

The treatment of neonatal hip dysplasia with splints in the United Kingdom: time for consensus?

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Abstract

Purpose To understand the variation in the management of hip dysplasia identified from the United Kingdom neonatal selective screening programme.

Methods Having been designed and tested by the research committee of the British Society for Children's Orthopaedic Surgery (BSCOS), a nationwide online survey was conducted of BSCOS members to ascertain their treatment strategies for neonatal hip dysplasia.

Results There were 111 responses (60% of members), which illustrated wide variation in care. In all, 91 (over 80%) of respondents treat more than ten cases per year, yet only 61 (55%) work to an agreed protocol. A total of 90 (81%) use the Graf classification and 103 (93%) use the Pavlik harness initially. Consensus is lacking in key areas including duration of harness use, hours per day, clothing and weaning. Importantly, notable differences of opinion even exist regarding which hip pathologies need treatment.

Conclusion This study quantifies the wide variation in many key elements of the initial treatment of neonatal hip dysplasia in the United Kingdom. This variation appears unnecessary and unacceptable as the Getting It Right First Time programme seeks to standardize care pathways. The charitable sector has called for consensus to mitigate parental anxiety, and it has been suggested that this could allow better integration of hip dysplasia into national screening pathways. Standardized care benefits patients and represents the platform from which we can begin understanding effectiveness and optimizing outcomes.

Level of Evidence Level V

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Introduction

Pavlik's method of functional treatment by active movement is an established treatment for developmental dysplasia of the hip (DDH) in the infant, with good short-term and long-term results.^{1,2} The method has undergone many modifications since its original description, including shortening the duration of treatment from the 'many months' originally described by Pavlik.^{3,4} Some authors still advocate a minimum treatment duration of three months, or four months in older infants, to prevent late residual acetabular dysplasia,⁵ despite long-term follow-up studies showing prolonged treatment after the hip has stabilized does not reduce the rate of residual dysplasia.^{6,7}

Very few comparative studies exist to inform the use of the Pavlik harness,^{8,9} so it is unsurprising that there is little consensus among orthopaedic surgeons relating to the duration of use, or the timing and method of cessation. There is frequently discussion related to how many hours per day the harness is worn, if clothing is allowed beneath the harness, when treatment should be ceased and if it is stopped immediately or weaned. Some clinicians vary their method according to the exact pathology being treated (dysplasia *versus* dislocation), and inconsistencies exist even in the pathologies for which treatment is recommended.

The absence of consensus amongst surgeons is increasingly recognized, particularly as parents and carers become more informed through involvement in online fora and support groups, and national programmes such as the United Kingdom's 'Getting It Right First Time' which promotes the standardization of care by healthcare providers.¹⁰ Furthermore, the committee of the Newborn and Infant Physical Examination Programme (NIPE) has indicated that standardization of diagnosis and treatment pathways would be a prerequisite for establishing a national universal ultrasound screening programme in the United Kingdom.

Past international surgeon surveys on the treatment of DDH did not address many of the inconsistencies in management strategies.¹¹⁻¹³ More recently, a 2018 survey of members of the European Paediatric Orthopaedic Society (EPOS) and the Pediatric Orthopaedic Society of North America (POSNA) clarified a number of important issues but it is unclear how many of the respondents were United Kingdom practitioners.¹⁴

The purpose of this study is, therefore, to detail the variation that exists amongst members of the British Society of

Children's Orthopaedic Surgery (BSCOS) in their use of the Pavlik harness in the treatment of DDH, in order to inform the development of United Kingdom consensus statements and comparative studies in the first instance, and ultimately to enhance patient outcomes and experience.

Materials and methods

A survey was designed by the lead author (DJW), and reviewed, tested and revised by six surgeon members of the BSCOS Research Committee (see Acknowledgements). All practising members of BSCOS were contacted by email and asked, if they are actively involved in treating the condition, to fill out a questionnaire relating to the non-operative management of DDH. A reminder email was sent a week later. An online survey generator was used to collect and analyze all responses (SurveyMonkey, San Mateo, California). The survey was left open for four weeks. The questions are detailed in Table 1.

Results

A total of 111 of the 184 (60%) practising members of BSCOS responded, 94% of whom completed the survey

in full. In all, 91 respondents (82%) reported treating over ten cases of DDH per year (see Table 2), and most have been in practice between five and 15 years.

In all, 88% work alongside colleagues and 12% work alone. In total, 63% of those who work with colleagues have an agreed departmental protocol to which they all adhere (55% of all respondents).

In all, 90 (81%) of respondents use the Graf classification, or a modification of it (e.g. as described by Rosendahl et al¹⁵), to guide their decision-making (see Table 3). A total of 30 (27%) use Harcke and three use Terjesen and 21 (18%) do not use the Graf classification (or any modification of it). Of these, 12 use Harcke, six use another classification and three use no formal classification. Of those using Graf, 18 (20%) also use Harcke.

Respondents were asked about which pathologies they would treat initially with a flexion/abduction orthosis (see Table 2). In all, 35% of respondents state that they treat a stable dysplastic hip in an infant of less than six weeks of age with a flexion/abduction orthosis. A total of 53% had a treatment threshold (the mildest form of hip pathology deemed to require treatment) of dysplasia at age above six weeks. For 11%, the threshold was an unstable or dislocatable hip. There was near universal agreement that subluxed or dislocated but reducible hips require treatment

Table 1 Survey Questions

Question	Answer options
How many cases of DDH do you manage per year? (please include those cases managed by allied health professionals under your supervision, for instance in a 'hub and spoke' arrangement)	< 10 10 to 30 30 to 50 > 50
How many years have you been in practice?	< 5 5 to 15 > 15
Do you work alone or alongside consultant colleagues?	Alone With colleagues
If with colleagues, do you have a departmental protocol to which you all adhere?	Y / N
Which classification system(s) do you use in your decision-making? [select all that apply]	Graf original Graf modified Harcke Terjesen Other I do not use a classification system
Which hips do you treat initially with a flexion/abduction orthosis? [select all that apply]	Dysplastic age < 6 weeks Dysplastic age > 6 weeks Unstable / dislocatable Subluxed Dislocated and reducible Dislocated and irreducible Pavlik harness Other
What is your first line treatment for DDH in the newborn? [If Other, no further questions]	Other
How many hours a day do you advise the harness to be worn when treatment is started?	24, 23, 22, 21, 20 or less
Do you allow clothing to be worn beneath the harness?	Y / N
Assuming initial success, when do you decide to cease harness use?	Free text
Do you have a minimum duration of treatment?	Y / N
If yes, what is it?	Free text/
Do you cease immediately, or reduce time in harness over a number of weeks (wean)?	Immediate Wean
Do you use any further orthosis after ceasing harness treatment? E.g. fixed abduction brace	Y / N
If yes, which?	Free text

Table 2 Case volume and experience of respondents

Cases/year	n (%)	Years in practice	n (%)
< 10	20 (18)	< 5	32 (29)
10 to 30	48 (43)	5 to 15	40 (36)
31 to 50	18 (16)	> 15	39 (35)
> 50	25 (23)	0 (0)	0 (0)

Table 3 Answers to 'Which classification system(s) do you use in your decision-making?' and to 'Which hips do you treat initially with a flexion-abduction orthosis?' (respondents could choose more than one answer to both questions)

Classification	n (%)	Hip type	n (%)
Graf (original)	49 (44)	Dysplasia < 6 weeks age	39 (35)
Graf (modified)	45 (41)	Dysplasia > 6 weeks age	92 (83)
Harcke	30 (27)	Unstable / dislocatable	105 (95)
Terjesen	3 (3)	Subluxed	105 (95)
Other	11 (10)	Dislocated and reducible	106 (96)
No system	3 (3)	Dislocated and irreducible	48 (43)

at any age. In all, 43% attempt to treat a dislocated but irreducible hip with a harness. There were no identifiable trends among those who treat dysplasia under six weeks or irreducible dislocations in terms of caseload or years in practice.

A total of 93% of respondents use the Pavlik harness as their first line of treatment for DDH in the newborn. Of those who use the Pavlik harness, 72% recommend it to be worn 24 hours a day and 26% advise 23 hours (one respondent advises 22 hours and one less than 20 hours). In all, 57% do not permit any clothing to be worn beneath the harness. Permitting clothes and allowing time out of harness were linked. Clothing was permitted beneath the harness by 69% of those who advise 23 hours a day wear, as opposed to 34% of those who advise 24-hour wear.

Of those who use the Pavlik harness, 17% state that they have a standard duration of treatment, regardless of the time the hip takes to normalize. This ranged from six to 16 weeks, with the majority being 12 weeks, followed in many cases by a further period of weaning. The remainder judge the duration of harness use depending on when a certain criterion is met (the hip has 'normalized'). In most cases (74%), this is a normal ultrasonographic appearance but some describe clinical stability, a reduced hip, or, in one case, when the baby can roll on their side as the trigger to begin ceasing treatment. Of those who wait for the hip to normalize, most begin to cease treatment as soon as the criterion is met (40%), but some (30%) also require a minimum duration, usually six weeks (range of two to 12). Some (20%) continue harness treatment for a set period of time after their criterion has been met, ranging from two to 12 weeks, or a factor of the time taken for the hip to normalize (normally twice). Once the decision has been taken to begin to cease treatment, 65% immediately remove the harness, while the rest employ a period of weaning (reducing the hours the harness is worn in

a staged fashion). A total of 7% of respondents use an abduction brace after ceasing harness treatment.

Among the 103 complete responses from clinicians who use the Pavlik harness, at least 27 different protocols were described. However, some of these differed only in terminology (e.g. "when hip reduced" versus "when ultrasound normal" or "when hip stable"). When broadly grouped, the two most common protocols were immediate cessation as soon as the hip had normalized (25 respondents) and a minimum duration of at least 12 weeks of treatment (21 respondents, many of whom employed a further weaning period).

Discussion

There is wide variation between United Kingdom practitioners' treatment strategies for managing neonatal hip dysplasia but consensus exists in some areas. Developing consensus would have many benefits. The Getting It Right First Time programme is seeking to standardize care pathways and the variation demonstrated by this survey appears unnecessary and unacceptable. The Steps charity has called for consensus in order to mitigate parental angst in discussion forums. Parents and carers can feel anxious that their child is more severely affected if, for example, a longer duration of treatment is recommended, or if their treatment plan differs from that recommended by a well-known centre. The NIPE committee has suggested that standardization of treatment may be the basis on which to better integrate hip dysplasia into national screening pathways. Standardized care benefits patients and is the platform from which we can begin to understand effectiveness and optimize outcomes.

All respondents to this survey were current ordinary members of BSCOS. Ordinary Membership of BSCOS is open to United Kingdom consultant orthopaedic surgeons for whom children's orthopaedics represents a substantial part of their practice and professional interest, and who have been accepted by the board following recommendation by two current members. We feel that the response rate of 60% is sufficient to draw valid conclusions on current practice trends in the United Kingdom and is higher than recent surveys of members of BSCOS, EPOS and POSNA.^{14,16-18} Furthermore, it was requested that only consultant surgeons actively involved in the initial management of DDH responded to the survey. We recognize that there may be some practitioners treating DDH who are not members of BSCOS. However, the aims of this survey are to help form consensus and inform prospective studies, both of which will be driven by or through members of the society. We must however emphasize that, at present, the results of this survey do not represent a position statement from BSCOS and should not be considered so.

In total, 72% of respondents advise the harness to be worn for 24 hours a day when initiating treatment. Hines et al⁸ recently suggested that neither reducing harness wear to 23 hours a day, nor reducing frequency of review, had an adverse effect on treatment success in Ortolani positive hips. Interestingly, of those who advise 23 hours a day, most have been in practice for less than five years, suggesting an awareness of current literature may trump 'early years' caution.

There is great variation among United Kingdom practitioners in the recommended duration of wear. Many will immediately remove the harness as soon as the hip has normalized (usually judged by ultrasonographic appearance), which could be as little as a few weeks for hips that were not frankly dislocated. Others recommend 16 weeks full-time wear. The authors are not aware of any evidence supporting this longer duration of use. The only study comparing duration of wear reported statistically insignificant trends towards higher rates of avascular necrosis (AVN) and lower rates of re-intervention with longer treatment due to a weaning period.⁹ This study had short follow-up and an important confounding factor (age at start of treatment differed between the groups).

While low risk, the Pavlik harness is not an entirely benign treatment. The rate of AVN has been as high as 27% in published series but most authors accept that the rate is much lower with the correct application.^{5,19} AVN has been associated with a longer duration of treatment, even on the unaffected side.^{20,21} While other complications from a correctly applied harness are rare, it can cause skin crease dermatitis, femoral nerve palsy (recently linked with treatment failure²²), inferior dislocation, brachial plexus injury and pseudo-paralysis, as well as placing significant strain on parents and carers.^{23,24} It may, therefore, be beneficial to keep the time spent in harness to a minimum.

The two most common treatment protocols among respondents were immediate removal of the harness as soon as the hip had normalized, and a period of at least 12 weeks treatment, either from when first applied or from when the hip was deemed normal. If a prospective comparative study were to be designed using the data from this survey, then these two groups would seem the most appropriate to compare, given the difference in duration of wear and hence the potential effect on rates of AVN and need for further intervention due to persistent instability or dysplasia.^{5,9} It would be hard to argue that our national community could not approach this question from a position of clinical equipoise, given the number of different treatment protocols described in this survey and the lack of evidence supporting them.

There are other significant inconsistencies highlighted by this study, namely permitting clothes beneath the harness (57% no *versus* 43% yes), hours of daily wear (72% 24 hours *versus* 26% 23 hours) and whether to wean or

remove immediately. The first two may be intrinsically linked as a permitted period out of harness facilitates changing clothes.

Alves et al¹⁴ performed a similar survey of EPOS and POSNA members in 2018. While they received an impressive 459 responses, nearly half treat fewer than 11 cases per year. United Kingdom practitioners are similar to their European and North American counterparts in their preference of the Graf technique and the Pavlik harness. However, they are less likely than EPOS members to treat a stable dysplastic hip at under six weeks of age (35% *versus* 48%).

There is unnecessary variation in the treatment of infantile DDH. This variation is preventing the United Kingdom national screening programme adopting standards for reporting within their NIPE-Smart system because they too are uncertain of the correct treatment pathway. Furthermore, the uncertainty may contribute to the apparent failure of screening within the UK compared to other healthcare systems.²⁵⁻³⁰ This study clarifies current trends in ultrasound interpretation and reporting among United Kingdom clinicians which will assist the committee in this process. Agreement amongst surgeons of a minimal dataset for reporting appears to be the basis on which reporting standards can be formulated, and intervention studies designed. In the most basic form, consensus is urgently needed on how to measure and define DDH in this population.

Two valuable consensus statements have recently been published. Kelley et al³¹ provide the North American perspective on the behalf of the International Hip Dysplasia Institute, using a Delphi process to provide guiding principles. The International Interdisciplinary Consensus Meeting on Evaluation of Developmental Dysplasia of the Hip provided a thorough review of the relevant literature and stated levels of agreement on statements regarding diagnosis and treatment.³² The executive of the BSCOS have recently approved the development of consensus guidelines in this area, which we hope will form the basis of a unified approach to the treatment of infant DDH that will benefit both families and clinicians, and form the basis on which to modify and improve the pathway using a robust scientific approach. Understanding the status quo will enable the identification of potential barriers to change and facilitate dissemination and implementation.

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COMPLIANCE WITH ETHICAL STANDARDS

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OA LICENCE TEXT

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ETHICAL STATEMENT

Ethical approval: Ethical approval was not sought for this study as it involves no information specific to individual patients.

Informed consent: Formal consent was not sought from survey correspondents as all data was anonymized. Correspondents provided all data voluntarily with no inducements, explicit or implied.

ICMJE CONFLICT OF INTEREST STATEMENT

None declared.

AUTHOR CONTRIBUTIONS

DJW: Study design, Data acquisition, Manuscript preparation, manuscript revision.

DCP: Data analysis and interpretation, Manuscript preparation.

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REFERENCES

1. **Nakamura J, Kamegaya M, Saisu T, et al.** Treatment for developmental dysplasia of the hip using the Pavlik harness: long-term results. *J Bone Joint Surg [Br]* 2007;89-B:230-235.
2. **Pollet V, Pruijs H, Sakkars R, Castelein R.** Results of Pavlik harness treatment in children with dislocated hips between the age of six and twenty-four months. *J Pediatr Orthop* 2010;30:437-442.
3. **Herring JA.** Conservative treatment of congenital dislocation of the hip in the newborn and infant. *Clin Orthop Relat Res* 1992;281:41-47.
4. **Pavlik A.** Stirrups as an aid in the treatment of congenital dysplasias of the hip in children. By Arnold Pavlik, 1950. *J Pediatr Orthop* 1989;9:157-159.
5. **Weinstein SL, Mubarak SJ, Wenger DR.** Developmental hip dysplasia and dislocation: part II. *Instr Course Lect* 2004;53:531-542.
6. **Cashman JP, Round J, Taylor G, Clarke NM.** The natural history of developmental dysplasia of the hip after early supervised treatment in the Pavlik harness. A prospective, longitudinal follow-up. *J Bone Joint Surg [Br]* 2002;84-B:418-425.
7. **Grill F, Bensahel H, Canadell J, et al.** The Pavlik harness in the treatment of congenital dislocating hip: report on a multicenter study of the European Paediatric Orthopaedic Society. *J Pediatr Orthop* 1988;8:1-8.
8. **Hines AC, Neal DC, Beckwith T, Jo C, Kim HKW.** A comparison of Pavlik Harness treatment regimens for dislocated but reducible (Ortolani+) hips in infantile developmental dysplasia of the hip. *J Pediatr Orthop* 2019;39(10):505-509.
9. **Westcott DJ, Mackay ND, Waton A, et al.** Staged weaning versus immediate cessation of Pavlik harness treatment for developmental dysplasia of the hip. *J Pediatr Orthop B* 2014;23:103-106.

10. **No authors listed.** Getting It Right First Time Programme. www.gettingitrightfirsttime.co.uk (date last accessed 11 February 2020).
11. **Heeres RH, Witbreuk MM, van der Sluijs JA.** Diagnosis and treatment of developmental dysplasia of the hip in the Netherlands: national questionnaire of paediatric orthopaedic surgeons on current practice in children less than 1 year old. *J Child Orthop* 2011;5:267-271.
12. **Seidl T, Placzek R, Funk JF.** Do German-speaking paediatric orthopaedic surgeons agree on diagnostics and treatment of the neonatal hip? *Z Orthop Unfall* 2012;150:170-176.
13. **Al-Essa RS, Aljahdali FH, Alkhalawi RM, et al.** Diagnosis and treatment of developmental dysplasia of the hip: a current practice of paediatric orthopaedic surgeons. *J Orthop Surg (Hong Kong)* 2017;25(2):2309499017717197.
14. **Alves C, Truong WH, Thompson MV, et al.** Diagnostic and treatment preferences for developmental dysplasia of the hip: a survey of EPOS and POSNA members. *J Child Orthop* 2018;12:236-244.
15. **Rosendahl K, Markestad T, Lie RT.** Ultrasound in the early diagnosis of congenital dislocation of the hip: the significance of hip stability versus acetabular morphology. *Pediatr Radiol* 1992;22:430-433.
16. **Shore BJ, Shrader MW, Narayanan U, et al.** Hip surveillance for children with cerebral palsy: a survey of the POSNA membership. *J Pediatr Orthop* 2017;37:e409-e414.
17. **Jamjoom BA, Butler D, Thomas S, Ramachandran M, Cooke S.** Opinion survey of members of British Society of Children's Orthopaedic Surgery related to specific case scenarios in slipped capital femoral epiphysis. *J Pediatr Orthop B* 2017;26:340-343.
18. **Sonnega RJ, van der Sluijs JA, Wainwright AM, Roposch A, Hefti F.** Management of slipped capital femoral epiphysis: results of a survey of the members of the European Paediatric Orthopaedic Society. *J Child Orthop* 2011;5:433-438.
19. **Iwasaki K.** Treatment of congenital dislocation of the hip by the Pavlik harness. Mechanism of reduction and usage. *J Bone Joint Surg [Am]* 1983;65-A:760-767.
20. **Pap K, Kiss S, Shisha T, Marton-Szücs G, Szöke G.** The incidence of avascular necrosis of the healthy, contralateral femoral head at the end of the use of Pavlik harness in unilateral hip dysplasia. *Int Orthop* 2006;30:348-351.
21. **van der Sluijs JA, De Gier L, Verbeke JI, et al.** Prolonged treatment with the Pavlik harness in infants with developmental dysplasia of the hip. *J Bone Joint Surg [Br]* 2009;91-B:1090-1093.
22. **Upasani VV, Bomar JD, Matheney TH, et al.** Evaluation of brace treatment for infant hip dislocation in a prospective cohort: defining the success rate and variables associated with failure. *J Bone Joint Surg [Am]* 2016;98:1215-1221.
23. **Hassan FA.** Compliance of parents with regard to Pavlik harness treatment in developmental dysplasia of the hip. *J Pediatr Orthop B* 2009;18:111-115.
24. **Jennings HJ, Gooney M, O'Beirne J, Sheahan L.** Exploring the experiences of parents caring for infants with developmental dysplasia of the hip attending a dedicated clinic. *Int J Orthop Trauma Nurs* 2017;25:48-53.
25. **Broadhurst C, Rhodes AML, Harper P, Perry DC, Clarke NMP, Aarvold A.** What is the incidence of late detection of developmental dysplasia of the hip in England?: a 26-year national study of children diagnosed after the age of one. *Bone Joint J [Br]*. 2019;101-B(3):281-287.
26. **Biedermann R, Riccabona J, Giesinger JM, et al.** Results of universal ultrasound screening for developmental dysplasia of the hip: a prospective follow-up of 28 092 consecutive infants. *Bone Joint J [Br]*. 2018;100-B(10):1399-1404.

27. **Marson BA, Hunter JB, Price KR.** Value of the 'clicky hip' in selective screening for developmental dysplasia of the hip. *Bone Joint J [Br]*. 2019;101-B(6):635–638.
28. **Choudry QA, Paton RW.** Neonatal screening and selective sonographic imaging in the diagnosis of developmental dysplasia of the hip. *Bone Joint J [Br]*. 2018;100-B(6):806–810.
29. **Anderton MJ, Hastie GR, Paton RW.** The positive predictive value of asymmetrical skin creases in the diagnosis of pathological developmental dysplasia of the hip. *Bone Joint J [Br]*. 2018;100-B(5):675–679.
30. **Perry DC, Paton RW.** Knowing your click from your clunk: is the current screening for developmental dysplasia of the hip fit for purpose? *Bone Joint J [Br]*. 2019;101-B(3):236–237.
31. **Kelley SP, Feeney MM, Maddock CL, Murnaghan ML, Bradley CS.** Expert-based consensus on the principles of Pavlik harness management of developmental dysplasia of the hip. *JBJS Open Access* 2019:e0054.
32. **O'Beirne JG, Chlapoutakis K, Alshryda S, et al.** International Interdisciplinary Consensus Meeting on the evaluation of developmental dysplasia of the hip. *Ultraschall Med* 2019;40:454–464.