging	40	21
Anterior imaging	3	6

Respondents selected all that apply

and 23% of EPOS members left the harness/brace on during ultrasound if the hip was unstable, while 13% of POSNA and 43% of EPOS members always obtained ultrasound images out of the harness/brace. Of the providers that use stress ultrasounds, about 75% of POSNA and EPOS members stressed or manipulated the hips for imaging at some point during harness treatment. A total of 28% of POSNA members reported that stress should be applied at the initial ultrasound, and 31% at completion of treatment, while 27% of EPOS members reported stress should be applied at the initial ultrasound, and 19% at completion of treatment. Of responding POSNA and EPOS members, respectively, 19% and 26% allowed their patients to always wear clothes underneath their brace,

9% and 18% never allowed clothes, 23% and 16% only allowed clothes once the hip was clinically stable, and 35% and 19% only allowed onesies/underwear.

After applying a harness/brace to an unstable hip, surgeons most frequently preferred to see the patient for the first follow-up at one week. The most common times for the first repeat ultrasound were at one week for POSNA members (37%) and four weeks for EPOS members (22%).

Many respondents (36% POSNA, 44% EPOS) did not believe that follow-up was required for a breech infant with a normal early ultrasound. Of the surgeons suggesting that a follow-up was necessary, the most common suggested age for follow-up was six weeks (one to 24 months for both POSNA and EPOS). Only 32% of POSNA members and 7% of EPOS members felt that a radiograph should be obtained at 4 to 6 months of age.

For a newborn with a hip click and ultrasound showing mild dysplastic change and no dynamic instability (50% covered, alpha angle 55°) 68% of POSNA and 52% of EPOS members recommended returning at a specific time for repeat imaging, with 39% of POSNA and 30% of EPOS members having patients return for repeat imaging at six weeks of age. In all, 10% of POSNA and 13% of EPOS members would treat a hip click with these ultrasound parameters using a Pavlik harness or other brace, and 5%

and 9% of POSNA and EPOS members, respectively, recommended double diapers in this situation, while 7% of POSNA and 8% of EPOS members felt no treatment or follow-up was required.

Assuming that harness/brace treatment is working, the duration of harness/brace wear for a six-week-old baby in three different scenarios – a reduced dislocatable hip, reducible dislocated hip or irreducible dislocated hip – had similar responses (Fig. 3). The most frequent response was until the ultrasound and clinical exam were normal (~40% of POSNA members, ~55% of EPOS members), for respondents who treat based on a set amount of time, the most frequent treatment duration for both groups, was 12 weeks. Two-thirds of responding POSNA members wean infants off harness/bracing, while half of EPOS members wean. The most frequent responses for weeks of weaning were four weeks (21% for POSNA and 15% for EPOS members) and six weeks (28% for POSNA members and 15% for EPOS members).

Once failure was determined (Fig. 4), POSNA members were much more likely than EPOS members to try a rigid brace (60% and 23%, respectively). The most frequent response for the number of weeks surgeons were willing to try a rigid brace for was three (POSNA) and four (EPOS). When considering a 12-month-old with residual

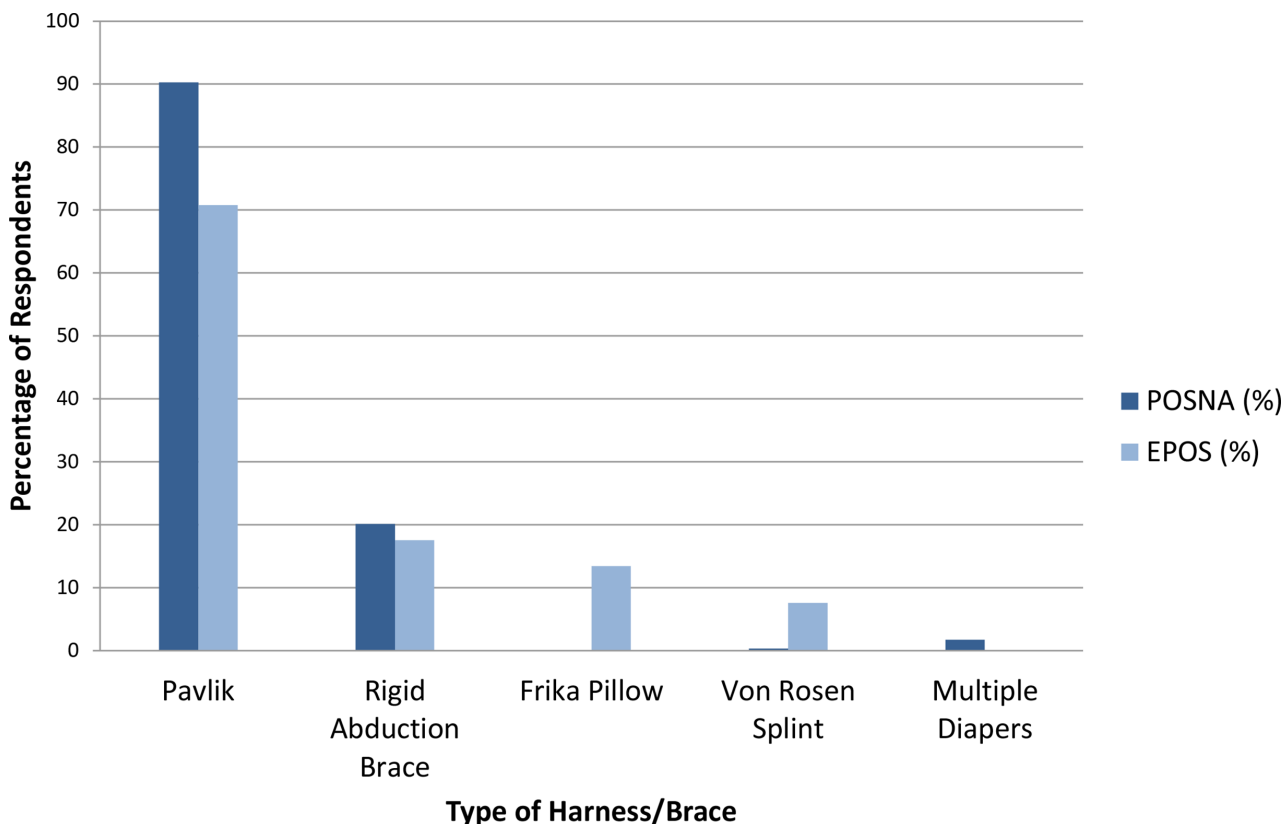


Fig. 2 Graph demonstrating harness/brace preferences (POSNA, Pediatric Orthopaedic Society of North America; EPOS, European Paediatric Orthopaedic Society). Respondents were encouraged to select all that apply.

acetabular dysplasia, but located hips, 57% of POSNA and 27% of EPOS members responded that they would use an abduction brace, most commonly for 12 hours per day. The two most frequent responses for earliest age at which surgeons would perform a closed reduction and spica casting were three months (24%) and six months (25%) for POSNA members and one month (15%) and three months (16%) for EPOS members; with only 5% of POSNA members and 15% of EPOS members willing to carry out closed reduction and casting as early as one month of age. The two most frequent responses for earliest age at which surgeons would perform an open reduction and spica casting were six months (32%) and 12 months (13%) for POSNA members and six months (16%) and 12 months (15%) for EPOS members; with only 3% of POSNA and EPOS members willing to do an open reduction at less than three months of age. 76% of POSNA members responded that they never use pre-reduction traction, while only 35% of EPOS members reported no use of traction. Only 19% of POSNA and 13% of EPOS members believed that open reduction should be delayed until the ossific nucleus was visible.

Most surgeons switched from ultrasound to radiograph imaging at six months of age, and the anteroposterior

pelvis was the most common view, although many surgeons also ordered a frog lateral view. Residual dysplasia on radiograph was commonly assessed using the acetabular index and Shenton's line, while other radiographic measures were used less often (Fig. 5). The most frequent answer for an abnormal acetabular index was similar between POSNA and EPOS members at various ages: > 30° at six months, > 30° at 12 months (although a significant proportion chose > 25°), > 20° (POSNA) and > 25° (EPOS) at two years and > 20° at five years of age.

Follow-up surveillance of treated hips was quite frequent in children less than five years of age and peaked at six months, one year and two years of age. There was a small spike in return visits at ten years of age for patients of POSNA members (25% saw patients at this age), however, a low percentage of patients were seen at skeletal maturity (Fig. 6).

Discussion

The goal of this study was to describe the diagnostic and treatment preferences of practising paediatric orthopaedic surgeons who care for patients with DDH on a regular basis. Previous studies evaluating the diagnostic and

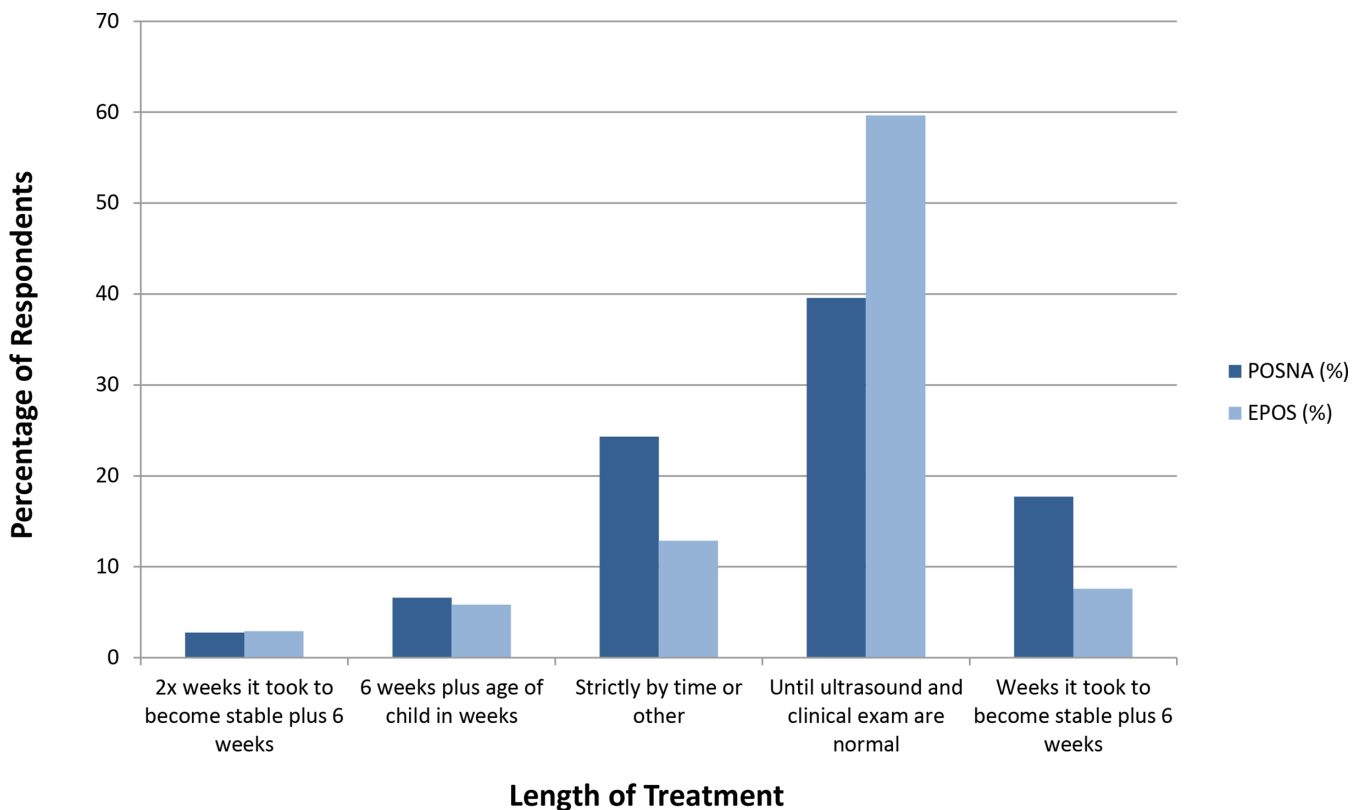


Fig. 3 Graph demonstrating preferred length of treatment for a clinical scenario: 'Consider a 6-week-old baby with a confirmed dislocated hip that is reducible with gentle manual manipulation, assuming that treatment is working, how long would you treat in harness/brace?' (POSNA, Pediatric Orthopaedic Society of North America; EPOS, European Paediatric Orthopaedic Society). Respondents were encouraged to select their preferred treatment algorithm.

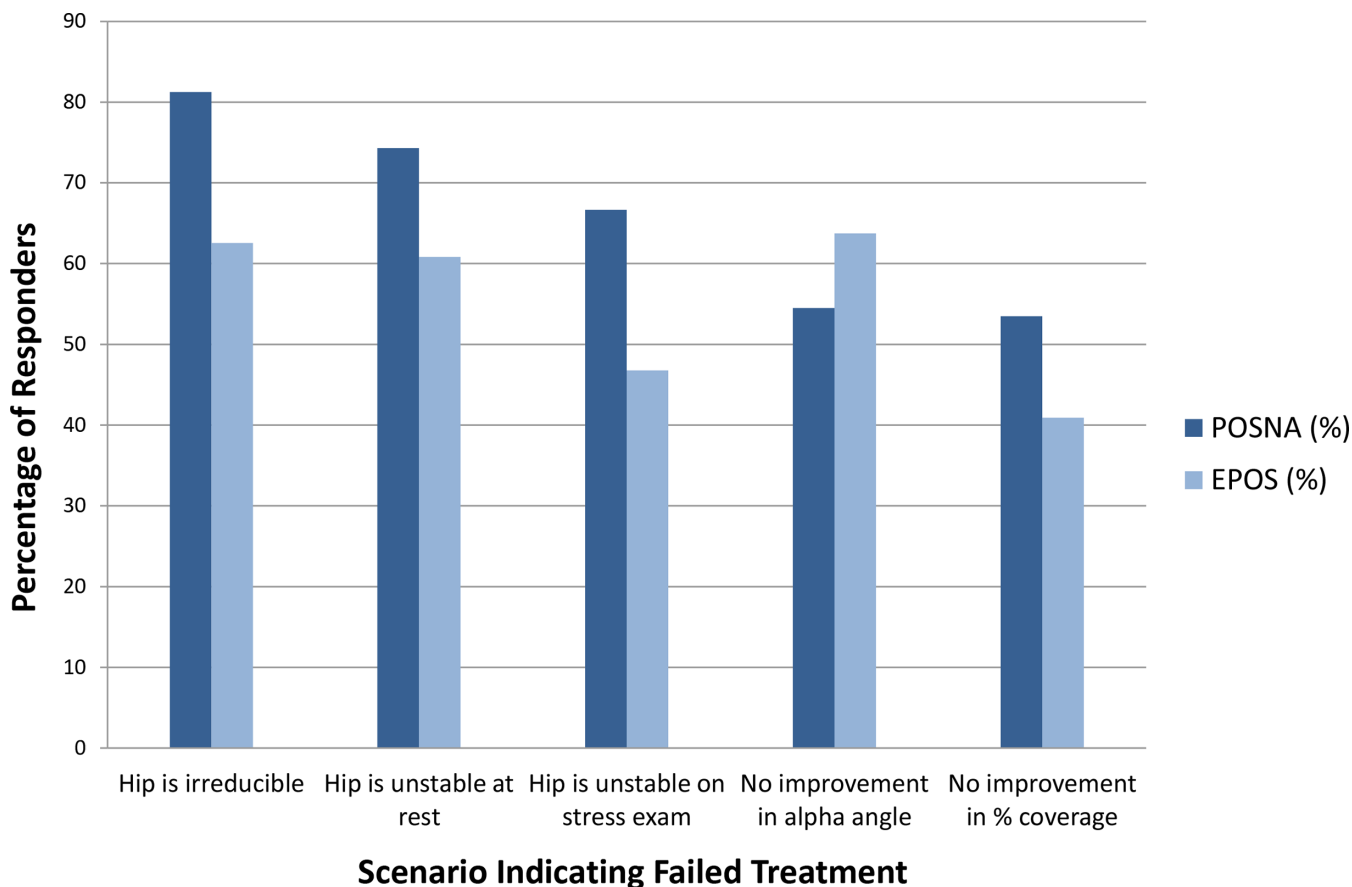


Fig. 4 Graph demonstrating which scenarios are felt to indicate failed brace treatment (POSNA, Pediatric Orthopaedic Society of North America; EPOS, European Paediatric Orthopaedic Society). Respondents were encouraged to select all that apply.

treatment preferences of orthopaedic surgeons caring for patients with DDH reported wide variation. In a survey of 57 members of the Dutch Paediatric Orthopaedic Society, there was a lack of consensus among the 36 responding surgeons about methods of diagnosing and treating DDH, particularly regarding duration of treatment.² A study assessing diagnoses and initial treatment of DDH in five countries found major differences in treatment for similar hips.⁴ In a survey of 297 European paediatric orthopaedic surgeons the importance of several diagnostic criteria was found to vary significantly.³ In a different survey of 100 members of the British Society of Children's Orthopaedic Surgery (BSCOS) there was similarly poor consistency among responders when assessing criteria useful for diagnosis of DDH in newborns.⁵ This survey of POSNA and EPOS members found likewise that there was wide variation in surgeon diagnostic and treatment preferences when caring for patients with DDH, both within and between societies. The response rate was approximately 30%, similar to many previous EPOS and POSNA surveys on various topics.^{3,5-9}

Most surgeons used ultrasonography to diagnose DDH in infants under the age of six months, and used the Graf Classification to determine treatment; similar to findings from a survey about DDH diagnosis in the Netherlands.² However, there was little consensus among surgeons on whether infants with torticollis, clubfoot, a hip click or asymmetric thigh folds required a screening ultrasound (Table 1). Additionally, there was poor consistency in who captured ultrasound images and who interpreted them. Although members of POSNA and EPOS used similar measurements to assess for residual dysplasia on radiographs (Fig. 6), there was variation regarding which ultrasound metrics were most important to consider (Table 2). POSNA members were much more likely to use percentage coverage and less likely to use beta angle as metrics for making clinical decisions compared with EPOS members. There was also much variation, regardless of society membership, as to what percentage coverage was considered indicative of a dislocation. Overall, preferred diagnostic tools and decision-making varied greatly across the globe; this was similarly demonstrated in a study of EPOS and

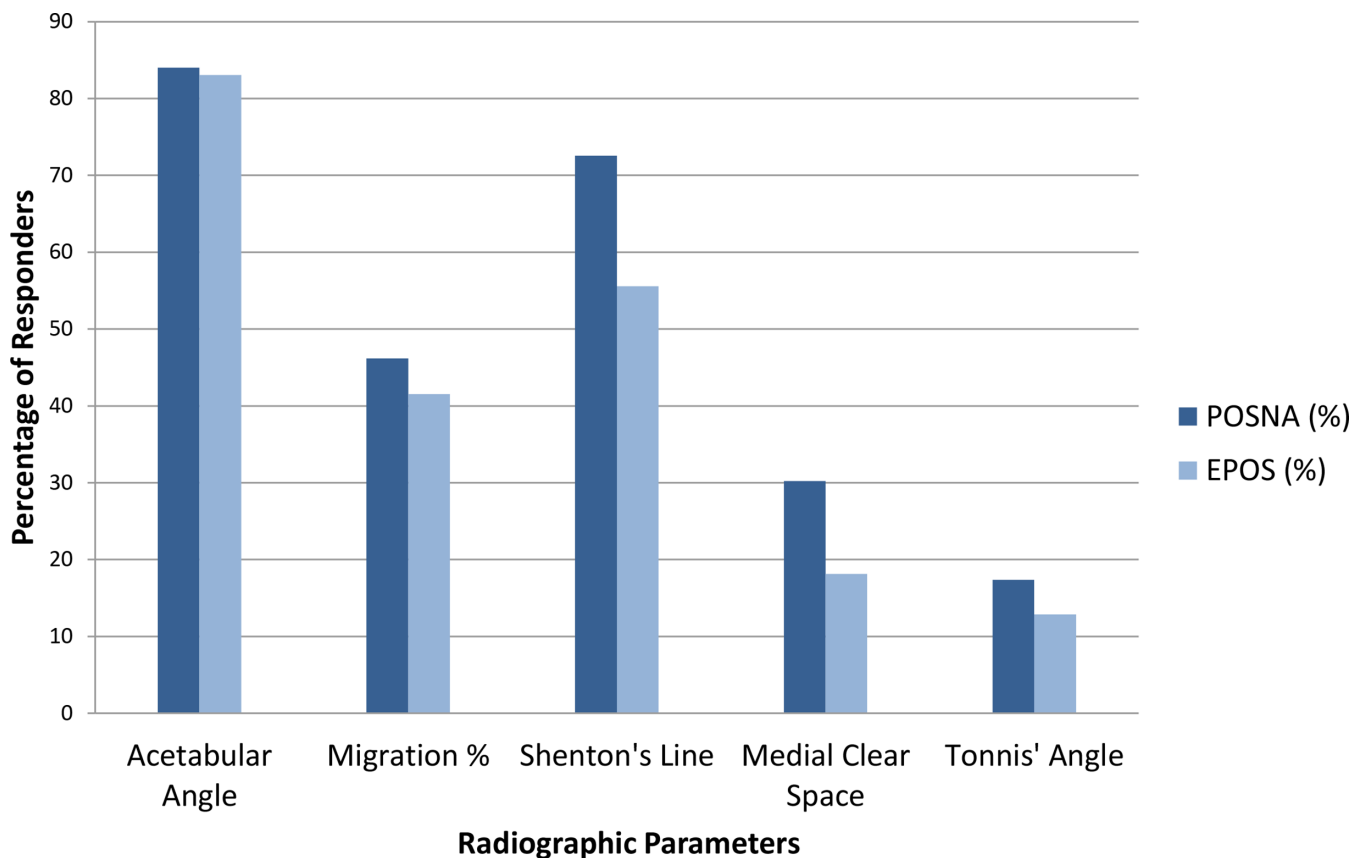


Fig. 5 Graph demonstrating which radiographic parameters respondents use to evaluate for residual dysplasia (POSNA, Pediatric Orthopaedic Society of North America; EPOS, European Paediatric Orthopaedic Society). Respondents were encouraged to select all that apply.

BSCOS members on their preferences for DDH diagnostic criteria.³

The vast majority of surgeons used the Pavlik harness as their preferred brace (Fig. 2). However, there was wide variation both within and between societies on length of treatment, utility of weaning, criteria for determining brace failure and whether a second, more rigid brace should be attempted following initial brace failure. POSNA members were more likely to try another brace after initial failed treatment than EPOS members. The majority of EPOS members believed that there was utility in using traction prior to closed or open reduction while POSNA members rarely considered this modality.

This study has a number of limitations. First, the response rate was 29%, however, this response rate is similar to previous EPOS and POSNA surveys.⁶⁻⁹ Also, surgeons belonging to both societies only responded to the survey invitation from POSNA or EPOS, not both, thus the actual response rate is slightly greater than the calculated value of 29%. Second, respondents were often passionate about their DDH diagnostic and treatment protocols

and frequently responded with additional comments, some of which could not be coded and included in the analysis. Third, the results reported here were based on the total number of surgeons who responded, and for each question some answers were left blank. Thus, percentages reported here may be lower than reality, as the non-responders contributed to the denominator but not the numerator. Fourth, this survey is representative only of surgeons within EPOS and POSNA memberships; there may be potentially greater differences globally than those identified here. Fifth, it is possible that due to a survey length of over 50 questions, responder burnout ensued, resulting in rushed selections or incomplete responses. Finally, this study is only able to document what surgeons reported they would do in certain hypothetical situations, not what they necessarily do in practice; however, there is evidence that surveys accurately evaluate physicians' attitudes¹⁰ and physician survey answers correlate well with behaviour in practice.¹¹

With 523 total surgeons surveyed from 52 different countries, this is the largest, most comprehensive study

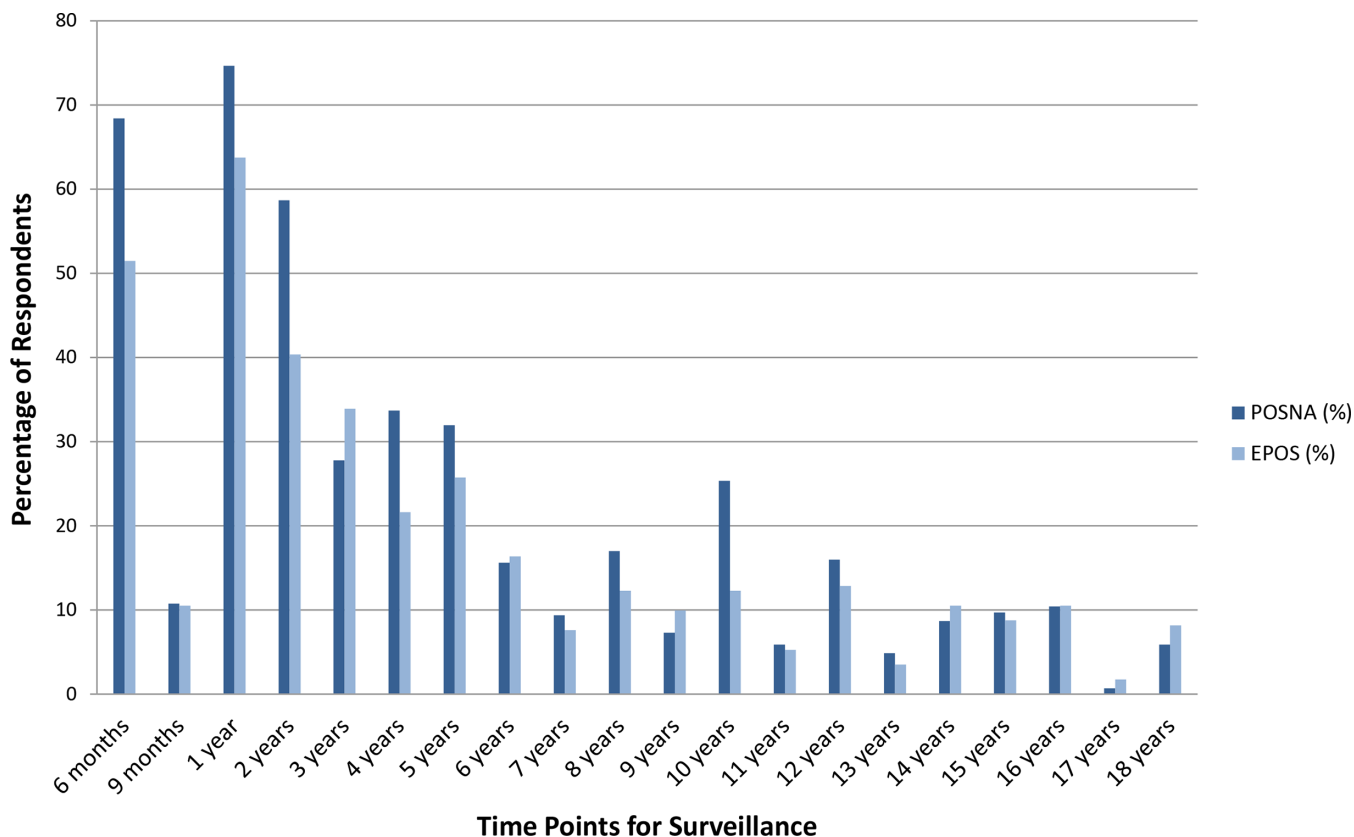


Fig. 6 Graph demonstrating which time-points respondents recommend for routine surveillance following harness/brace treatment for developmental dysplasia of the hip (DDH) (POSNA, Pediatric Orthopaedic Society of North America; EPOS, European Paediatric Orthopaedic Society). Respondents were encouraged to select all that apply.

surveying paediatric orthopaedic surgeons on preferences for diagnosing and treating DDH in infants to date. This study demonstrates major differences in diagnostic and treatment preferences within and across societies. While some consensus exists, such as using the Graf classification when diagnosing DDH on ultrasonography and applying a Pavlik harness to treat DDH in infants less than six months old, the great variability in other aspects of diagnosis and treatment represent unanswered questions ripe for scientific research. With wide variations in practice, there is room for quality improvement. The results of this study clearly show that large scale, multicentre, international studies are necessary to elucidate which diagnostic and treatment practices lead to the best outcomes. Larger collaborative studies should inspire the adoption of optimal diagnostic and treatment methods across societies, and ultimately lead to solid, unified, evidence-based treatment guidelines to improve the care of children with DDH.

Supplementary material

A copy of the survey can be found alongside the online version of this article.

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COMPLIANCE WITH ETHICAL STANDARDS

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OA LICENCE TEXT

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ETHICAL STATEMENT

Ethical approval: All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. This article does not contain any studies with animals performed by any of the authors.

ICMJE CONFLICT OF INTEREST STATEMENT

None declared.

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