The Pavlik Harness as Treatment for Developmental Dysplasia of the Hip

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> "The Pavlik harness has been shown to be extremely successful in the treatment of developmental dysplasia of the hip (DDH). Risk factors for failure and complications have been identified and can therefore be minimized."

Developmental dysplasia/dislocation of the hip (DDH) is a congenital condition that represents a number of anatomical abnormalities where the hip joint is not fully formed at birth. The femoral head is not held firmly in the acetabulum. It can be caused by the acetabulum being too shallow and/or the hip ligaments being lax. This means that it can range from slight ligament laxity to complete dislocation. Newborns are screened for DDH, as left untreated it can lead to abnormal gait, pain and osteoarthritis in early adulthood[1]. It is more common in girls, especially first-borns, and tends to run in families[2]. There is no definite cause; it may be a reaction to the mother's hormones during pregnancy, due to a tight uterus that does not allow foetal movement, or being born breech. It is often graded by Graf classification, ranging from I to IV, with IV being the most severe form of dislocation. The Pavlik harness is the most common harness used to treat DDH[3].

Ultrasound is reported as the most sensitive method for detecting hip abnormalities in infants[4], followed by clinical examination using the Barlow and Ortolani manoeuvres. Both tests are performed with the hip and knee bent to 90 degrees. Barlow's test is performed by adducting the hip and applying a downward pressure. The feeling of the femoral head slipping out of the socket posterolaterally indicates a positive result. The Ortolani manoeuvre involves gently abducting the hip and pulling the femoral head anteriorly. An audible and palpable clunk demonstrates a positive result. However, a study by O'Grady et al.[5] found that 84% of the units they included in their study (n=19) in the Republic of Ireland relied on radiographs for diagnosis. Only 37% had access to hip ultrasounds and only 42% of the units included in their study had formal DDH screening. This study highlights the fact that the two most effective methods of diagnosis are not routinely being used in Ireland today. Another study states that almost all authors agree that Ortolani-

positive hips should be treated and all Barlow-positive hips should be treated[3]. It can be difficult to decide whether or not slightly unstable hips should be treated with the Pavlik harness, as it puts healthy or almost healthy hips at a higher risk of complications, with avascular necrosis (AVN) being reported in healthy hips.

The Pavlik harness is the preferred treatment for DDH. First presented by Arnold Pavlik in Prague in 1946[6], the harness prevents extension and adduction but allows for safe movement. The weight of the limb generates a force that repositions the femoral head. Sleep appears to be an essential factor in repositioning, as the reduced muscle tone allows the bone to move[7]. The abduction caused by the harness stretches the adductor muscles, and the hip flexion caused by the harness helps to shift the head of the femur posteriorly into the acetabulum from its dislocated anterior position. In a newborn with an Ortolani-positive or Barlow-positive hip, stability is usually seen on clinical examination after two to three weeks. It is often recommended to continue wearing the harness for six to eight weeks to maintain the integrity of the joint[3]. Van der Sluijs showed that the Pavlik harness can be worn for up to 32 weeks before stability is reached, without resulting in AVN[8]. In an infant over three or four months, the hip must be monitored clinically and ultrasonographically, with at least three weeks of continuation of treatment recommended when stability is reached. The child is then gradually weaned off the harness for a few hours each day. If no reduction is seen after three weeks in the Pavlik harness, an attempt may be made to carry out a closed reduction after a period of skin traction. If a closed reduction proves unsuccessful, an open reduction must be performed. After a reduction has been obtained, the child should be placed in a spica cast in 95 degrees of hip flexion and 55 to 65 degrees of abduction.

The Pavlik harness has been reported with various success rates. Walton et al. report a 100% success rate of the Pavlik harness in treatment of subluxatable hips, although they report a 100% failure rate of hips that were irreducible on ultrasound scan on initial assessment[9]. Peled et al. report a 95.8% success rate for the Pavlik harness in treating Graf Type III hips and 61.5% in Graf Type IV hips. Similarly, Mostert et al. report relocating 97% Graf Type III hips and 50% of Type IV10, and Malkawi recorded a 100% success rate in 699 hips[11]. However Atalar et al. report only 58% successful reduction in hips graded Graf IIc or more severe with the Pavlik harness[12], and Wilkinson et al. report that 30% of their 43 hips graded Graf III or IV required further treatment[13]. However, it should be noted that the studies with high success rates report early diagnosis and intervention, and the studies with lower success rates commenced treatment later. Therefore, the Pavlik harness has been accepted as an effective treatment for Graf III and some Graf IV hips, with early intervention increasing the effectiveness of treatment. According to Vitale and Skaggs, patients under six months of age have a better outcome[14].

Therefore, if early diagnosis and treatment is essential to outcome of treatment, it is imperative that the clinician is aware of predisposing factors that lessen the effect of the Pavlik harness or are predictive of failure. A study found that there was no association between success and gender (although this study of 23 patients included only two boys), side of pathology or findings on clinical examination[12]. However it did support previous findings, stating that hips in which treatment commenced before the patient was seven weeks of age had a higher success rate than patients of eight weeks or over. They also found that the less severe the dislocation, the better the results, with hips graded IIc, IId and III resolving better than hips graded IV. Patients presenting with these factors should be monitored extremely closely to identify failure of treatment so that another appropriate treatment can be started as soon as possible.

As with many treatment techniques, the use of the Pavlik harness has complications and risks. The most serious risk is AVN. AVN is caused by forced attempts at reduction, especially in

abduction, which can damage the blood supply to the growing head of femur and therefore allow the bone tissue to die. Pap et al. reflected on patients treated between 1974 and 1982, a period in which ultrasonography was not routinely used to screen DDH and therefore many patients were unnecessarily treated[15]. The overall occurrence of AVN in this study was 11.7%. They found that there was a strong relationship between age at the start of treatment and AVN forming on the dysplastic side, the younger hips being less likely to develop necrosis. This study also showed that AVN can form in the healthy contralateral hip. There was no relationship between age at the start of treatment and AVN in the healthy hip, but it was linked to a prolonged length of treatment. However it should be noted that no AVN severe enough to cause substantial damage (Tönnis grade III) was found on the healthy side. Suzuki et al. reported an 8% incidence of AVN in 19967. They found no connection between age and occurrence of AVN; however, a close relationship was seen between the type of dislocation and the presence of AVN, the more severely dislocated hips being more likely to develop AVN. Reduction usually occurs during sleep due to the weight of the limbs and decreased tone, but as extreme abduction can decrease blood supply, the author recommended placing pillows under the legs while sleeping to prevent this.

Another possible complication is the development of femoral nerve palsy. This is thought to be caused by high degrees of hip flexion compressing the femoral nerve under the inguinal ligament. A study by Murnaghan et al. reports a 2.5% prevalence of femoral nerve palsy in their study of their 1218 patients[16]. 87% of the cases were diagnosed in the first week of treatment. All babies had complete return of femoral nerve function, with no reports of permanent damage. It appears that larger or heavier babies are at an increased risk of femoral nerve palsy, as are older babies, but no relationship was found between sex, bilaterality, ethnicity or birth weight. Interestingly, the success rate of the Pavlik harness in the palsy group was 47% compared to 94% in the control group, with the impact of femoral nerve palsy being greater on hips that were Ortolani-positive or hips with a fixed dislocation. If the palsy lasted more than three days there was a 30% success rate for the Pavlik harness, which shows the importance of checking the quadriceps at follow-up visits. The author advised temporarily removing the harness until the palsy resolves, but not completely abandoning it.

As mentioned previously, it is essential that healthcare professionals monitor the hips for development and complications. They must endeavour to do all that they can to ensure the harness is used correctly. However, realistically, there is only so much that can be done at appointments, so the responsibility lies with the parents. Hassan et al. studied the compliance of parents with the Pavlik harness[17]. The study included a wide variety of mothers, with ages ranging from 20 to 42 years old, some with a university level of education (being the majority group at 38.12%), some with college level or high school education and the minority having below high school level (9.51%). Upon first seeing the harness, without seeing its application, 33.8% reported it would be easy to use, 45% said difficult and 21.3% said complex. However, after watching it being applied and trying it for themselves this changed to 96.25% reporting it as easy and 3.75% calling it difficult. No relationship was noted between the mothers' level of education and their emotional reaction to the harness. 94.37% reported following the physicians advice strictly as they believed their child had a serious condition, resulting in an average duration of 6 to 16 weeks of treatment. The 3.12% who reported removing the harness for portions of the day (as they did not view the condition as serious) had an average treatment duration of 12 to 18 weeks. Again there was no relationship between the parents' educational level and compliance. 96.25% reported receiving adequate information about application and use of the harness, although 48.1% would have preferred to receive a leaflet with written instructions, again with no link to education. 22.66% reported difficulty reapplying the harness after bathing in

the first week. 61.87% were concerned to leave the child a week without bathing, and 88.8% had significant emotional difficulties with the child being uncomfortable. This study shows that most parents are compliant with the treatment, but highlights factors that influence compliance. The healthcare provider must emphasise the importance of using the harness exactly as prescribed to ensure the best outcome for the child. They must ensure that the parents take the condition seriously as they govern the treatment. This study also reminds the reader that use of the Pavlik harness can be emotional and distressing for parents who are anxious about their new baby. They must be supported, encouraged and educated about the treatment, and provided with as much information as possible.

The Pavlik harness has been shown to be extremely successful in the treatment of DDH. Risk factors for failure and complications have been identified and can therefore be minimized. From the evidence given above, it seems that early diagnosis and intervention, along with regular check-ups, are crucial to both treatment effectiveness and avoidance of AVN. It must be remembered that a diagnosis of DDH may be traumatic for parents, who must be educated on the successfulness of the harness and certain complications for which to look out. With co-operation between the parents and the medical team, the Pavlik harness can avoid a lifetime of hip problems and give a child a normal life.

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