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Routine screening for developmental dysplasia of the hip by chiropractors: a case report of late diagnosis in an infant

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Background: *Developmental Dysplasia of the Hip (DDH) is a common musculoskeletal condition of infancy, but diagnosis can be delayed. In parts of Australia, after the four-month routine assessment, there is a 16-week interval before the next well-child assessment. This may result in a delay in diagnosing late developing DDH.*

Case Presentation: *This case report describes the diagnosis and management of an 18-week old infant with late-onset DDH who was successfully managed with simultaneous Pavlik harnessing with Denis Browne Bar.*

Summary: *This case underscores the importance of routine ongoing hip joint screening, inter-professional collaboration of all health care practitioners, and the importance of appropriate training of all practitioners seeing infants, to reduce instances of undetected*

Contexte : *La dysplasie développementale de la hanche (DDH) est une affection musculosquelettique courante chez les enfants en bas âge. Il arrive que le diagnostic de cette maladie soit tardif. Dans certaines régions de l'Australie, après l'examen de routine à l'âge demquatre mois, 16 semaines s'écoulent avant le prochain examen de l'enfant bien portant. Par conséquent, le diagnostic d'une DDH à évolution tardive risque d'être retardé.*

Exposé du cas : *Ce compte rendu présente le cas d'un nourrisson de 18 semaines présentant d'une DDH à évolution tardive, qui a été traitée avec succès par le port du harnais de Pavlik et de l'attelle de Denis-Browne.*

Résumé : *Ce cas souligne l'importance d'un dépistage systématique et continu de la dysplasie de la hanche, de la collaboration entre tous les praticiens de santé et d'une formation appropriée pour tous les praticiens traitant des nourrissons et ce, pour réduire le nombre de cas de DDH non détectés, réduire le fardeau pour*

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DDH, reduce medical burden, and prevent otherwise unnecessary surgical intervention.

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KEY WORDS: chiropractic, screening, developmental dysplasia

les services médicaux et prévenir une intervention chirurgicale autrement inutile.

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MOTS CLÉS : chiropratique, dépistage, dysplasie développementale

Introduction

Developmental dysplasia of the hip (DDH) is one of the most common musculoskeletal conditions of infancy[1,2], and can range in severity from instability that may spontaneously resolve to dislocation requiring surgical intervention. DDH may present with varying degrees of acetabular dysplasia.[3–5] A South Australian centre reported an incidence of seven per 1000 live births.[6] Of concern is the incidence of late-detection, defined as DDH diagnosed at older than 12 weeks of age, which has increased from 0.22 per 1000 live births in 1988-2003 to 0.7 per 1000 in 2003-2009.[7,8] One cause is suggested to be swaddling practices aimed at reducing unsettled behaviour.[7]

In the presence of abnormal examination findings on hip screening or surveillance, infants should be referred to their General Medical Practitioner (GP) or paediatrician for further evaluation or imaging.[9,10] The purpose of this case report is to chronicle the diagnosis and management of an 18 week of age infant with late-diagnosed DDH. This case report was prepared following CARE guidelines.[11]

Case Presentation

Patient history

An infant presented at a chiropractic clinic for assessment and management of breastfeeding difficulty involving bilateral arching off the breast, and general fussiness at four weeks of age. She was a first-born female. Oligohydramnios, a condition of reduced amniotic fluid, was diagnosed at 41 weeks prompting an emergency caesarean section at 41 weeks gestation after 36 hours of labour. She was not in breech position. Her parents were not aware of a family history of DDH at time of birth, but subsequently informed their GP of a family history of DDH after it was diagnosed. Birth weight was above average at 3.91kg, length was 49.5cm, head circumference 35cm, and both 1- and 5-minute Apgar scores were nine.

Physical examination

On initial examination, at four weeks of age, there was a leftward head rotation positional preference (torticollis). Passive range of motion assessment revealed restriction in normal cervical spine range of motion. Age appropriate tone was present on Ventral and Vertical suspension tests, as well as age appropriate Galants and Perez primitive reflex responses. Muscle stretch reflexes (C6, C7, L4 and S1 nerve roots) were symmetrical, age appropriate, and brisk. Cranial examination revealed normal appearing sutures with no evidence of synostosis, the premature closure of one or more cranial sutures, or head asymmetry. Extremity examination was unremarkable. Hip joint assessment incorporating supine straight leg length, Allis, Thomas, Barlow, Ortolani, Telescoping and Abduction tests was unremarkable (Appendix 1).

Management

A course of treatment to correct the upper cervical spine joint dysfunction was commenced. The upper cervical spine joints were treated with age-modified spinal manipulative therapy. As a part of periodic surveillance, the treating chiropractor performed hip joint screening (Allis, Ortolani, Thomas, Telescoping and Abduction tests) at four, six, and eight weeks of age, yielding no abnormality. Beyond 12 weeks of age, hip screening was altered to exclude Ortolani test, but Allis, Thomas, Telescoping and Abduction tests were all continued to be used. Hip joint assessment by her MCHN occurred at birth, two, four, and eight weeks of age, and 16 weeks of age, and by her GP at six weeks of age with no abnormality found. Hip joint screening by the treating chiropractor at 18 weeks of age found decreased left hip abduction of greater than 20

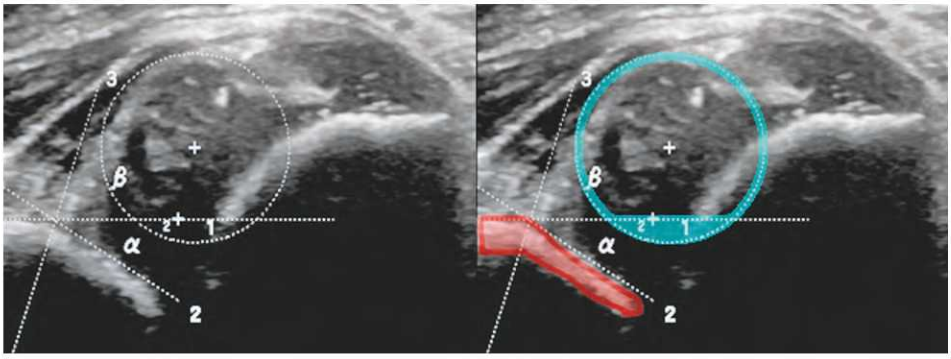

Figure 1A.
Initial ultrasound performed at 18 weeks of age (left hip - dysplastic). Red area indicates iliac bone, blue indicates femoral head. Blue shaded region indicates bony coverage (12%).

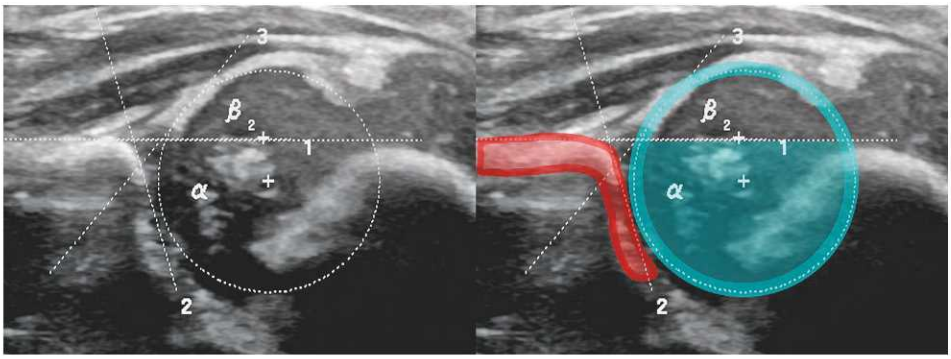

Figure 1B.
Initial ultrasound performed at 18 weeks of age (right hip - normal). Red area indicates iliac bone, blue indicates femoral head. Blue shaded region indicates bony coverage (69%).

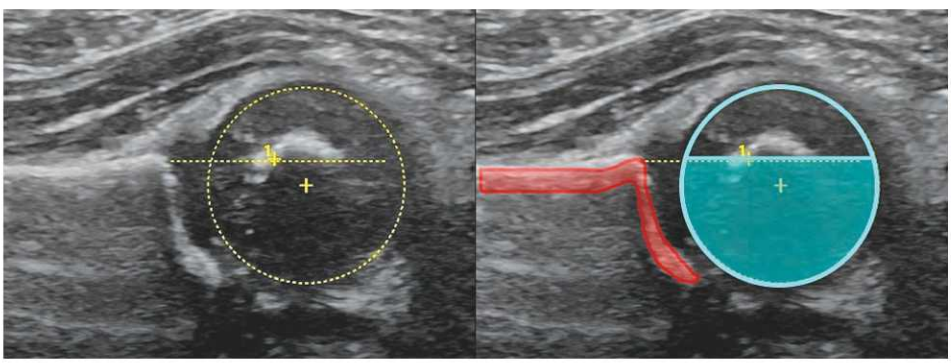

Figure 2.
Repeat left hip ultrasound performed eight weeks post-diagnosis. Red area indicates iliac bone, blue indicates femoral head. Blue shaded region indicates bony coverage (67%).

degrees difference with an accompanying "unusual sensation", along with a shortened appearance of the left leg and positive Galeazzi sign on Allis test on the left leg. The findings of asymmetry greater than 20 degrees on hip abduction test, a shortened appearance of the leg on leg length testing, and a positive Galeazzi sign suggest the diagnosis of DDH.[12,13] Standard procedure upon identification of potential DDH is referral to a GP for further evaluation, but as this patient had a pre-existing appointment with a paediatrician for reflux within two days, the paediatrician was notified of the concerns. The paediatrician referred for hip joint ultrasound.

Imaging and treatment

Ultrasonography performed at 18 weeks of age revealed marked left hip dysplasia with the left hip markedly subluxated; bony coverage was 12%, alpha angle was 33° and the beta angle 72° (Figure 1A). The right hip, in comparison, was considered normal with a bony coverage of 69%, alpha angle of 74° and beta angle of 50° (Figure 1B). Prompt management involving simultaneous Pavlik harnessing with Denis Browne Bar for 24 hours per day for six weeks was initiated after consulting with a paediatric orthopaedic specialist (Appendix 2). This was followed by 22 hours per day of bracing for an additional eight

Table 1.
Risk factors and patient history factors associated with DDH

Common history factors associated with DDH[12]	Risk Factors for Late Developing DDH[18,21]
• Breech Presentation • First-Degree Relative treated for DDH • Breech presentation in utero, born by vertex delivery • Any family history of hip dysplasia • Oligohydramnios • Female gender • First-born baby girl • Birth weight greater than 4000g • Multiple births or pregnancies of mother • Born by Caesarean section	• Rural birth • Female gender • Infants discharged from hospital in under four days • History of swaddling

weeks. Repeat ultrasound eight weeks post-diagnosis demonstrated persistent irregularity of the left acetabulum but improved femoral head coverage and stability under stress testing suggesting a reduction in subluxation. Bony coverage had improved to 67%, alpha angle 61° and the beta angle 36° (Figure 2). An ultrasound performed 11 weeks post-diagnosis indicated that the left hip showed restoration of acetabular morphology to within normal limits with good femoral head coverage.

Discussion

This case report details an 18-week old infant with late diagnosed DDH. The patient presented with five of the 10 history risk factors for DDH listed by Roposch[12], in addition to the risk factor of torticollis[14,15]. Breech position, female gender, and a positive family history are well defined risk factors associated with DDH.[5,9,16] Roposch discussed whether infants should undergo more thorough or frequent hip screening based on history items suggestive of increased risk of DDH (Table 1).[12] However, there can be a variation in risk factors for both late-diagnosis DDH[17] and gender.[18,19] In the presence of risk factors for DDH, more regular screening is recommended to reduce the risk of missed or late diagnosis[9,18] even though most cases of DDH will occur in infants without risk factors present[20]. Enhanced screening or surveillance was indicated in this case.[6]

In Australia, it is recommended that General Medical Practitioners (GP) and Maternal and Child Health Nurses (MCHN) screen for DDH by performing Ortolani, Barlow, Abduction and Allis tests (Appendix A), as well as observing for leg length and thigh crease asymmetry.[22–25] This follows guidelines established by the American Academy of Orthopaedic Surgeons.[9,26] Studer discussed that even with the current screening and surveillance that occurs in South Australia, there has been an increase in the incidence of late onset DDH.[8] Regular screening is important as early management of DDH involves bracing and non-surgical intervention compared to potential surgical intervention for those older than six months of age.[6]

A review by Schaeffer and Mulpuri[27] highlighted the shortcomings of routine screening using ultrasound and x-ray imaging for developmental dysplasia of the hip. By delaying screening until after 28 days of age, the number of visits required to diagnose DDH was reduced[28], without increasing the late diagnosis of DDH or the need for surgery[29]. One of the main shortcomings with screening prior to 28 days of age is that normal ligamentous laxity may be present in infant hips until six weeks after birth[30], and this may present with false positive findings[31].

Clinical hip examination by the infants' GP and MCHN remains the primary screening method to identify infants with possible DDH who require further investigation.[3,12,32,33] Current routine screening in Victoria, Australia, occurs at two, four, and eight weeks of age, as well as four and eight months of age, and involves assessing for thigh crease asymmetry as well as performing Ortolani, Barlow, Abduction and Allis/Galeazzi tests (Appendix A).[25] The 16 week interval between assessments from four to eight months of age is a concern as late onset DDH identification is likely to be delayed.

Routine clinical screening utilises several hip ortho-

Table 2.
Comparison of Ortolani and Barlow with Hip Abduction test. Legend: PPV= Positive predictive value; NPV = Negative predictive value

	Testing	**Sensitivity (%)**	**Specificity (%)**	**PPV (%)**	**NPV (%)**
Jimenez[41]	Ortolani/Barlow	9.2-51.2	80.7-87.8	1.9-13.2	95.1-98.5
Padilla-Raygoza[42]	Ortolani	22.73	98.51	71.43	88.59
	Barlow	13.64	98.51	60	87.42
Jari[34]	Abduction (Unilateral)	23-42	99.1-99.9	Not listed	Not listed
Choudry[37]	Abduction (Unilateral)	14.4	99.3	40	97.3
Custovic[39]	Abduction	Not listed	Not listed	40.3	80.4

paedic tests which are listed in Appendix 1. Recent literature has questioned the sensitivity and specificity of these tests when used as individual hip tests, stressing the importance of compound findings incorporating multiple tests to reduce false negatives (Table 2).[34–39] As a single test, hip Abduction has high specificity and negative predictive value (Table 2) for unilateral DDH, making it ideal for screening in infants over eight weeks of age.[3,12,34,37,39,40]

In a 2009 study by Duni and Ruci, the reliability of Ortolani, Barlow and Abduction tests were retrospectively analysed.[43] Ortolani and Barlow testing were more sensitive when performed by an orthopaedic surgeon compared to other healthcare specialists, but Abduction testing was not statistically significantly different between the two groups. This suggests that adequate training and education in Abduction test interpretation may be an appropriate and effective surveillance test for other primary healthcare practitioners to adopt. Ortolani and Barlow may become less accurate as testing can become difficult for the untrained practitioner after two to three months of age due to muscular development and soft tissue contracture in the infant.[3] In contrast, unilateral limited hip abduction is an important clinical sign due to its high specificity for DDH, especially after three months of age.[3,34]

An observational study by Talbot *et al*. reported that 58% of all irreducible hip dislocations diagnosed and treated are detected after three months of age, despite the established hip screening and surveillance programs.[17] There are two proposed aetiologies for the development of late DDH; improper positioning of the hips, such as incorrect swaddling practice, promoting persistent lateral hip subluxation or dislocation[7,18], or false negative findings from testing performed prior to proper joint cavity development, resulting in undetected DDH that progresses[44].

In Australia, the developmental nature of DDH is well recognised, prompting recommendations of regular assessment until six to nine months of age,[5] and the use of multiple tests at each consultation to reduce the likelihood of false negative findings. Currently, with infant health appointments in Victoria, Australia, occurring at four and eight months of age[25] there is concern that the large time gap between appointments at four and eight months of age for surveillance of DDH may result in increased delayed diagnoses and increased need for surgical intervention. In Victoria there is a noticeable drop-off in attendance from the four month of age assessment (93.8%) to 84.3% at eight month of age assessment.[45] Data for New South Wales was limited; the most recent data available stating only 49.6% of infants up to 11 months of age attended an early child health centre on one or more occasions.[46] This indicates 50.4% of infants do not attend at all. Data regarding other states of Australia was unable to be obtained in a timely manner.

If the case presented in this report had been assessed as per government recommendation, it is unlikely that the hip pathology would have been detected prior to eight months of age, resulting in an increased likelihood of surgical intervention and increased medical costs.

This case presentation demonstrates the importance of all health care practitioners involved in the care of infants being adequately trained to assess infant hip joints. Infants attending primary health care practitioners, such as chiropractors, physiotherapists, and osteopaths, should undergo additional hip assessment between recommended MCHN and GP-based appointments. Williams (2018) discussed this point, raising a suggestion of regular GP surveillance to reduce the incidence of late-stage DDH diagnosis.[6] Expanding this surveillance net to incorporate all health practitioners would reduce the risk of delayed diagnosis further.

In addition to improved outcomes for the infant, early detection improves cost effectiveness while reducing medical burden.[28,39] Detection of DDH after three months of age was associated with a seven-fold increase in short-term costs when compared to those detected prior to three months of age.[47]

The typical management for hip dysplasia in infants under six months of age is sustained hip positioning of flexion and abduction in a Pavlik harness with a success rate of up to 99%.[48] After six months of age, the risk of permanent change to the shape of the acetabulum and the likelihood of non-improvement requiring surgical intervention increases.[5,17,47] Surgical intervention after failed closed reduction typically involves femoral or pelvic osteotomy.[48] The outcomes of surgical intervention have varied; Terjesen found that when open reduction for children with a late diagnosis of DDH was performed, fewer secondary procedures were required and by skeletal maturity, the hips had a better radiographic appearance[49], whereas Pollet determined that one in five children post-surgery had a poor radiological outcome, with one in five children experiencing pain or limitations of normal daily activities[50]. This suggests that early detection and management is associated with improved long-term outcomes. Surgery may be considered low-risk, but there are risks associated with surgical intervention that may be avoidable.[50–52]

The case presented in this report had several risk factors for DDH and had a normal screen at four months of age. The case was seen at a paediatric only chiropractic clinic where the policy reflects recommendations that all infants seen undergo hip joint screening at least every four weeks over the first 12 months of life when attending for other issues.[53] Screening frequency may be increased in cases identified as being at increased risk of DDH. Increased surveillance in this case prompted hip joint screening at 18 weeks of age allowing early detection of late onset DDH and prompt referral for appropriate management. Following normal recommendations relating to hip joint screening would have most likely delayed diagnosis until eight months of age, an age when surgical intervention is likely. The treatment provided in the form of bracing resulted in bony coverage after an eight-week period sufficient to avoid surgical intervention. Further research investigating the impact of chiropractic co-management in cases of DDH may be beneficial.

We acknowledge that this is a single case report, and therefore is not representative of all individuals with late-diagnosed DDH. A review of Pubmed, ChiroIndex, EBSCOhost, Embase and Scopus databases was unable to find case reports or case series detailing chiropractic clinical assessment, diagnosis, or management of DDH. This case report demonstrates the importance of regular hip assessment or screening by all primary health care practitioners to reduce the risk of delayed diagnosis, while highlighting the importance of adequate training and education in infant hip joint assessment.

Summary

This case report details the detection and successful management of an 18-week of age infant with DDH. Current recommended hip screening at four months of age and not again until eight months of age may be inadvertently creating a risk of late-developing DDH being delayed in diagnosis. Utilising primary health care practitioners adequately trained in paediatric hip assessment to provide additional screening may help to reduce instances of undetected DDH, reduce medical burden, and prevent otherwise unnecessary surgical intervention. This case underscores the necessity of appropriate training, education, and collaboration for all healthcare providers involved in the care of infants.

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Appendix 1.

Figure 3.
Supine straight leg length (image used with guardian permission). Leg length is assessed with the infant supine and with both hips and knees extended. In the presence of a dislocated hip, there will be an apparent shortening of the affected leg observable at the line formed when comparing medial malleolus position.

Figure 4.
Allis test (image used with guardian permission). The Allis test is performed supine with infant's feet placed together on the examining table with the hips and knees flexed. In the presence of a dislocated hip, there will be relative and apparent shortening of the affected femur, producing the Galeazzi sign.

Figure 5.
Thomas test (image used with guardian permission). The Thomas test involves full flexion of one hip to rest on the infant's chest, with the other leg straightened as much as comfortably possible. Due to in utero contractures, a degree of residual flexion would be observed in infants under 6 weeks of age; however, this flexion contracture should not be present after 6 weeks of age. In the presence of hip pathology, expected flexion contractures would be absent in infants younger than six weeks of age, and a flexion contracture will develop in infants older than six weeks of age.

Figure 6.
Barlow manoeuvre (image used with guardian permission). As the Barlow manoeuvre has no proven predictive value for future hip dislocation, and could create instability if performed incorrectly, it is not recommended to be performed as a part of routine screening assessment. The AAP recommends that if the Barlow test is performed that it be done by gently adducting the hip while palpating for the positive indication of pathology with the femoral head shifting out the back of the acetabulum. It is important that no posteriorly directed force be applied.

Figure 7. *Ortolani test (image used with guardian permission). The Ortolani test is a manoeuvre to reduce a recently dislocated hip. In performing this test, the thigh is flexed and abducted, and the femoral head is lifted anteriorly into the acetabulum. In the presence of a dislocated hip, relocation will be felt as a "clunk," not an audible "click".*

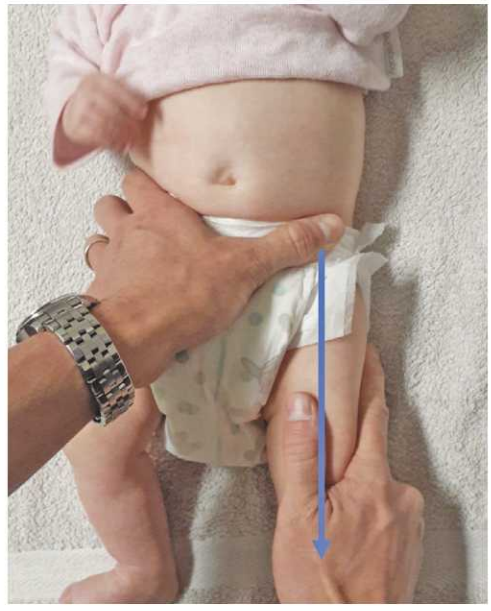

Figure 8. *Telescoping test (image used with guardian permission). The Telescoping test involves applying a traction force on the supine infant's leg, contacting above the knee joint. In the presence of hip instability or dislocation, there would be increased passive motion detected on the affected side.*

Figure 9A.
Hip abduction test, initial position (image used with guardian permission).

Figure 9B.
Hip abduction test; full abduction on left hip (image used with guardian permission).

The hip Abduction test is performed with the infant supine, with hip and knee flexed to 90° (Figure 9A). In the presence of hip pathology, unilateral limitation of hip abduction is defined as a hip that shows less than 60° abduction when at 90° flexion or an asymmetry in abduction of greater than 20°.

Appendix 2.

Figure 10.
Pavlik harnessing with Denis Browne Bar.