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Original Article

Late recurrence of developmental dysplasia of the hip following Pavlik harness treatment until normal ultrasound appearance

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ABSTRACT

Purpose: Establish whether recurrent dysplasia once a dysplastic hip has been treated to ultrasonographic normality is possible.

Methods: 370 babies were referred to a hip ultrasound clinic from June 2005 to 2007 to assess for dysplasia. 96 dysplastic hips underwent appropriate treatment until normal hip morphology achieved on follow-up ultrasounds. Minimum further 12 months follow-up.

Results: 3 children (4%) developed late recurrence of dysplasia. Two required a plaster hip spica. One had an additional adductor tenotomy. One required late pelvic osteotomy.

Conclusion: This study highlights the need for long-term follow-up of dysplastic hips with an early pelvic X-ray at around six months.

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1. Introduction

The incidence of hip dysplasia, persistent on ultrasound assessment in babies aged 4–8 weeks, is 3–5 per 1000 births.^{1–5} Early diagnosis and treatment can lead to a favourable outcome but neglected hip dysplasia can be devastating and often requires major surgery. The introduction of targeted ultrasound has led to a reduction, though not an abolition, of patients presenting with a late diagnosis.⁶

In the orthopaedic literature, prior to the advent of selective ultrasound screening, several authors postulated that a

form of late dysplasia may exist.^{7–9} It has been argued that this may reflect the inaccuracies of clinical examination, pelvic rotation or the poor sensitivity and quality of hip radiographs.^{8,10–12} However, it has also been suggested that there is a susceptible group of patients of polygenic aetiology with a risk of persistent acetabular dysplasia.¹³ Length of follow-up period depends on whether we assume hips treated to 'normality' in the neonatal period with Pavlik harnesses develop normally thereafter, or whether a significant relapse risk exists. Since the advent of ultrasound screening programmes, a recent published report on Pavlik harness

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treatment simply excluded late recurrence in their analysis and commentary.¹⁴

We undertook this study to determine whether babies treated successfully in Pavlik harness progress to recurrent dysplasia.

2. Methods

370 infants were retrospectively reviewed from an outpatient database at the Birmingham Children's Hospital from June 2005 until June 2007. Patients were referred either with a positive family history, breech presentation, another packaging disorder or clinical signs of instability. A review of all ultrasound images demonstrated 261 normal hips, 96 dysplastic hips in 76 children, and 32 patients were untraceable or failed to attend. All hips were clinically examined by the senior authors (CEB or CFB) and an ultrasound scan was performed by a musculoskeletal radiologist following the technique described by Harcke et al.¹⁵ The ratio of femoral head cover was assessed according to the Morin¹⁶ classification system with the transducer positioned laterally in a plane parallel to the long axis of the body with hip at 90° flexion. The first ultrasound was performed at a median average of 2 weeks of age (range 1–20). All hips were also assessed dynamically and repeat clinical and ultrasonographic examination was performed every 1–2 weeks for those babies with abnormal findings. For demonstration purposes, final ultrasound images were exported into JPEG format and alpha angles were calculated using ImageJ (version 1.47v 64-bit for Apple Macintosh, National Institutes of Health, USA).

For those patients in whom the hip was clinically unstable but reducible, a Pavlik harness was applied and continued until a normal clinical and ultrasound examination was achieved. It was left to the discretion of the consultant surgeon whether or not weaning was implemented. Stable hips with dysplasia were monitored initially and reassessed according to protocol within two weeks, with treatment escalated to a Pavlik harness if spontaneous improvement not observed. Double nappies were neither encouraged nor discouraged, as there is little evidence supporting its efficacy^{17,18} and neither are direct complications reported. Ultimately the decision to nurse infants in double nappies during the “watch and wait” period was at parental discretion.

3. Results

There were 96 dysplastic hips detected: 31 patients had dysplasia affecting the left hip, 25 the right, and 20 with bilateral pathology. Nineteen patients had a positive family history and 26 babies were breech presentations at birth. Initial treatment instigated; watch and wait 10%, Pavlik harness 78% and open reduction in 12%. More than half of the parents of children in the “watch and wait” group opted for double nappies (60%). If a Pavlik harness was used, it was first placed on the child at an average age of five weeks, and remained in the majority of patients for six weeks in total. 26% of patients were weaned. One patient developed a femoral nerve neuropraxia that resolved. Despite normal ultrasound findings on final follow-up ultrasound, further hip dysplasia was found in three patients:

3.1. Case 1

Third born female following a normal delivery. There was a positive family history with her elder sister requiring an open reduction. The first ultrasound was performed at 2 weeks of age. The femoral cover was assessed at 20% on both sides initially. Pavlik harness treatment was commenced at two weeks of age for a seven-week period. The final ultrasound can be seen (Fig. 1A) with more than 50% femoral head cover on both sides (alpha angles 62° on the left and 65° on the right). Following harness removal at nine weeks of age the patient was reviewed with radiographs at six months of age. This demonstrated a dysplastic left hip (Fig. 1B). She was then treated by EUA, arthrogram and hip spica for three months with a CT scan confirming adequate femoral head reduction.

3.2. Case 2

First-born Caucasian female delivered via caesarean section for breech presentation. The first ultrasound examination was performed at eight weeks of age when the hips were felt to be clinically stable. The ultrasound examination at this time showed 50% cover on both sides but both acetabulae were reported as shallow. The patient was placed in double nappies for 2 weeks following, which repeat ultrasound examination was normal (Fig. 2A). However, again at six months a pelvic radiograph demonstrated a dysplastic left hip, which was clinically dislocatable (Fig. 2B). The patient went on to have an

Fig. 1 – (A) USS appearance before Pavlik harness removed in Case 1 with alpha angles > 60° bilaterally and femoral head coverage over 50%. (B) Pelvic radiograph at 6 months age, showing recurrent dysplasia on the left.

Fig. 2 – (A) USS appearance before Pavlik harness removed in Case 2 – alpha angle 61° right and 60° left. (B) Pelvic radiograph at 6 months age, showing recurrent dysplasia on the left.

examination under anaesthesia, adductor tenotomy and hip spica for three months.

3.3. Case 3

Fourth born female following a normal delivery. She first presented at 4 months of age, following incidental emergency department attendance for another complaint. Initial ultrasound at that stage showed 50% femoral head cover on the left and 40% on the right. She was treated in a Pavlik harness for seven weeks after which the final ultrasound showed normal femoral head coverage on each side, with alpha angles of 60° on the right and 61° on the left (Fig. 3A). She was subsequently weaned from the harness over a two-week period. At eight months of age a pelvic X-ray showed a dysplastic right hip (Fig. 3B) treated with Salter osteotomy at 18 months of age.

4. Discussion

It has previously been reported that there appears to be no good anatomical or physiological reason why a hip, which is stable at birth, in an otherwise normal child, should become dysplastic at a later stage.¹² The cases in this study have demonstrated further episodes of hip dysplasia despite a normal ultrasound appearance on follow-up after treatment in three patients, one of which subsequently went on to dislocate. There are three possible explanations for this: first of all a hip that is normal on ultrasound assessment

does not guarantee normal anatomic contours, capsule or ligamentum teres competence. Secondly, the hip is indeed normal with extrinsic factors (e.g. genetic) responsible for the dysplastic 'relapse'. Thirdly, the ultrasonographic evaluation is inaccurate and operator dependent, with one study quoting nearly 1 in 3 breach presentation infants progressing onto dysplasia despite normal ultrasound study at 6 weeks.¹⁹

These hips were assessed for femoral head cover according to the Morin classification based on Harcke's ultrasonographic method of evaluation.¹⁵ There are several ways in which the hips can be evaluated on ultrasound with most papers describing scans based on either Graf²⁰ or Morin's classification systems. Graf's method relies upon measurements of alpha and beta angles, using a line drawn from the ilium and angles measured from the bony and cartilaginous acetabulum as landmarks. Morin's technique of assessing the percentage of femoral head cover has been reported as consistently more easily determined and correlating better with radiographic determinations of acetabular development.¹⁶ While both Graf's and Morin's techniques have been shown to be reproducible,²¹ Morin's technique relies upon measurement of the bony acetabulum assessing the percentage femoral head cover, defining less than 33% as abnormal, 33–58% as borderline and more than 58% cover as normal.¹⁶

The hips in our series were dynamically tested under ultrasound at each visit and had been considered stable at final ultrasound assessment. If at all, it could be argued that the right

Fig. 3 – (A) USS appearance before Pavlik harness removal in Case 3. Alpha angles of 60° right side and 61° left side. (B) Pelvic radiograph at 8 months age, showing recurrent dysplasia on the right.

hip in the first case is shallow but it was the left side that went on to dislocate subsequently. In our unit patients are initially placed into a Pavlik harness if there is clinical instability or gross dysplasia on ultrasound. Babies with stable yet dysplastic hips on ultrasound are followed until age 6 weeks and then treated if dysplasia persists. We routinely use Pavlik harness for at least six weeks with fortnightly clinical and ultrasonographic checks to monitor progress and adjust the harness. Provocative testing is not performed during this period.

Duration of Pavlik harness treatment along with the need for weaning remains controversial, with decisions often tailored to a patient individually. Published recommendations include: continuing Pavlik treatment for as long in months as the child's age in weeks at presentation,²² or weaning over four to six weeks after stabilisation.²³ Others propose 12 weeks in Pavlik harness and no weaning,¹ weaning for one hour each day out of harness and then for increasing periods until only at night and no longer tolerated by the child,⁵ or removal of the harness when the head coverage is 40%.⁶ It has also been postulated that there may be a reduction in avascular necrosis rate when a shorter period of time is spent in a splint.²⁴ In our group, a quarter of infants were weaned, yet one still presented with late recurrence of dysplasia. Thus weaning can neither be recommended as an alternative to continued monitoring with repeat plain radiographs between 6 months and walking age.

Vedantam and Bell¹ advised obtaining a check radiograph at 5 months and 2 years in babies with neonatal instability, regardless whether ultrasound has demonstrated stability after treatment. Gwynne-Jones et al²⁵ reported seven subsequent developmental hip dislocations in whom ultrasound had demonstrated reduced and stable hips. Perhaps the most compelling supportive evidence is from Cashman et al²⁶ who identified a 4% recurrence of late acetabular dysplasia similar to our findings, following successful treatment of 316 children up to the age of five. However their recommendation to follow-up children clinically and with radiographs until age five, increases clinic burden and radiation exposure, despite a very low 1.3% late surgical intervention rate. In contrast, a study by Williams et al²⁷ concluded that X-ray was not required even at five months unless ultrasound at six weeks demonstrated a low alpha angle or less than 50% cover.

5. Summary

We report a 4% late recurrence rate (3 of 76 children) of hip dysplasia despite successful early Pavlik harness treatment as determined by normal ultrasound appearances. We agree that all patients with a diagnosis of hip dysplasia should be followed up radiographically to demonstrate appropriate joint development and suggest that an X-ray at six months and at walking age is mandatory even if the ultrasound is classified as normal after six weeks treatment, irrespective of weaning. Previously it remained the surgeon's discretion as to whether or not weaning was implemented following successful harness treatment, however our unit protocol is now to wean off the Pavlik harness over two to four weeks dependent on the length of time taken for the hip anatomy to normalise on ultrasound, and we hope to report our findings in the future.

Conflicts of interest

All authors have none to declare.

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